Guide to Color Coding of Specifications:

The 2010 Standard Construction Specifications have vertical bars adjacent to the left side of the text that has been changed from the 2007 version of the Standard Construction Specifications. To help the reader understand the origin of the changes that have been made, the attached CD text is color coded as follows:


Blue Text: Added language from ODOT's 2008 version of their Standard Specifications for Construction.


Red Text with Yellow Highlight: Added language made during review by the three Bureaus (Environmental Services, Transportation, Water) and the City Attorney’s Office for preparation of the 2010 version of the Standard Construction Specifications.
CITY OF PORTLAND

STANDARD CONSTRUCTION SPECIFICATIONS
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PART 00100 - GENERAL CONDITIONS

Section 00110 - Organization, Conventions, Abbreviations and Definitions

Organization

00110.00 Organization of Standard Specifications - The Specifications are comprised of Part 00100 "General Conditions," which deals with the solicitation process and contractual relationships; and Parts 00200 through 03000, which contain the detailed "Technical Specifications" involved in prosecution of the Work, organized by subject matter. In addition, throughout these Standard Specifications:

(a) Each Part is divided into Sections and Subsections.

(b) Reference to a Section includes all applicable requirements of the Section.

(c) When referring to a Subsection, only the number of the Subsection is used; the word "Subsection" is implied.

(d) Where Section and Subsection numbers are not consecutive, the interval has been reserved for use in the Special Provisions, or future expansion of the Standard Specifications.

Conventions

00110.05 Conventions Used Throughout the Specifications Include:

(a) Grammar - Part 00100 of the Standard Specifications is written in the indicative mood, in which the subject is expressed. Parts 00200 through 03000 of the Standard Specifications are generally written in the imperative mood, in which the subject is implied. Therefore, throughout Parts 00200 through 03000, and on the Plans:

(1) The subject, "the Contractor", is implied.

(2) "Shall" refers to action required of the Contractor, and is implied.

(3) "Will" refers to decisions or actions of the Owner or the Engineer.

(4) The following words, or words of equivalent meaning, refer to the actions of the Owner or the Engineer, unless otherwise stated: "allowed", "directed", "established", "permitted", "ordered", "designated", "prescribed", "required", "determined".

(5) The words "approved", "acceptable", "authorized", "satisfactory", "suitable", "considered", and "rejected", "denied", "disapproved", or words of equivalent meaning, mean by or to the Owner or the Engineer, subject in each case to Section 00150 of the General Conditions.
The words "as shown", "shown", "as indicated", or "indicated" mean "as indicated on the Plans".

Certain Subsections labeled "Payment" contain statements to the effect that "payment will be made at the Contract amounts for the following items" (followed by a list of items). In such cases the Owner shall pay for only those Pay Items listed in the Schedule of Items.

(b) Capitalization of Terms - Capitalized terms, other than titles, abbreviations, and grammatical usage, indicate that they have been given a defined meaning in the Standard Specifications. Refer to Section 00110.20 "Definitions". Defined terms will always be capitalized in Part 00100; in Parts 00200 through 03000, defined terms will generally not be capitalized, with the notable exception of "the Contractor", "the Owner" and "the Engineer".

(c) Punctuation - In this publication the "outside method" of punctuation is employed for placement of the comma and the period with respect to quotation marks. Only punctuation that is part of the quoted matter is placed within quotation marks.

(d) References to Laws, Acts, Regulations, Rules, Ordinances, Statutes, Orders, and Permits - References are made in the text of the Specifications to "laws", "acts", "rules", "statutes", "regulations", "ordinances", etc. (collectively referred to for purposes of this Subsection as "Law"), and to "orders" and "permits" (issued by a governmental authority, whether local, State, or federal, and collectively referred to for purposes of this Subsection as "Permits"). Reference is also made to "applicable laws and regulations". The following conventions apply in interpreting these terms, as used in the Specifications.

- Statutes and Rules - Oregon Revised Statutes (ORS) and Oregon Administrative Rules (OAR) referenced in the Specifications are accessible online, including through the Oregon Legislative Counsel Committee web site and through the Oregon Secretary of State Archives Division web sites.

- Law - In each case, unless otherwise expressly stated therein, the Law is to be understood to be the current version in effect. This also applies where a specific Law is referenced or cited, regardless of whether the text of the Law has been included in the Specifications or not, and regardless of whether the text of the Law has been summarized or paraphrased. In each case, the current version of the Law is applicable under any Contract. The reader is therefore cautioned to check the actual text of the Law to confirm that the text included in the Specifications has not been modified or superseded.
• **Permits** - Orders and permits issued by a government agency may be modified during the course of performing the Work under a Contract. Therefore, wherever the term "order" or "permit" is used in the Specifications, it is intended to refer to the then-current version. That version may be embodied in a modified, superseding order or permit, or it may consist of all terms and conditions of prior orders or permits that have not been superseded, as well as the additional terms added by amendment or supplement. In certain cases, the orders or permits are identified by name in the Specifications; in other cases the terms are used in the generic sense. The reader is cautioned to check the text(s) of each order and permit identified either by name or by generic reference.

• **Applicable Laws and Regulations** - Where the phrase "applicable laws and regulations" appears, it is to be understood as including all applicable laws, acts, regulations, administrative rules, ordinances, statutes, and orders and permits issued by a governmental or regulatory authority.

(e) **Owner's Representative and Engineer Terms** - The specifications uses both the terms "Owner's Representative" and "Engineer". The Contractor is to direct all requests, including requests for an Engineer's decision, to the Owner's Representative who in turn will forward all engineering matters to the appropriate engineer for resolution. This includes questions about whether to follow the manufacture's recommendations for a given product application.

### Abbreviations

00110.10 **Abbreviations** - Following are meanings of abbreviations used in Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other abbreviations and meanings of abbreviations may be in the individual Sections of the Standard Specifications to which they apply and in the Special Provisions.

- **AAN** - American Association of Nurserymen
- **AAR** - Association of American Railroads
- **AASHTO** - American Association of State Highway and Transportation Officials
- **ABC** - Associated Builders and Contractors, Inc.
- **AC** - Asphalt Concrete
- **ACI** - American Concrete Institute
- **ACWS** - Asphalt Concrete Wearing Surface
- **ADA** - Americans with Disabilities Act
- **AGA** - American Gas Association
- **AGC** - Associated General Contractors of America
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<tr>
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<td>AITC</td>
<td>American Institute of Timber Construction</td>
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<td>ANSI</td>
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<td>Department of Geology and Mineral Industries, State of Oregon</td>
</tr>
<tr>
<td>DSL</td>
<td>Division of State Lands, State of Oregon</td>
</tr>
<tr>
<td>EAC</td>
<td>Emulsified Asphalt Concrete</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ESCP</td>
<td>Erosion and Sediment Control Plan</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration, U.S. Department of Transportation</td>
</tr>
<tr>
<td>FSS</td>
<td>Federal Specifications and Standards, General Services Administration</td>
</tr>
<tr>
<td>GSA</td>
<td>General Services Administration</td>
</tr>
<tr>
<td>HMAC</td>
<td>Hot Mixed Asphalt Concrete</td>
</tr>
<tr>
<td>ICEA</td>
<td>Insulated Cable Engineers Association (formerly IPCEA)</td>
</tr>
<tr>
<td>IES</td>
<td>Illuminating Engineering Society</td>
</tr>
<tr>
<td>IMSA</td>
<td>International Municipal Signal Association</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>ITE</td>
<td>Institute of Traffic Engineers</td>
</tr>
<tr>
<td>JMF</td>
<td>Job Mix Formula</td>
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<tr>
<td>JSA</td>
<td>Job Safety Analysis</td>
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<tr>
<td>MDFT</td>
<td>Mil Dry Film Thickness</td>
</tr>
<tr>
<td>MFTP</td>
<td>Manual of Field Test Procedures (ODOT)</td>
</tr>
<tr>
<td>MIL</td>
<td>Military Specifications</td>
</tr>
<tr>
<td>MSS</td>
<td>Manufacturers Standard Specifications</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>MSPCP</td>
<td>Manufacturing Standards for Precast Concrete Products</td>
</tr>
<tr>
<td>MSC</td>
<td>Minor Structure Concrete</td>
</tr>
<tr>
<td>MUTCD</td>
<td>Manual of Uniform Traffic Control Devices for Streets and Highways, FHWA, US Department of Transportation</td>
</tr>
<tr>
<td>NACE</td>
<td>National Association of Corrosion Engineers</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturer's Association</td>
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<td>NESC</td>
<td>National Electrical Safety Code</td>
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<td>NFPA</td>
<td>National Fire Protection Association</td>
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<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NLMA</td>
<td>National Lumber Manufacturer's Association</td>
</tr>
<tr>
<td>NMFS</td>
<td>National Marine Fisheries Services, a part of the National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NPS</td>
<td>Nominal Pipe Size (dimensionless)</td>
</tr>
<tr>
<td>NSF</td>
<td>National Sanitation Foundation</td>
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<td>NUCA</td>
<td>National Underground Contractors Association</td>
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<tr>
<td>OAR</td>
<td>Oregon Administrative Rules</td>
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<tr>
<td>OD</td>
<td>Outside Diameter</td>
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<tr>
<td>ODA</td>
<td>Oregon Department of Agriculture</td>
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<tr>
<td>ODF</td>
<td>Oregon Department of Forestry</td>
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<tr>
<td>ODFW</td>
<td>Oregon Department of Fish and Wildlife</td>
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<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
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<tr>
<td>OR-OSHA</td>
<td>Oregon Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>ORS</td>
<td>Oregon Revised Statutes</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration (Federal)</td>
</tr>
<tr>
<td>PCA</td>
<td>Portland Cement Association</td>
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<tr>
<td>PCI</td>
<td>Precast/Prestressed Concrete Institute</td>
</tr>
<tr>
<td>PCP</td>
<td>Pollution Control Plan</td>
</tr>
<tr>
<td>PBOT</td>
<td>Portland Bureau of Transportation</td>
</tr>
<tr>
<td>PF</td>
<td>Pay Factor of a constituent</td>
</tr>
</tbody>
</table>
PLS - Professional Land Surveyor
PMBB - Plant Mixed Bituminous Base
PTI - Post-Tensioning Institute
PUC - Public Utility Commission
PWB - Portland Water Bureau
QA - Quality Assurance
QC - Quality Control
QCT - Quality Control Technician
QL - Quality Level
RAP - Reclaimed Asphalt Concrete Pavement
REA - Rural Electrification Administration, U.S. Department of Agriculture
RMA - Radio Manufacturers Association or Rubber Manufacturers Association
SAE - Society of Automotive Engineers
SI - International System of Units (Système Internationale)
SRCM - Soil and Rock Classification Manual (ODOT)
SSPC - Society for Protective Coatings
SSSHP - Site Specific Safety and Health Plan
T - Tolerances, AASHTO Test Method
TM - Test Method (ODOT)
TV - Target Value
UBC - Uniform Building Code (as adopted by the State of Oregon)
UFC - Uniform Fire Code
UL - Underwriters' Laboratories, Inc.
UMC - Uniform Mechanical Code
UPC - Uniform Plumbing Code (as adopted by the State of Oregon)
USASI - United States of America Standards Institute
USC - United States Code
WAQTC - Western Alliance for Quality Transportation Construction
WCLIB - West Coast Lumber Inspection Bureau
00110.20 Definitions - Following are definitions of words and phases used in the Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other definitions may be in the individual Sections of the Standard Specifications to which they apply in the Special Provisions, and in the Code of the City of Portland.

Acceptance of Work - This term signifies that the Work has been completed to the Owner’s satisfaction and occurs when the Owner approves the Certificate of Completion executed by the Contractor.

Act of God or Nature - A natural phenomenon of catastrophic proportions or intensity, such as an earthquake, flood, cloudburst, tornado, or hurricane.

Addenda or Addendum - Additions or deletions to, material changes in, or general interest explanations of, the City’s Solicitation Documents.

Additional Work - Increased quantities of any Pay Item, within the scope of the Contract, for which a unit price has been established.

Advertisement - The public announcement (Notice to Bidders) inviting Bids for Work to be performed or Materials to be furnished.

Aggregate - Fractured rock, unless otherwise indicated, of specified quality and gradation.

Application for Payment - A written request for payment based on an estimate of work performed that is submitted by the Contractor to the Engineer, accompanied by such supporting documentation as is required by the Contract Documents.

Architect - The person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Contract Documents and is referred to throughout the Contract Documents as if singular in number. The term “Architect” means the Architect or the Architect’s authorized representative.

Architect’s Supplemental Instructions (ASI) - Information provided to the Contractor by the Architect regarding the Project.

As-Built Drawings (“As-Builts”) - Drawings showing how the Project has been constructed.

Attorney - The City Attorney of the City of Portland, Oregon, or authorized representative.
**Auditor** - The City Auditor of the City of Portland, Oregon, or authorized representative.

**Award** - The decision of the Owner to execute a Contract with a particular Bidder or proposer.

**Base** - A Course of specified material of specified thickness placed below the Pavement.

**Bid** - A competitive offer binding on the Bidder and submitted in response to an Invitation to Bid.

**Bid Bond** - The bond or other security required to be submitted with each Bid, which assures that the Bidder will enter into a Contract if its Bid is accepted.

**Bid Documents** - Those documents upon which a Bidder bases its Bid to Owner, which include, but are not limited to, the Instructions to Bidders, general bidding requirements and the proposed Contract Documents including: the Specifications, Plans, Addenda issued prior to Bid opening, and Permits and other documents included in the Specifications by specific reference, and any other documents that may be designated therein as part of the Bid Documents.

**Bidder** - Any person who submits a Bid in response to the Owner’s Invitation to Bid.

**Bike Lane** - A lane in the Traveled Way, designated by striping and Pavement markings for the preferential or exclusive use of bicyclists.

**Bonds** - Documents issued by third parties that provide financial protection to the Owner in the event that the Bidder fails to either enter into a Contract (“Bid Bond”) or perform the work as required by the Contract Documents (“Payment and Performance Bonds”).

**Borrow** - Material lying outside of planned or required Roadbed excavation used to complete Project earthwork.

**Boulders** - Particles of rock that will not pass a 12 inch square opening.

**Bridge** - A single or multiple span Structure, including supports, that carries motorized and non-motorized vehicles, pedestrians, or utilities on a Roadway, walk, or track over a watercourse, highway, railroad, or other feature.

**Bureau** - A subdivision of the City of Portland. The Bureaus of the City of Portland include, but are not limited to, the following: Environmental Services, Internal Business Services, Parks and Recreation, Development Services, Transportation, and Water.

**Buttress** - A rock fill placed at the toe of a landslide or potential landslide in order to resist slide movement.
Calendar Day - Calendar days, including weekdays, weekends and holidays, beginning at midnight and ending at midnight, 24 hours later, unless otherwise specified by a more specific provision of the Contract Documents.

Camber - A slight arch or curvature in a surface or Structure to compensate for loading.

Certificate of Completion - A document that may be provided by Owner that requires the Contractor to certify that the Work has been satisfactorily completed, if the Contract Documents require one.

Certificate of Occupancy/Certificate of Final Inspection - A document provided by a regulatory agency that authorizes partial or full occupancy of a building or structure.

Change Order - A written agreement between the Owner and Contractor changing the Contract.

Chief Procurement Officer - The individual in charge of the Procurement Services Division of the Office of Management and Finance.

City - The City of Portland, Oregon, synonymous with Owner.

Claim - A request by a Contractor for additional compensation, Contract Time, or both, that is prepared and submitted to the Engineer in conformance with Contract requirements regarding claims and notice of claims.

Claims Package - Documents required to be submitted to substantiate a Contractor's right to, and the amount of, additional compensation.

Clay - Soil passing a No. 200 sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents.

Clear Zone - Roadside border area, starting at the edge of the Traveled Way, which is available for safe use by errant vehicles. Establishing a minimum width Clear Zone implies that rigid objects and certain other hazards within the Clear Zone should be relocated outside the Clear Zone, or shielded, or remodeled to make them break away on impact or be safely traversable.

Close Conformance - Where working tolerances are given on the Plans or in the Specifications, Close Conformance means compliance with those tolerances. Where working tolerances are not given, Close Conformance means compliance, in the Engineer's judgment, with reasonable and customary manufacturing and construction tolerances.

Coarse Aggregate - Crushed Rock or crushed Gravel retained on a 1/4 inch sieve, with allowable undersize.

Cobbles - Particles of Rock, rounded or not, that will pass a 12 inch square opening and be retained on a 3 inch sieve.
**Code** - The ordinances adopted by the City Council of Portland that are in effect as of the date of the Contract and as subsequently amended. The term “Code” includes all regulations adopted by Bureaus pursuant to authority given by the Code.

**Commercial Grade Concrete** - Concrete furnished according to Contractor proportioning, placed in minor Structures and finished as specified.

**Construction Change Directive** - A written statement prepared by the Owner's Representative directing the Contractor to make additions, deletions, or other revisions to the Work to be performed. The directive will be issued when changes to the Work are necessary, but the Owner and Contractor are unable to reach agreement regarding the effect of the changes on the Contract Amount or Contract Time, or both.

**Construction Schedule** - Schedule provided by Contractor to Owner, as required by the Contract, which shall not exceed the Contract Time, shall relate to the entire Project, and shall provide for the expeditious and practical execution of the Work.

**Contract Amount** - The authorized amount of money to be paid to the Contractor for performing the Work.

**Contract Documents** - The written agreement between the Owner and the Contractor that defines the obligations of the Contractor and the Owner regarding the Work to be performed. The Contract Documents include, but are not limited to, the Advertisement for Bids, the Invitation for Bids, Plans, the Standard Specifications, Special Specifications, Addenda, Change Orders, and any other documents that may be referenced therein as part of the Contract.

**Contract Time** - The amount of time stated in the Contract Documents for performance of all of the Work, or any specified portion thereof.

**Contractor** - Any person who has entered into a Contract with the Owner for the Work.

**Contractor's Representative** - A person designated in writing by the Contractor to sign contract changes, accept payments, and to act upon instructions from the Owner.

**Council** - The City Council of the City of Portland, Oregon.

**Course** - A specified Surfacing Material placed in one or more Lifts to a specified thickness.

**Coverage** - One Pass by a piece of Equipment over an entire designated area.

**Cross Section** - The exact image formed by a plane cutting through an object, usually at right angles to a central axis, to determine area.

**Current** - When used in relationship to a code, edition, manual or version of reference material, it is the document that is available for use as of bid opening.
Day - A Calendar Day.

DCVR/DCRFI - Design Clarification and Verification Request ("DCVR") or Design Clarification Request For Information ("DCRFI") is a form approved for use by the Owner and used by Contractors to request information regarding the Project. It is equivalent to a Request for Information ("RFI").

Defective Work - Work that a) is performed in an unsatisfactory, faulty, or deficient manner, b) does not conform to the Contract Documents, c) does not meet the requirements of any reference standard, test, or approval referred to or incorporated by the Contract Documents, or d) has been damaged by anyone other than the Owner prior to Acceptance of the Work, whether or not such Work is in possession of Owner or in use by Owner.

Deficiency List - A list prepared by the Owner's Representative reflecting items of work that need to be completed or corrected before the Owner's Representative accepts the contract as Substantially Complete.

Durable Rock - Rock that has a slake durability index of at least 90% based on a two-cycle slake durability test, according to ASTM D 4644. In the absence of test results, the Engineer may evaluate the durability visually.

Easement - The right to use a defined area of property for a specific purpose or purposes.

Emulsified Asphalt - Emulsified asphalt cement.

Emulsified Asphalt Concrete - A mixture of Emulsified Asphalt and graded Aggregate.

Engineer - A person holding an engineering license who is also authorized to act as the Owner's Representative. Engineers who may act as Owner's Representatives are the City Engineer, the Traffic Engineer, the Chief Engineer of the Portland Water Bureau, the Chief Engineer of the Bureau of Environmental Services, and any other Engineer authorized by the Contract Documents to act as the Owner's Representative. (See 00110.05(e))

Entity - A natural person capable of being legally bound, sole proprietorship, limited liability company, corporation, partnership, limited liability partnership, limited partnership, profit or nonprofit unincorporated association, business trust, two or more persons having a joint or common economic interest, or any other person with legal capacity to contract, or a government or governmental subdivision.

Environmental Laws - Any applicable statute, law, ordinance, order, consent decree, judgment, Permit, license, Code provision, covenant deed, common law, treaty, convention, or other requirement pertaining to protection of the environment, health or safety, natural resources, conservation, wildlife, waste management or disposal or Hazardous Substances or pollution, including but not limited to regulation of releases to air, land, water and groundwater.
Equal - A substitute for a product, component or process whose use in or on a particular Project is specified. The "Equal" substitute shall be the same or better for that named, in features, function, performance, quality, reliability, utility, value, and suitability for the particular use.

Equipment - All machinery, tools, manufactured products, and fabricated items needed to complete the Contract or specified for incorporation into the Work.

Equitable Adjustment - A term used to describe a change in the Contract Amount, Contract Time, or both when the Contract Documents authorize such a change.

Establishment Period - The time specified to assure satisfactory establishment and growth of planted Materials.

Existing Surfacing - Pavements, slabs, curbs, gutters, walks, driveways, and similar constructions of bricks, blocks, Portland cement concrete, bituminous treated materials, and granular surfacing materials on existing Highways.

Extra Work - An item of work not provided for in the Contract as Awarded, but ordered, in writing, by the Engineer as essential to the proper completion of the Contract within its intended scope.

Field Order - A written order issued by the Engineer that does not involve a change in the Contract Amount or Contract Time or the intent of the Contract.

Final Completion - The date, following Substantial Completion, when the Owner agrees that the Contractor has satisfied all requirements of the Contract and may request Final Payment. It has the same meaning as Acceptance of Work.

Final Inspection - The inspection conducted by the Owner's Representative to determine that the Project has been completed in accordance with the Contract.

Final Payment - The last progress payment made to the Contractor for earned funds, if any, plus withheld Retainage, less deductions permitted or required by the Contract.

Fine Aggregate - Crushed Rock, crushed Gravel, or Sand that passes a 1/4 inch sieve, with allowable oversize.

Force Account Work - Extra work performed by the Contractor at a cost determined by the contract documents that was ordered in writing by the Engineer, when negotiation has not resulted in a price mutually acceptable to the Contractor and the Owner.

Foreign Contractor - A Contractor who is not domiciled in Oregon or registered by the Secretary of State of the State of Oregon to do business in the State of Oregon.
Granular Material - Graded and selected free-draining material composed of particles of Rock, Sand, and Gravel.

Gravel - Particles of Rock, rounded or not, that will pass a 3 inch sieve and be retained on a No. 4 sieve.

Hazardous Substances - Substances or materials defined as hazardous in Oregon law. Examples include hazardous wastes, as defined in ORS 466.005, any substance defined as a hazardous substance pursuant to section 101(14) of the federal Comprehensive Environmental Response, Compensation and Liability Act, oil, and any substance designated as hazardous by the State Environmental Quality Commission.

Highway - Every road, street, thoroughfare and place, including bridges, viaducts and other structures within the boundaries of the State, open, used or intended for use by vehicular traffic.

Incidental - A term identifying those acts, services, transactions, property, or other items for which the Owner will make no separate or additional payment.

Incidental Work - Work necessary for fulfillment of the Contract, but which is not listed as a Contract Pay Item and for which no separate or additional payment is made.

Inspector - An employee of the Owner and representative of the Engineer or Owner's Representative authorized to inspect and report on some aspects of Contract performance. Inspectors must be distinguished from Regulatory Inspectors (defined below).

Interfacing Work - That portion of the Work that connects to, abuts, or meets with work of another Contractor, which may require cooperation between the two Contractors in order that the Work is successfully completed.

Invitation to Bid - The written document that invites bids from prospective contractors.

Landscape Architect - A person duly registered with the State Landscape Architect Board who performs professional services such as consultation, investigation, reconnaissance, research, design, preparation of drawings and Specifications and responsible supervision where the dominant purpose of the services is a) the preservation and enhancement of land uses and natural land features; b) the location and construction of aesthetically pleasing and functional approaches for structures, roadways and walkways or other improvements for natural drainage and erosion control; or c) the design for equestrian trails, plantings, landscape irrigation, landscape lighting and landscape grading.

Law - Any federal, state, or local law, ordinance, Code, regulation or rule.

Leveling - Placing a variable-thickness Course of Materials to restore horizontal and vertical uniformity to existing Pavements, normally continuous throughout the Project.
Lift - The compacted thickness of material placed by Equipment in a single Pass.

Lump Sum - A way of expressing the Contract Amount for the Work, or the price bid for a portion of the Work, stated as a single price for all labor, materials, supplies, Incidental Work, overhead and profit without any breakdown into its component parts.

Materials - Any natural or manmade substance specified for use in the construction of the Project or for incorporation into the Work.

MBE/WBE/ESB (“M/W/ESB”) - Minority Business Enterprises, Women Business Enterprises, and Emerging Small Businesses are those businesses certified as such by the State of Oregon Office of Minority, Women, and Emerging Small Business.

Median - The portion of a divided Highway separating traffic traveling in opposite directions.

Mobilization - Necessary actions taken by the Contractor to begin the Work, such as the establishment of temporary facilities, equipment and personnel at the jobsite.

Multiple Course Construction - Two or more Courses, exclusive of Patching or Leveling, placed over the entire Roadway width.

Multi-Use Path - That portion of the Highway Right-of-Way or a separate Right-of-Way, physically separated from motor vehicle traffic and designated for use by pedestrians, bicyclists and other non-motorized users.

Neat Line - Theoretical lines specified or indicated on the Plans for measurement of quantities.

Nondurable Rock - Rock that has a slake durability index of less than 90% based on a two-cycle slake durability test, as tested by ASTM D 4644, or Rock that is observed to readily degrade by air, water, and mechanical influence.

Notice - A written communication delivered by hand or by mail to an individual, employee, agent, official, or officer of the Owner or Contractor authorized to receive notice, as set forth in the Contract Documents or as prescribed by law. Communications sent by facsimile transmission (“fax”) are not considered to be adequate notice unless a copy of the original is mailed to the Owner.

Notice to Proceed - Written Notice issued by the Engineer to the Contractor authorizing the Contractor to proceed with all, or part of, the Work.

On-Site Work - Any Work taking place on the Project Site, including designated staging areas adjacent to the Project Site, except for installation of covered temporary signs according to Section 00225.
Organic Soil - A Soil with sufficient organic content to influence the Soil properties.

Owner - The City of Portland.

Owner-Controlled Lands - Lands owned by the Owner, or controlled by the Owner under lease or agreement, or under the jurisdiction and control of the Owner for the purposes of the Contract.

Owner's Representative - An employee acting on behalf of the Owner who has authority to make decisions regarding the Work and the Contract, except to the extent that City Council approval is required by the City's Charter, Code or any specific ordinance. In any particular Contract, the Owner's Representative may be designated as the Engineer, Architect, Project Manager, Construction Manager or other individual. (See 00110.05(e)).

Panel - The width of specified Material being placed by Equipment in a single Pass.

Pass - One movement of a piece of Equipment over a particular location.

Patching - Placing a variable-thickness Course of Materials to correct sags, dips, or bumps to the existing grade and Cross Section, normally intermittent throughout the Project.

Pavement - Asphalt concrete or Portland cement concrete placed for the use of motor vehicles, bicycles, or pedestrians on Roadways, Shoulders, Multi-Use Paths and parking areas.

Pay Item - A specific unit of Work for which a price is provided in the Contract.

Pea Gravel - Naturally occurring round gravel that will pass a 3/8 inch sieve and be retained on a No. 4 sieve.

Peat - A Soil composed primarily of vegetative matter in various stages of decomposition, usually with an organic odor, dark brown to black color, and a spongy consistency.

Performance Bond and Payment Bond - Documents issued by a Surety that promise, in general, that a) the Work will be completed and performed in accordance with the Contract Documents and b) that all persons supplying labor or materials for the Project will be paid, in the event of a Contractor default.

Permit - Written authorization to do specific work issued by City Bureaus or outside agencies having statutory or proprietary jurisdiction over portions of the Work.

Person - "Person" includes an individual, firm, partnership, joint venture, corporation, limited liability company, joint stock company and association.
**Plans** - The Project-specific official plans, profiles, cross sections, elevations, details, and other working, supplementary and detail drawings, or reproductions, stamped by a person licensed to do the same, that show the location, character, dimensions and details of the work to be performed. Plans may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents.

**Prequalification** - A Process by which Bidders become eligible to submit Bids.

**Procurement Rules** - Those rules adopted by the City of Portland that govern purchasing of goods, services and materials found in Chapter 5.33 and 5.34 of the Code of the City of Portland.

**Project** - General term encompassing all phases of the work to be performed under the Contract, synonymous with the terms Improvement or Work.

**Project Manager** - The authorized representative of the Engineer assigned to administer the Contract executed by the Contractor, unless the Contract specifies otherwise.

**Project Site** - The geographical dimensions of the real property on which the Work is to be performed, including designated contiguous staging areas.

**Provide** - When related to an item or part of the Work, the word provide shall be understood to mean furnish and install the Work complete and in place.

**Public Traffic** - Vehicular or pedestrian movement, not associated with the Contract Work, on a public way.

**Publicly-Owned Equipment** - Equipment acquired by the Owner primarily for use in its own operations.

**Punch List** - The Work necessary after Substantial Completion to complete the Project.

**Purchasing Agent** - See "Chief Procurement Officer".

**Quality Assurance** - All those planned and systematic actions by the Owner necessary to provide confidence that a product or service will satisfy given requirements for quality.

**Quality Control** - All Contractor or vendor operational techniques and activities that are performed or conducted to fulfill the contract requirements.

**Railroad** - Publicly or privately owned rail carriers, including passenger, freight, and commuter rail carriers, their tenants, and licensees. Also, Utilities that jointly own or use such facilities.
Reference Specifications - Bulletins, standards, rules, methods of analysis or testing, Codes and Specifications of other agencies, engineering societies, or industrial associations referred to in the Contract Documents that when included in the Contract Documents establish the basis by which specific portions of the Work are to be performed. All such references specified refer to the latest edition thereof including any amendments which are in effect and published at the time of advertising for bids or of issuing the Permit for the Project.

Regulatory Inspectors - Persons employed by regulatory bodies such as the Bureau of Buildings who have authority to determine whether work performed by the Contractor has been performed according to the regulations and codes applicable to that portion of the Work (e.g., electrical, plumbing, etc.).

Release - When used in regard to environmental regulations, the term “release” has the meaning ascribed to it by Oregon law.

Request for Information (“RFI”) - A form approved for use by the Engineer that the Contractor uses to request information, and upon which the Engineer’s response will be returned.

Request for Proposal or Proposal Request (“PR”) - A Request for Proposal or Proposal Request after the Contract is awarded is a written communication by the Owner to the Contractor seeking information about the effects of a possible change to the Work.

Retainage - The difference between the amount earned by the Contractor and the amount paid on the Contract by the Owner.

Right-of-Way - A general term denoting public land, property, or interest therein, acquired for or devoted to a public street, public access or public use.

Roadbed - Completed excavations and embankments for the Subgrade, including ditches, side slopes, and slope rounding, if any.

Roadway - That portion of a street or highway improved, designed or ordinarily used for vehicular travel, including its appurtenances between curbs, gutters, or ditches, but exclusive of the berm or shoulder.

Rock - Natural deposit of solid material composed of one or more minerals occurring in large masses or fragments.

Sand - Particles of Rock that will pass a No. 4 sieve and be retained on a No. 200 sieve.

Schedule of Items - The list of Pay Items, their units of measurement, estimated quantities, and prices.
**Schedule of Values** - A general itemization of work to be performed accompanied by an associated cost that is sometimes required when the Work, or a portion of the Work, has been priced on a Lump Sum basis. When accepted by the Owner, the Schedule of Values determines how much money the Contractor is entitled to receive for work performed in a given time period based on its progress in completing the items of work listed.

**Shoulder** - The part of a Roadbed contiguous to the Traveled Way or Roadway, whether paved or unpaved, for accommodating stopped vehicles, for emergency use and for lateral support of Base and surface Courses.

**Shown** - As used herein, the words “shown,” or “as shown,” shall be understood to refer to work shown, indicated, or described on the Plans in the Contract which can be reasonably inferred as belonging to the item of Work described or indicated and which is required by good practice to provide a complete and satisfactory system or structure.

**Silt** - Soil passing a No. 200 sieve that is nonplastic or exhibits very low plasticity.

**Single Course Construction** - A wearing Course only, not including patching or leveling Courses or partial width Base Course.

**Slope** - Ratio of vertical distance to horizontal distance, unless otherwise specified.

**Soil** - Accumulations of particles produced by the disintegration of Rock, which sometimes contains organic matter. Particles may vary in size from Clay to Boulders.

**Solicitation Document** - Any document that requests submission of a Bid or Proposal or other offer to the Owner to enter into a Contract. All documents mentioned in the solicitation document are incorporated by reference in the solicitation document. May also be called Bid Documents.

**Special Provisions** - A portion of the Contract Documents that is typically applicable to a specific Project that may modify the Standard Specifications, impose additional requirements applicable to a specific project, or both.

**Special Services** - Force Account Work services that the Contractor and Engineer agree cannot be satisfactorily performed by the Contractor's and Subcontractors' forces, e.g., fabrication and machining work that is most effectively performed away from the Project Site, or rental of operated Equipment as defined in 00197.20(1).

**Specifications** - Contract documents that describe the Work and include any Reference Specifications incorporated therein.

**Specified** - As used herein, the word “specified,” or “as specified,” means as required by the Contract.
**Standard Details and Drawings** - Standard plans of structures, devices, or instructions adopted by Owner in the Standard Specifications and in force at the time of the Bid as a standard and referred to by the Contract.

**Standard Specifications/General Conditions** - The terms, directions, provisions and requirements set forth in the City of Portland Standard Construction Specifications in effect at the time of the Bid. These provisions are sometimes referred to as the “General Conditions” of the Contract.

**Station** - A distance of 100 feet measured horizontally along the established centerline of a street, sewer, or other work, unless specified otherwise.

**Street** - Any public Right-of-Way, whether improved or unimproved, including, but not limited to, an avenue, boulevard, alley, lane, bridge, bicycle path, road, public thoroughfare or public way and any land over which a Right-of-Way has been obtained or granted for any purpose of public travel.

**Structures** - Bridges, retaining walls, endwalls, cribbing, buildings, culverts, manholes, catch basins, drop inlets, sewers, service pipes, underdrains, foundation drains, and other similar features which may be encountered in the Work.

**Subbase** - A Course of specified material of specified thickness between the Subgrade and a Base.

**Subcontractor** - An individual, partnership, firm, corporation, or any combination thereof, with whom the Contractor enters into a subcontract to perform a part of the Work.

**Subgrade** - The top surface of completed earthwork on which Subbase, Base, Surfacing, Pavement, or a Course of other Material is to be placed.

**Substantial Completion** - A state of Contract performance that is less than full performance of all the work required by the Contract Documents, but is nonetheless sufficiently complete to permit occupancy or use of the Project for its intended purpose, and where the omissions and deviations from full performance are inadvertent and unintentional, do not impair the Work as a whole, can be easily remedied, and may be paid for by deductions from the Contract Amount.

**Substructure** - Those parts of a Structure which support the Superstructure, including bents, piers, abutments, and integrally built wingwalls, up to the surfaces on which bearing devices rest. Substructure also includes portions above bearing surfaces when those portions are built integrally with a Substructure unit (e.g., backwalls of abutments). When Substructure and Superstructure elements are built integrally, the division between Substructure and Superstructure is considered to be at the bottom soffit of the longitudinal or transverse beam, whichever is lower. Culverts and rigid frames are considered to be entirely Substructure.

**Superstructure** - Those parts of a Structure above the Substructure, including bearing devices.

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**Surety** - An entity providing a Bid Bond, Performance Bond, Payment Bond, Warranty or Maintenance Bond, or any combination thereof.

**Surfacing** - The Course or Courses of material on the Traveled Way, auxiliary lanes, Shoulders, or parking areas for vehicle use.

**Technical Specifications** - Requirements of a technical nature particular to the Project and included in the Specifications.

**Ton** - One short ton of 2000 pounds (Tn).

**Topsoil** - Soil ready for use in a planting bed.

**Traffic Lane** - That part of the Traveled Way marked for moving a single line of vehicles.

**Traveled Way** - That part of the Highway for moving vehicles, exclusive of auxiliary lanes, berms and Shoulders.

**Typical Section** - That Cross Section established by the Plans which represents in general the lines to which the Contractor shall work in the performance of the Contract.

**Unit Price** - The dollar amount bid to do a particular portion of Contract work when such prices are required by the Bid Documents. In some cases, unit prices are used in order to determine the lowest responsive and responsible Bidder.

**Unsuitable Material** - Frozen material, or material that contains organic matter, muck, humus, peat, sticks, debris, chemicals, toxic matter, or other deleterious materials not normally suitable for use in earthwork.

**Utility** - A line, facility or system for producing, transmitting, or distributing communications, power, electricity, heat, gas, oil, water, steam, waste, stormwater not connected with highway drainage, or any other similar commodity that directly or indirectly services the public. The term “utility” also shall mean the utility company, district, or cooperative, including any wholly owned or controlled subsidiary thereof, which provides utility services.

**Wetlands** - Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated Soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

**Work** - All material, labor, tools, equipment, and all appliances, machinery, systems, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete, functioning, and satisfactory system or structure.
00110.20

**Working Day** - Any and every day shown on the calendar, excluding Saturdays, Sundays and City of Portland legal holidays, synonymous with "workday".

**Working Drawings** - Shop drawings and other submittals as outlined in 00150.35, not furnished by the Owner, that the Contractor is required to submit to the Engineer.
Section 00120 - Bidding Requirements and Procedures

Provisions and Requirements

00120.10 Examination of Contract, Site of Work and Subsurface Data:

(a) The Bidder shall carefully examine the sites (including material sites) of the proposed Work, the Bid, Plans, Special Provisions, Specifications, Addenda, and Contract forms. The submittal of a Bid shall be conclusive evidence that the Bidder has made such examinations and understands all the requirements for the performance of the completed Work.

(b) The Bidder shall determine the methods, materials, labor, and equipment required to perform the completed Work and shall reflect their cost in the Bid prices. Any costs exceeding those anticipated by the Bidder will not entitle it to additional compensation.

(c) If the Owner has made an investigation of the site specifically for the proposed Work, boring log data, soil sample test data, subsurface data, or any historical data accumulated by the Owner’s Representative will be made available for inspection by the Bidders at the Owner’s office or another location. The Owner is under no obligation to search its records for other data that may or may not be helpful for the Bidder’s inspection, and the parties agree that no Claim for additional compensation may be made if such additional test data is not provided. It is mutually recognized and agreed to by all parties that:

(1) When any of this data is included in the Bid Documents, it is for the purpose of disclosing design information and is not a part of the Contract.

(2) The subsurface investigations made by the Owner are for the sole purpose of obtaining data necessary for planning and designing the Project.

(3) The Owner assumes no responsibility whatsoever for the sufficiency or completeness of the data furnished with respect to meeting the needs of the Bidder in planning his work as it was obtained for an entirely different purpose.

(4) The Owner warrants that the data represents with reasonable accuracy the conditions and materials found in the specific borings at the time the borings were made. The Owner does not warrant that the condition, materials, or proportions of materials at any other locations, or between the borings, is identical to what was found.
(5) The Owner makes no representation or warranty express or implied that:

a. The Owner’s interpretations from the data are correct.

b. Moisture conditions and indicated water tables will not vary substantially from those found at the time the borings were made.

c. The ground at the location of the boring has not been physically disturbed or altered after the boring was made.

(6) The disclosure of subsurface information from the Owner’s Representative is solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risks or of any duty to make his own examinations and investigations as required by this Subsection or any other responsibility under the Contract.

(7) The Bidder acknowledges that it has ascertained the nature and location of the Work, and that it has investigated and assured itself as to the general and local conditions that can affect the Work or its cost. The Bidder also acknowledges that it is satisfied as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered so far as this information can be reasonably ascertained from an inspection of the site, including exploratory work done by the Owner, as well as from the Bid Documents and any data that may be provided or made available. Failure of the Bidder to take these actions will not relieve it of responsibility for properly estimating the difficulty and cost of successfully completing the Work, or for proceeding to successfully complete the Work without additional cost to the Owner.

(8) The Owner assumes no responsibility for conclusions or interpretations made by the Bidder based on the information that the Owner makes available. Statements made by Owner representatives at the pre-bid or pre-proposal conference or elsewhere are not binding on the Owner and shall not change the Solicitation Document unless the Owner confirms the statements and changes to all prospective Bidders or proposer by written addendum to the Solicitation Document.

(9) In the event of a conflict between Codes, industry standards and Reference Specifications, the most stringent requirements apply and Bidders shall submit their Bids based on the most stringent requirements. See 00165.00(b).

00120.15 Basis of Bid - A Bid shall be based on the requirements of the Contract Documents. The Contractor shall not submit a Bid anticipating that any portion of the Contract Documents will be changed, modified or not enforced. However, if the Contractor believes that any portion of the Contract Documents conflicts with, or is at variance with, any law, it shall immediately notify the Owner so that the Owner can analyze the situation before Bids are submitted.
00120.20 Interpretation of Quantities in Bid Schedule:

(a) The Owner reserves the right to increase or decrease the amount of any class, item, or portion of the Work and to delete any bid items in their entirety after the Contract is awarded. Those changes shall not be considered as a waiver of any condition of the Contract nor shall such changes invalidate any of the remaining provisions of the Contract Documents.

(b) The estimate of quantities of work to be done under Unit Price Bids is approximate and is given only as a basis of calculation for comparison of Bids and award of the Contract. The Owner does not guarantee that the amount of work to be performed will be the same as the amount estimated in the Bid Documents.

00120.35 Assignment of Claim Relief - The Contractor hereby assigns to the Owner any Claim for relief that the Contract has or may have in the future by reason of violation of 15 USC §§ 1-15 or ORS 646.725 or ORS 646.730.
00130.10 Award and Execution of Contract

Provisions and Requirements

00130.10 Award of Contract - The Owner's Procurement Rules shall govern the Bidding and Award of any Contract by the Owner.

00130.80 Restrictions on Commencement of Work:

(a) The Notice to Proceed is a written document that authorizes the Contractor to begin the work described in the Contract Documents and sets forth the time when Contract Time will begin.

(1) Work shall not begin until the Notice has been given.

(2) Before starting Work, the Contractor shall file with the Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by ORS 279C.830(3) unless otherwise exempt. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work, unless otherwise exempt.

(b) The Notice to Proceed will not be given until the Contractor provides Owner with all documentation necessary for Contract performance, including, but not limited to, all necessary signatures on Contract Documents, a Performance and Payment Bond, proof of all required insurance. After receipt of all required documentation Owner will review the submitted documentation for conformance with Contract requirements. If the documentation conforms to Contract requirements, Owner will issue the Notice to Proceed within 30 Calendar Days after receipt. If the documentation does not conform, Owner will notify Contractor as soon as possible so that proper documentation can be provided.

(c) The Owner may delay the issuance of the Notice to Proceed beyond 30 Calendar Days if all required Easements or Permits have not been obtained, if necessary Utility relocation, construction or reconstruction has not been completed by Owner or Contractor, or for Owner's convenience. If issuance of the Notice to Proceed is delayed for these reasons, Owner shall notify Contractor of the delay.
00140.00  Purpose of Contract:

(a) The Contract Documents govern the Work to be done, set forth the relative responsibilities of the Owner and Contractor, and establish the method by which changes in the Contract are made.

(b) Some details of the Work may be found in only one location in the Contract Documents. Therefore, the Contractor must review all portions of the Contract Documents in order to know the full scope of Work.

(c) The Owner has adopted Standard Specifications and Standard Plans that may be applicable to this Contract. Any reference to a Standard Plan or Standard Specification in this Contract refers to the ones in effect at the time that the Contract was advertised. In case of any confusion, contact the Owner’s Representative for an explanation.

00140.30  Owner-Required Changes in the Work:

(a) Changes to the Plans, quantities or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of Project construction. Without impairing the Contract, the Owner reserves the right to require changes it deems necessary or desirable within the scope of the Project.

(b) Changes to the Work may be accomplished by mutual agreement of the Owner and Contractor. When agreement is reached, the parties will execute a written Change Order that sets forth their agreement pursuant to Section 00196.10.

(c) When Extra Work or changed work is necessary, but the Owner and Contractor cannot reach agreement on the terms of a Change Order, the Owner will direct such changes by issuing a Construction Change Directive (CCD), a written statement prepared by the Owner’s Representative. The CCD may result in additions, deletions or other revisions to the Work to be performed. Upon receipt of a CCD, the Contractor shall promptly follow the direction given in the CCD and proceed with the change in the Work involved. Payment for work performed shall be made as specified in Section 00197.

(d) In contrast to a CCD, a Field Order is oral or written advice, direction or instruction provided to the Contractor by the Owner’s Representative, Inspector, or other authorized persons that is intended to assist in the completion of the Work without additional cost or Contract Time to either the Owner or to the Contractor. Field Orders include, but are not limited to, identifying relevant Contract provisions in response to a Contractor’s question, clarifying a contractual requirement or directing minor changes to Contract work that can be performed by the Contractor without additional cost and without the need for additional Contract Time.
00140.40

(e) If the Contractor believes that following the advice, direction or instruction provided by a Field Order will result in additional costs, require additional compensation or require additional Contract Time, is contrary to the requirements of the Contract Documents or that the Field Order requires the performance of Extra Work the Contractor shall follow the requirements of 00199.30 regarding Claims for additional compensation and requests for additional Contract Time.

00140.40 Differing Site Conditions:

(a) The Contractor shall promptly, and before the conditions are disturbed, give written Notice to the Owner’s Representative of:

(1) Pre-existing subsurface or latent physical conditions at the site which differ materially from those indicated in this Contract, or;

(2) Pre-existing unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in the work of the character provided for in the Contract.

(b) After receipt of the Notice, the Owner’s Representative will investigate the conditions encountered by the Contractor promptly. If the Representative finds that the conditions are materially different and cause a material increase or decrease in the Contractor’s cost of, or the time required for, performing any part of the Work under this Contract, whether or not changed as a result of the conditions, an Equitable Adjustment to the Contract will be made under this clause and the Contract modified in writing accordingly. If possible, Owner and Contractor shall agree on the adjustment to be made. If they are unable to agree, the Representative will determine the amount of the Equitable Adjustment and adjust the time to perform if appropriate. If the Representative finds that differing site conditions do not exist, that decision is final and binding upon the Contractor.

(c) Contractor has waived its right to bring a Claim for additional compensation or Contract Time for encountering a differing site condition unless the Contractor has given the Notice required by 00140.40(a). No request by the Contractor for an Equitable Adjustment to the Contract as a result of a differing site condition will be allowed if the request is made after Final Payment under this Contract.

00140.50 Environmental Pollution Changes - ORS 279C.525 will apply to any increases in the scope of the Work required as a result of environmental or natural resources laws enacted or amended after the submission of Bids for the Contract.

00140.60 Extra Work:

(a) Owner may at any time, by written order, require Contractor to perform extra or changed work. It is the Contractor’s responsibility to notify the Surety of such order if the cost of the changed or Extra Work exceeds 25% of the total original Contract Amount.
(b) When so ordered in writing, by the Owner’s Representative, Contractor shall proceed with the performance of any changed or Extra Work regardless of whether an agreement has been reached on how that performance affects Contract Amount or Contract Time. If the Contractor refuses to perform the changed or Extra Work, this is a material breach of Contract and Owner shall have all remedies available to it at law and equity for that breach. Contractor shall have no right to additional Contract Time for delay incurred by Contractor’s refusal to perform because the price, time, or both, has not yet been agreed upon. Contractor’s remedy is, instead, to proceed as required by 00199.30.

(c) When the Owner’s Representative is contemplating changed or Extra Work, a Notice of the proposed changed or Extra Work together with a solicitation for a quotation for the performance of the changed or Extra Work will be issued to the Contractor, in writing, by the Owner’s Representative.

(1) The Contractor shall submit a price quotation and Proposal for performing the changed or Extra Work within 10 days unless the Owner agrees upon a longer period of time in writing. The Contractor shall submit data to substantiate both the cost of performing the work and any additional Contract Time that may be requested.

(2) The Contractor’s delay in submitting a price quotation and Proposal shall not, in and of itself, extend the Contract Time. If the Contractor is unable to prove that the extra or changed work will cost additional money or is unable to substantiate that it requires additional Contract Time, Contractor has waived any Claim it might have to either Contract Time or additional money after the decision to proceed with the work has been made by Owner and communicated to Contractor.

00140.70 Cost Reduction Proposals - The Contractor may submit written proposals to the Engineer that modify Plans, Specifications, or other Contract Documents for the sole purpose of reducing the total cost of construction.

(a) Proposal Requirements - The Owner will not accept a cost reduction proposal that impairs essential functions or characteristics of the Project including but not limited to service life, economy of operation, ease of maintenance, designed appearance, or design and safety standards.

To conserve time and funds, the Contractor may first submit a written request for a feasibility review by the Engineer. The request should contain a description of the proposal together with a rough estimate of anticipated dollar and time savings. The Engineer will, within a reasonable time, advise the Contractor in writing whether or not the proposal would be considered by the Owner, should the Contractor elect to submit a detailed cost reduction proposal.
A detailed cost reduction proposal shall include without limitation the following information:

(1) A description of existing Contract requirements for performing the Work and the proposed change;

(2) The Contract items of Work affected by the proposed change, including any quantity variation caused by the proposed change;

(3) Pay Items affected by the proposed change including any quantity variations;

(4) A detailed cost estimate for performing the Work under the existing Contract and under the proposed change. Cost estimates shall be based on a force account payment basis. Costs of re-design, which are incurred after the Owner has accepted the proposal, will be included in the cost of proposed work; and

(5) A date by which the Engineer must accept the proposal in order to accept the proposed change without impacting the Contract Time or cost reduction amount.

(b) Continuing to Perform Work - The Contractor shall continue to perform the Work according to Contract requirements until the issuing of a Change Order incorporating the cost reduction proposal. If the Owner fails to issue a Change Order by the date specified in the proposal, the proposal shall be deemed rejected.

(c) Consideration of Proposal - The Owner is not obligated to consider any cost reduction proposal. The Owner will not be liable to the Contractor for failure to accept or act upon any cost reduction proposal submitted.

The Owner will determine in its sole discretion whether to accept a cost reduction proposal as well as the estimated net savings in construction costs from the adoption of all or any part of the proposal. In determining the estimated net savings, the Engineer may disregard the Schedule of Items. The Engineer will establish prices that represent a fair measure of the value of Work to be performed or to be deleted as a result of the cost reduction proposal.

(d) Sharing Investigation Costs - As a condition for considering a Contractor's cost reduction proposal, the Owner reserves the right to require the Contractor to share in the Owner's costs of investigating the proposal. If the Owner exercises this right, the Contractor shall provide written acceptance of the condition to the Engineer. Such acceptance will authorize the Owner to deduct its share of investigation costs from payments due or that may become due to the Contractor under the Contract.

(e) Acceptance of Proposal Requirements - If the Contractor's cost reduction proposal is accepted in whole or in part, acceptance will be made by a Change Order that will include without limitation the following:
• Statement that the Change Order is made in accordance with 00140.70;

• Revised Plans and Specifications that reflect all modifications necessary to implement the approved cost reduction measures;

• Any conditions upon which the Owner's approval is subject;

• Estimated net savings in construction costs attributable to the approved cost reduction measures; and

• A payment provision pursuant to which the Contractor will be paid 50% of the estimated net savings amount as full and adequate consideration for performance of the Work of the Change Order.

The Contractor's cost of preparing the cost reduction proposal and the Owner's costs of investigating the proposal, including any portion paid by the Contractor, will be excluded from determination of the estimated net savings in construction costs. Costs of re-design, which are incurred after the Owner has accepted the proposal, will be included in the cost of the Work attributable to cost reduction measures.

If the Owner accepts the cost reduction proposal, the Change Order that authorizes the cost reduction measures will also address any Contract Time adjustment.

(f) Right to General Use - Once submitted, the cost reduction proposal becomes the property of the Owner. The Owner reserves the right to adopt the cost reduction proposal for general use without additional compensation to the Contractor when it determines that a proposal is suitable for application to other contracts.

00140.90 Final Trimming and Cleanup:

(a) Before final payment is issued, the Contractor shall neatly trim and finish the Project and remove all remaining unincorporated Materials and debris. Final trimming and cleanup shall include without limitation the following:

(1) The Contractor shall retrim and reshape earthwork, and shall repair deteriorated portions of the Project Site.

(2) Where the Work has impacted existing facilities or devices, the Contractor shall restore or replace those facilities to their pre-existing condition.

(3) The Contractor shall clean all drainage facilities and sanitary sewers of excess Materials or debris resulting from the Work.

(5) The Contractor shall remove temporary buildings, construction plants, forms, falsework and scaffolding, surplus and discarded Materials and rubbish.

(6) The Contractor shall dispose of Materials and debris including without limitation forms, falsework, scaffolding, and rubbish resulting from clearing, grubbing, trimming, clean-up, removal, and other Work. These Materials and debris become the property of the Contractor. The Contractor shall dispose of these Materials and debris immediately.
Section 00150 - Control of Work

Provisions and Requirements

00150.00 Authority of the Owner's Representative:

(a) The Work shall be performed in accordance with the requirements of the Contract Documents. The Owner's Representative will determine whether that has occurred.

(b) The Owner's Representative's decisions will be final, binding and conclusive on the Contractor on all questions that arise regarding the quantity of materials and work, the quality of materials and work, the acceptability of materials furnished and work performed, the acceptable rate of progress of the work, the interpretation of the Plans and Specifications, the measurement of all quantities, the acceptable fulfillment of the Contract on the part of the Contractor, and payments under the Contract.

(c) Work will not be considered completed until it has passed final inspection by the Owner's Representative and is accepted by the Owner. The authority of the Owner's Representative is such that the Contractor shall at all times carry out and fulfill the instructions and directions of the Owner's Representative in so far as they concern the work to be done under the Contract.

(d) If the Contractor fails to comply with any reasonable order made under the provisions of this Subsection, the Owner's Representative will have the authority to cause unacceptable work to be remedied or removed and replaced, and unauthorized work to be removed, and to deduct the costs thereof from any money due or to become due the Contractor.

(e) The Owner's Representative has the authority to suspend work for cause as set forth in 00180.85.

(f) Nothing in this Subsection or elsewhere in the Contract shall be construed as requiring the Owner's Representative to direct or advise the Contractor on the method or manner of performing any work under the Contract. No approval or advice as to the method or manner of performing or producing any materials to be furnished shall constitute a representation or warranty by the Owner that the result of such method or manner will conform to the Contract, relieve the Contractor of any of the risks or obligations under the Contract, or create any liability to the Owner because of such approval or advice.

(g) An Architect, Engineer, Designer or other person hired by Owner under a separate Contract is not the Owner's Representative, unless the Contract Documents expressly state otherwise. Contractor will be notified if the Owner's Representative has been changed.
00150.02 Inspector’s Authority and Duties:

(a) The Owner’s Representative may assign Inspectors, assistants and other persons to advise the Owner whether the work and materials meet Contract requirements. Such determination may extend to any or all parts of the Work and to the preparation or manufacture of materials to be used.

(b) In the event that assigned personnel discover defective materials or work not being performed safely or in accordance with Contract requirements, the Owner’s Representative will have the authority to reject the materials or to suspend the Work.

(c) Assigned personnel, including but not limited to, Inspectors and assistants, are not authorized to approve or accept any portion of the Work, to accept materials, to issue instructions or to give advice that is contrary to the Contract. Work done or material furnished that does not meet Contract requirements shall be at the Contractor’s risk, and does not provide a basis for a Claim even if it is asserted that assigned personnel changed Contract requirements.

(d) In the event that assigned personnel or the Owner’s Representative fail to observe, call out or note faulty work, defective materials, errors, or the Contractor’s failure to comply with Contract requirements, that failure does not constitute acceptance or approval of that particular portion of the Work. If this occurs, the Contractor remains obligated to perform the Work in accordance with the Contract Documents, without additional compensation or Contract Time.

(e) The provisions of 00150.02 do not apply to Regulatory Inspectors.

(f) If the Owner’s Representative notes faulty work, defective materials, errors or the Contractor’s failure to comply with Contractor requirements, it will notify the Contractor’s Representative.

00150.10 Coordination of Specifications and Plans; As-Built Drawings:

(a) The Owner intends the Plans and Specifications to coordinate with each other to provide for a complete Project. Patent conflicts in the Contract Documents, or obvious omissions, are ones that should have been discovered before submission of a Bid to the Owner by a reasonable person in the Contractor’s position if all the Documents had been reviewed. In such a situation, the Contractor has a duty to inquire of the Owner before submitting its Bid about the correct interpretation of the Contract. This permits the Owner to clarify by Addendum what is intended by the Contract. That is particularly true for errors in figures, drawings or Specifications.

(b) If the Contractor fails to bring a patent conflict or error to the Owner’s attention before it submits a Bid, it has waived its right to additional compensation when the Owner resolves it.
(c) Anything shown on the Plans and not mentioned in the Specifications, or mentioned in the Specifications and not shown on the Plans, shall be of like effect as if shown or mentioned in both. This does not constitute a conflict, discrepancy or error between the two.

(d) In cases of apparent discrepancies or conflicts between the Plans and the Specifications, the Contractor shall first determine if the matter can be resolved pursuant to the rule stated in 00150.10(c) above. If not, the apparent conflict shall be resolved by designating the portion of the Contract Documents that takes precedence over the others. Therefore, when preparing its Bid, or when beginning any portion of the Work, the Contractor shall use the following order of precedence to resolve any apparent conflict:

1. Permits from Outside Agencies required by law
2. Change Orders
3. Addenda
5. Plans
6. Information furnished by written notes or schedules on drawings
7. Large Scale Drawings over small scale drawings
8. Standard Details and Standard Drawings
9. Standard Specifications
10. All other contract documents not listed above

(e) Contractor shall bring any real or perceived discrepancy concerning dimensions, quantities or location between the drawings, details or Specifications to the attention of the Owner’s Representative before beginning that portion of the Work.

(f) In the event of any inconsistency in the Drawings and Specifications unless otherwise ordered in writing by the Owner’s Representative, the Contractor shall provide the better quality of, or the greater quantity of Work or materials. This provision shall apply only to inconsistencies in express requirements of the Drawings and Specifications and not the interpretations by the Owner or Architect.

(g) The Contractor shall check and compare all Plans and Specifications prior to construction and notify the Owner if conflicts, discrepancies, errors or omissions are apparent in order to permit correction at the lowest possible cost to all concerned. A current copy of the Plans and Specifications reflecting all changes that have been made during the Work shall be kept on or near the site of the Work at all times.

(h) The Contractor shall provide all work and materials reasonably required or intended to complete the Work, regardless of whether they are expressly mentioned in the Plans and Specifications.
(i) The Contractor shall verify measurements provided by the Plans and Specifications at the Project site to determine if they are still correct since changes to the Plans, Specifications, and Project site are common and the inherent changing nature of construction work may require adjustments to such measurements. Similarly, the Contractor is not entitled to rely on measurements deduced or scaled from, but not explicitly provided by, the Plans.

(j) The Owner reserves the right to issue additional drawings or written instructions if that appears helpful or necessary to complete the Work. If so, the Contractor shall perform the Work in accordance with the additional details or instructions.

(k) The Contractor shall maintain at the site for the Owner one record copy of the drawings, Plans, Specifications, Addenda, Change Orders and other modifications, in good order and marked currently to record changes and selections made during construction, as well as Working Drawings that have been reviewed and are being used. These shall be available to the Owner’s Representative and shall be delivered to the Owner’s Representative upon request and upon completion of the Work. The As-Built Drawings shall have recorded upon them all changes and corrections, all actual dimensions, locations and other details of the Work as actually built in progress.

(l) Within 5 working days of submitting a notice of substantial completion, the Contractor shall submit a complete, signed set of plans and specifications showing all As-Built Drawings conditions on the Project.

00150.15 Construction Stakes, Lines and Grades:

(a) The Owner will provide and set construction stakes establishing lines and grades as may be necessary for the Work. The Contractor shall notify the Owner’s Representative not less than 3 Working Days in advance of when survey services are required in connection with the layout of any portion of the Work.

(b) Unless otherwise indicated in the Special Provisions, the Owner will furnish and set construction stakes establishing lines and grades as indicated below:

1. **Temporary easements** - Temporary easement limits painted or staked every 25 feet and at corners with stakes or paint marks clearly identifying the character of the line, i.e., "Temp Easement Boundary".

2. **Manholes** - Stake offset to sewer manholes, cleanouts, inlets, and proposed lines at 50 foot intervals with cuts/fills to invert elevation.

3. **Curbs, Medians, Sidewalks** - Stake curbs, medians, and sidewalks with offsets to face of curb at 25 foot intervals and at the beginning and end of all curves with 1/4 points on larger curves. Stakes will be marked with cuts/fills to finish grade.

4. **Curb Ramps** - Stake curb at ramps with offsets to grade break points.
(5) Street Staking:

a. Offset Stakes - Set offset stakes, outside the area of construction, at 50 foot intervals and grade breaks referencing cuts/fills to subgrade at centerline and gutter line.

b. Subgrade Stakes - Subgrade blue-tops at 50 foot intervals and grade breaks on the 1/4 and center points.

c. Aggregate Stakes - Top of base aggregate at 50 foot intervals and grade breaks on the 1/4 and center points.

d. Asphalt Concrete Pavement Stakes - Top of asphalt concrete pavement, after base lift has been placed, at 25 foot intervals and grade breaks on the 1/4 and center points.

(6) Traffic Signal and Street Lighting Staking:

a. Poles - Signal and Light poles with 2 points each with cut/fill to sidewalk finish grade.

b. Controllers - Offsets to control cabinets with cut/fill to sidewalk finish grade.

(7) Structure Staking:

a. Piling - Set stakes with offsets to locate center of each pile.

b. Abutments/Pier Caps - Set stakes and benchmark to locate centerline of abutments or pile caps.

c. Retaining Walls - Set stakes and benchmark to locate wall control line.

d. Bridge Decks - Calculate and provide finish deck grades.

(8) Water Facilities - Waterline and appurtenances shall be staked.

(9) Striping - Stake control points every 40 feet on tangent, every 20 feet on a curve and at the beginning and end of all transition points and tapers.

The Contractor shall be responsible for supplementing as needed or transferring the lines and grades to the work from the offset stakes established by the Engineer. The Owner will provide one set of construction stakes. The cost to replace damaged or lost stakes shall be borne by the Contractor. If the Contractor desires additional construction staking beyond those listed above or in the Special Provisions, the cost thereof shall be borne by the Contractor on a time and materials basis.
Work performed by the Contractor without lines and grades having been established by the Owner’s Representative and work performed beyond the lines and grades is prohibited. The Contractor shall remove, replace or correct such work at its own expense if directed to do so by the Owner’s Representative.

The Contractor shall coordinate all requests for survey staking with the Owner’s Inspector and submit all requests in writing. The Owner will initiate the staking of each request within 3 City business days of the Survey department’s receipt of the request. If an area requested is not ready for staking within the 3 City business days, the Contractor shall reinitiate the request. The Owner’s Representative will provide the Contractor with sufficient “Request for Survey” forms for their use.

All elevations shown on the Plans are City of Portland datum. This datum plane has its zero elevation set equivalent to 1.375 feet below mean sea level as set by the U.S. Coast and Geodetic Survey 1947 adjustment.

Inspection:

- The Owner’s Representative may test Materials furnished and inspect Work performed by the Contractor to ensure Contract compliance. If the Contractor performs Work without the Owner's Representative's inspection or uses Materials that the Engineer has not approved, the Owner's Representative may order affected portions of the Work removed at the Contractor's expense. The foregoing sentence shall not apply if the Owner's Representative fails to inspect the Work within a specific period of time required in the Contract, or in the absence of a specific period of time, within a reasonable period of time after receiving the Contractor's timely written request for inspection or testing.

At the Owner's Representative's direction, any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore these portions of Work to the standard required by the Contract. If the Owner's Representative rejects Work due to Materials or workmanship, or if the Contractor performed such Work without providing sufficient advance request for inspection to the Owner's Representative, the Contractor shall bear all costs of uncovering and restoring the Work. If the Owner's Representative accepts the uncovered Work, and the Contractor performed the Work only after providing the Owner's Representative with sufficient advance notice, the costs of uncovering and restoring the Work will be paid for by the Owner as Extra Work.

- The Contractor shall furnish walkways, railings, ladders, tunnels, platforms and other facilities necessary to permit the Owner's Representative to have safe access to the Work to be inspected. The Contractor shall require producers and fabricators to provide safe inspection access as requested by the Owner's Representative.
(c) **Sampling** - The Contractor shall furnish the Owner's Representative with samples of Materials that the Owner's Representative will test. All of the Contractor's costs related to this required sampling are Incidental.

(d) **Inspection by Third Parties** - Where third parties have the right to inspect the Work, the Contractor shall coordinate with the Owner's Representative and shall provide safe inspection access.

00150.30 **Delivery of Notices** - Whenever written notices are required or permitted to be given by the Contract Documents, they shall be delivered via first class mail, or in person to the current office address as shown in the records of the Owner. Notices delivered via first class mail shall be deemed delivered 5 Working Days following the postmarked date.

00150.35 **Working Drawings and Other Submittals:**

(a) For purposes of this subsection the following definitions apply:

1. **Shop Drawings** - Shop drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor, a Subcontractor at any tier, manufacturer, supplier or distributor to illustrate some portion of the Work.

2. **Product Data** - Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3. **Samples** - Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4. **Submittals** - Submittals are documents required by the Contract to be submitted to the Owner for review. However, they are not part of the terms and conditions of the Contract. They may include shop drawings, product data, samples, or a schedule of construction events.

(b) Shop Drawings, Product Data, Samples and other Submittals are not part of the Contract. Their purpose is to demonstrate, for those portions of the Work for which Submittals are required, the way the Contractor proposes to conform to the requirements of the Contract and the design concept expressed in the Contract.

(c) The Contractor shall review, approve and submit to the Owner all Shop Drawings, Product Data, Samples and other Submittals required by the Contract regardless of whether the document originated with the Contractor or with some other Subcontractor or supplier. They shall be submitted at the time required by the Contract, or, if no time is specified, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate Contractors. Submittals made by the Contractor that are not required by the Contract may be returned without action or may not be returned at all.
(d) Informational Submittals that do not require the Owner to take responsive action may be so identified in the Contract.

(e) The Contractor shall provide 6 copies of any Submittal required by the Contract or when requested by the Owner's Representative. In addition, the Contract may also require the Contractor to provide information about the products and materials it proposes to incorporate into the Work and to provide samples of such products and materials for inspection or testing. The Contractor shall be responsible for all Submittals presented to the Owner for review, no matter what their point of origin may have been.

(f) The Contractor shall not perform a portion of the Work that requires the Owner to review a Submittal until the respective Submittal has been reviewed by the Owner as outlined below. Such work shall be performed in accordance with Submittals that conform to the Contract Documents.

(g) When tendering a Submittal to the Owner for review, the Contractor represents that it has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained in such Submittals with the requirements of the Work and of the Contract. The Contractor shall expressly note where any submittal differs from or varies from the requirements of the Contract, notwithstanding any belief on the part of the Contractor that the variance is obvious.

(h) The Owner’s review of any Submittal does not relieve the Contractor from its responsibility to follow the requirements of the Contract. The Owner is not responsible for ensuring that Submittals are correct. Failure of the Owner to discover that a submittal varies from the requirements of the Contract Documents does not relieve the Contractor of its responsibilities to conform to the Contract nor provide a basis for a Change Order. Nevertheless, the Owner’s Representative shall review any Submittals provided in order to make a general determination about whether they appear to meet Contract requirements or the intended design of the Project. The Contractor remains responsible for following the Contract, including, but not limited to:

1. Confirming and correlating all dimensions;
2. Fabricating and construction techniques;
3. Coordinating the work with that of all other trades and Subcontractors;
4. Satisfactorily performing the Work in accordance with the Contract Documents;
5. The means and methods of construction; and
6. Conforming to all the requirements of the Contract

(i) The Owner’s Representative will have 14 days to review any Submittals, unless a different time is established elsewhere in the Special Provisions. The Owner’s Representative will review the Submittals and return them to the Contractor with one of the following notations:

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(1) **“NO EXCEPTIONS TAKEN”** If the Submittal is marked, “NO EXCEPTIONS TAKEN,” this means that the Contractor may immediately begin the work encompassed by the Submittal.

(2) **“MAKE CORRECTIONS NOTED”** If the Submittal is marked “MAKE CORRECTIONS NOTED” the Contractor is required to make any revisions listed by the Owner’s Representative and, upon correction, may immediately begin the work indicated by the Submittal or may incorporate the material or equipment covered by the Submittal into the Work.

(3) **“REVISE AND RESUBMIT”** If the Submittal is marked “REVISE AND RESUBMIT,” the Contractor is required to revise the Submittal and resubmit it to the Owner’s Representative. No work shown on the Submittal, or which is dependent upon approval of the Submittal or material or equipment covered by the Submittal, may be incorporated into the Work until the Contractor has made the necessary revisions, resubmitted the Submittal and received the Submittal back marked either “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED”.

(4) **“REJECTED”** If the Submittal is marked “REJECTED” it means that the Owner’s Representative has found the Submittal, material or product data to be unacceptable and not in conformance with the Contract. Generally speaking, rejection of a Submittal simply indicates the Owner’s Representative’s belief that the defects in the Submittal are so great that it cannot be revised in order to make it conform to the Contract, as indicated in 00150.35(i-3) above. The Contractor may not begin work indicated by the Submittal, nor incorporate material or equipment, nor proceed with Work dependent upon review of the Submittal, into the Work based on any Submittal, product data or material that has been marked “REJECTED”.

(5) **“SUBMIT SPECIFIED ITEM”** If the Submittal is returned marked “SUBMIT SPECIFIED ITEM,” it means that additional information is required to permit a full review. Work may begin on incorporating the material or equipment covered by the Submittal into the Work, only if it is not affected by the item to be submitted. However, if any material or equipment is affected by the item to be submitted, then no work may begin until the Submittal is resubmitted and returned marked either “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED”.

(j) The following rules about Contract Time shall apply to Submittals. Contract Time will not be extended if:

(1) The Contractor’s delay resulted from the Owner’s use of the full amount of allotted time under the Contract to review the Contractor’s Submittal;

(2) The Contractor’s delay resulted from its own failure to provide a submittal in a timely manner;

(3) The Contractor’s delay resulted from a submittal that properly was marked “Revise and Resubmit,” “Rejected,” “Submit Specified Item”; or

(4) The Contractor did not understand what it was required to submit and failed to inquire about it in a timely manner.
(k) If the Contractor disagrees with the Owner’s review of its Submittal and the Owner’s action has the potential of increasing the Contractor’s costs, the Contractor shall proceed as required by 00199.30.

(l) The Contractor shall keep a current list of submittals available for the Owner’s Representative to review.

(m) Working Drawings - The Contractor shall supplement the Owner-prepared Plans with stamped or unstamped Working Drawings that show all information necessary to complete the Work. The applicable Section or Subsection of the Standard Specifications will indicate the supplemental information required and whether the drawings are to be stamped or unstamped. Stamped and unstamped Working Drawings are defined as follows:

1. Stamped Working Drawings - Working Drawings, calculations and other data which are prepared by or under the direction of a Professional Engineer licensed in the State of Oregon, and which bear the engineer’s signature, seal, and expiration date.

2. Unstamped Working Drawings - Working Drawings, calculations and other data that do not bear an engineering seal.

(n) Number and Size of Drawings - The Contractor shall submit 7 copies of Working Drawings for steel Structures and 6 copies of Working Drawings for other Structures to the Engineer. The submitted copies shall be clear and readable. Drawing dimension shall be 8 1/2 inches by 11 inches, 11 inches by 17 inches, or 22 inches by 36 inches in size. One copy of the submitted Working Drawings will be returned to the Contractor after processing. The Contractor shall submit such additional number of copies to the Engineer for processing as the Contractor would like to have returned.

(o) Processing Working Drawings - The Engineer will process Working Drawings and include all comments on them as follows:

1. Stamped Working Drawings - Stamped Working Drawings will be designated as “reviewed” or “reviewed with comment” by the Engineer.

2. Unstamped Working Drawings - Unstamped Working Drawings will be designated on the face of the Drawing, as “approved,” “approved as noted,” “returned for correction,” or “rejected” by the Engineer.

The Contractor shall not fabricate or construct any structural components until the stamped or unstamped Working Drawings are returned by the Engineer with written notation of approval or review, as applicable, of the Working Drawings.

The Engineer’s processing of the Working Drawings does not amend any contractual obligations of the parties.
The Engineer will process and return Working Drawings within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt by the Engineer. If the Engineer fails to return such drawings within this period of time, the Engineer will consider granting a Contract Time extension according to 00180.80.

00150.37 Equipment Lists and Other Submittals - The Contractor shall submit Equipment lists, and other required submittals for approval by the Engineer. The Engineer will respond to requests for approval within the time frame set forth in each Section of the Specifications that requires such approval.

00150.40 Cooperation and Superintendence by the Contractor:

(a) The Contractor shall:

1. Keep one complete set of Contract Documents available on the Project Site at all times.
2. Cooperate in good faith with the Owner’s Representative, Inspectors, the public and other contractors in performance of the Work.
3. Designate, from the Contractor’s organization, a competent single representative responsible for the Project, experienced in the type of Work being performed, and capable of reading and thoroughly understanding the Plans and Specifications.
4. Provide access, facilities and assistance to the Owner’s Representative in establishing such lines, grades and points as the Owner’s Representative requires.
5. Carefully protect and preserve the Owner’s marks and stakes.
6. Provide all assistance reasonably required by the Owner’s Representative to obtain information regarding the nature, quantity, and quality of any part of the Work.
7. Allow the Owner’s Representative reasonable access to the Contractor’s books and records at all times. To the extent permitted by public records laws, the Owner’s Representative will make reasonable efforts to honor the Contractor’s request for protection of confidential information.
8. Furnish the Owner’s Representative all data necessary to determine the actual cost of all, or any part, of the Work.
9. Diligently pursue progress of the Work according to the schedule requirements of Section 00180.
10. Coordinate and control all Work performed under the Contract, including without limitation the Work performed by Subcontractors.
The Contractor shall appoint a single designated representative for the Project in writing. The single designated representative responsible for the Project shall:

1. Have full authority and responsibility to promptly execute orders or directions of the Engineer.
2. Have full authority and responsibility to promptly supply the Materials, Equipment, labor, and incidentals required for performance of the Work.
3. Be available during the hours of work on the Project site for communication with the Engineer and
4. Be present for all On-Site Work except as provided in the Contract Documents, or approved by the City.

For short periods of time during the performance of minor or Incidental portions of the Work, the Contractor may designate a person to act on behalf of the single designated representative responsible for the Project. The Contractor shall submit the designation in writing to the Engineer. The form of designation shall state the designee’s name, duration of appointment, and scope of authority. The single designated representative responsible for the Project shall be available to the Engineer at all times for contact by telephone or radio.

If, for some reason, neither the Contractor nor a fully authorized representative is available, and communication is necessary, the Owner may communicate with, or give directions to, any person working for the Contractor. The Contractor shall follow any direction given by the Owner. Such directions will be confirmed in writing at the Contractor’s request.

The Contractor’s failure to provide the superintendence required by these provisions constitutes a material breach of the Contract, and the Engineer may impose any remedies available under the Contract, including but not limited to Contract termination or suspension of Contract performance.

Nothing in this Subsection changes the Contractor’s duties as outlined elsewhere in the Contract Documents. For example, the Architect’s or Engineer’s presence does not relieve the Contractor from performing the Work in accordance with the law, statutes, ordinances, or building Codes nor does it relieve the Contractor from obtaining all required Permits.

Utilities:

(a) General Rules regarding Utilities:

1. The parties agree that:
   a. A normal and usual occurrence in the construction of underground improvements is the discovery of utilities, service laterals, underground pipes, drains and structures that interfere with the Contractor’s work;
b. A reasonable number of such occurrences are usual and ordinary on Projects that include underground work;

c. Work must sometimes be done in close proximity to these conditions and that such work may be made more difficult than originally thought;

d. Such conditions may require a change in the Contractor’s operations, such as changing the amount of traffic control, pavement and backfill that is required; and

e. The Contractor’s Bid to the Owner reflected all costs in dealing with such conditions.

(2) Owner will require a reasonable amount of time to perform design changes necessitated by conflicting utilities. In addition, Utility owners will require a reasonable amount of time to make necessary Utility relocations if such relocations are required.

(b) Owner Responsibilities:

(1) Owner will provide information it has to Contractor regarding the location of existing watercourses, drains, sewer lines and Utility lines for purposes of preparing its Bid. Owner does not always have or receive accurate information about the location of utilities. Therefore, such information must be considered to be approximate, and not guaranteed to be accurate. Contractor is responsible for determining the exact location of utilities and existing improvements when performing its work.

(c) Contractor’s Responsibilities:

(1) Contractor shall protect the property of utilities, railways and fire control authorities that may be affected by Contractor’s work as well as Utility lines, pipelines, and underground tanks.

(2) Contractor shall obtain written permission from the PWB before operating any potable water valve or hydrant. Unauthorized operation is prohibited. Contractor shall pay any fee associated with their operation.

(3) Contractor is required to maintain the flow of sewers, drains and water courses that might be interrupted by its work and restore that flow as directed by Owner.

(4) The Contractor is responsible for any damage caused to any Utility, whether known or unknown, and whether or not that was disclosed by the Contract Documents.
(5) Contractor shall maintain in place all utilities whether or not shown on the Contract Documents. If any Utility needs to be temporarily relocated for the Contractor’s convenience or because of the method of construction or as a result of site conditions, Contractor shall bear all costs for that temporary relocation. Contractor shall maintain utilities that are relocated by others in their relocated positions in order to avoid interference with structures that cross the Project Work.

(6) Contractor shall not hinder the work of Owner or the owner of a Utility in the event that they relocate any Utility.

(d) Notification:

(1) The Contractor shall follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in Oregon Administrative Rules. Copies of these rules may be obtained by contacting the Center. If there are questions about the rules, contact the Center. The parties agree that any Project Plans or Permit issued by Owner will be deemed to have this language incorporated by reference.

(2) In addition to the notification required by 00150.50(d)(1), Contractor shall also give Notice to the Owner of any intended excavation at least 2 Working Days in advance of the proposed excavation.

(3) Contractor shall maintain any markings showing the presence of underground facilities. If Contractor does not maintain such markings, and Owner is required to re-establish them, Contractor shall pay Owner any and all costs associated with that activity.

(e) Utility Information:

(1) Arranging for a utility company to remove, relocate, or adjust a facility is the responsibility of the Owner. The Contractor shall schedule work so as to afford the utility companies sufficient time and space to perform their work. Contact the Owner for information regarding these arrangements.

(2) A list of the organizations that may be adjusting utilities within the work area during the life of this Contract and an estimate of when the adjustment work is to be completed will be provided in the Special Provisions.

(3) The estimates of when adjustment work is to be completed, provided by organizations, are based upon available Working Days, not Calendar Days, and are not necessarily concurrent or continuous.

(4) The Contractor shall be responsible for all other utility adjustments to finish grade.

(5) A list of the Utilities and their field coordinators will be included in the Special Provisions.
(6) There may be unavoidable delays due to utility companies or utility contractors working in the same construction zone. It is imperative for the Contractor to provide accurate work schedules to the Owner's Representative. Notify the Owner's Representative immediately when utility work causes delays or construction issues.

(7) The utility companies or utility contractors may be in the right-of-way working concurrently with this Contract. The Contractor's schedule and the schedules of the utility companies shall be coordinated and agreed upon prior to beginning construction. The Contractor shall work with the utility companies or the utility contractors so that all work on the project is completed within the Contract Time.

(8) The Owner does not guarantee the site conditions will remain the same after the utility companies or the utility contractors have performed their work. The Contractor shall perform an assessment of site conditions prior to beginning work and after the utility companies or utility contractors have completed their work to determine actual conditions.

00150.55 Cooperation with Other Contractors:

(a) Owner reserves the right to Award other Contracts, or issue Permits, for work that may require coordination with the Contractor's operations under this Contract.

(b) Contractor shall cooperate with the Owner and other Contractors and provide all reasonable opportunities to allow them to perform their separate work, including, but not limited to, the introduction and storage of materials and equipment.

(c) The Contractor shall promptly notify the Owner's Representative if:

(1) The performance of other Contractors hinders, delays, or prevents the Contractor from successfully completing its Work or makes its performance more costly;

(2) The Contractor's operations are interrelated or dependent upon the work of others Contractors and their work has defects that hinders, prevents or otherwise makes unsuitable the successful completion of Contractor's Work.

(d) Failure to provide the Notice stated in 00150.55(c) constitutes Contractor's acceptance of the other contractors work and constitutes a conclusive waiver of any later Claim for additional compensation or Contract Time as a result of the other contractors work or activities.

(e) Contractor shall defend, hold harmless and indemnify Owner from all Claims and all costs asserted by a separate contractor who asserts that the Contractor damaged its Work or property, as provided in 00170.72.
(f) Contractor is responsible for any cutting, fitting and patching that may be required to complete the Work, except as otherwise specifically provided in the Contract Documents. The Contractor shall not endanger any work of any other contractors by cutting, excavating or otherwise altering any work and shall not cut or alter the work of any other contractor, except as directed by the Owner’s Representative.

(g) Contractor agrees that if a dispute arises regarding clean-up costs, the Owner’s Representative may apportion such costs to Contractor and other contractors as the Representative determines is fair and equitable.

(h) Contractor shall not damage any work that the Owner has performed, either with its own forces or through the forces of another contractor. If the Contractor desires or needs to alter, change, cut or otherwise modify the work of Owner or another contractor in any way it shall seek the Owner’s Representative’s written approval. If the Owner seeks the Contractor’s approval to alter, change, cut or otherwise modify its work, Owner will notify Contractor of that fact.

00150.60 Construction Equipment Restrictions:

(a) Load and Speed Restrictions for Construction Vehicles and Equipment - The Contractor shall comply with legal weight and speed restrictions when moving Materials or Equipment beyond the limits of the Project Site. The Contractor shall provide a copy to the Engineer of the jurisdiction permit authorizing any overweight load(s).

The Contractor shall control vehicle and Equipment loads and speeds within the Project Site according to the following restrictions, unless the Special Provisions provide otherwise:

(1) The Contractor shall restrict loads and speeds as necessary to avoid displacement or loss of Materials on Subgrades and Aggregate Bases.

(2) The Contractor shall restrict weights to legal loads, and shall travel at speeds of no more than 45 mph or the posted construction speed, whichever is less, on treated Bases, Pavement, or wearing Courses.

(3) The Contractor shall not cross Bridges or other Structures with Equipment or vehicles exceeding the legal load limit without prior written permission of the Owner’s Representative. The Contractor shall make any such request in writing, describing the loading details and the arrangement, movement, and position of the Equipment on the Structure. The Contractor shall comply with any restrictions or conditions included in the Engineer’s written permission.

(b) Protection of Buried Items - The Contractor shall use temporary fill, steel plates or other methods to avoid overload of pipes, box culverts, and other items that are covered, or to be covered, by fill or backfill.
(c) **Responsibility for Damages** - The Contractor shall assume responsibility for damages caused by excessive Equipment speed or loads while performing the Work, both inside and outside the Project Site. The Engineer's or other jurisdiction's permission to cross Bridges and other Structures, according to 00150.60(a) will not relieve the Contractor from responsibility for load-caused damages.

00150.80 **Removal of Unacceptable and Unauthorized Work:**

(a) Any portion of the Work that does not conform to the requirements of the Contract is unacceptable and defective and shall be removed and corrected by the Contractor, even if it is contended that the Owner’s Representative or other assigned personnel knew or should have known of the existence of the unacceptable work.

(b) All portions of the Work that do not conform to the requirements of the Contract Documents shall be corrected within a reasonable time at the Contractor’s sole expense and without an extension of Contract Time.

(c) The Owner may replace or correct work within a reasonable time if the Contractor fails to do so and may charge the Contractor with all reasonable costs incurred with performing that work and with the costs of storing any salvageable materials or equipment. If that occurs, the Owner also is entitled to deduct such costs from any sums otherwise due the Contractor.

   (1) If salvageable materials, equipment, or both are stored, the Owner will notify the Contractor of the storage and give the Contractor 10 days to remove the materials. If the Contractor fails to remove them by the end of that time, the Owner may sell them in any commercially reasonable manner, whether privately or publicly.

   (2) If sale is made, the Owner will keep all proceeds to the extent that the proceeds do not exceed the costs incurred in correcting and replacing the work and in storing the materials and equipment. Contractor still owes Owner for any difference in costs that may remain after the sale. However, if the proceeds exceed the Owner’s cost it will forward those sums to the Contractor.

(d) The Contract Documents or regulatory agencies may require that portions of the Work be observed, reviewed or inspected before they are obscured or covered. Similarly, the Owner’s Representative is entitled to observe portions of the Work before they are covered or obscured upon request. If the Contractor covers or obscures a portion of the Work that is required or requested to be observed, it shall uncover the Work for observation and bear any cost associated with that activity without a change in Contract Time.

(e) The Owner’s Representative may request to see a portion of the Work that has been covered regardless of the requirements of the Contract Documents, regulatory agencies or a prior request. Thereafter the Contractor shall comply with the Owner’s request. If, upon inspection by the Owner’s Representative, the portion of the Work that is uncovered is found to be in accordance with the Contract Documents, the Owner will bear all costs associated with that activity.
and provide additional Contract Time, if that activity would cause the Contractor to incur liquidated damages. However, if, upon inspection by the Owner’s Representation, the portion of the Work that is uncovered is found not to be in accordance with the Contract Documents, the Contractor shall correct the Work and bear any cost associated with that activity without a change in Contract Time.

(f) Replacement and correction of Defective Work prior to the time that the Work is completed and accepted is not limited by any warranty period otherwise established by the Contract.

(g) Owner retains the right to accept portions of the Work that do not conform to the requirements of the Contract Documents. However, such acceptance will be in writing and given only by the Owner’s Representative. Inspectors, employees and other agents of Owner have no authority to bind the Owner to accept nonconforming portions of the Work. If the Owner’s Representative chooses to accept nonconforming portions of the Work, and those portions cost less than what the Contractor would have spent to comply with the Contract Documents, Owner is entitled to a credit for the difference in price, which may be deducted from the Contract Amount.

00150.85 Use of Work During Construction:

(a) The Owner may decide to use part of the Work that has been completed before completion of all of the work required by the Contract. If that occurs, the Owner will notify the Contractor in writing of its intention.

(b) When use of part of the Work by the Owner begins, the Contractor is:

(1) Relieved of the duty of maintaining and protecting that portion of the Work, provided that it has been completed in accordance with the Contract.

(2) Relieved of responsibility for injury or damage to the portion of Work used by the Owner from use by public traffic or from the action of the elements of nature or from any other cause, except injury or damage resulting from the Contractor’s own operations or from its negligence.

(3) Relieved of the responsibility of cleaning up that portion of the Work before final acceptance, unless the Contractor’s own operations require such cleanup.

(c) Use by the Owner of a part of the Work as described in this Subsection does not constitute final acceptance of the Work as a whole or any part thereof.

00150.86 Furnishing Temporary Services and Facilities - Contractor shall provide temporary light, power, water and other temporary services or facilities complete with connecting, piping, wiring, lamps and similar equipment as required during construction of the Work, including testing and start up, and remove temporary facilities upon completion. Obtaining permits and bearing the costs of temporary services and facilities is included within the Contract Amount.
00150.96 Maintenance Warranties and Guarantees:

(a) The Contractor expressly warrants its work shall be performed to the highest standards of good workmanship. That warrant shall extend to the fullest extent permitted by law and shall continue beyond the 2 year correction period discussed below.

(b) In addition to, and not in lieu of, any other express or implied warranties, the Contractor shall make all necessary repairs and replacements to remedy any and all defects, breaks, or failures of the Work occurring within 2 years following the date of Substantial Completion due to faulty or inadequate materials or workmanship. Such repairs and replacements shall conform to the Contract Specifications under which the Contractor originally performed the work. The Owner shall notify the Contractor if such problems occur within the 2 year period.

(c) In the event of a dispute regarding any portion of the Work, the Contractor shall nonetheless provide any warranty service, repairs or replacements as described in 00150.96(a) and 00150.96(b) above, for that portion of the Work that is not in dispute. In the event that a dispute delays Acceptance of the Work, the warranty for portions of the Work not in dispute shall run from the date of Substantial Completion of the remaining portions of the Work.

(d) The Contractor shall also repair any damage or remedy any disturbance to other publicly owned property or improvements if caused by the Contractor’s work and if the damage occurs during the warranty period.

(e) If the Contractor performs warranty work, the warranty work also shall have a 2 year warranty period from the date of its completion and acceptance by Owner.

(f) The Owner will provide the Contractor with written Notice of the need to perform warranty work unless it is determined that an emergency exists, that delay would cause serious additional loss or damage, or if any delay in performing the work might cause injury to any member of the public. If the Contractor, after written Notice, fails within 10 days to comply with the Owner’s request, the Owner has the right to perform the warranty work either by hiring another Contractor or by using its own forces. In that event, the Contractor and its Surety shall be liable to the Owner for the cost of the work performed and any additional damage suffered by the Owner.

(g) The Contractor shall provide a bond during the 2 year warranty period to guarantee the Contractor’s performance of warranty work. The Contractor shall provide to the Owner a bond in the amount of 20% of the final Contract Amount in one of the following ways:
(1) Continuance of the Contract performance Bond and the Payment Bond;

(2) Any new performance Bond and Payment Bond, acceptable to Owner, which covers the Contractor’s warranty obligations imposed by the Contract Documents.

(3) Cash deposit to the City Treasury. Proof of the deposit shall be a receipt from the Treasurer.

(4) Other arrangements proposed by the Contractor that the Owner finds acceptable.

00150.97 Responsibility for Materials and Workmanship:

(a) The successful performance of this Contract will provide a benefit to the citizens, ratepayers, or taxpayers of the City of Portland. Therefore, satisfactory completion of the Project by the Contractor is of paramount importance. The Contractor agrees that by accepting this Contract it is required to perform the Contract in accordance with the Contract Documents and cannot contend that its performance was excused by any action of the Owner, except to the extent that the Contract terms have been modified by a written Change Order executed by both parties.

(b) The Owner is entitled to insist upon completion of the Contract in the manner and to the extent required by the Contract Documents. Therefore, any measurement, estimate or certificate made by the Owner that is incorrect may be corrected by the Owner at any time, regardless of whether that occurs before or after acceptance of the Project. Similarly, if work, equipment, parts, products or materials do not conform to what is required by the Contract Documents, the Owner may require that the work be redone and that materials, parts, products, and equipment be replaced, regardless of prior approval by any agent or employee of the Owner.

(c) Acceptance of the Work by the Owner will not preclude the Owner from:

(1) Later insisting that the Work be performed in accordance with the Contract Documents.

(2) Recovering damages for breach of contract or pursuing any other remedies that the law may provide.

(3) Any other remedy for breach of contract permitted by law.

(d) No action whatsoever, nor any verbal or written statement whatsoever, made by any employee or agent of the Owner, will operate as a waiver or as an estoppel, or otherwise preclude the Owner from insisting upon its rights to performance of the Contract in accordance with the Contract Documents.
Section 00160 - Source of Materials

Provisions and Requirements

00160.05 Construction Products List (CPL) - The CPL is a listing of manufactured products available on the market (shelf items) that BES and PBOT have evaluated and found suitable for specified use in construction. The CPL is published yearly and is available upon request. It may also be viewed on PBOT’s web site. The current version of the CPL at the time of Bid Opening is the version in effect for the Project. The Engineer may approve for use a conditionally qualified product, or a product qualified for inclusion in a later edition of the CPL, if the Engineer finds the product acceptable for use on the Project. Use of listed products shall be restricted to the category of use for which they are listed. The Contractor shall install all products as recommended by the manufacturer. The Contractor shall replace qualified products not conforming to Specifications or not properly handled or installed at the Contractor's expense.

00160.06 Potable Water System Materials - A Materials List of commercially available products that PWB has evaluated and found suitable for specified use in construction is located on the PWB website. For additional details concerning the PWB Materials Manual, contact the PWB Owner’s Representative. The current version of the Materials List at the time of Bid Opening is the version in effect for the Project. A conditionally qualified product, Special Application Only product, or a product qualified for inclusion in a later edition of the Materials List may be used only if the Owner’s Representative finds the product acceptable for use on the Project. Use of listed products shall be restricted to the category of use for which they are listed. Unless otherwise specified, the Contractor shall install all products as recommended by the manufacturer. The Contractor shall replace qualified products not conforming to Specifications or not properly handled or installed at Contractor expense.

00160.20 Preferences for Materials:

(a) Buy America - If federal highway funds are involved on the Project, the Contractor shall limit the quantity of foreign Materials incorporated into the Work as follows. Section 635.410 of Title 23, Code of Federal Regulations, and the Intermodal Surface Transportation Efficiency Act require that all iron or steel manufacturing processes, including without limitation the casting of ingots, for iron or steel Materials permanently incorporated into the Project shall occur in the United States, unless the cost of foreign-origin iron or steel Materials does not exceed one-tenth of 0.1% of the Contract Amount or $2,500, whichever is greater. The Contractor shall not incorporate foreign-origin iron or steel Materials in excess of this amount into the Project. All foreign-origin iron or steel Materials incorporated in the Project in excess of the amount indicated above shall be removed and replaced with domestic iron or steel Materials at the Contractor’s expense. For purposes of this Specification, the cost of foreign-origin iron or steel Materials shall be the value of the iron or steel products as of the date they are delivered to the Project Site.
Manufacturing processes include without limitation the application of coatings to finished iron or steel products or components. Coatings include epoxy coating, galvanizing, painting, and any other coating that protects or enhances the value of the steel or iron product or component. The Contractor shall provide the Owner's Representative with a Certificate of Materials Origin, on a form furnished by the Owner's Representative, before incorporating any iron or steel products into the Project. Unless a Certificate of Materials Origin has been provided to the Owner's Representative, the Materials shall be considered of foreign origin.

The Contractor shall retain manufacturers' certificates verifying the origin of all domestic iron or steel Materials for 3 years after the date of final payment for the Project, and shall furnish copies to the Owner's Representative upon request.

(b) Buy Oregon - According to ORS 279A.120, the Contractor shall give preference to goods or services produced in Oregon if price, fitness, availability, and quality are equal. This provision does not apply to Contracts financed wholly or in part by federal funds.

00160.60 Contractor-Furnished Materials and Sources - Unless otherwise specified in the Contract, the Contractor shall:

(a) Acquire and furnish, at its own expense, all products and materials required for the Work from suppliers or sources of its own choosing.

(b) Acquire and furnish, at its own expense, access to and the use of all material sources.

(c) Acquire and furnish, at its own expense, upon request, any and all Permits from federal, state and local agencies necessary to use any source for materials.
Section 00165 - Quality of Materials

Description

00165.00 General - The Contractor shall incorporate into the Work only Materials conforming to the Specifications and approved by the Owner's Representative. The Contractor shall incorporate into the Work only manufactured products made of new materials unless otherwise specified in the Contract. The Owner may require additional testing or retesting to determine whether the Materials or manufactured products meet Specifications.

Materials not meeting the Specifications at the time they are to be used are unacceptable and must be removed immediately from the Project Site, unless otherwise directed by the Owner's Representative.

(a) Materials, parts, products, and equipment shall meet the requirements of the latest printed edition, as of bid opening, of any applicable building Codes, Reference Specifications or industry standards stated in the Contract Documents for determining their acceptability in the Contract Documents.

(b) Contractor is obligated to comply with Codes, industry standards and Reference Specifications that are made applicable by the Contract Documents. Such Codes, standards and Reference Specifications may include, but are not limited to, the OSHA, UBC, UFC, UMC, NEC, AASHTO, NSF, ASTM, AWWA and WEF. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable Codes and standards. In case of conflict between Codes, standards, Reference Specifications or other portions of the Contract Documents, the most stringent requirements shall govern. Any conflict between such standards and the Contract Documents shall be brought to the attention of the Owner's Representative for clarification and direction prior to ordering or providing any materials or furnishing labor.

00165.01 Rejected Materials - The Owner's Representative may reject any Materials that appear to be defective (00150.80) or that contain asbestos or other hazardous substances. The Contractor shall not incorporate any rejected Materials into the Work. Rejected Materials whose defects have been corrected may not be incorporated into the Work until the Owner's Representative has approved their use. The Owner's Representative may order the removal and replacement by the Contractor, at Contractor's expense, of any defective Materials. (Refer also to 00150.20.)

00165.02 Materials Conformance and Quality Compliance Documents - For purposes of this Section, "Materials Conformance Documents" means the Contractor's quality-control, the Owner's verification, and the independent assurance test results and the identity of the testing facility. "Quality Compliance Documents" means those documents specified in ODOT's Nonfield-Tested Materials Acceptance Guide, unless otherwise specified in the Contract.
(a) As used in this Section, the following definitions are applicable:

**Products** - refers to purchased items for incorporation into the Work, regardless of whether specifically purchased for the Project or taken from the Contractor's stock of previously purchased products.

**Materials** - refers to products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.

**Equipment** - refers to products with operational parts, regardless of whether motorized or manually operated, including products with service connections such as wiring or piping.

**Parts** - refers to portions of products, materials, and equipment.

**Certifications** - refers to documents that show that materials, products, parts and equipment required by the Contract meet the requirements of a Reference Specification. Certifications shall require no interpretation of test results by Owner's employees to determine whether the requirements of the Reference Specification have been met.

**Conformance Documents** - refers to documents that show that the material, part, product or equipment meets the requirements of the Contract. Examples of Conformance Documents that may be acceptable include shop drawings, material lists, equipment lists, catalog description sheets and manufacturer's brochures.

(b) The Contractor must establish that the materials, products, parts, and equipment that it proposes to use meet the requirements of the Contract Documents, including the requirements of any Reference Specifications or industry standards, by submitting the Certifications and Conformance Documents required by the Contract.

(c) The Contractor shall bear the cost of providing Certifications and Conformance Documents, including the costs of any sampling and testing that must be performed in order to achieve certification. Materials, products, parts and pieces of equipment shall not be incorporated into the Work without acceptable certifications or Conformance Documents.

(d) Certification shall be provided by the manufacturer or testing agency verifying that Contract requirements have been met. The certification shall identify the testing agency, the representative responsible for the test results, and include a copy of the specified test results (for example, ASTM, AASHTO, UL, etc.).

(e) Conformance Documents shall be sufficient to permit the Owner to determine that the Contractor has provided what is required by the Contract Documents.
Certifications and Conformance Documents shall be clear and understandable to determine whether the material, product, part, or equipment is the one specified by the Contract Documents. Certifications or Conformance documents that are unclear or require analysis in order to determine whether the materials, parts, products or equipment meet the requirements of the Contract are insufficient and will be rejected. The Contractor shall bear all costs of and is responsible for any delay that occurs as a result of unclear certifications or conformance documents.

Certifications and Conformance Documents shall be delivered to the Owner with the shipment of the material, part, product or material to which the certification corresponds, unless other portions of the Contract Documents specify a different procedure.

Testing by Owner - When testing Materials, the Owner will conduct the tests in the field, in the Owner's central laboratory, field laboratories, or other laboratories designated by the Owner's Representative, even though certain AASHTO, ASTM, and other Materials specifications may require testing at the place of manufacture. Results of the Owner's tests will be made available to the Contractor.

Costs of Testing - One of the following Type "A", "B", "C", or "D" schedule will be required under the Contract. The type of schedule will be identified in the Special Provisions.

- Method "A" - Contractor shall provide and pay for all quality control testing of Materials.
- Method "B" - Owner will provide and pay for all quality control testing of Materials.
- Method "C" - Owner will provide and pay for quality control testing of Materials except as follows: The Owner will pay the cost of the first source-review tests on unprocessed Aggregates when requested by the Contractor. Thereafter, additional source-review test performed at the Contractor's request shall be paid by the Contractor.
- Method "D" - The responsibility for providing and paying for quality control testing is allocated according to the table in the Special Provisions.

Provisions and Requirements

Materials Acceptance Guides - Unless otherwise specified elsewhere in the Contract, Materials will be accepted according to the following guides:

Field-Tested Materials - Field-tested Materials will be accepted according to the ODOT Manual of Field Test Procedures (MFTP). The MFTP is available at the ODOT Procurement Office Construction, Contractor Plans, 455 Airport Road SE, Building K, Salem, Oregon 97301-5348 (telephone 503-986-6936).
(b) Nonfield-Tested Materials - Nonfield-tested Materials will be accepted according to the ODOT Nonfield Tested Materials Acceptance Guide (NTMAG), unless otherwise specified in the Contract. The NTMAG is available at the ODOT Procurement Office Construction, Contractor Plans.

(c) A “sample” is a physical example of workmanship, equipment, materials or products that is proposed to be or has been incorporated into the Work by the Contractor.

(d) The Owner retains the right at any time during construction or at any time during production, fabrication or preparation of the Work, to test samples to determine whether they meet the requirements of the Contract Documents. The Owner may test any sample, regardless of prior certification, and regardless whether any prior certification was required. The Owner may either conduct the test with its own forces or hire other persons to perform this work.

(e) The Contractor shall cooperate with any sampling and testing that is required or requested. The Contractor shall provide samples without charge and provide them in time to permit testing before use.

(f) If a sample is to be tested prior to its incorporation into the Work the Contractor shall not incorporate the material, product, part or equipment into the Work until testing is completed and the Owner gives permission for its use.

(g) The Owner will bear the costs of quality assurance testing unless the tests show that the material, product, part or equipment failed the test and did not conform to the requirements of the Contract, in which case the Contractor shall bear the costs of testing.

(h) If the sample previously was incorporated into the Work and testing shows the sample does not meet the requirements of the Contract Documents, the Contractor shall pay for replacing and repairing any equipment, materials, products or portion of the Work in order to meet the requirements of the Contract Documents.

00165.20 Materials Specifications and Test Method References:

(a) References to Materials specifications and test methods of ODOT, WAQTC, AASHTO, ASTM, AWWA other governmental agencies, or other recognized organizations mean those officially adopted and in current use by the Owner or organization on the date of Advertisement.

(b) If there are conflicting references, or if no reference is made to Materials specifications or test method, Materials must meet the Materials specifications or test methods required by the first applicable of the following agencies and organizations:
00165.30 Field-Tested Materials:

(1) Special Provisions

(2) MFTP

(3) Standard Specifications

(2) Nonfield Tested Materials:

(a) ODOT

(b) WAQTC

(c) AASHTO

(d) ASTM

(e) AWWA

(f) NSF

(g) Other recognized national organizations, such as ANSI, AWPA, IMSA, and UL

(h) Industry standards in the location where the Work is being performed

(c) If there are conflicting references in the Contract to required sampling and testing frequencies, the Contractor shall sample and test the Materials according to the first applicable of the following:

(1) Special Provisions

(2) MFTP

(3) Standard Specifications

00165.30 Field-Tested Materials:

(a) Contractor's Duties - The Contractor shall:

(1) Furnish Materials of the quality specified in the Contract;

(2) Provide and administer a quality control program as described in the Quality Assurance Manual portion of the MFTP. Upon request, the Contractor shall provide to the Owner's Representative the names, telephone numbers, and copies of certifications for all personnel performing field testing; and

(3) Perform other testing as required by the Contract.

(b) Types of Tests - The types of tests and testing methods generally required by PBOT are described in the ODOT MFTP.
(c) **Acceptance of Field-Tested Materials** - The Contractor's test results for field-tested Materials will be verified by the Owner according to the Quality Assurance program outlined in the MFTP. If the Owner's QA test results verify the Contractor's results, the Materials will be analyzed for acceptance according to one of the following methods before the Owner's Representative will accept them for incorporation into the Work:

1. Statistically, according to 00165.40, to determine "Pay Factors" for produced Aggregate;
2. Statistically, according to 00165.40, to determine "Composite Pay Factors" for mixtures; or
3. Other methods determined by the Owner's Representative.

If the Owner's verification testing reveals that the Contractor's data is incorrect, the Owner may require additional testing to determine whether the Materials meet Specifications. The Contractor shall perform additional quality control testing or provide split samples to the Owner for additional testing as directed. If the Materials do not meet Specifications, the Contractor shall reimburse the Owner for the cost of the additional testing, which may be deducted from monies due or to become due the Contractor under the Contract. Incorporated Materials that do not meet Specifications will be evaluated according to 00165.01 and 00150.80. If the Materials meet Specifications the Owner will pay the cost for the additional testing.

00165.35 **Nonfield-Tested Materials** - The Contractor shall furnish Materials meeting Specifications, along with all Materials Conformance and Quality Compliance Documents.

(a) **Test Results Certificate** - The Certificate shall:

1. Be from the manufacturer verifying that the Material furnished has been sampled and tested and the test results meet the Specifications
2. Include, or be accompanied by, a copy of the specified test results (ODOT, AASHTO, ASTM, AWWA, NSF, UL or other)
3. Identify the testing agency and the representative responsible for the test results
4. Permit positive determination that Material delivered to the Project is the same Material covered by the test results
5. Be delivered to the Owner's Representative with the shipment of the material
(b) Quality Compliance Certificate - The Certificate from the manufacturer shall:

(1) Verify that the Material meets the Specifications, and identify by number the specified test methods used (ODOT, AASHTO, ASTM, AWWA, NSF, UL, or other)

(2) Permit positive determination that Material delivered to the Project is the same Material covered by the certificate

(3) Be delivered to the Owner’s Representative with the shipment of the Material, or be an identification plate or mark, decal, sticker, label, or tag attached to the container or Material

(c) Equipment List and Drawings - Submit these lists to the Owner’s Representative for review of conformance with the Specifications. These consist of lists of proposed Equipment and Materials, such as:

(1) Shop drawings

(2) Material lists

(3) Equipment lists

(4) Catalog description sheets

(5) Manufacturer’s brochures

(d) Certificate of Origin of Steel Materials:

(1) When specified, complete ODOT Form 734-2126 as required by 00160.20 for Federal-aid projects.

(2) Materials will be subject to acceptance testing if the Owner’s Representative so elects. The Owner’s Representative may reject damaged or non-Specification Materials regardless of the Materials Conformance Documents furnished.

00165.40 Statistical Analysis - When 00165.30(c) or 00165.50 applies, the Contractor shall divide the Materials into lots and sublots, randomly sample and test them as required, and analyze the results statistically to determine whether the Materials conform to the Specifications.

All acceptance test results of lots and sublots will be analyzed collectively using the Quality Level Analysis procedure set out in this Subsection. This procedure shall not be used for a lot with less than three sublots. Sampling of Material for a lot that contains two or fewer sublots shall be increased to obtain at least three sublots. The Owner’s Representative has discretion to either accept or reject lots originating with two or fewer sublots, even after sampling is increased.
(a) **Lot** - A lot is the quantity of Materials produced by a single process or JMF that is sampled, tested, and statistically evaluated, as specified in this Subsection.

(b) **Sublot** - A sublot is a portion of a lot, for which a sample test value may be normally obtained.

(c) **Quality Level Analysis** - Quality Level Analysis is a statistical procedure to determine, for each lot:

1. The percentage of each constituent of the Materials meeting Specifications;
2. The Pay Factor for each constituent; and
3. The Composite Pay Factor, when specified.

(d) **Pay Factor and Composite Pay Factor Computation** - Procedures for determining the percent meeting Specifications, Pay Factors, and Composite Pay Factor for a lot of Materials are as follows:

1. Compute lot arithmetic mean ($\overline{X}$) for each constituent:
   \[
   \overline{X} = \frac{\sum X}{n}
   \]
   Where $\sum X$ = summation of sample test values
   \(n = \) total number of samples

2. Compute standard deviation (sd) for each constituent:
   \[
   sd = \sqrt{\frac{\sum X^2 - n \overline{X}^2}{n - 1}}
   \]
   Where $\sum X^2$ = summation of the squares of each sample test value
   $\overline{X}^2$ = square of the lot arithmetic mean

3. Compute the upper quality index ($QU$) for each constituent:
   \[
   QU = \frac{USL - \overline{X}}{sd}
   \]
   Where USL (upper specification limit) is the target value plus allowable tolerance
(4) Compute the lower quality index ($Q_L$) for each constituent:

\[ Q_L = \frac{\bar{X} - LSL}{sd} \]

Where LSL (lower specification limit) is the target value minus allowable tolerance

(5) From Table 00165-1, for each constituent, determine the percent within the upper specification limit ($P_U$) which corresponds to a given $Q_U$. If USL is 100% or is not specified, $P_U$ will be 100.

(6) From Table 00165-1, for each constituent, determine the percent within the lower specification limit ($P_L$) which corresponds to a given $Q_L$. If LSL is 0 or not specified, $P_L$ will be 100.

(7) Compute the quality level, or total percent within specification limits ($P_T$), for each constituent:

\[ P_T = \frac{P_U + P_L}{100} \]

(8) Using the $P_T$ from Step 7, determine the Pay Factor (PF) from Table 00165-2 for each constituent tested. A minimum PF of 1.00 will be used when all sublot test values are within the upper and lower specification limits, regardless of the calculated PF.

(9) Compute the Weighted Pay Factor (WPF) for each constituent:

\[ WPF = (PF) \times (f_i) \]

Where $f_i$ = weighting factor listed in the specifications for each constituent tested.

(10) Compute the Composite Pay Factor (CPF) for the lot and report the results to three decimal places.

\[ CPF = \frac{\sum WPF}{\sum f_i} \]

Where $\sum WPF$ = sum of the weighted pay factors for each constituent

$\sum f_i$ = sum of the weighting factors listed in the specifications
## Table 00165-1

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**NOTE:** For negative values of Q_u, or Q_l, or P, or P, is equal to 100 minus the table value for P, or P. If the value of Q_u, or Q_l, does not correspond exactly to a figure in the table, use the next higher figure.
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**Table 00165-1**

**QUALITY LEVEL ANALYSIS BY THE STANDARD DEVIATION METHOD**

**NOTE:** For negative values of $Q_0$ or $Q_1$, $P_0$ or $P_1$ is equal to 100 minus the table value for $P_0$ or $P_1$. If the value of $Q_0$ or $Q_1$ does not correspond exactly to a figure in the table, use the next higher figure.
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REJECT QUALITY LEVELS LESS THAN THOSE SPECIFIED FOR A 0.75

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REJECT QUALITY LEVELS LESS THAN THOSE SPECIFIED FOR A 0.75

NOTE: If the computed QUALITY LEVEL does not correspond exactly to a figure in the table, use the next lower value.
Statistical Acceptance Sampling and Testing - The Contractor shall sample and test Materials for acceptance, as required by the Contract. The Contractor may statistically evaluate test results for purposes of quality control or to predict a Pay Factor or Composite Pay Factor. The following apply:

(a) Statistical Acceptance - Owner's Representative will perform statistical analysis according to 00165.40 for acceptance and to determine a Pay Factor (PF) or Composite Pay Factor (CPF). The Owner's Representative's determination of the PF or CPF shall be controlling.

(b) Pay Adjustments - an incentive to produce quality Materials, the Owner's Representative's acceptance will be based upon the following:

(1) Specification Materials - constituent with a PF of 1.00 or greater, or any Materials with a CPF of 1.0000 or greater, will be considered Specification Materials. A constituent with a PF greater than 1.00 or Materials with a CPF greater than 1.0000 will be considered of superior quality and, when specified, may earn a PF adjustment greater than 1.00, up to a maximum of 1.05.

(2) Nonspecification Materials - constituent with a PF less than 1.00, or any Materials with a CPF less than 1.0000 will be considered nonspecification Materials. When specified, a lot containing nonspecification Materials may be accepted at a reduced price as described in (c) below.

(c) Nonspecification Materials:

(1) Isolation of a Partial Sublot - The Owner's Representative may isolate from a sublot or adjoining sublots any Material that is suspected of being nonspecification. The Contractor shall perform additional testing or provide split samples to the Owner as directed. Such isolated Material will not include an original test location.

(2) Isolation of an Entire Sublot - The Owner's Representative may isolate a sublot or a series of sublots in which tests show the Material to be nonspecification. The Contractor shall perform additional testing or provide split samples to the Owner as directed. Isolated Material will be statistically evaluated as a separate lot.

(3) A Lot-in-Progress - The Contractor shall shut down production when any of the following occurs:

a. The CPF for a lot-in-progress drops below 1.0000, and the Contractor is taking no corrective action;

b. The CPF is less than 0.7500; or

c. Any constituent test is continually out of specification limits, regardless of whether or not the CPF is below 0.7500.
The Contractor shall not resume production until the Owner's Representative has determined that Specification Materials can be produced, and has given approval to resume.

(4) An Entire Lot - Owner's Representative may reject an entire lot of Materials with a CPF between 0.7500 and 1.0000, or may take action in accordance with 00150.80(g).

For a lot of Material with a CPF below 0.7500, the Owner's Representative will take one or more of the following actions:

a. **Remain in Place** - Allow materials to remain in place with an appropriate price reduction that may range from 25% to 100% (no payment);

b. **Corrective Work** - Require corrective work, at the Contractor's expense, with an appropriate price reduction that may range from zero (full payment) to 100% (no payment); or

c. **Remove and Replace** - Require complete removal and replacement with Specification Materials. No payment will be made for the rejected Materials, the cost of removal, or for the costs of sampling and testing.

00165.70 Use of Materials without Acceptable Materials Conformance Documents:

(a) **General** - The Contractor shall not incorporate Materials into the Project prior to submittal of Materials Conformance Documents acceptable to the Owner's Representative. The Owner's Representative may waive this requirement temporarily if Materials are necessary for immediate traffic safety.

(b) **Materials Incorporated for Immediate Traffic Safety** - If Materials are incorporated into the Project for immediate traffic safety before acceptable Materials Conformance Documents are available, no payment will be made for the value of the Materials, or the costs of incorporating them, until Materials Conformance Documents have been submitted to and approved by the Owner's Representative, or the Materials are otherwise found through testing to comply with Specifications.

(c) **Contractor's Request for Testing Assistance** - If acceptable Materials Conformance Documents are not available, the Contractor may either have the necessary tests performed at a private laboratory or request in writing that the Owner's Representative:

(1) Determine if the Owner or its agents can sample and test;  
(2) Estimate the cost to the Contractor for the testing service; and  
(3) Estimate the time required to obtain the test results.
The Owner's Representative will provide this information to the Contractor in writing. If the Contractor requests the Owner's Representative, in writing, to proceed, the Owner's Representative will arrange for the sampling and testing, at the Contractor's expense. If these tests determine the Material complies with the Specifications, the Materials may be incorporated into the Project, or for Materials previously incorporated pursuant to (b) above, payment will be authorized.

**00165.75 Storage and Handling of Materials:**

(a) The Contractor shall store and handle Materials so as to preserve their quality and fitness for incorporation into the Work. The Contractor shall restore all storage sites to their original condition according to 00140.90, or to comply with any applicable permits, orders, or agreements, at the Contractor's expense.

(b) Stored Materials:

1. Shall be readily accessible for inspection;
2. May be stored on approved parts of the Right-of-Way; and
3. May be stored on private property if written permission of the owner or lessor is obtained.

**00165.76 Relationship to Submittals** - If the Contract requires that a product, material, part or equipment must be submitted to the Owner for review before use in the Work, the Contractor shall follow the requirements of 00150.35 regarding the submittal process.

**Measurement**

**00165.80 Measurement** - No separate measurement will be made of Work performed under this Section.

**Payment**

**00165.90 Incidental Basis** - No separate or additional payment will be made for sampling, testing, certification, or other associated Work performed under this Section, whether performed by the Contractor, manufacturer, producer or supplier. No separate payment will be made for providing quality control personnel.

**00165.91 Fabrication Inspection Expense:**

(a) Fabrication of certain items outside of the State creates additional shop and plant inspection expense to the Owner. It is impractical, and extremely difficult, to determine the actual additional expenses incurred. Therefore, each time that inspection by Owner personnel is necessary, payment to the Contractor will be reduced by an amount computed at the following rates:
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<th>Zone</th>
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<th>Reduction in Payment</th>
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<td>1</td>
<td>All of State of Oregon, and those portions of adjacent states within 50 airline miles of the Oregon border</td>
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<td>Outside of Zone 1, and up to 300 airline miles from the Oregon border</td>
<td>$100 per Calendar Day</td>
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<td>Outside of Zone 2, up to 3,000 airline miles from the Oregon border, and within the continental United States.</td>
<td>Round trip coach airfare from Portland, Oregon plus $100 per Calendar Day</td>
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<td>Outside of Zone 3, or outside of the continental United States.</td>
<td>Round trip coach airfare from Portland, Oregon plus $150 per Calendar Day</td>
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</table>

(b) Calendar Day charges begin on the first day the Owner's inspector begins travel to begin work at the fabrication site, and continue without interruption through the final day of travel back to the State. The Contractor will be notified in writing of the dates of beginning and ending of Calendar Days used in computing payment reduction.

(c) This Subsection applies to all fabricated items or manufactured Materials that are inspected by Owner personnel when fabricated or manufactured in the State. They include, but are not limited to:

1. Structural steel fabrication;
2. Prestressed concrete members;
3. Precast concrete;
4. Signs;
5. Preservative treatment of wood products;
6. Epoxy coating of reinforcing steel; and
7. Other items specifically identified in the Specifications as requiring fabrication site or in-plant inspection by the Owner.
Section 00170 - Legal Relations and Responsibilities

Description

00170.00 General:

(a) The Contractor shall comply with all federal, state, and municipal laws in regard to all matters concerning this Contract. This includes, but is not limited to, compliance with the ADA (Americans with Disabilities Act), Title 10 of the City Code regarding Erosion Control, City business license requirements, EEO certification requirements, Equal Benefits compliance, and CCB licensing and bonding requirements. The Contractor also shall comply with the orders, rulings, decrees and decisions of any administrative or judicial officials that in any manner whatsoever affects the Project, the Work, the safety of persons around the construction site, or the manner in which the Work is performed.

(b) If the Contractor observes that any portion of the Work is to be performed in a way that violates any law, Code, or regulation, it shall notify the Owner in writing immediately.

Provisions and Requirements

00170.01 Other Agencies Affecting Owner Contracts: Representatives of regulatory bodies or units of government whose Laws may apply to the Work shall have access to the Work according to 00150.20(d). These may include but are not limited to those in the following (a), (b), (c), and (d).

(a) Federal Agencies:

1. Agriculture, Department of:
   a. Forest Service
   b. Natural Resources Conservation Service

2. Army, Department of the:
   a. Engineers, Corps of

3. Commerce, Department of
   a. National Oceanic and Atmospheric Administration
   b. National Marine Fisheries Service

4. Homeland Security, Department of:
   a. US Coast Guard

5. Interior, Department of:
   a. Heritage, Conservation and Recreation Service
   b. Indian Affairs, Bureau of
   c. Land Management, Bureau of
   d. Mines, Bureau of
   e. Reclamation, Bureau of
   f. Geological Survey
   g. Minerals Management Service
   h. Surface Mining, Reclamation and Enforcement, Office of
| 6) Minerals Management Services |
| 7) Solar Energy and Energy Conservation Bank |
| 8) US Fish and Wildlife Service |
| 9) Labor, Department of: |
|   a. Mine Safety and Health Administration |
|   b. Occupational Safety and Health Administration (OSHA) |
| 10) Transportation, Department of: |
|   a. Federal Highway Administration |

(b) State of Oregon Agencies:

| 1) Administrative Services, Department of |
| 2) Agriculture, Department of |
|   a. Natural Resources Division |
|   b. Soil and Water Conservation Division |
| 3) Consumer and Business Services, Department of |
|   a. Insurance Division |
|   b. Oregon Occupational Safety and Health Division |
| 4) Energy, Department of |
| 5) Environmental Quality, Department of (DEQ) |
| 6) Fish and Wildlife, Department of |
| 7) Forestry, Department of |
| 8) Geology and Mineral Industries, Department of |
| 9) Human Resources, Department of |
| 10) Labor and Industries, Bureau of |
| 11) Land Conservation and Development Department |
| 12) Park and Recreation, Department of |
| 13) State Lands, Division of |
| 14) Water Resources Department |
(c) **Local Agencies:**

1. City Council
2. County Courts
3. County Commissioners, Board of
4. Design Commissions
5. Historical Preservation Commissions
6. Metro
7. Planning Commissions
8. Port of Portland
9. Public and Private Utilities:
   a. County Service Districts
   b. Fire Protection Districts
   c. Irrigation Districts
   d. Lighting Districts
   e. Metropolitan Service Districts
   f. Sanitary Districts
   g. Water Districts
10. TriMet

(d) **Oregon Federally Recognized Tribal Governments:**

1. The Confederated Tribes of Grand Ronde Community of Oregon
2. The Siletz Tribe
3. The Warms Spring Tribe
4. The Cowlitz Tribe (WA)

**Permits, Licenses, and Taxes:**

(a) The Contractor shall, without additional expense to the Owner, be responsible for paying any necessary fees, obtaining any necessary licenses and Permits, and for complying with any Federal, State, and municipal laws, Codes, and regulations applicable to the performance of the Work, unless expressly provided otherwise in other portions of the Contract Documents. However, the Owner will pay the fee charged by the Bureau of Development Services commonly known as the “plan check” fee.

(b) The Contractor understands that preliminary approval of the Owner’s Plans and Specifications by regulatory agencies does not prohibit such agencies from requesting changes in order that the Work complies with the provisions of applicable Codes, laws and regulations. Contractor agrees that a reasonable number of changes directed by Regulatory Inspectors are inherent in the nature of construction work and that the Bid includes the costs of making them.
Contractor shall bear the expense of complying with the requirements of Regulatory Inspectors for a reasonable number of changes even if such requirements require different or extra work than that originally contemplated by the Contract Documents.

(c) Contractor shall defend, hold harmless and indemnify Owner for all claims brought against the Owner if such claim arose in whole or in part out of Permits and licenses that were the responsibility of the Contractor to obtain as provided in 00170.72.

00170.03 Rights-Of-Way, Easements and Premises:

(a) The Contractor shall confine its construction activities within property lines, rights-of-way, limits of Easements and limits of construction Permits as shown or specified in the Contract Documents unless the Contractor has obtained permission to use other land from the owner(s) of adjacent private property. The Contractor's Bid shall include all costs related to its needs for additional space and property if such is needed by the Contractor's method of operation to perform the Work. In order to protect the City from any claim by an owner of private property, the Contractor shall provide the Owner's Representative with written permission from the property owner prior to the use of the property.

(b) The Contractor shall obtain and bear the cost of Permits for special occupancy and use of specified work areas from all appropriate and necessary governmental agencies.

(c) Unless required to be obtained in the name of the Contractor, the Owner will obtain and pay for the following when they are required by the applicable Laws or by Plans or Specifications:

1. All necessary Rights-of-Way;
2. Permits required for crossing or encroaching upon navigable streams;
3. Permits required for removing materials from or depositing materials in waterways;
4. Permits required for operating in City-controlled source of Materials or disposal area;
5. System development fees charged by local units of government;
6. Building construction permits, not including specialty work such as heating, ventilation, air conditioning, or electrical;
7. Cost of referencing and replacing endangered survey monuments; and
8. Environmental permits, including erosion control permits
00170.04 Patents, Copyrights, and Trademarks - The Contractor shall acquire and pay for all patents, royalties and license fees required to perform the Work. Contractor shall defend, hold harmless and indemnify Owner for all claims brought against it regarding royalties, license fees and patents as provided in 00170.72.

00170.60 Safety, Health, and Sanitation Provisions:

(a) General - The Contractor has complete responsibility for the safety and health of its employees and the employees of its Subcontractors at any tier. The Contractor shall not delegate this responsibility to its Subcontractors other persons or agencies. The Contractor is responsible for ensuring that employees and Subcontractor tiers follow the following safety and health requirements, receive training, and understand the Owner's applicable policies and procedures that affect the Work. The Contractor shall require additional safety measures as may be necessary for a particular project.

(b) Definitions:

(1) Job Safety Analysis - A detailed study of a job or activity to determine what potential safety and health hazards exist during the various job steps. The JSA focuses on the relationship between the worker, the task, the tools, and the work environment. After identifying any uncontrolled hazards, the JSA should identify ways to eliminate or reduce them.

(2) Competent Person - Means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary and who is authorized to require corrective measures to eliminate them.

(c) Contractor Compliance - The Contractor shall comply with all federal, state, and local safety and health regulations and laws including, but not limited to, the following:

(1) Oregon Revised Statutes - ORS 654 - The Oregon Safe Employment Act

(2) Oregon Administrative Rules - OAR 437 - The Oregon Occupational Safety and Health Code

(3) Oregon Occupational Safety & Health Administration (OR-OSHA)

   a. Division 1 - General Administrative Rules
   b. Division 2 - General Occupational Safety & Health Rules
   c. Division 3 - Construction

(4) Department of Labor and Industries

(5) Oregon Department of Transportation
(d) **Statute Versus Contract Documents** - In the event that the law requires greater safety obligations than those imposed by the Contract Documents, the Contractor shall perform the obligations required by law without additional cost to the Owner.

(e) **Coordination** - The Contractor shall coordinate the Work with police, fire, emergency service providers, TriMet, and other agencies, school districts and individuals as may be required. Refer to Names, Address, and Phone Numbers found in Notice to Bidders for specific contact information.

(f) **Site Specific Safety and Health Plan** - The Contractor shall develop and submit an SSSHP addressing safety issues for all persons working on the Project, regardless of their employer. The SSSHP shall be prepared by a Competent Person and consist of a narrative and supporting plans detailing the methods for dealing with all the known exposures and risks. The SSSHP shall detail the methods for addressing Work hazards identified by the Job Safety Analysis (JSA).

(g) **Document Control** - The Contractor shall maintain at least one current copy of the SSSHP at the project Site for the Project duration, instruct all employees where this document is available for reference, and inform the Owner's Representative where to find a copy on the project site.

(h) **Subcontractors** - The Contractor shall develop a plan for distributing information in the SSSHP to all persons working on the Project, regardless of their employer, establish a method for documenting all safety training, and maintain an inventory of personal protective equipment provided to all works.

(i) **Other Specifications** - SSSHP shall also comply with the requirements of the Contract Documents.

(j) **Public Safety** - The Contractor shall ensure the public safety during its performance of the Work and minimize public inconvenience. Prepare a description of the methods for securing the Work area from public access.

(k) **Competent Persons** - The Contractor shall supply a list of competent persons, together with 24-hour contact numbers and areas of expertise for each of the applicable following specialties:

   (1) Confined Space
   (2) Excavation and Shoring
   (3) Cranes and Rigging
   (4) Electrical and Hot Work
   (5) Chemicals and Biohazards

(l) **Working Procedures** - The SSSHP shall contain detailed information outlining safe working procedures to address any identified hazards and risks when completing the Work, including the following:
(1) **Confined Space** - Describe entrance and exit procedures from confined spaces. Outline procedures and equipment requirements when working in a confined space. Define the rescue procedure to extract an employee during an emergency. Describe all personal protective equipment provided to employees working in a confined space including gas monitoring equipment use, maintenance, and storage.

(2) **Excavation and Shoring** - Define the procedures when excavating undisturbed and previously disturbed soils. Describe the requirements when working around existing utilities, manholes, and connections, lateral connections, work within historic trench limits, and entering and exiting from trenches.

(3) **Cranes and Rigging** - Provide requirements for operators and equipment certifications including lift capacity. Identify all lift equipment to be used on the Project, describe the plan(s) for moving, and lifting materials, and define equipment location(s) and position(s) to perform safe lifts.

(4) **Electrical and Hot Work** - Describe lockout/tagout procedures for electrical equipment, define the procedures for requesting that existing systems be taken out of service, for testing and trouble shooting new equipment and coordinating with any outside utility or agency.

(5) **Chemical and Biohazards** - Identify all substances, agents and site conditions that present a hazard and recommend actions for their control. Provide and maintain equipment in good working order to test and monitor for hazardous substances.

(6) **Other Issues** - Describe procedures for addressing any other safety issues other than what has been described above.

(m) **Project Emergency Procedures** - The Contractor shall develop and implement a Project Emergency Procedures Plan to handle any catastrophic event that could occur on the Project, such as flood, fire, cave-in, slide, power outage, sewer gas, chemical spill, or similar emergencies. Some examples of topics the plan could address include safe distance and staging area (safety zones), evacuation routes, emergency medical treatment and first aid, emergency alerting and response procedures, personal protective and emergency equipment.

(n) **Submittal Requirements** - The Contract shall submit copies of the Project SSSHP, including the JSA, for review to the Owner's Representative. The Owner's Representative will review the plan to determine if it addresses known exposures and risks in a reasonable manner and reject the submittal if it fails to do so. Nevertheless, the Owner's review is not intended to, nor does it, relieve the Contractor of its obligation to be completely responsible for the safety and health of all persons working on the Project nor does it diminish any other contractual or legal obligation of the Contractor.
(o) **Review and Acceptance** - Construction activity shall not begin until the Owner's Representative has reviewed and accepted the SSSHP. Continued acceptance of the SSSHP will be predicated on demonstrated performance to comply with the plan's requirements. If a work situation poses a safety hazard not covered by the Plan, the Contractor shall take immediate action to correct the safety hazard and modify the SSSHP accordingly.

(p) **Secure Construction Site** - The Contractor shall provide and maintain all labor, material, and equipment needed to secure the construction site from damage until the Work is complete and accepted by the Owner. This may include labor, lighting, fencing, alarm systems and other miscellaneous materials to maintain security at all sites where the Contractor may be working, staging work and storing materials or equipment. The Contractor also shall assure that only authorized personnel are at the Project Site.

(q) **Safety Equipment** - The Contractor shall furnish all safety equipment required by the SSSHP.

(r) **Cost** - The Contractor shall include the cost of development, implementation, and maintenance of the SSSHP in its Bid, and therefore it is included in the Contract Amount. No separate or additional payment will be made for the SSSHP. Payment will be included in payment made for the appropriate items under which this work is required.

00170.70 **Insurance:**

(a) **General Provisions:**

1. The Contractor shall obtain, at its own expense, the minimum insurance coverage described in 00170.70(c), 00170.70(d), 00170.70(e) and 00170.70(f) below and maintain that coverage until final acceptance of the entire Project. By requiring such minimum insurance, the Owner does not guarantee that the insurance is sufficient to cover all the risks the Contractor may face. Instead, the Contractor should assess its own risks and, if it deems it appropriate and prudent, maintain higher limits, broader coverages, or both, than the coverage required by the Owner. The Contractor is not relieved of any liabilities if it fails to obtain and maintain the minimum insurance required. The insurance carried by the Contractor shall be the primary coverage and non-contributory, and any insurance maintained by the Owner is excess and solely for damages or losses for which the Owner is responsible.

2. The Contract Amount includes the cost of any insurance required by the Contract Documents. The Contractor is not entitled to additional compensation because it misunderstood what insurance coverage was required. Any confusion regarding what coverage is required should be brought to the Owner's attention prior to submission of a Bid or Proposal.
The Owner may, but is not required to, obtain insurance it deems prudent under the circumstances if it discovers that the insurance required by the Contract Documents has not been obtained or, for whatever reason, is no longer in effect. If so, Owner may recover the cost of obtaining that insurance from the Contractor from any sums due, or to become due, the Contractor on this or any other Contract.

All insurance shall be procured from a company, or companies, lawfully authorized to conduct business in the State of Oregon.

(b) Certificates and Review of Coverage before Contract Execution:

(1) The Contractor shall provide the City Auditor certificates of insurance and additional insured endorsements signed by the insurance carrier. The certificates shall show the effective dates of coverage, be presented on Insurance Service Office forms, and show that the coverage required by the Contract Documents has been obtained. This shall be provided within 10 Calendar Days of the announcement of the intent to Award the Contract to the Contractor by the Owner. The certificates shall contain a provision that states substantially the following: “The insurance described in this certificate shall not be canceled or materially altered without giving the City Auditor 30 days written Notice in advance of that action.” Failure to comply with the reporting provisions of this Contract shall not affect the coverages provided to the City of Portland, the Owner and their officers, employees and agents.

(2) The City Attorney’s Office will review the certificates for approval. The City Attorney’s office may reject any proposed certificate if the insurance proposed to be provided is not the same as the coverage required by the Contract Documents, may reject the certificate if it is unclear, or require that the underlying policy be presented for review. If the City Attorney’s office determines that the certificates are unclear, the Contractor shall provide revised certificates that clearly show the insurance required by the Contract Documents has been obtained. Review or approval of the City Attorney’s office of any insurance certificate does not excuse the Contractor from providing the insurance required by the Contract Documents.

(3) The certificate(s) will identify all of the parties who are Additional Insureds or Loss Payees. In addition, there shall be no cancellation, non-renewal, material change, or potential exhaustion of aggregate limits without 30 days written notice from the Contractor or its insurer(s) to the Owner. The certificates shall reflect these requirements. To the extent certificates of insurance contain words to the effect that Contractor shall “endeavor to send notice of cancellation” or similar language, Contractor shall require its insurer(s) to send such notice by making sure that the words “endeavor to” or similar words are removed from the Certificate.

(4) Any deductible in excess of $50,000 shall be disclosed to the Owner in writing prior to Issuance of a Notice to Proceed and is subject to Owner's approval.
(5) If the Contractor fails or refuses to provide the required insurance coverage or certificates in a form satisfactory to Owner within the time required, the Owner is entitled to take any and all of the following actions:

a. Reject the Contractor's Bid;
b. Award the Contract to someone other than the Contractor; and
c. Recover any costs suffered by the Owner as a result of taking the actions above from the Contractor or its Bid Bond.

(c) Workers' Compensation and related Insurance:

(1) The Contractor shall provide, and require all Subcontractors to provide, Workers' Compensation coverage on a statutory basis for all persons employed in performing services under the Contract, in accordance with ORS Chapter 656, either as:

a. A carrier-insured employer; or
b. A self-insured employer.

(2) Proof of such coverage shall be filed with the Owner and maintained for the duration of the Contract. The coverage shall include Employer's Liability Insurance with coverage limits of not less than $100,000 for each accident, a $500,000 disease "policy" limit, and $100,000 disease "each employee" limit.

(3) The Contractor shall require proof of such Workers' Compensation Insurance by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.

(4) Where work under this Contract is subject to the Federal Longshoremen's and Harbor Workers' Act or the Federal Jones Act, or any other workers' compensation system, proof of such coverage shall be provided to the Owner for approval and maintained for the duration of the Contract with similar coverage as that required by (c-2) above.

(d) Liability and Property Damage Insurance:

(1) Commercial General Liability (CGL) - Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract and as specified below, Commercial General Liability Insurance (CGL) covering bodily injury and property damage in a form and with coverages that are satisfactory to the Owner. This insurance shall include personal injury liability, products and completed operations, and contractual liability coverage for the indemnity provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace), and shall be issued on an occurrence basis. Combined single limit per occurrence shall not be less than $1,000,000 for each occurrence, $1,000,000 Personal Injury/Advertising Injury; $1,000,000 Products/Completed Operations, and; $1,000,000 General Aggregate.
(2) Coverage Limits - The insurance shall include the following coverage: Premises/Operations, Contingent Liability/Independent Contractor; Broad Form Property Damage; Fire Liability; Contractual Liability; and Explosion, Collapse and Underground Hazard Liability. The policy shall be endorsed to extend the completed operations for 2 years after Final Completion of the Work.

(3) Contractor's Pollution Liability: The insurance shall include Contractor's Pollution Liability coverage when otherwise required by the Contract Documents. The Owner requires the Contractor to provide completed operations coverage for 2 years after Final Completion of the Work. When required, such coverage shall include:

   a. Bodily injury including death, sickness, disease, mental anguish or shock sustained by any person;

   b. Property Damage including natural resource damages, physical injury to or destruction of tangible property including resulting loss of use, clean up costs, and the loss of use of tangible property that has not been physically injured or destroyed;

   c. Defense, including costs, charges and expenses incurred in the investigation, adjustment or defense of claims for such compensatory damages;

   d. Cleanup costs, removal, storage, disposal, and or use of the pollutant; and defense, including costs and expenses incurred in the investigation, defense, or settlement of claims;

   e. Coverage shall apply to sudden and gradual pollution conditions resulting from the escape of release of smoke, vapors, fumes, acids, alkalis, toxic chemicals, liquids, or gases, natural gas, waste materials, or other irritants, contaminants, or pollutants (including asbestos). If the coverage is written on a claims-made basis, the Contractor warrants that any retroactive date applicable to coverage under the policy precedes the effective date of this contract; and that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (or specify desired number) years beginning from the time that work under this contract is completed;

   f. On the Automobile Liability Coverage, endorsements CA9948 and MCS-90 are required if the Contractor is transporting any type of hazardous materials; and

   g. This policy must be kept in effect for up to 2 years after completion of the project.

(4) Insurance Coverage - The insurance coverage obtained by the Contractor:

   a. Shall not be affected by any insurance coverage otherwise existing;

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b. Shall name the Owner, its officers, employees and agents as additional insureds. The "additional insured" requirement shall also apply to Products/Completion Operations coverage. If for any reason Contractor cannot obtain such coverage from its insurer, it shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, including Products/Completed Operations coverage for up to 24 months after Final Completion, naming the City of Portland, its officers, employees and agents as Named Insured with not less than a $1,000,000 limit per occurrence, $1,000,000 Products/Completed Operations Aggregate and $1,000,000 general aggregate. This policy must be kept in effect for 24 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to its issuance of a Notice to Proceed;

c. Shall protect each insured in the same manner as though a separate policy had been issued to each, notwithstanding the naming of any number of additional insureds. However, this requirement is not intended to increase the insurer's liability as set forth in the policy beyond the amount, or amounts, for which the insurer would have been liable if only one person or entity had been named as the insured;

d. Shall permit partial occupancy or use of the Project by Owner in advance of Substantial Completion without cancellation or discontinuance of coverage. In that event, the Owner and Contractor shall agree upon the time when partial occupancy or use of the Project by the Owner shall occur. If the insurance coverage provided by the Contractor requires consent of the Insurer before such occupancy or use occurs, the insurance policy shall also state that such consent shall not be unreasonably withheld; and

e. Shall be provided on an "occurrence" basis. If the Owner elects to accept insurance on a "claims made" basis, then "tail" coverage will be required at the completion of this Contract for a duration of 24 months or the maximum time period available in the marketplace if less than 24 months. Contractor will be responsible for furnishing coverage for 24 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage provided its retroactive date is on or before the effective date of this Contract. This will be a condition of the final acceptance of Work or services and related warranties.

(e) Builder's Risk Insurance - The Contractor shall obtain Builder's Risk Insurance or a Builder's Risk Installation Floater, as described below:

(1) Builder's Risk - If this contract involves the construction of a building, an addition to an existing building or extensive renovations to an existing building, the Contractor shall purchase and maintain in force during the term of this Contract, at its own expense, Builder's Risk insurance in an
amount equal to the Contract Amount, including any subsequent modifications for the entire project at the site on a replacement cost basis, including covering all costs needed to repair the structure or work (including overhead and profits) based on the value figured at the time of rebuilding or repairing, not at the time of loss. Such coverage shall be maintained, unless otherwise provided in the Contract Documents, or otherwise agreed to in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made or until no person or entity other than the Owner has insurable interest in the property to be covered, whichever is earlier. The Builder's Risk insurance shall include interests of the Owner, the Contractor, Subcontractors and sub-tier contractors in the project.

(2) Special Covered Cause of Loss Form - Builder’s Risk Coverage shall be on a special covered cause of loss form and shall include theft, vandalism, malicious mischief, collapse, false-work, temporary buildings and debris removal including demolition, increased cost of construction, architect's fees and expenses, flood and earthquake coverage, and all below and above ground structures, water and sewer mains. Other coverage may be required if provided in contract documents. Coverage shall be written for 100% of the completed value (replacement cost basis) of the work being performed.

(3) Amendments and Provisions - The Builder's Risk shall also include the following amendments and provisions.

a. Waiver of Subrogation - Waiver of subrogation against all parties named as insured, but only to the extent the loss is covered;

b. Beneficial Occupancy Clause - The policy shall specifically permit partial or beneficial occupancy at or before substantial completion or final acceptance of the entire work. Partial occupancy or use of the work shall not commence until the insurance company or companies providing insurance have consented to such partial occupancy or use. The Owner and Contractor shall take reasonable steps to obtain consent of the insurance company or companies and agree to take no action, other than upon mutual written consent, with respect to occupancy or use of the work that could lead to cancellation, lapse or reduction of insurance;

c. Equipment Breakdown Coverage - Equipment breakdown coverage (aka boiler & machinery coverage) shall be provided that specifically covers insured equipment during installation and testing;

d. Interior Damage - Any clause that excludes recovery of damage to the interior of building shall be deleted. The Builder's Risk policy shall provide for recovery for damage to the interior of a building if caused by perils insured against in the Builder's Risk Policy;

e. Design Error - The Builder's Risk policy shall not exclude coverage of damages caused by design error;
f. **Settlement, Cracking, Etc** - The Builder's Risk policy shall cover settling, cracking, shrinking or expansion (including coverage for loss resulting from settling, cracking, shrinking or expansion) of foundation walls, floors and other parts of the structure; and

g. **Deductible** - Any deductible shall not exceed $50,000 for each loss, except the earthquake and flood deductible shall not exceed 2% of each loss or $50,000, whichever is more. The deductible is the responsibility of the Contractor.

(4) **Builder's Risk Installation Floater** - If Builder's Risk insurance is not required, then the Contractor shall obtain, at the Contractor's expense, and keep in effect during the term of this Contract, a Builder's Risk Installation Floater in the initial Contract Amount, as well as subsequently amended, on a replacement cost basis, including covering all costs needed to repair the structure or Work (including overhead and profit) based on the values figured at the time of rebuilding or repairing, not at the time of loss. Such coverage shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed to in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made or until no person or entity other than the Owner has an insurable interest in the property to be covered, whichever is earlier. The Builders' Risk Installation Floater shall include interest of the Owner, Contractor, Subcontractors and sub-tier Contractors in the project.

(5) **Special Covered Cause of Loss Form** - The Builders' Risk Installation Floater shall be on a Special Covered Cause of Loss Form and shall include theft, vandalism, malicious mischief, faulty workmanship, labor, materials and equipment to be installed. Other coverages may be required if provided in the Contract Documents. The Builders' Risk Installation Floater shall also provide a Waiver of Subrogation against all parties named as insured, but only to the extent the loss is covered. Coverages shall be written for 100% of the completed value (replacement cost basis including labor and materials) of the work being performed or other limit as specified in the Contract Documents.

(6) **Insured Loss** - A loss insured under the Builder's Risk Insurance or Builder's Risk Installation Floater shall be adjusted in conjunction with the Owner and any payments or settlements shall be made payable to the Owner for the insureds, as their interests may appear. The Contractor shall pay Subcontractors their just share of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors make payments to the Sub-subcontractors in similar manner. The owner shall have power to adjust and settle a loss with insurers. If is expressly agreed that nothing in this section shall be subjected to arbitration and any references to arbitration are expressly deleted.

(7) **Deductible** - Any deductible shall not exceed $50,000 for each loss. However, if earthquake and flood perils are both covered by the policy, the deductible shall not exceed 2% of each loss of $50,000, whichever is greater.
(f) **Automobile Liability** - The Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, non-owned and hired vehicles. This coverage may be combined with the Commercial General Liability Insurance policy. The combined single limit per occurrence shall not be less than $1,000,000.

(g) **Negligence of Owner** - Nothing in this section requires the Contractor or its insurer to provide insurance to the Owner for claims arising out of the death or bodily injury to persons or damage to property caused, in whole or in part, by the negligence of the Owner.

(h) **Claims of Damage** - Contractor shall defend, indemnify and hold the Owner harmless from any and all claims of damage, including attorney fees and costs, resulting from Contractor's activities in regard to notification of utilities and emergency service providers, as more specifically provided in 00170.72.

00170.71 **Independent Contractor Status** - The service or services to be rendered under this Contract are those of an independent Contractor. Contractor is not an officer, employee, or agent of the City as those terms are used in ORS 30.265.

00170.72 **Indemnity/Hold Harmless:**

(a) The Contractor shall indemnify, hold harmless, and defend Owner, its officers, employees and agents from any and all claims, losses, damages, attorney fees, costs and liabilities arising out of accidents, unforeseen difficulties, or the intentional, reckless or negligent acts or omissions of the Contractor, its Subcontractors, suppliers, employees, or agents in the performance of the Work. For purposes of this Subsection, “claims” includes any assertion of a right to money damages or equitable relief or any combination thereof.

(b) Owner shall notify Contractor of any claim of which it is aware that requires Contractor to defend, indemnify and hold Owner harmless. Thereafter, Contractor shall notify Owner in writing within 30 days that it will defend, indemnify and hold Owner harmless. Contractor's failure to provide such notification is a breach of contract. In the event that Contractor fails to give Notice within 30 days, Owner may defend the claim and charge Contractor with any costs associated with that effort.

(c) Owner reserves the right to participate in any claim irrespective of Contractor's obligations to indemnify, hold harmless, defend or notify. However, if Owner elects to participate in any claim after receiving notification from Contractor, Contractor is not obligated to indemnify Owner for the costs associated with that participation, although its other obligations to indemnify, hold harmless and defend remain intact.
(d) Nothing in this section requires the Contractor or its insurer, to indemnify the Owner for any claims or losses arising out of death, or bodily injury to persons or property damage caused, in whole or in part, by the negligence of the Owner.

00170.74 Employee Drug Test Program - As required by ORS 279C.505(2), the Contractor shall have in place, and maintain during the period of the Contract, an employee drug-testing program. The Owner retains the right to audit or monitor the program. On request by the Owner’s Representative, the Contractor shall furnish a copy of the employee drug-testing program.

00170.79 Third Party Beneficiary - The parties agree that the execution of this Contract is not intended to, nor does it create, any third party beneficiary rights in any person.

00170.80 Responsibility for Damage to Work:

(a) The Contractor shall perform the Work as required by the Contract Documents, including, but not limited to, providing all labor, materials, equipment, tools, machines and Incidental Work necessary for its performance. In addition, the Contractor is responsible for the means and methods of construction.

(b) Until the Work is completed and accepted by Owner, the Contractor is responsible for any damage caused to either permanent or temporary work, utilities, materials, plants and equipment, all of which shall be repaired to the satisfaction of the Owner’s Representative at the Contractor’s expense. Damage to any portion of the Work that has been completed and accepted by the Owner and which is open for public use is not the responsibility of the Contractor unless caused by the Contractor.

(c) The Contractor shall repair any damage for which it is financially responsible promptly. If the damage is something for which the Contractor is not financially responsible, the Owner’s Representative may direct the Contractor to repair the damage with compensation established as follows:

(1) If the Contract was one that had Unit Prices established for performing the work, the Contractor will be compensated at those Unit Prices.

(2) If the Contract, or a portion of the Contract, was one that used Lump Sum pricing, then the Owner and Contractor shall use the Schedule of Values.

(d) The Owner reserves the right to have any work performed for which the Contractor is not financially responsible by its own forces or by hiring another Contractor to perform the work.

(e) Contractor shall make sure its Work is in good condition to receive subsequent work that may be performed by another Contractor. See 00150.55.
(f) Partial Relief of Responsibility for Damage to Work Caused by Public Traffic:

(1) Interim Acceptance - The Contractor may request in writing interim acceptance of certain completed portions of the Work, such as drainage facilities and traffic control devices. If approved, the Owner's Representative will issue written interim acceptance stipulating the scope and duration of the Contractor's relief from responsibility for damage to Work caused by public traffic. The Owner's Representative will also include in the interim acceptance the scope and duration of Contractor's relief, if any, from responsibility for protection and maintenance.

(2) Scope of Relief - For the duration of interim acceptance issued by the Owner's Representative, the Contractor will be relieved of responsibility to repair those portions of the Work upon which relief was granted under this Subsection. The scope of potential relief applies only to damages caused by public traffic, and is limited to the following:

- A segment of Roadway, drainage facilities, Slopes, lighting, traffic control devices and access facilities;
- A Bridge or other Structure within a segment of Roadway;
- Traffic signals and appurtenances at an intersection;
- Permanent, passive traffic control devices;
- Complete circuits of a highway lighting system; and
- Portions of a building open to public use.

(g) Vandalism - The Contractor shall provide reasonable protection of the Work from vandalism until Substantial Completion of the Work. If reasonable protection has been provided, the Contractor's responsibility for damage resulting from vandalism will be limited to $5,000 per occurrence. Requests for reimbursement of amounts in excess of $5,000 shall be in writing and directed to the Owner's Representative. Upon receipt, the Owner's Representative will investigate, evaluate the amount of damages and their cause, and determine whether, and how much, the Contractor will be recompensed.

00170.82 Responsibility for Damage to Property and Facilities:

(a) Property Protection - Contractor shall protect, and take every reasonable precaution to avoid damage to, all public and private property that might be damaged by its operations. See 00170.03, regarding Rights of Way, Easements and construction limits.
(b) **Property Repair** - If public or private property, or both, is damaged by the Contractor’s operations, the Contractor shall either repair the damage, or have the damaged repaired by others at its own expense, without additional compensation from Owner. The repair shall bring the property damaged back to the same condition as it was before the damage occurred. If repair and restoration is not feasible, the Contractor shall pay the Owner of the damaged property for the damage. If the damage has been caused to property of the Owner, the Owner has the right to determine whether the property shall be repaired and restored by the Contractor or not. If Owner elects to have the property repaired with its own forces or by another entity, the Contractor shall pay the Owner all costs associated with that repair and restoration.

(c) **Vehicle and Other Removal Notice** - Contractor shall give reasonable Notice to owners and occupants of property adjacent to the Work to permit them to remove vehicles, trailers and other possessions as well as salvage or relocate plants, trees, fences, sprinkler systems or other improvements in the Easement or Right-of-Way that are designated for removal or which might be destroyed or damaged by the Contractor’s operations.

(d) **Landscape Protection/Restoration** - Contractor shall protect all trees not designated for removal, lawns and planted areas within the Right-of-Way or Easements and restore all disturbed areas, by seeding, mulching and providing erosion control as set forth in the Contract Documents. If conditions are such that seeding cannot be done, provide temporary erosion control measures as set forth in the Contract Documents or as directed by the Owner’s Representative.

(e) **Clearing Work Review** - Contractor shall review the location, limits and methods to be used with the Owner’s Representative prior to performing any clearing work.

(f) **Sign Protection** - Contractor shall protect all signs, including business signs and tourist-oriented direction signs, from damage whether the signs are to remain in place or are placed on temporary supports until they are reinstalled on permanent supports in the same or similar location. Signs that are damaged shall be repaired at Contractor’s expense. Contractor is responsible for any and all damages that result from the displacement of such signs.

(g) **Permanent Survey Markers:**

1. Contractor shall notify the Owner’s Representative not less than 5 Working Days prior to starting work in order that the Representative may take necessary measures to ensure the preservation of survey monuments, stakes, lot stakes and bench marks. Contractor shall not disturb permanent survey monuments, stakes, lot stakes or bench marks without the consent of the Owner’s Representative, and shall bear the expense of replacing any that are disturbed.

2. When a change is made in the finished elevation of the pavement of any roadway in which a permanent survey monument is located, Contractor shall adjust the monument cover to the new grade at no additional expense to Owner.
(h) Construction and Survey Markers - Contractor shall preserve construction survey stakes and markers for the duration of their usefulness during construction. If survey stakes are lost or disturbed through the Contractor's negligence and therefore need to be replaced, the Contractor shall pay for the cost of the replacement. The amount of that cost may be deducted from any payment due to Contractor.

(i) Protection and Restoration of Non-City Property and Facilities - The Contractor shall determine the location of properties and facilities that could be damaged by the Contractor's operations, and shall protect them from damage. The Contractor shall protect monuments and property marks until the Engineer has referenced their location and authorized their removal. The Contractor shall restore property or facilities damaged by its operations to the condition that existed before the damage, at no additional compensation.

The Contractor shall provide temporary facilities when needed, e.g., to maintain normal service or as directed by the Engineer, until the required repair, rebuilding, or replacement is accomplished.

The Contractor shall protect specific service signs, e.g., business logos, and tourist-oriented directional signs (TODS) from damage, whether the signs are to remain in place or be placed on temporary supports. The Contractor shall repair or replace damaged signs at no cost to the City.

00170.85 Responsibility for Defective Work:

(a) The Contractor shall make good any defective Work, Materials or Equipment incorporated into the Work.

(b) Manufacturer Warranties and Guarantees:

(1) Manufacturer Warranties - For those specification Sections referencing this Subsection, the Contractor shall furnish Warranties from the Manufacturer and signed by a Manufacturer's Representative.

The Warranty period will be specified in the applicable Specification Section for which it applies.

The Warranty will start on the date the Owner's Representative accepts the work and authorizes final payment unless otherwise specified in the Contract.

When the Owner makes written notification to the Manufacturer of failure of an item covered by this Warranty, the Warranty period will stop for the affected item or the portion of the affected item that failed, as applicable until the required repairs or replacements are made and accepted. All repaired or replaced items shall meet current specifications, unless otherwise specified in the Contract, and will be warranted for the remaining Warranty period.
Warranty work shall be performed when weather permits. If, in the opinion of the Owner's Representative, temporary repairs are necessary, the temporary repairs will be made by the Owner or an independent contractor at the Manufacturer's expense. The Manufacturer shall replace all temporary repairs at no additional cost to the Owner.

The Manufacturer shall provide all required traffic control during repair or replacement of failed items at no additional cost to the Owner.

(2) Trade Practice Guarantees - For those items installed on the Project that have customary trade practice guarantees, the Contractor shall furnish the guarantees to the Owner's Representative at the completion of the Contract.

00170.93 Trespass - Contractor is responsible for trespass or encroachment upon or damage to adjacent property and from claims resulting from the Contractor's operations.

00170.94 Use of Explosives - The Contractor shall comply with all Laws regarding the use of explosives. The Contractor shall notify anyone having facilities near the site of the intended use or storage of explosives. The Contractor shall be responsible for all damage resulting from the Contractor's own, its agents' and employees' and its Subcontractors' use of explosives. Comply with the Contract Documents and contact the City of Portland Fire Bureau for details on required permit.

00170.95 Overtime Work:

(a) The Contractor shall obtain approval from the Owner's Representative in order that the work can be appropriately monitored.

(b) The Owner's Representative may refuse the Contractor the right to perform overtime work if the Owner does not have sufficient staff to inspect the work or when the Representative determines that the overtime is not in the public interest.

(c) Work performed during overtime in the absence of the Owner's inspection or other staff must be performed at Contractor's expense unless expressly authorized.

(d) This Subsection does not apply to labor performed in the manufacture or fabrication of any material ordered by the Contractor or manufactured or fabricated in any plant or place other than the place where the main Contract is to be performed.

00170.96 Records:

(a) The Contractor and its Subcontractors shall maintain all fiscal records relating to public Contracts in accordance with generally accepted accounting principles. In addition, Contractors and Subcontractors shall maintain any other records necessary to clearly document their performance of the work and any Claims for additional compensation or requests for additional Contract Time.
arising from or relating to their performance under a public Contract. Contractors and Subcontractors shall make all records pertaining to their performance, any Claims or requests under a public Contract accessible to the Owner at reasonable times and places, regardless of whether litigation has been filed as to such Claims.

(b) The Owner may, at reasonable times and places, have access to, and an opportunity to inspect, examine, copy and audit the books and records of any person who has submitted cost or pricing data according to the terms of a Contract to the extent that such books and records relate to such cost or pricing data. Any person who receives a Contract, for which cost or pricing data are required, shall maintain such books and records that relate to such cost or pricing data for three years from the date of Final Payment under the Contract, unless a shorter period is otherwise authorized in writing.

(c) The Owner and its authorized representatives shall be entitled to inspect, examine, copy and audit the books and records of the Contractor and its Subcontractors and suppliers as provided in 00170.96(b). Such books and records shall be maintained by the Contractor and all Subcontractors, and kept accessible and available at reasonable times and places for a minimum period of three years from the date of Final Payment under the public Contract, or until the conclusion of any audit, controversy, litigation, dispute or claim arising out of, or related to, the public Contract.

(d) Contractor shall produce all such records in Portland, Oregon, regardless of whether the records are produced pursuant to this provision of the Contract or as a result of a claim, litigation, arbitration or other proceeding. Contractor may produce the records elsewhere if it fully compensates the Owner for the reasonable costs of travel to and from the place where the records are produced and the reasonable cost of any employee’s time in having to travel.

00170.97 Partial Occupancy or Use:

(a) The Owner may occupy or use any completed or partially completed portion of the Work, at any state of construction, provided such occupancy or use is not prohibited by regulatory agencies having jurisdiction over the Work.

(b) The partial occupancy or use may commence before that portion is substantially complete. Before partial occupancy, the Owner’s Representative and Contractor shall discuss payments, retainage, if any, security, maintenance, utilities, damage to the Work and insurance, the period of time for correction and completion of the portion of the Work occupied and the commencement date of any applicable warranties and reduce matters of agreement to writing. Disputes about these matters shall be handled as provided by 00199.30.
(c) Before partial occupancy or use, the Owner’s Representative and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Thereafter a list shall be prepared recording the items that need correction and completion. This list is not a “punch list” and does not represent that Substantial Completion has occurred. Either the Owner’s Representative or Contractor may inspect the portion separately if the other refuses to join in an inspection in a timely fashion.

(d) Partial occupancy or use of a portion or portions of the Work shall not constitute Owner’s Acceptance of Work not complying with the requirements of the Contract Documents, nor does it waive rights the Owner has to completion of the Contract in accordance with the requirements of the Contract Documents.

(e) Owner also is entitled to occupy or use all or a portion of the work upon Substantial Completion. Occupancy or use upon Substantial Completion does not constitute Owner’s Acceptance of Work not complying with the requirements of the Contract Documents nor does it waive rights the Owner has to completion of the Contract in accordance with the requirements of the Contract Documents.
00180.15 Owner's Right to Do Work at Contractor's Expense:

(a) If the Contractor refuses or fails to comply with the Contract, the Owner may correct any deficiency or defect or perform work that the Contractor has failed to perform, or take other appropriate action without prejudice to any other remedy the Owner may have under the Contract. Before taking that action, the Owner will provide the Contractor and its sureties with 7 Days Notice of its intentions, unless an emergency or dangerous condition exists, in which case the action may be taken without Notice. In the event that the Owner performs part of the Contractor’s work, corrects deficiencies or is required to take action as a result of an emergency or dangerous condition, the Owner will deduct the cost of that action from any payment then or thereafter due the Contractor. In the event that the cost of the Owner’s action exceeds any sums held by Owner and otherwise payable to Contractor, Contractor agrees to reimburse Owner for any excess costs.

(b) The Owner has the right to delete work from this Contract and the parties agree that such action does not constitute a breach of contract. Therefore, Owner may delete work from the Contract and perform it with its own forces or have such work performed by another Contractor. If work is deleted from the Contract, the cost of performing such work will be deducted from the Contract Amount to be paid to the Contractor. Any objections to the change in Contract Amount shall be processed as a Claim as required by 00199.30.

00180.21 Subcontracting:

(a) Contractors are responsible for performing the Work required by the Contract Documents. Use of Subcontractors is permitted. However, the use of Subcontractors, material suppliers, equipment suppliers or others to perform portions of the Work does not release the Contractor from any contractual obligation. The Contract Awarded to the Contractor cannot be assigned or transferred to another person without the Owner's written approval.

(b) The Contractor shall provide in all of its subcontracts that the Subcontractor, material supplier and equipment supplier shall be bound by the terms and conditions of this Contract.

(c) All agreements, subcontracts and purchase orders executed between the Contractor and others for the Project must provide that they are assignable or otherwise transferable to the Owner at the Owner's option, in the event that this agreement is terminated for any reason. If the agreements, subcontracts and purchase orders are not assignable, the Contractor shall be liable for any additional costs incurred by Owner in procuring the same or substitute services, materials, equipment, supplies, or parts.

(d) The Contractor shall provide the Owner with copies of all its subcontracts, purchase orders and supply agreements relating to the Work upon request of the Owner within 3 business days of the request.
(e) Substitution of Subcontractors shall be in accordance with Oregon law. In addition, substitution of M/W/ESB Subcontractors requires notification to the Owner’s Representative, approval of the Chief Procurement Officer and good faith efforts to acquire a new Subcontractor, as more specifically provided in the Good Faith Effort Specifications, which are hereby incorporated by reference.

00180.30 Materials, Equipment, and Work Force - The Contractor shall remove from the job any laborer, worker, mechanic, foreman, superintendent or other person who is found to be incompetent or who fails or refuses to perform the work properly. In addition, the Contractor shall remove any person who disrupts the Work by being intemperate, troublesome, or disorderly. If the Contractor refuses to take such actions the Owner’s Representative may order the person to be removed and those instructions shall be followed. Replacement of that person is at the Contractor’s cost.

00180.31 Substitution of Materials and Equipment to be Incorporated into the Work:

(a) Whenever a process is designated, or a manufacturer’s name, brand or item designation is given, or whenever a process or material covered by patent is designated or described, it shall be understood that the words “or approved Equal” follows that name, designation or description. The Owner does not know, and cannot guarantee, however, that an “Equal” actually exists. If the Contractor submits a Bid assuming that the Owner will approve an Equal, it does so at its own risk, and remains responsible for providing the item specified in the event the proposed substitution is rejected.

(b) The Contractor may offer to substitute materials, products, parts or equipment of Equal or better quality and performance from those specified after execution of the Contract. To do so, the Contractor shall submit any and all information to the Owner to show that the proposed substitution is Equal to or better than that specified by the Contract, including any and all information regarding changes to, or coordination with, any other portion of the Work, that may be affected by the substitution.

(c) The Owner’s Representative has the sole discretion to accept or reject an offer of substitution. If the Owner’s Representative accepts the proposed substitution, the Contractor may proceed to use the substituted material, product, part or equipment and incorporate it into the Work. Thereafter, the contractor is legally responsible for the substitution. Acceptance by the Owner’s Representative shall not relieve the Contractor from full responsibility for the efficiency, sufficiency, quality and performance of the substitution.

(d) No substitutions can be made without written approval of the Owner’s Representative. Any cost differential between what was originally specified and what was substituted and any change in Contract Time resulting from the substitution will be reflected in a Change Order executed before the substitution is effective. If no Change Order is executed before the substitution occurs, the parties agree that the substitution had no affect on either the Contract Amount or Contract Time.
(e) If the Owner’s Representative rejects the proposed substitution the Contractor shall proceed to follow the Contract Documents as originally drafted, without a change in the Contract Amount or Contract Time. Therefore, the Contractor shall not order materials, products, parts or equipment in anticipation of the substitution prior to the time that the offer of substitution is accepted.

00180.40 Limitation of Operations:

(a) In General - The Contractor shall comply with all Contract provisions and shall:

1. Conduct the Work at all times so as to cause the least interference with traffic; and
2. Not begin Work that may allow damage to Work already started.

(b) On-Site Work - The Contractor shall not begin On-Site Work until the Contractor has:

1. Received Notice to Proceed;
2. An approved Project Work schedule;
3. An approved Traffic Control Plan;
4. An approved Pollution Control Plan;
5. An approved Erosion and Sediment Control Plan;
6. Met the Owner’s Representative at the required preconstruction conference, and provided information required by the Contract Documents;
7. Assembled all materials, equipment and labor so that Work can proceed according to the Project Work schedule;
8. Completed any other task required by the specifications before On-Site Work begins;
9. An approved Site Specific Safety and Health Plan; and
10. An approved shoring plan (if applicable).

00180.41 Project Work Schedules:

(a) An accurate and regularly updated schedule is essential for Owner to monitor progress of the Work. The Contractor shall provide an updated schedule as described in this Subsection.

(b) A preliminary Construction Schedule shall be submitted by the Contractor at the preconstruction conference, unless requested at a different time by the Owner’s Representative. The preconstruction conference is a meeting scheduled by Owner between the Owner and Contractor before work begins to discuss the Project.
(c) Within three (3) weeks of receipt of the Notice to Proceed or before starting work, which ever is earlier, the Contractor shall submit for Owner’s written review a comprehensive Construction Schedule in the form required by the Contract Documents. If during the course of that review the Owner’s Representative notices that the schedule conflicts in some way with the Contract Documents, that fact will be brought to Contractor’s attention. However, failure to catch errors or inconsistencies in the schedule by Owner’s Representative shall not relieve the Contractor from having to comply with the Contract Documents, or from finishing the Work within the Contract Time.

(d) If it is desirable to carry on portions of the Work in more than one location simultaneously, Contractor shall submit a schedule for each location at least two (2) weeks in advance of that activity, or at such other time as requested by the Owner’s Representative.

(e) In the event that the Contractor’s proposed Construction Schedule does not meet the requirements of the Contract, Contractor shall immediately resubmit a schedule that conforms to the Contract.

(f) Schedules must show the proposed sequence of work, state the time required for completion of major tasks, take into account the passage and handling of traffic with the least practicable interference, and the orderly, timely, and efficient prosecution of work. Owner will use the Contractor’s schedule to check on the progress of work, to coordinate related activities such as Utility relocation, to ensure adequate inspection resources, and to plan and coordinate surveying and testing.

(g) Contractor shall prepare and submit a revised schedule whenever requested by the Owner’s Representative or when substantial changes in the sequence, timing, or progress of work require it. The Owner’s Representative may request a revised schedule at any time and, if so, Contractor shall provide one within 7 Calendar Days of the request.

(h) In the event a schedule or revised schedule does not accurately reflect work on the Project or conflicts with requirements of the Contract, the Owner’s Representative may direct that the Contractor’s work be suspended until satisfactory schedules are provided. The suspension will not entitle the Contractor to additional Contract Time or additional compensation. In addition, the Owner’s Representative may withhold part or all of a progress payment until proper schedules and revised schedules are submitted.

(i) The Contractor shall meet with the Owner’s Representative once a week to discuss the progress of the work. A written schedule for the next 2 weeks’ work will be submitted at that time with particular attention given to the next week’s schedule. If the 2-week schedule deviates more than 1 week behind the overall schedule, the Contractor shall resubmit an updated overall schedule that indicates what measures will be taken to get the project completed within the allotted time.
(j) The Contractor shall submit a Project Work schedule meeting the requirements of either 00180.41(k), (l), or (m) as required in the Special Provisions to the Owner’s Representative. The Project Work schedule is intended to identify the sequencing of activities and time required for prosecution of the Work. The schedule is used to plan, coordinate, and control the progress of construction. Therefore, the Project Work schedule shall provide for orderly, timely, and efficient prosecution of the Work, and shall contain sufficient detail to enable both the Contractor and the Owner’s Representative to plan, coordinate, analyze, document, and control their respective Contract responsibilities. The Project Work schedule shall include all contract milestone dates and reflect how the work required prior to a milestone date shall be completed prior to that date.

Contractor’s activity related to developing, furnishing, monitoring, and updating these required schedules is Incidental.

One of the following Type "A", "B" or "C" schedules will be required under the Contract. The type of schedule will be identified in the Special Provisions.

(k) Type "A" Schedule - When a Type "A" schedule is required, the Contractor shall do the following:

1. Schedule - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Owner's Representative 4 copies of a Project Work schedule, including a time-scaled bar chart and narrative, showing:
   a. Expected beginning and completion dates of each activity, including all staging;
   b. Elements of the Traffic Control Plan as required according to the Contract Documents, and
   c. Elements of the Diversion of Flow Plan as required according to the Contract Documents.

The schedule shall show detailed Work activities as follows:

d. Construction activities;
e. The time needed for completion of the utility relocation work;
f. Submittal and approval of Materials samples and shop drawings;
g. Fabrication, installation, and testing of special Materials and Equipment; and
h. Duration of Work, including completion times of all stages and their subphases.
For each activity, the Project Work schedule shall list the following information:

i. A description in common terminology;

j. The quantity of Work, where appropriate, in common units of measure;

k. The activity duration in Calendar Days; and

l. Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

m. The length of bar shall represent the number of Work Days scheduled.

n. The time scale shall be appropriate for the duration of the Contract.

o. The time scale shall be in Calendar Days.

p. The smallest unit shown shall be 1 Calendar Day.

q. The first day and midpoint of each month shall be identified by date.

r. Distinct symbols shall be used to denote multiple shifts, holiday, and weekend Work.

Each page of the bar chart shall include a title block showing the Contract name and number, Contractor’s name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch by 36 inch, using multiple sheets when needed.

Within 7 Calendar Days after the preconstruction conference, the Owner’s Representative and the Contractor shall meet to review the Project Work schedule as submitted. The Owner’s Representative will review the schedule for compliance with all Contract Time limitations and other restraints. Within 10 Calendar Days of this meeting, the Contractor shall resubmit to the Owner’s Representative 4 copies of the Project Work schedule, including required revisions if necessary.
(2) Review with the Owner's Representative - The Project Work schedule may need revision as the Work progresses. Therefore, the Contractor shall periodically review the Project Work schedule and progress of the Work with the Owner’s Representative. If the Owner’s Representative or the Contractor determines that the Project Work schedule no longer represents the Contractor’s own plans or expected time for the Work, a meeting shall be held between the Owner’s Representative and the Contractor. At this meeting, the Contractor and the Owner’s Representative shall review Project events and any changes for their effect on the Project Work schedule.

The Contractor shall compile an updated Project Work schedule incorporating any changes to the Project completion time(s). The bar chart shall reflect the updated information. The Contractor shall submit 4 copies of the updated Project Work schedule to the Owner's Representative within 7 Calendar Days after the meeting. The report shall include without limitation the following:

a. Sufficient narrative to describe the past progress, anticipated activities, and stage Work;

b. A description of any current and expected changes or delaying factors and their effect on the construction schedule; and

c. Proposed corrective actions.

(l) Type "B" Schedule - When a Type "B" schedule is required, the Contractor shall do the following:

(1) Initial Schedule - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Owner's Representative 4 copies of a time-scaled bar chart Project Work schedule showing:

a. Expected beginning and completion date of each activity, including all staging;

b. Elements of the Traffic Control Plan as required according to the Contract Documents;

c. Elements of the Diversion of Flow Plan as required according to the Contract Documents; and

d. Work elements performed by or supplied by the Owner such as Owner-furnished equipment, testing by Owner or planting by Owner.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in 00180.41(l)(2) and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.
(2) **Detailed Schedule** - In addition to the above requirements, and within 30 Calendar Days after the Notice to Proceed, the Contractor shall provide the Owner’s Representative 4 copies of a detailed time-scaled bar chart Project Work schedule indicating the critical course of the Work, including the following:

a. Construction activities;

b. The time needed for completion of the utility relocation work;

c. Submittal and approval of Material samples, mix designs, and shop drawings;

d. Procurement of critical Materials;

e. Fabrication, installation, and testing of special Material and Equipment;

f. Duration of Work, including completion times of all stages and their subphases; and

g. Crew resources which identify and clearly depict Contractor’s crew or subcontractor performing the Work associated with the scheduled activity.

For each activity, the Project Work schedule shall list the following information:

h. A description in common terminology;

i. The quantity of Work, where appropriate, in common units of measure;

j. The activity duration in normal Work Days; and

k. Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

l. The length of bar shall represent the number of normal Work Days scheduled.

m. The time scale shall be appropriate for the duration of the Contract.

n. The time scale shall be in normal Work Days (every day except Saturday, Sunday, and legal holidays).

o. The smallest unit shown shall be 1 Calendar Day.
**The first day and midpoint of each month shall be identified by date.**

**Distinct symbols shall be used to denote multiple shifts, holiday, and weekend Work.**

The bar chart drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

Within 10 Calendar Days after submission of the Project schedule the Owner’s Representative and the Contractor shall meet to review the Project schedule as submitted. Within 10 Days of the meeting, the Contractor shall resubmit to the Owner’s Representative 4 copies of the Project schedule, including required revisions if revision.

The accepted Project schedule shall represent all Work, as well as the planned sequence and time for the Work. Review of this and subsequent schedules by the Owner’s Representative shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

**Review and Reporting -** The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

- **Review with the Owner’s Representative -** The Contractor shall perform ongoing review of the Project Work schedule and progress of the Work with the Owner’s Representative. If the Owner’s Representative or the Contractor determines that the Project Work schedule no longer represents the Contractor’s own plans or expected time for the Work, a meeting shall be held between the Owner’s Representative and the Contractor. At this meeting, the Contractor and the Owner’s Representative shall review Project events and any changes for their effect on the Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the Project Work schedule.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include commencement and completion dates on activities started or completed, or if still in progress, the remaining time duration.
The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it.

The Contractor shall evaluate this information and compare it with the Contractor's project schedule. If necessary, the Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal Work Days remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit 4 copies of the updated bar chart to the Owner's Representative within 7 Days after the progress meeting, along with a progress report as required by 00180.41(l)(3)(b).

b. Progress Report - The Contractor shall submit a progress report to the Owner’s Representative each month with the pay estimate request. The report shall include the following:

1. Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
2. A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
3. Proposed corrective actions.

(m) Type "C" Schedule - When a Type "C" Schedule is required, the Contractor shall do the following:

(1) Initial Schedule - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Owner's Representative 1 digital copy and 4 full-size paper copies of a time-scaled bar chart Project Work schedule. The digital copy shall be compatible with MS Project 2003, Primavera P3 or another scheduling program approved by the Owner’s Representative. The initial schedule shall show:

a. The expected beginning and completion date of each activity, including all stages and phases;
b. The time needed for completion of the utility relocation work;
c. The elements of the traffic control plan as required according to the Contract Documents;
d. Elements of the Diversion of Flow Plan as required according to the Contract Documents; and

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e. Work element performed by or supplied by the Owner such as Owner-furnished equipment, testing by the Owner or planting by the Owner.

A logic diagram and a time-scaled bar chart will be acceptable in lieu of a time-scaled logic diagram.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in 00180.41(m)(2), and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.

(2) Detailed Project Work Schedule - In addition to the above requirements, and within 30 Calendar Days after the Notice to Proceed, the Contractor shall provide the Owner’s Representative 1 digital copy and 4 full-size copies of a detailed time-scaled critical path method (CPM) network schedule and computer analysis printout, both clearly indicating the critical path. The digital copy shall be compatible with MS Project 2003, Primavera P3 or another scheduling program approved by the Owner’s Representative. The first submitted detailed schedule shall also contain a listing of the quantity of Work for each activity, when appropriate, in common units of measure. Upon request, provide additional copies of the schedule and updates in electronic data files in a format readable by and compatible with Microsoft Project or Primavera software.

Detailed work schedule activities shall include the following:

a. Construction activities;

b. Any limitations of operation specified in the Contract Documents;

c. The time needed for completion of the utility relocation work;

d. Implementation of the TCP for each stage and phase;

e. Submittal and approval of Material samples, mix designs, and shop drawings;

f. City timeframes to process and return Contractor submitted plans, working drawings, equipment lists and other submittals;

g. Procurement of critical Materials;

h. Fabrication, installation, and testing of special Material and Equipment;

i. Duration of Work, including completion times of all stages and their subphases;

j. Specified cure times for all concrete elements; and

k. Crew resources which identify and clearly depict Contractor’s crew or subcontractor performing the Work associated with the scheduled activity.
The first submitted detailed schedule shall also contain a listing of the quantity of Work for each activity, when appropriate, in common units of measure.

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Owner’s Representative.

Detailed sub-networks will include all necessary activities and logic connectors to describe the Work and all restrictions on it. In the restraints, include those activities from the project schedule that initiated the sub-network as well as those restrained by it.

The time scale used on the Contractor's time-scaled CPM network schedule shall be appropriate for the duration of the activities and the Project duration. The time scale shall be in normal Work Days, defined as every day except Saturday, Sunday and legal holidays, with calendar dates identified no less than the first and midpoint of each calendar month. The smallest unit shown shall be one day. The network shall show the length of the activity or part scaled to accurately represent the number of normal Work Days scheduled. Distinct symbols or graphics shall be used to show multiple shift, holiday, or weekend work.

The schedule network drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the drawings shall be on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

The Contractor shall include a tabulation of each activity in the computer mathematical analysis of the network diagram. The following information represents the minimum required for each activity:

1. Event (node) number(s) for each activity;
2. Maintain event (node) numbers throughout the Project;
3. Activity description;
4. Original duration of activities (in normal Work Days);
5. Estimated remaining duration of activities (in normal Work Days);
6. Earliest start date and actual start date (by calendar date);
7. Earliest finish date and actual finish date (by calendar date);
8. Latest start date (by calendar date);
9. Latest finish date (by calendar date); and
10. Slack or float time (in work days).
Computer print-outs shall consist of at least a node sort and an "early start/total-float" sort.

Within 14 Calendar Days after submission of the detailed time-scaled critical path method (CPM) network Project schedule, the Owner’s Representative and the Contractor shall meet to review the detailed time-scaled critical path method (CPM) network Project schedule as submitted. Within 7 Calendar Days of the meeting, the Contractor shall resubmit to the Owner’s Representative 1 digital copy and 4 full-size paper copies of the detailed time-scaled critical path method (CPM) Project Work schedule, including required revisions if necessary.

The first accepted detailed time-scaled critical path method (CPM) network Project Work schedule, also called the accepted Project Work schedule, shall represent all work, as well as the planned sequence and time for the Work. Review and acceptance of any Project Work schedules and Project narratives by the Owner’s Representative shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

(3) Project Narrative - In addition to the above requirements, and within 30 Calendar Days after First Notification, the Contractor shall provide to the Owner’s Representative a final written Project narrative that discusses the planning, coordinating, scheduling and resourcing of the Work. The Project narrative shall include the following written description:

a. Plans for staging the Project.
b. All critical activities.
c. All near critical activities defined as those with less than 30 days of float.
d. All subcontractor activities that are critical, near critical, and those that are greater than 2 weeks in duration.
e. Labor resourcing, by stage and phase, to include the number of crews, average crew size and planned night/weekend shifts activities including that of subcontractors.
f. Equipment allocation, by stage and phase to include mobilization, demobilization and planned activities including that of subcontracts.
g. Notification required under the Contract during each stage and phase which may include, but is not limited to, road closures, lane closures, night work, cold plane pavement removal, and pile driving.
h. Provide discussion on addressing reasonably predictable weather conditions and their impact on all weather sensitive activities. Also provide discussion on other weather limitations that may affect the project schedule.
i. Submittal and approval of material samples, mix designs, and stop drawings.

j. Procurement of critical materials.

k. Plans for dealing with "unique" construction items.

l. Coordination of utilities and any immediate concerns for impacts/delays.

m. Constructability issues.

n. Cost Reduction Proposals or immediate requests for changes to the specifications.

o. Concerns/issues that need to be addressed with the first 90 days following First Notification.

The accepted Project narrative shall represent all critical and near critical Work, as well as the planned sequence and time for the Work.

**4) Review and Reporting** - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

a. **Review with the Owner’s Representative** - The Contractor shall perform ongoing review of the Project Work schedule and progress of the Work with the Owner’s Representative. If the Owner’s Representative or the Contractor determines that the Project Work schedule no longer represents the Contractor’s own plans or expected time for the Work, a meeting shall be held between the Owner’s Representative and the Contractor. At this meeting, the Contractor and the Owner's Representative shall review Project events and any changes for their effect on the Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the Project Work schedule.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include commencement and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed subnetworks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it. The procedure for acceptance of the revised or updated Project Work schedule as the new accepted Project Work schedule will be as provided above.
The Contractor shall evaluate this information and compare it with the Contractor's project schedule. If necessary, the Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal Work Days remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit 4 copies of the updated bar chart to the Owner's Representative within 7 days after the progress meeting, along with a progress report as required by (b.) below.

b. Progress Report - The Contractor shall submit a progress report to the Owner's Representative with each monthly update of the Project Work schedule with the pay estimate request. The report shall include the following:

1. A sufficient narrative to describe the past progress, anticipated activities, and stage Work;
2. A description of any current and expected changes or delaying factors and their effect on the construction schedule;
3. Proposed corrective actions;
4. Proposals to keep the Project on schedule in the event of a delay; and
5. Any changes to the logic as compared to the accepted Project Work schedule.

(n) Substitution of Schedules - When a Type "A" schedule is required, a Type "B" or Type "C" schedule may be substituted for the Type "A" schedule. When a Type "B" schedule is required, a Type "C" schedule may be substituted for the Type "B" schedule.

(o) Specified Contract Time Not Superseded by Schedule Revisions - The predicted completion date(s) for the Project Work schedule shall be within the specified Contract Time(s) or adjusted Contract Time or as shown on pending requests for adjustments of Contract Time. If the Contractor believes that additional Contract Time is due, the Contractor shall submit, with the updated Project Work Schedule, a request for adjustment of Contract Time according to 00180.60.

(p) Float Time - Float time shown on the Project Work schedule, including any time between a Contractor’s scheduled completion date and the specified Contract completion date, does not exist for the exclusive use of either party to the Contract and belongs to the Project.
q Schedules Do Not Constitute Notice - Submittal of a Project Work schedule with supporting Project narrative does not constitute or substitute for any notice the Contractor is required under the terms of the Contract to give the Owner.

r Owner’s Representative Review - The Owner’s Representative review of the Contractor’s schedules will not constitute a warranty or representation by the Owner that the Contractor can perform the Work according to such schedule. Review of the Project Work schedules and subsequent schedules by the Owner’s Representative shall not relieve the Contractor of the responsibility for timely and efficient execution of the Contract.

s Failure to Provide Schedule - The Project Work schedule is essential to the Owner. The Contractor’s failure to provide the schedule, schedule information, progress reports or schedule updates when required or requested may delay the Work and permits the Owner to take any actions necessary to protect itself and cause the schedule to be delivered, including, but not limited to, withholding Contract payments.

00180.42 Preconstruction Conference:

(a) Before meeting with the Owner’s Representative for the preconstruction conference, hold a group utility scheduling meeting with representatives from the utility companies involved with this project. Incorporate the utilities time needs into the Contractor’s schedule submitted at the preconstruction conference.

(b) After the contract is awarded, unless otherwise approved in writing by the Owner’s Representative, but before any work is performed, meet with the Owner’s Representative for a preconstruction conference at a time mutually agreed upon. Submit the following at the preconstruction conference:

(1) The names and telephone numbers of its Project Manager, Superintendent and Office Manager and a list of personnel authorized to sign change orders and receive progress payments;

(2) The name, address and telephone numbers of two or more persons employed by the Contractor who can be reached at any time of the day or night to handle emergency matters;

(3) A list of all subcontractors that will work on the project, a description of work they will perform, and a contact list for each subcontractor with phone numbers and address;

(4) An overall project schedule and a detailed schedule of the first 2 weeks;

(5) Traffic Control Plan (00225.05);

(6) Erosion and Sediment Control Plan (00280.02, 00280.03);

(7) A list of materials suppliers and products;
(8) A list of all labor classes and equipment (year, make, model) to be used on the project;

(9) A detailed breakdown of all lump sum bid items, except Mobilization and Temporary Protection and Direction of Traffic;

(10) Copies of all subcontracts between the Prime Contractor and Subcontractor;

(11) Site Safety Plan (00170.60(f));

(12) Utility Protection Plan (00405.41(f));

(13) Pollution Control Plan (00290.30(b));

| (14) Labor Burdens Information for Force Account Work; and
| (15) Shoring Plan (if applicable). |

(c) The Contractor shall invite a representative from each subcontractor to attend the pre-construction conference.

00180.50 Contract Time to Complete Work:

(a) Contract Time will be expressed in one or more of the following ways:

(1) By a calendar date on which the Work shall be completed; or

(2) By a given number of Calendar Days.

(b) When Contract Time is expressed as a given number of Calendar Days, the date on which it will begin is the first Calendar Day following the date of the Notice to Proceed, unless the Notice establishes a different date.

(c) Contractor shall provide the necessary labor, equipment and materials to ensure that work is completed within the Contract Time. If the Contractor does not complete the Work within the Contract Time, Owner is entitled to impose liquidated damages in addition to any other remedies Owner may have under the Contract Documents.

00180.60 Adjustment of Contract Time:

(a) The amount of Contract Time that a Contractor has to complete a Project may be adjusted, but only as specified in this subsection.

(b) The Owner has discretion to decrease the amount of Contract Time if a portion of the Work is eliminated and the amount of remaining work to complete the Project will take less time. The Owner and Contractor shall try to reach an agreement regarding any reduction in Contract Time before the Owner’s exercise of discretion.
(c) Contract Time will be increased only if three events all occur: 1) the Contractor must encounter one or more excusable delays, and 2) the excusable delay must be shown to have actually affected the overall completion date of the Project, and 3) the Contractor must give the Owner a request for an increase in Contract Time in the manner specified by 00199.30.

(d) An excusable delay is one that arises from unforeseeable causes that are beyond the control and without the fault or negligence of the Contractor, its Subcontractors and suppliers. Excusable delays alone do not justify an extension of Contract Time unless the two other factors noted in 00180.60(c) have occurred.

1. Examples of excusable delays include:
   a. Act of God.
   b. Act of Public Enemy.
   c. Act of Vandalism.
   d. Strikes, labor disputes, or freight embargoes which, despite the Contractor’s reasonable efforts to avoid, cause a shutdown of the entire Project or one or more controlling operations. A strike or labor dispute may involve a union bargaining with the Contractor, a Subcontractor, supplier or the Owner.
   e. Suspension of the work by written order of the Owner’s Representative when the suspension is not because of Contractor’s failure or neglect.
   f. Unusually severe weather. Unusually severe weather is weather that is abnormal compared to past weather at the same location for the same time of year, which actually has an adverse impact on critical work and which could not reasonably have been anticipated by the Contractor. Rain, windstorms, and other natural phenomena for the specific locality of work, which might reasonably have been anticipated from the previous ten years of historical records of the general locality of the work shall not be construed as abnormal or unanticipated. However, it is agreed that rainfall greater than the following cannot be reasonably anticipated:
      1. Daily rainfall equal to, or greater than 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by 25% or more; or
      2. Daily rainfall equal to, or greater than, 0.75 inch at any time.
   g. The office of the Environmental Data Service of the National Oceanic and Atmospheric Administration (NOAA) shall be considered the official agency of record for weather information and the closest reporting station nearest the locality of the Work shall be used to measure rainfall and other typical weather conditions.
h. Unreasonable delays caused by actions of the Owner that delay an item of work on the Project. Such delays might stem from errors, changes or omissions in the Plans, quantities or Specifications, Extra Work, and Right-of-Way and access delays if they meet the conditions stated in 00180.60(e).

i. The Owner’s direction to perform extra work.

(2) Examples of delays that are not excusable include:

a. Delays by Subcontractors or suppliers at any tier unless it can be shown that the delay was unforeseeable and not caused by any failure or neglect on the part of the Subcontractor or supplier.

b. Delays that affect the Contractor’s planned early completion, but do not affect the specified or adjusted Contract Time.

c. Shortages of materials or equipment if the supplies, services, or equipment were obtainable from other sources in sufficient time to permit the Contractor to meet the required schedule.

d. Inadequacy or late delivery of materials and equipment.

e. Financial difficulties.

f. Lack of knowledge or other inability to perform.

g. Labor problems other than the examples specified in 1(d) above.

h. Any requirement that the Contractor use equipment designated by the Owner for the Project (“sole source” equipment).

i. Time used by the Owner that is permitted by the Contract. Examples include the Owner’s use of time to review Contractor requests for substitutions, Contractor requests for Proposals and Contractor submittals.

(e) As noted above, Right-of-Way and access delays may be considered to be excusable delays. Such delays are excusable delays only if the Contractor’s work is actually delayed because of the Owner’s failure to make available to the Contractor necessary Right-of-Way for performance of the work, or Owner controlled access to or rights of occupancy of buildings and other properties which the Contractor is required to enter or to disturb under Contract requirements.
00180.70 Remedies for Delay:

(a) The parties agree that the occurrence of an excusable delay that delays overall Project completion may not result in additional compensation paid to the Contractor. No additional compensation will be paid to Contractor for excusable delays that are not the fault of either the Contractor or Owner, such as those listed in 00180.60(d)(1)(a) through 00180.60(d)(1)(f). In that situation, the Contractor is only entitled to an adjustment of Contract Time.

(b) No additional compensation will be paid to Contractor for any time period when the overall Project completion date is delayed as a result of concurrent delay. Delays are considered to be concurrent when the Contractor encounters an excusable delay as defined in 00180.60(d)(1)(h) or 00180.60(d)(1)(i), but also has caused its own delay to the Project for the same period of time. In that situation, the Contractor is only entitled to an adjustment of Contract Time for the length of the concurrent delay.

(c) Additional compensation will be paid to the Contractor if unreasonable delays caused by the Owner as described in 00180.60(d)(1)(h) and 00180.60(d)(1)(i) are the sole reason that the overall Project completion date is delayed. No additional compensation is warranted for delay if that delay does not affect the overall Project completion date.

(d) When the Contractor is entitled to additional compensation for delay, the compensation shall be calculated as provided in Section 00197, as if it were force account work, and only to the extent that the Contractor incurred additional costs for labor, equipment and materials as a result of the delay.

(e) All adjustments of Contract Time will be solely for the period of time during which the overall Project completion date was actually delayed.

00180.80 Time is of the Essence:

(a) Time is of the essence of this Contract - The time allowed to complete the Work will be stated in the Proposal or Special Provisions and will be known as the “Contract Time.” The Contractor agrees to complete the Work within the Contract Time.

(b) Liquidated Damages:

(1) If the Contractor fails to complete the Work within the original or adjusted Contract Time, the parties agree that Owner will be damaged and that the amount of damage to Owner and to the public will be difficult to determine. Therefore, Contractor agrees to pay the amount of liquidated damages stated in the Special Provisions in the Contract Documents. If no liquidated damages are specified, Contractor shall be liable to Owner for whatever damages Owner may actually establish. Liquidated damages will be measured not only by direct losses to the Owner as a result of delay, but intangible losses to the general public such as loss of use.
Liquidated damages are assessed for each Calendar Day of delay, including holidays and weekends and shall run until the Project is substantially complete, regardless of whether the Contractor or a replacement Contractor achieves Substantial Completion.

Liquidated damages are intended to compensate Owner and the public for Contractor's delay in completion of the Work. The Owner has the right to recover additional damages that are not based solely on delay in addition to liquidated damages, such as the excess costs of reprocurement or completion, the costs of restoring uncompleted work, and costs paid to other Contractors, or Owner's own employees, to complete the Work.

Permitting Contractor to finish the Work, or any part thereof, after the original or adjusted Contract Time has expired, is not a waiver of Owner's rights under the Contract Documents, including Owner's right to recover liquidated or additional damages.

Owner may retain liquidated damages from any payment or Retainage due to Contractor. Payment or assessment of liquidated damages does not release the Contractor's obligation to fulfill the entire Contract.

**Suspension of Work** - The Owner has the authority to suspend all or part of the work of the Contractor as provided below.

(a) The Owner may suspend all or part of the Contractor's work for its convenience for a period of time that the Owner's Representative determines necessary.

(b) If suspension occurs for Owner convenience or at the direction of the federal government, as a result of the operation of law, such as an injunction issued by the court or a directive from the federal or state government, Contractor shall be provided an adjustment of Contract Time corresponding to the period of the suspension and shall be reimbursed for its direct costs incurred as a result of the delay and an additional sum based on 10% of the direct costs to compensate for overhead and profit. However, if performance of work would have stopped as a practical matter for other reasons irrespective of Owner convenience, such as unusually adverse weather conditions or other excusable delays noted in 00180.60(d), then no additional compensation will be provided.

(c) The Contractor is responsible for protecting the work already performed during the period of suspension. It also shall provide temporary protection devices to warn, safeguard, protect and inform traffic and the public during this same time. Costs are recoverable for such measures only if provided in 00180.85(b) above.
(d) The Owner is also entitled, but not required, to suspend work on the Project if the Contractor has failed or neglected to perform work in the manner required by the Contract or if the Contractor has created any unreasonable risk to safety. Contractor is not entitled to any additional compensation or Contract Time if suspension occurs because the Contractor has failed or neglected to carry out any provision of the Contract.

(e) Work shall resume as soon as possible after the Contractor receives Notice that the Owner has canceled the suspension of work.

00180.90 Termination of Right to Proceed:

(a) Termination for Default:

(1) The Owner has the right to terminate the Contractor’s right to proceed with all or any portion of the Work if the Contractor is found to be in default of its obligations under this Contract. Default will occur if:

a. The Contractor refuses or fails to prosecute the Work or any separate part of the Work, with the diligence that will ensure its completion within the time specified in this Contract including any extension of Contract Time that has been granted;

b. The Contractor fails to construct the Project in accordance with the Plans and Specifications or fails to follow the directions of the Owner’s Representative;

c. The Contractor is adjudged a bankrupt or has made a general assignment for the benefit of creditors; or

d. The Contractor fails to comply with other provisions of the Contract Documents or disregards laws and ordinances applicable thereto.

(2) If the Contractor is in default, the Owner will notify the Contractor and all of its sureties of its intention of terminating the Contractor’s right to proceed with the Work in writing no less than 7 Days in advance of the date of the actual termination. The Contractor and the sureties are notified if the Notice is sent to the last known address provided to Owner by the Contractor and its sureties. For purposes of computing time in this subsection, the first day counted will be the day that the Notice is mailed or sent by the Owner.

(3) When termination occurs, the Owner may take over the Work and complete it, and may take possession of any materials, tools, plant and appliances thereon, as well as all other materials whether on the premises or not, for which the Contractor has received whole or partial payment that are necessary to complete the Work. The Contractor and its sureties shall be liable for any damage to the Owner resulting from the Contractor’s default, whether or not the Contractor’s right to proceed with the Work is terminated. This liability includes any costs incurred by the Owner in completing the work that exceeds any remaining Contract balance.
(4) When termination occurs, the Owner may elect to have the Contractor assign any and all subcontracts and material contracts to Owner or to the Owner’s designee, which may be another Contractor. Contractor shall execute such assignments within 4 Calendar Days of their receipt.

(5) Upon termination, Owner will make no further payments to Contractor. Contractor shall receive additional payment for work performed prior to termination only if the cost of completion of the work is less than the Contract balance held by Owner.

(6) If, after termination of the Contractor’s right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties, including the right to any damages, will be the same as if the termination had been issued for the convenience of the Owner as provided in 00180.90(b) below.

(7) The rights and remedies of the Owner in this Subsection of the Contract are in addition to any other rights and remedies provided by law or under this Contract.

(b) Termination for Public Convenience:

(1) The Owner may terminate performance of work under this Contract in whole, or in part, if the Owner determines that a termination is in the Owner’s interest.

(2) The Owner will notify the Contractor and its sureties in writing when it decides to terminate a Contract for convenience no less than 7 Days in advance of the date of the actual termination. The date of termination, which is the date after which no work shall be performed, shall be stated in the Notice. Notice shall be deemed to have been given if sent to the Contractor’s or any Surety’s last known address provided to Owner by the Contractor and its sureties. For purposes of computing time in this subsection, the first day counted shall be the day that the Notice is mailed or sent by the Owner.

(3) After Receipt of a Notice of Termination, and except as directed by Owner, the Contractor shall immediately proceed with the following obligations:

a. Stop work by the date as specified in the Notice;

b. Award no further subcontracts nor place further orders for materials, services, or facilities, except as necessary to complete the continued portion of the Contract, if any;

c. Terminate all Subcontractors and orders to the extent that they relate to the work terminated;

d. Assign to the Owner, if directed by the Owner’s Representative, all right, title and interest of the Contractor under the subcontracts
terminated, in which case the Owner will have the right to settle or to pay any termination settlement proposals arising out of those terminations;

e. With approval or ratification to the extent required by the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause;

f. As directed by the Owner, transfer title and deliver to the Owner, (a) the fabricated or unfabricated parts, work in process, completed work, supplies and other materials produced or acquired for the work terminated, and (b) the completed or partially completed Plans, drawings, information and other property that, if the Contract had been completed, would be required to be furnished to the Owner;

g. Take any actions that may be necessary, or that the Owner's Representative may direct, for the protection and preservation of the property related to this Contract that is in the possession of the Contractor and in which the Owner has or may acquire an interest; and

h. Use its best efforts to sell, as directed or authorized by the Owner's Representative, any property of the type referred to in 00180.90(b)(3)(f) above; provided, however, that the Contractor (a) is not required to extend credit to any purchaser and (b) may acquire the property under the conditions prescribed by, and at prices approved by, the Owner's Representative. The process of any transfer or disposition will be applied to reduce any payments to be made by the Owner under this Contract, credited to the price or cost of the work, or paid in any other manner directed by the Owner's Representative.

(4) Upon termination, the Owner will pay the Contractor the following costs as a result of the termination and no other:

a. In regard to the Contract work performed before the effective date of termination, the total (without duplication of any items) of the following costs:

1. The cost of this work, as determined by the method of payment established by the Contract Documents;

2. The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the Contract if such costs are not included in 00180.90(b)(4)(a)(1) above and if the Owner does not have the contracts assigned for the purpose of settlement; and
3. A sum as profit on 00180.90(b)(4)(a)(1) above, not to exceed 10% of that amount, unless it appears that the Contractor would have sustained a loss on the entire Contract had it been completed. However, no profit is permitted on costs compensated under 00180.90(b)(4)(a)(2).

b. The reasonable costs of settlement of the work terminated, including:

1. Accounting, clerical and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data, except that no Allowance will be made for costs incurred as attorney fees;

2. The termination and settlement of Subcontractors (excluding the amounts of such settlements); and

3. Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection or disposition of the termination inventory.

(5) No other costs other than those allowed in 00180.90(b)(4) shall be paid. By way of example only, and not by way of limitation, costs that would not be allowed include anticipated profits on unperformed work, consequential damages, post-termination overhead, Bid or Proposal preparation costs, costs for retraining employees, depreciation on idle equipment, cost of common items reasonably usable on the Contractor’s other work and costs unrelated to the work performed prior to the date of termination.

(6) The Owner may deduct from any sums otherwise due the Contractor under 00180.90(b)(4) above, the cost of advance payments made to the Contractor under the terminated portion of this Contract, any Claim which the Owner has against the Contractor whether or not arising from this Contract, and the agreed price of, or proceeds of sale of, materials, supplies or other things acquired by the Contractor or sold under the provision of 00180.90(b)(3)(h), and not recovered by or credited to the Owner.

(7) Payment from the Owner is not due until the Contractor has submitted an itemization of its recoverable costs to the Owner in writing, together with supporting documentation. The Contractor shall supply additional supporting documentation upon request by the Owner in order to recover its costs.

(8) The Contractor shall maintain all records and documents relating to the termination until the Owner and the Contractor resolve the amount of costs to be paid by the Owner to the Contractor as a result of this termination. Such records shall be made available to the Owner within 30 days of the request.
00180.95 Subcontractor Termination Claims:

(a) This Subsection establishes the procedure and provides additional details regarding costs allowed by 00180.90(b) when a Contractor must terminate subcontracts when its own Contract has been terminated for convenience. It is not applicable if the Contractor assigns its subcontracts to Owner for the purpose of settling or paying termination settlements to those Subcontractors as provided in 00180.90(b)(3).

(b) The Contractor shall reach a binding agreement with the Subcontractor before the Contractor can recover the amount of the Subcontractor's Claim from the Owner. That agreement shall be reached before the Contractor presents its Claim to the Owner. Contingent agreements with Subcontractors are prohibited.

(c) The Owner is only liable for reasonable settlement costs between the Contractor and its Subcontractors. Therefore, if the Contractor has agreed to pay an unreasonable amount to a Subcontractor by way of settlement, the Owner is liable only for reasonable costs incurred in that settlement. Reasonable settlement costs do not include the Subcontractor’s anticipated profits on unperformed work or consequential damages, or costs similar to those excluded by 00180.90(b)(5).
Section 00190 - Measurement of Pay Quantities

Description

00190.00 Scope - The Owner's Representative will measure pay quantities for accepted Work according to the United States standard measure unless otherwise provided in the Contract. Unless otherwise specified in the Contract, the Owner's Representative will round off all quantity computations using the following convention:

- The final significant digit will not be changed when the succeeding digit is less than 5.
- The final significant digit will be increased by one when the succeeding digit is 5 or greater.

The measurement provisions contained in the Specifications for each Pay Item will supplement or modify the above convention by:

- Imposing measurement limitations
- Describing measurement or computation procedures
- Giving conversion factors or adjustment conditions
- Providing for determination of reasonably accurate and representative Pay Item quantities

Measurements required or allowed to be made by the Contractor will be subject to the Owner's Representative's verification. The Owner's Representative's decision about measurement is final.

00190.10 Measurement Guidelines:

(a) Unit Basis - Unit will be each, unless otherwise specified in the Contract and will be determined by actual count of units in place.

(b) Length Basis - Length will be feet or mile, unless otherwise specified in the Contract and will be determined by measuring the length at least to the nearest 0.1 foot or at least to the nearest 0.1 mile, as applicable, unless otherwise specified in the Contract. Measurements will be limited to the dimensions shown or specified, or as directed by the Owner's Representative.

(c) Area Basis - Areas will be square foot, square yard, or acre, unless otherwise specified in the Contract and will be determined by measuring the width and the length (or height) at least to the nearest 0.1 foot and computed at least to the nearest 0.1 square foot, nearest 0.1 square yard, or nearest 0.1 acre, as applicable, unless otherwise specified in the Contract.
(d) **Weight Basis** - Weight will be pound or ton, unless otherwise specified in the Contract and will be determined as follows:

(1) **Pound** - Pound weight will be determined by the net weight identified on the manufacturer's packaged labels, subject to periodic check weighing. Weight by pound will be measured at least to the nearest 1.0 pound unless otherwise specified in the Contract.

Provide a certificate with each shipment together with a certified copy of the weight of each delivery. If the check weight is less than the manufacturer weight by more than 0.4%, the discrepancy will be resolved by the Owner’s Representative.

(2) **Ton** - Ton weight will be determined on Contractor-provided scales as required under 00190.20 unless otherwise allowed by the Specifications. Weight by ton will be measured at least to the nearest 0.01 ton unless otherwise specified in the Contract.

If bituminous materials, Portland cement, lime, and similar bulk Materials are shipped by truck or rail, the supplier's shipping invoice with net scale weights, or volumes converted to weights, may be used for Pay Item quantity determination in place of weights determined on the Contractor-provided vehicle scales.

Shipping invoice weights of the supplier's truck or transport shall be subject to periodic check weighing on the Contractor's vehicle scales, or other scales designated, according to 00190.20. If the check weight is less than the supplier weight by more than 0.4%, the discrepancy will be resolved by the Owner's Representative.

No payment will be made:

- For quantities in excess of the supplier weight
- When materials have been lost, wasted or otherwise not incorporated into the Work
- For additional hauling costs resulting from the checking weight.

(e) **Volume Basis** - Volume will be cubic yard truck measure or in-place measure, gallons, foot board measure (FBM), or thousand foot board measure (MFBM), unless otherwise specified in the Contract and will be measured at least to the nearest 0.1 cubic yard, nearest 1.0 gallon, nearest 0.1 FBM, or nearest 0.1 MFBM, as applicable, unless otherwise specified in the Contract.

Truck measure will be the measured and calculated maximum "water level" capacity of the vehicle. Quantities will be determined at the point of delivery, with no allowance for settlement of Material during transit. When required to facilitate measurement, the vehicle load shall be leveled at the point of delivery. Payment will not be made for Material in excess of the maximum "water level" capacity. Deductions will be made for loads below the maximum "water level" capacity.
When bituminous materials are measured by volume, the volume will be measured at 60 °F or will be corrected to the volume at 60 °F using the correction factors found in the MFTP (ODOT TM 321).

(f) Time Basis - Time will be hour, Day, or year, unless otherwise specified in the Contract, and will be measured to at least the nearest 0.5 hour, nearest 1.0 Day, or nearest 1.0 year, as applicable, unless otherwise specified in the Contract.

(g) Standard Manufactured Items - If standard manufactured items, such as fence, wire, plates, rolled shapes, pipe, conduit and other similar items are specified in the Contract by properties such as gauge, unit weight, or section dimensions, the manufacturing tolerances established by the industry involved will be accepted unless more stringent tolerances are cited in the Contract.

(h) Lump Sum Basis - Lump sum, when used, means the Work described shall be completed and accepted without measurement unless changes are ordered in writing by the Owner's Representative. If estimated quantities of the Work to be performed are listed in the Special Provisions, they provide only a basis for adjusting payment amounts. Estimated quantities are approximate only, and are made from a reasonable interpretation of the Plans and Specifications. Computations based on the details and dimensions shown on the Plans or Specifications are not guaranteed to equal estimated quantities.

If the Owner issues no Change Order, the Owner will make no pay adjustment for quantities based on the Contractor's computations that overrun or underrun the estimated quantities.

If the Owner issues Change Orders for changes in the Work, the Owner's Representative will measure such changes according to the standards set by 00195.20 to determine adjustment of payment.

00190.20 Contractor to Provide Vehicle Weigh Scales:

(a) General - If the Specifications require measurement by weighing on vehicle weigh scales, the Contractor shall provide vehicle weigh scales and shall transport Materials to the scales. Subject to the Owner's Representative approval, weights may be determined by plant or hopper scales according to 00190.30.

Contractor-provided scales shall be furnished, installed and maintained by the Contractor or its supplier, or, subject to the Owner's Representative approval, may be commercial scales located in the vicinity of the Project.

Unless otherwise provided in the Contract, Pay Items to be measured by weight shall include all Contractor costs for providing, maintaining, inspecting, and testing scales; for furnishing appropriate weigh tickets; for self-printing scales; and for transporting Materials to the scales or to check weighing.

(b) Requirements - The scales shall conform to ORS Chapter 618, or the laws of the state in which they are located, and NIST Handbook 44, and shall be:

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(1) Licensed by the Oregon Department of Agriculture, or by the analogous regulatory body for scales located outside the State;
(2) Technically suitable for weighing the Materials;
(3) Properly installed and maintained; and
(4) Accurate to the required tolerances.

The weight of any Materials weighed by anyone other than the Owner's Representative will be subject to check weighing as the Owner's Representative directs.

(c) Approaches - Vehicle scale approaches shall be:

(1) At each end of the scale platform;
(2) Straight and in line with the platform; and
(3) Long enough to accommodate combination vehicles longer than the scale platform so that they are level and allow release of brakes before weighing.

(d) Inspections - Contractor shall have all scales certified, that is inspected and their accuracy tested, by the Oregon Department of Agriculture, an analogous regulatory body for scales located outside the State, or a scale service company as follows:

(1) Before use if installed at a new site;
(2) 60 Calendar Days after initial inspection;
(3) Every 6 months thereafter; and
(4) When the Owner's Representative directs additional inspections.

No Materials weighed on scales without current certifications in accordance with this Subsection will be accepted. The Contractor shall provide a copy of all required certifications to the Owner's Representative.

Testing by a scale service company within the State of Oregon shall comply with ORS Chapter 618.

If additional inspections directed by the Owner's Representative confirm that the scale accuracy is within the required tolerances, the Owner will pay the cost for inspecting and testing the scales. If the scale accuracy is not within these tolerances, the Contractor shall pay the cost for inspecting and testing the scales.

(e) Inspection Results - If an inspection indicates the scales have been under-weighing (indicating less than the true weight), the Owner will make no additional payment to the Contractor for Materials previously weighed.
If an inspection indicates the scales have been over-weighing (indicating more
than the true weight), the weights will be reduced for Materials received after
the time the Owner's Representative determines the overweighing began or, if
that is not possible, after the last acceptable certification of the scales. The
reduction will be the amount of error in excess of the 0.2% maintenance
tolerance allowed in the Contract.

(f) Contractor-Provided Weigh Technician - The Contractor shall provide a
technician to operate Contractor-provided vehicle weigh scales. The Owner
will observe procedures and require check weighing in accordance with the
following:

(1) Scale with Automatic Printer - If the scales have an automatic weigh
memo printer that does not require manual entry of gross weight
information, the Owner may periodically have a representative at the
scales to observe the weighing procedures. In addition, the Owner's
Representative may periodically check the weight for a load of Materials by
directing the haul vehicle to reweigh on a different scale that has been
inspected and certified in accordance with 00190.20(b) and 00190.20(d).

If a different scale is not available within a 30 mile round trip from the
regular haul route the Owner will allow check weighing on an approved
alternate basis. Check weights within 0.4% of the Contractor-provided
weight are acceptable.

The Owner's Representative will resolve discrepancies found by check
weighing. Owner employee costs will be paid by the Owner. The
Contractor shall pay all other costs resulting from the check weighings,
including without limitation the use of other scales.

If more than 50 tons per day of all types of Materials are received from a
scale, the Contractor shall make random check weighings at least every
tenth day on which more than 50 tons is received or at each interval that
10,000 tons has been weighed, whichever occurs first, or as directed by
the Owner's Representative. The Contractor shall make at least one check
weighing on projects where more than 2,000 tons of all types of materials
are received from a scale. The Contractor shall provide the Owner's
Representative with the results of the check weighing.

(2) Scale Without Automatic Printer - If the scales require manual entry
of gross weight information, the Owner may periodically have a
representative weigh witness at the scales to observe the weighing
procedures. The Contractor shall inform the Owner's Representative of his
intent to use a scale without an automatic printer at least 3 Working Days
before weighing begins or before the Contractor changes to a scale that
does not have an automatic printer. The Contractor shall pay costs for the
weigh witness. The hourly cost of the weigh witness will be as stated in
the Special Provisions. In addition, the Owner's Representative may
periodically check the weight for a load of Materials by directing the haul
vehicle to reweigh on a different scale that has been inspected and
certified in accordance with 00190.20(b) and 00190.20(d).
If a different scale is not available within a 30 mile round trip from the regular haul route the Owner will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Owner's Representative will resolve discrepancies found by check weighing. Owner employee costs for check weighings will be paid by the Owner. The Contractor shall pay all other costs resulting from the check weighings, including without limitation the use of other scales.

If more than 50 tons per day of all types of materials are received from a scale, the Contractor shall make random check weighings at least every tenth day on which more than 50 tons is received or at each interval that 10,000 tons has been weighed, whichever occurs first, or as directed by the Owner's Representative. The Contractor shall make at least one check weighing on all projects where materials are received from a scale without an automatic printer. The Contractor shall provide the Owner's Representative with the results of the check weighing.

(3) Duties of Weigh Technician - The Contractor's weigh technician shall:

\(a\). Determine twice a day, or as otherwise directed by the Owner's Representative, the empty haul weights (tare weights) of hauling vehicles, unless vehicles are tared before each load;
\(b\). Furnish daily a listing of the tare weights if 10 or more loads are hauled during that day;
\(c\). Furnish a note listing the net weight for each consecutive ten loads with the following load;
\(d\). Furnish a daily listing of the net weights and total weight for each type of Material hauled during that day; and
\(e\). Furnish a legible, serially numbered weigh memo for each load of Materials to the Owner's Materials receiver at the point of delivery, or as directed by the Owner's Representative. The memo shall identify the Project, the Materials, the date, net weight (gross and tare as appropriate), and identification of vehicle, driver and weigh technician.

(g) Owner-Provided Weigh Technician - If the Contractor provides vehicle weigh scales without a weigh technician meeting the requirements of this Subsection, the Owner will provide a weigh technician at the Contractor's expense. The hourly cost for the weigh technician will be as stated in the Special Provisions. The Contractor shall provide a weighhouse for the weigh technician in accordance with Section 00205 of the current Oregon Standard Specifications for Construction. The Owner's weigh technician will:
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(1) Determine tare weights;
(2) Prepare weigh memos for each load;
(3) Compile the weigh records; and
(4) Not participate in the production of Materials or the loading of haul vehicles.

00190.30  Plant Scales - The Contractor, with the Owner’s Representative written approval, may weigh plant-mixed Materials on scales that have either:

- An automatic weight batching and mixing control printer system; or
- A weigh hopper printer system.

Any additional costs resulting from the use of these scales shall be borne by the Contractor. Check weighing will be done in accordance with 00190.20(f).

Except for 00190.20(c) regarding approaches, the Contractor’s use of plant scales shall comply with all provisions of 00190.20.

The Owner’s Representative’s approval for the Contractor’s use of plant scales to determine pay weights will be rescinded if check weighing or scale inspections indicate the scales do not consistently determine weights within the tolerances allowed by state law.
Section 00195 - Payment

Description

00195.00 Scope and Limit:

(a) General:

(1) The Contractor shall be paid the Contract Amount for performing the Work.

(2) The Contract Amount for Lump Sum Contracts is the amount bid by the Contractor for performing the Work, as changed by any authorized Change Orders.

(3) The Contract Amount for Unit Price Contracts is determined by multiplying the final bid item quantities by the Unit Prices bid by the Contractor, as changed by any authorized Change Orders.

(4) The Contract Amount for Contracts using a combination of Unit Prices and Lump Sum prices is determined by adding together the amount bid by the Contractor for the Lump Sum items with the amount determined for the Unit Price items, as noted in 00195.00(a)(3) above, as changed by any authorized Change Orders.

(5) The Contract Amount is full compensation for furnishing all materials, Incidental Work, equipment, tools, labor and incidentals necessary to perform the Work in a complete manner in compliance with the Contract Documents, and for risk, loss, damage or expense arising from the nature or prosecution of the Work or from the action of the elements. In addition, the cost of Bonds, insurance and compliance with all legal requirements for the Project are included within the Contract Amount.

(6) Any work required to be performed by the Contract Documents for which no Pay Item is established shall be considered Incidental and no separate measurement or payment will be made for that work.

00195.20 Changes to Plans or Character of Work:

(a) Unless changes and alterations in the plans, or quantities or details of construction materially change the character of the work to be performed or the unit costs thereof, the Contractor shall accept as payment in full, so far as Contract Pay Items are concerned, payment at the same Unit Prices as are provided under the Contract for the accepted quantities of work done.

(b) In contracts based on Unit Price, changes in quantities do not entitle the Contractor to a change in compensation unless the final quantities are 125% or more, or 75% or less, than the quantities estimated in the bid documents for a major item of work. A “major item of work” is one that, under the original Contract, has a value greater than 5% of the Contract Amount. In that event, the Contractor shall be paid as follows:
(1) In the event that the quantities encountered are 125% or more, the Contractor shall be paid at the unit cost bid for all quantities up to 125%. For all additional quantities the Contractor shall be paid a fair and equitable price as determined by the Owner’s Representative.

(2) In the event that the quantities encountered are 75% or less, the Contractor shall be paid a fair and equitable price as determined by the Owner’s Representative.

(c) In the event that the Contractor disagrees with any decision of the Owner’s Representative regarding changes to compensation, it shall file a claim in the manner required by 0019.30.

00195.50 Progress Payments and Retained Amounts:

(a) The Owner will pay the Contractor the Contract Amount for the Work. See Section 00150 regarding the Owner’s Representative’s authority.

(1) The Contractor shall submit to the Owner’s Representative a Schedule of Values allocating costs to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Representative may require. This Schedule, unless objected to by the Owner’s Representative, shall be used as a basis for reviewing the Contractor’s applications for payment.

(2) The Owner’s Representative may reject any portion of any Schedule of Values that is reasonably believed to not reflect an accurate estimation of costs and substitute a fair estimate. Rejection of any part of the Schedule of Values does not change any subcontract amount entered into by the Contractor. Failure to object to any portion of the Schedule of Values is not an indication that the Owner’s Representative agrees that the costs listed are accurate. Instead, the Schedule is used only for the purpose of making payments.

(b) The Contract Amount shall be full compensation for all work on the Project of whatever nature, including all Incidental Work, such as, but not limited to, formwork, falsework, shoring, and cribbing that is necessary to perform the work. In Unit Price Contracts, no payment will be made for Incidental Work until the work for which the Incidental Work is required is in place or has been completed. If the Contract Amount is based on a Lump Sum and only a portion of the Work for which payment is made has been completed, then only a portion of the cost of the Incidental Work will be paid.

(c) The cost of Bonds and insurance are recoverable as part of the Contractor’s Mobilization costs if the Contract Documents or an approved Schedule of Values provide for a separate payment for Mobilization. Otherwise, no separate payment is made for such costs.

(d) The Contractor shall comply with ORS 279C.845 and submit certified payroll forms as required by the Oregon Bureau of Labor and Industries and shall ensure all Subcontractors do the same.

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Pursuant to ORS 279C.845(7), the Owner will retain 25% of any amount earned by the Contractor on this public works project until the Contractor has filed the certified statements required by law. The Owner will pay to the Contractor the amount retained under this section within 14 Days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements. The Owner is not required to verify the truth of the contents of certified statements filed by the Contractor under this section.

Pursuant to ORS 279C.845(8), the Contractor shall retain 25% of any amount earned by a first-tier Subcontractor on this public works project until the first-tier Subcontractor has filed with the Owner the certified statements required by law. Before paying any amount retained under this subsection, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 Days after the first-tier Subcontractor files the required certified statement the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection. Neither the Owner nor the Contractor is required to verify the truth of the contents of certified statements filed by a first-tier Subcontractor under this section.

**Mid-Month Payment:**

(a) The Owner will pay the Contractor two times per month on this Project as set forth below. Because Owner wants to ensure that Subcontractors are paid amounts owed in a timely fashion, Contractor is required to make payments to its Subcontractors twice per month as well. Contractor has no discretion to only accept one payment per month to avoid this obligation.

(1) On the 15th of each month, or on the next work day, the Contractor shall submit a good faith Estimate of the value of the work performed that was not included within the Contractor’s previous progress payment, if any. The Contractor’s Estimate shall be calculated in the manner otherwise established by the contract documents, whether that is based on Unit Prices, lump sum amounts, a Schedule of Values, a combination of these methods or otherwise.

(2) The Owner may either approve the Contractor’s Estimate or prepare its own Estimate of the work performed if the Contractor fails to prepare one on time or the Contractor’s submission appears to be incorrect. Thereafter, Owner will pay Contractor an advance payment based on the Contractor’s Estimate or the Owner’s estimate. Owner may withhold money from the advance for any of the reasons specified in 00195.54(c) below. The Owner is not required to pay for any portion of the Work that is disputed.

(3) The “mid-month” or advance payment will be deducted from any amount otherwise due the Contractor on the end of the month progress payment, or any subsequent advance payment or progress payment.
(4) Because the payment is an advance not otherwise required by law, the Contractor agrees that the only dispute about the amount of the advance payment is whether the Owner prepared its own Estimate in good faith. The Contractor acknowledges the advance payment is simply a rough estimate made for the purpose of providing the Contractor and its subcontractors with funds in advance of the progress payment and is not intended to represent the exact amount owed.

(5) The Owner's Representative may request additional documentation from the Contractor to verify any Estimate submitted or may instead calculate the Owner's own Estimate. If requested, Contractor shall provide documentation to establish its Estimate within 3 Working Days. Failure to provide additional documentation when requested precludes any dispute whether the amount of the Owner's Estimate was calculated in good faith.

(6) Owner has discretion not to make an advance payment if the amount of work performed by the 15th of any month is $5,000 or less, or if there is a chance that the advance payment might exceed the remaining amounts due the Contractor under the Contract.

(7) Because the mid-month payment is an advance on the monthly progress payment, no interest is due on the advance payment until the time when interest would otherwise be due under the progress payment.

(8) Within 10 Calendar Days from the date that any payment is sent by Owner to Contractor, Contractor shall pay its Subcontractors for work performed during the period covered by the Application for Payment regardless if the Subcontractor agrees to some different schedule. The Contractor is required to take all necessary good faith actions to ensure that it makes payment to its Subcontractors. In the event of a dispute, the Contractor shall pay the portion not in dispute and timely resolve the amount that is in dispute.

(9) Upon request from Owner, Contractor shall inform Owner of the portion of any advance payment owed to any of its Subcontractors.

(10) Nothing in 00195.51 requires the Contractor to pay its Subcontractors for any portion of the Work that is disputed or which otherwise would not be eligible for payment.
00195.52 Monthly Progress Payment:

(a) In addition to the mid-month payment described in 00195.51, the Contractor shall be paid a monthly progress payment as described in more detail in 00195.50(b) and (c). To receive a monthly progress payment, the Contractor first shall estimate the work performed in any calendar month and submit an invoice to the Owner’s Representative for approval before the fifth day of the following month based on the estimate. The invoice shall include the value of labor performed and materials incorporated into the project since the work began or the last invoice, whichever is applicable. The estimate may be an approximation of the work, labor and materials provided, but should bear a reasonable relationship to the entire contract amount due once the project is completed.

(b) Where the invoice is filled out incorrectly, or where there is any defect or impropriety in any submitted invoice or when there is a good faith dispute, the Owner’s Representative will so notify the Contractor within 15 Days stating the reason or reasons the invoice is defective or improper or the reasons for the dispute. A defective or improper invoice, if corrected by the Contractor within 7 Days of being notified by the Owner, shall not cause a payment to be made later than 30 Days after receipt of the original invoice from the Contractor or 15 Days after the payment is approved by the Owner’s Representative, whichever is the earlier date.

(c) The Owner’s Representative will approve of payment to the Contractor depending on how costs are calculated in the contract documents.

(1) If the Contract Documents establish Unit Prices to accomplish various portions of the Work, the Unit Prices shall be used to determine payment.

(2) If the contract documents establish a lump sum for the performance of the Work, payment will be made in accordance with any Schedule of Values submitted by the Contractor and approved by the Owner. If no Schedule of Values was submitted, or if a Schedule of Values is submitted by the Contractor that does not fairly reflect the cost of the work to be performed, the Owner’s Representative will determine a fair and equitable payment based on the percentage of work performed compared to the entire contract.

(3) If the contract documents establish a lump sum for a portion of the Work and Unit Prices for other portions of the Work the Owner’s Representative will approve of payment utilizing both methods (1) and (2) established above.

(4) The monthly progress payment invoice shall deduct any payments made by the Owner as an advance payment as explained in 00195.51(a) and 00195.52(a) above.

(d) Notwithstanding the provisions above, progress payments on Local Improvement District (LID) Contracts shall be made in accordance with the state law, the Contract Documents and City Code.
Advance Payment for Materials:

(a) The Owner’s Representative has discretion, but is not required, to approve payments to the Contractor of up to 85% of the total bid item price for materials and equipment that will be incorporated into the Work that are not yet incorporated if the following conditions are met:

(1) The value of the materials or equipment shall be greater than $5,000;

(2) The Contractor submits bills of sale or other documentation satisfactory to Owner establishing the Contractor’s proof of payment and title to the materials or equipment and the materials are free and clear of liens, claims, security interests or other encumbrances. When payments are made, the Contractor guarantees that title to all materials and equipment covered by a progress payment, whether incorporated in the Project or not, will pass to the Owner upon receipt of such payment by the Contractor, free and clear of all liens, claims, security interests or encumbrances;

(3) The Contractor shall protect the Owner’s interest in the materials or equipment, including applicable insurance and transportation to the site. In no event shall payment for such materials require the Owner to pay for replacement materials if the original materials or equipment for which payment was made are damaged or destroyed prior to their incorporation into the Work. By submitting a request for payment, the Contractor accepts full responsibility to continue to protect the stored materials and equipment from the elements and against loss or damage;

(4) The materials or equipment meet Contract requirements, proof that the materials or equipment conform to Contract requirements has been provided to Owner, are in a form ready for incorporation into the Project and are clearly marked and identified as being specifically fabricated, produced and reserved for use on the Project; and

(5) The Materials shall have been delivered or acceptably stored or stockpiled in accordance with the Specifications and as follows:

   a. At the Project Site;

   b. On Owner property;

   c. On property in the State of Oregon on which the property owner has authorized storage in writing. The written authorization must allow the Owner to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Owner; or
d. On property outside the State of Oregon on which the property owner has authorized storage in writing, provided that such storage location is allowed by the Special Provisions or authorized in writing by the Owner’s Representative. The permit must allow the Owner to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Owner.

00195.54 Retainage and Withheld Amounts:

(a) The Owner has discretion to withhold amounts from any progress payment otherwise due the Contractor if it receives claims for damages or costs from third parties as a result of the Contractor’s operations and the Owner determines such withholding is necessary to protect the Owner’s interests. Such withholding may continue until the claim is resolved.

(b) The Owner may retain and hold back up to 5% of amounts otherwise due the Contractor as “Retainage.” Retainage will be held and paid to the Contractor as part of the Final Payment of the Contract Amount. Alternatives to cash retainage, if approved by the Owner, shall be as permitted by ORS 279C.560.

(c) The Owner’s Representative may disapprove a payment previously made, withhold money from a future progress payment, or disapprove of an invoice submitted by the Contractor in whole or in part, if:

1. The Work has not progressed to the point indicated by the Contractor’s submittal;
2. Defective, unsatisfactory or improper work is discovered;
3. The Contractor fails to make payments to employees, Subcontractors and suppliers as required by the Contract;
4. The Contractor violated material terms and conditions of the Contract that remain to be remedied;
5. The Contractor performed unsatisfactory work for which payment was sought;
6. The Owner has a monetary claim against the Contractor that the Contractor has not yet paid;
7. Failure to submit a Construction Schedule or updated schedule required by the Contract;
8. The Contractor was exceeding the limits of Work Specified in 00405.41(b) or other work limits specified by the Contract;
9. The Contractor owes liquidated damages to the Owner; or
10. The Contractor fails to submit certified payrolls per 00195.50(d).
(d) The Contractor is not entitled to interest on money purposely withheld for any of the reasons specified in 00195.54(c).

(e) Progress payments reflect the Owner’s Representative’s best judgment about payment at the time payment is made. Such payments, however, do not constitute acceptance of the Work.

(f) The Contractor shall provide the Auditor’s Office with a list of personnel authorized to receive Contract payments. No payment will be released to an unauthorized person. In addition, no payment will be made if the estimate submitted by the Contractor is less than $5,000, unless approved in advance by the Owner’s Representative.

(g) If the Contractor fails to make timely advance payments or progress payments to its Subcontractors, the Owner is entitled to take any action permitted by law, including, but not limited to, the following:

1. Withhold all or a part of any progress payment until Contractor makes payment;

2. Impose liquidated damages in the amount of $250 per Day for each day that the payment is delayed by acts or omissions of the Contractor. Owner is paying Contractor to administer this Contract, to supervise the Work and to ensure that the Work is not hindered by poor relationships between Contractor and its Subcontractors. Owner has found that a failure to promptly pay Subcontractors causes complaints to be registered with Owner, and requires Owner to devote unnecessary time, resources and personnel to such matters. The parties mutually agree that it would be difficult, if not impossible, for Owner to determine the amount of damage caused to it by such actions, and that the amount of liquidated damages noted above is a reasonable amount and not a penalty;

3. Find the Contractor is a not a “responsible bidder” as that term is used in Oregon law;

4. Pay the Subcontractor who has not received proper payment directly; and

5. Terminate the Contract for Default as provided in 00180.90(a).

00195.90 Final Payment:

(a) The Contractor shall notify the Owner’s Representative in writing when it considers that all the work required by the Contract Documents is complete or is Substantially Complete. The Notice must be more than an invoice that requests the balance of the Contract Amount. Instead, the Notice shall plainly call to the Owner’s attention the Contractor’s belief that all work has been completed in accordance with the Contract. Retainage does not have to be returned to the Contractor until all work required by the Contract is complete.
Within 15 Days of receipt of the Notice, the Owner’s Representative will carry out a final inspection and will take one of the following actions:

1. Determine the Work is complete and prepare and forward to the Contractor a Certificate of Completion to be signed by the Contractor.

2. Determine that the Work is Substantially Complete and provide the Contractor with a Punch List of items that remain to be corrected and completed.

a. The Contractor is required to proceed promptly to complete the Punch List of items remaining. If the Contractor fails to do so within 30 Days or such other time as may be allowed by the Owner’s Representative, the Owner may terminate any further services of the Contractor under the Contract, complete the items remaining to be completed or corrected with the Owner’s own forces or by hiring another Contractor to perform the Punch List work. Costs of performing the Punch List work shall be deducted from any payments otherwise due the Contractor. If Owner has hired an Architect or Engineer to assist it on the Project, the Contractor shall pay costs for the Architect or Engineer’s services if more than one inspection of the work is required because remaining portions of the Work are incomplete.

b. When the Contractor believes the Punch List items have been corrected and completed, the Contractor shall again notify the Owner’s Representative that all the work required by the Contract Documents is completed and the Owner’s Representative will again take the actions referenced in 00195.90(b)(1) or 00195.90(b)(2); or

c. If the work is not complete despite the Contractor’s Notice that the punch list items are complete, and Owner has hired an Architect or Engineer to assist it on the Project, Contractor shall pay costs for the Architect or Engineer’s services if more than two inspections of the Work are required because the punch list remains incomplete.

d. Upon Substantial Completion, the Owner will be responsible for utilities, insurance, security, maintenance and damage to work caused by Owner’s agents and employees unless otherwise provided in the Certificate of Substantial Completion. Contractor remains responsible for damage to work caused by its Subcontractors, agents and employees during the performance of punch list work.

e. Warranties for products and services provided by the Contractor shall commence upon issuance of the Certificate of Substantial Completion, unless otherwise provided by the Contract Documents or agreed to in writing by the Owner’s Representative.
Determine the Work is neither complete nor Substantially Complete and provide the Contractor with a Deficiency list of items that remain to be corrected and completed. When all such items have been corrected and completed, the Contractor shall again notify the Owner’s Representative that the Work is complete or Substantially Complete.

In the event the Contractor does not notify the Owner, but the Owner determines the Work is complete or Substantially Complete, the Owner may, but is not required to, notify the Contractor of its determination. If so, the Owner will notify the Contractor and the Contractor shall proceed with either the completion of the Punch List items noted above or shall sign the Certificate of Completion in the same manner and within the same time as that stated in 00195.90(b)(1) and 00195.90(b)(2).

If the Contractor disagrees with the Owner’s conclusion that the Work is not Substantially Complete, the Contractor nevertheless shall perform the work that the Owner believes is required by the Contract. If the Contractor then believes that the performance of such work entitles it to additional compensation, additional Contract Time, or both, it shall follow the requirements of 00199.30. After performing the work that the Owner believes is required by the Contract the Contractor shall then again provide the Notice required by 00195.90(a) regarding the completion of work.

Following preparation of the Certificate of Completion, the Owner’s Representative will send it to the Contractor for the Contractor’s signature. After return of the Certificate, the Owner’s Representative will submit it, together with the estimate of the Final Payment due to the Contractor for ultimate acceptance of the Project. After acceptance, the Contractor shall be paid within 30 Days.

Invoices submitted by the Contractor to the Owner during the course of the Project are made to receive progress payments and are not binding on the Owner. In the event that any previous Invoice is discovered to be inaccurate, any resulting overpayment or underpayment to the Contractor may be corrected in the next payment or the Final Payment. Corrections of overpayments or underpayments between the Contractor and any Subcontractor or supplier are the sole responsibility of the Contractor.

The Final Payment shall be the difference between the Contract Amount, as adjusted by any authorized Change Orders, and the sums of all payments previously made, plus any Retainage held by the Owner.

The Owner may deduct against any progress payment, including the Final Payment, any amount previously paid to the Contractor in error or any other amount owed to the Owner for any reason resulting from the Contractor’s work under the Contract.

If the work under the Contract is designated for a Local Improvement District Project (LID), Retainage will not be released until the conclusion of the assessment hearings and the adoption of an assessment ordinance as provided in City Code.
(3) If the Owner declares a default of the Contract and the Contractor’s Surety fulfills its responsibility to ensure completion of the Work, then the Contractor agrees that all progress payments not yet made and all Retainage held by the Owner shall be paid to the Surety and not to the Contractor.

(4) ORS 279C.845 requires the Contractor or Contractor’s surety and every subcontractor or subcontractor’s surety to file certified statements with the Owner in writing certifying various matters regarding the hourly rate of wage paid each worker and that no worker has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract. If the Contractor fails to file these certified statements, the Owner is required by law to retain 25% of any amount earned by the Contractor until the Contractor has filed the statements. The Owner will follow the requirements of ORS 279C.845 as if fully set forth herein.

(g) Acceptance of the Work will not occur until the Contractor provides the Notice referenced in 00195.90(a), signs and submits the Certificate of Completion referenced in 00195.50(b), signs and submits the Acknowledgement Form referenced in 195.90(h), submits the Warranty Bond referenced in 0150.96 and all other documents required by the Contract, the Owner’s Representative presents a report recommending acceptance to the Owner and that report is approved. Thereafter, Final Payment will be made within 30 Days.

(h) At the conclusion of the Work, and as a condition of Final Payment, the Contractor shall sign an Acknowledgement Form:

(1) Acknowledging payment of sums previously paid to the Contractor except for Final Payment; and

(2) Releasing all monetary Claims against the Owner other than the receipt of Final Payment. However, if the Contractor has submitted a Claim to the Owner pursuant to 00199.30, the Contractor may state that a Claim has been submitted, and not yet resolved. If that occurs, no waiver of the Claims stated on the form will be deemed to have occurred. However, all Claims not specifically referenced on the form will be deemed to have been waived; and
(3) Certifying that:

   a. All amounts due for labor, materials and other obligations due to the Contractor's own workers, its Subcontractors and suppliers have been fully paid in accordance with Oregon law, Chapter 279C, except for amounts that might be due upon Final Payment or if a Claim submitted pursuant to 00199.30 that is specifically referenced on the form is later paid by the Owner in whole or in part; and

   b. If there are outstanding claims against the Contractor from any person, including the Owner, that are disputed by the Contractor that such claims are payable by its Performance and Payment Bond, its insurance carrier, or by the Contractor itself.

(4) At the conclusion of the Work, the Owner will provide the Contractor the Acknowledgement Form. If the Contractor fails to return the Acknowledgement Form, the Owner will send the Acknowledgement Form to the Contractor via certified mail. If the Contractor still fails to return the Acknowledgement Form within 30 days from the date of the mailing, such failure shall be deemed to serve as:

   a. An acknowledgement that all payments are correct; and

   b. A waiver of any future right to claims in respect to the Contract, except for claims that have already been submitted by the Contractor pursuant to 00199.30.
00196.00 General:

(a) Compensation may be adjusted if the Contractor performs Extra or changed Work. All adjustments to compensation will occur through a written Change Order. The Change Order may be the result of mutual agreement between the Owner and Contractor or, in the absence of agreement it maybe the result of the application of the force account payment provisions found in Section 00197.

(b) Compensation is not adjusted if the Contractor receives a Field Order, as described in 00140.30.

00196.10 Change Orders:

(a) The only authorized method for increasing or changing the amount of compensation, increasing the amount of Contract Time or changing the scope or work to be performed is through the execution of a written Change Order. Change Orders must be executed before the work is performed, unless the work has been performed on a Force Account basis pursuant to Section 00197.

(b) The Contractor's signature on the Change Order signifies the Contractor's agreement that the additional compensation stated on the Change Order is the total amount of compensation due to the Contractor for all costs, whether labeled as direct, indirect, "impact" or otherwise, and that the total amount of additional Contract Time, if any, is the total amount of additional Contract Time resulting from the changed or Extra Work. When signed by the Contractor, the Change Order represents an accord and satisfaction regarding the changed or Extra Work and precludes the Contractor from seeking any additional compensation or Contract Time.

(c) If the Contractor performs Extra Work and additional compensation is due, but the Contractor and Owner disagree about the amount of compensation that is due or any Contract Time that might be changed, the Owner may issue a unilateral Change Order. A unilateral Change Order is not signed by the Contractor. This permits Owner to pay Contractor what the Owner believes is due, and does not prejudice the right of the Contractor to file a Claim pursuant to 00199.30 for additional compensation or Contract Time. However, if after evaluation of the Contractor's Claim and documentation the Owner believes that it paid an incorrect amount or granted an inappropriate amount of Contract Time, the Owner may readjust the unilateral Change Order, either for or against the Contractor as necessary.
00197.01 Section 00197 - Payment for Force Account Work

00197.01 General:

(a) The materials, equipment, and labor rates agreed upon in this Subsection apply only to extra work ordered by the Owner’s Representative to be performed on force account basis. These rates do not apply to any other work performed under the Contract. The rates and markups listed acknowledge the Owner’s Representative’s authority to control and alter the materials, equipment, and labor used and to determine the time of execution of the ordered extra work.

(b) If extra work is ordered to be done on force account basis, the Owner’s Representative will record, on a daily basis, the materials, equipment, labor, and special services used for the force account work during that day. Records will be kept on approved forms. The Contractor and the inspector shall sign the form daily to indicate agreement on the materials, equipment, labor, and special services used for the work involved on that day. The Daily record will include:

(1) Materials actually used in the Work as directed by the Owner's Representative except those furnished and paid for under rental rates for use of equipment. See 00197.10.

(2) Equipment that the Owner’s Representative considers necessary to perform the work. Equipment hours will be recorded to the nearest quarter hour. See 00197.20.

(3) Labor, including equipment operators and supervisors in direct charge of the specific operations while engaged directly on the force account work. See 00197.30.

(4) Special services performed by a specialist, if the Owner’s Representative and Contractor agree that the Contractor's or subcontractor's forces cannot satisfactorily perform an item or service.

(c) The Contractor shall supply Owner with all documentation necessary to substantiate any claim for payment. Owner is not required to pay Contractor for any amount that is not supported by documentation sufficient to establish entitlement to payment.

00197.10 Materials:

(a) The Contractor will be paid for materials actually used in the extra work, except for those furnished and paid for under rental rates included with the use of equipment. Payments will be at actual cost, including transportation costs to the jobsite, from the supplier to the purchaser, whether the purchaser is the Contractor, subcontractor, or other forces. All costs are subject to the provisions of this entire subsection.
(b) If a commercial trade discount is offered or available to the purchaser, it shall be credited to the Owner, even though the discount may not have actually been taken. The Owner will not take any discounts for prompt or early payment, whether or not offered or taken.

(c) If materials cannot be obtained by direct purchase from and direct billing by the supplier, their cost shall be considered to be the price billed to the purchaser less commercial trade discounts, as determined by the Owner’s Representative, but not more than the purchaser paid for the material. No markup other than actual handling costs will be permitted as an actual cost.

(d) If materials are obtained from a supply or source wholly or partly owned by the purchaser, the cost shall not exceed the price paid by the purchaser for similar wholesale price for the materials delivered to the jobsite, whichever is lower.

00197.20 Equipment:

(a) Equipment Payment - Equipment approved by the Owner’s Representative to perform the work will be eligible for payment at the established rates only during the hours it is operated or on standby as ordered by the Owner’s Representative. Equipment hours will be recorded to the nearest quarter hour. Except as modified by these provisions, equipment use approved by the Owner’s Representative will be paid at the rental rates given in the Rental Rate Blue Books for Construction Equipment as shown in the Special Provisions.

(b) Equipment Billing Form - On the billing form for equipment costs, list for each piece of equipment and its attachments the information needed by the Owner’s Representative to determine the proper rental rate from the Blue Book.

(c) Rental Rate Formula - The Rental Rate Formula for Contractor Owned Equipment Without Operators: Rental Rates for equipment without operators will be paid on an hourly basis for the machine and for attachments according to the following formula:

\[
\text{Hourly Rate} = \text{Monthly Base Rate} \times \text{Rate Adjustment Factor} + \text{Hourly Operating Rate}
\]

176 hours/month

The terms used above are defined below:

1. **Monthly Base Rate** - The monthly base rate used above for the machine and for the attachments represents the major costs of equipment ownership, such as depreciation, interest, taxes, insurance, storage, and major repairs.

2. **Rate Adjustment Factor** - The rate adjustment factor used above will be determined as per page iii of each Section of the Rental Rate Blue Books.
(3) **Hourly Operating Rate** - The hourly operating rate used above for the machine and for attachments represents the major costs of equipment operations, such as fuel and oil, lubrications, field repairs, tires, or ground engaging components, and expendable parts.

(d) **Attachments** - Some attachments are considered "standard equipment" and are already included in the monthly base rate for the machine. That information can be obtained from the Blue Book publisher.

(e) **Limitations** - The “Regional Adjustment Factor,” usually found on page 1 of each Blue Book section, will not apply.

(f) **Multiple Attachments** - If multiple attachments are included with the rental equipment, only the attachment having the higher rental rate will be eligible for payment, provided that attachment has been approved by the Owner’s Representative as necessary to the force account work.

(g) **Small Tool Rental** - Rental will not be allowed for small tools that have a daily rate less than $5 or for unlisted equipment that has a value of $400 or less.

(h) **Equipment Condition** - The above rates apply to approved equipment in good working condition. Equipment not in good working condition, or larger than required to efficiently perform the work, may be rejected by the Owner’s Representative or accepted at reduced rates.

(i) **Moving Equipment** - When necessary to obtain equipment from sources beyond the project limits exclusively for force account work, the actual cost to transfer the equipment to its work site and return it to its original location will be allowed as an additional item of expense.

(1) Move-in and move-out allowances will not be made for equipment brought to the project for force account work if the equipment is also used on contract item or related work. If the move-out destination is not to the original location, the payment for move-out will not exceed the payment for the move-in.

(2) If the move is made by common carrier, the allowance will be the amount paid for the freight. If the equipment is hauled with the Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be 75% of the appropriate hourly rate for the equipment, without attachment, plus the equipment operator's wage.

(j) **Standby Time:**

(1) If ordered by the Owner's Representative, standby time will be paid at 40% of the hourly rate established above, excluding the hourly operating rate. Rates for standby time that are calculated at less than $1 per hour will not be paid. Payment will be limited to not more than 8 hours in a 24-hour period or 40 hours in a 1-week period.
(2) If a rate has not been established in the Blue Book, the Contractor may use the rate of the most similar model found in the Blue Book, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type if approved by the Owner’s Representative; request the Blue Book publisher to furnish a written response for a rental rate on the equipment, which shall be presented to the Owner’s Representative for approval; or request the Owner’s Representative to establish a rental rate.

(k) Outside Rental Equipment:

(1) If Contractor or subcontractor-owned equipment is not available, and equipment is rented from outside sources, payment will be based on the actual paid invoice. If the invoice specifies that rental rate does not include fuel, lubricants, field repairs, and servicing, an amount equal to the Blue Book hourly operating cost may be added for those items which were excluded. The Owner is only obligated to pay the reasonable rental value of the equipment, even if the actual cost to Contractor exceeds that amount. Therefore, Owner may reduce the payment when the invoice amount plus allowance is higher than the amount that would have resulted as specified in 00197.20(b) through 00197.20(h).

(2) Equipment not approved by Owner for use in advance of performing the work will be paid by using rates for the least expensive equipment that will accomplish the work or utilizing the applicable Blue Book rates established above.

(3) Equipment having a value of $400 or less will be considered to be tools or small equipment and no rental will be allowed on those items, unless they are not normally on the work site and must be rented from others. If so, then 00197.20(b) above will apply.

(l) Outside Rental Equipment with Operator:

(1) The use of equipment rented with operators will be permitted only if the following requirements are met:

a. The Contractor has submitted a written request accurately describing the service to be provided, its estimated cost and the estimated duration. The request must be approved by the Owner’s Representative before the service is provided.

b. The service is limited to:

1. Truck hauling of material; or

2. Performing minor, incidental, short duration work under the direct supervision of the Contractor or subcontractor with equipment not normally owned, leased, or operated by the Contractor, or equipment that is temporarily unavailable to the Contractor.
(2) In addition, the Contractor shall furnish the Owner's Representative with a copy of the rental agreement or purchase order covering the service provided. The Contractor shall make certain that the provider of the approved services submits payrolls as required by law and complies with applicable contractor provisions. The service provider will not be considered as a subcontractor under this Contract. If at any time the Owner's Representative determines that the service provided by rented, operated equipment is not minor, incidental, short duration work, any previous approval will be revoked, and the Contractor shall execute a subcontract agreement with the service provider and then submit it for approval to the Owner's Representative. Failure to execute a subcontract in such situations will be cause for removal of the service provider from the project.

00197.30 Labor:

(a) For all labor, including equipment operators and supervisors in direct charge of the specific operations while engaged directly on force account work, the Contractor will be paid:

(b) The actual wages paid to laborers and supervisors, if those wages are paid at rates not more than those for comparable labor currently employed on the project, or at the recognized, current, prevailing rates in the locality of the project. The Owner has no duty to pay rates higher than those stated above.

(c) The actual cost of industrial accident insurance, unemployment compensation contributions, payroll transit district taxes, and social security for old age assistance contributions incurred or required under statutory law and these specifications. The actual cost of industrial accident insurance is the National Council on Compensation Insurance (NCCI) rate for the assigned risk pool for the appropriate work class multiplied by the experience modification factor for the Contractor.

(d) The actual amount paid to, or in behalf of, workers by reasons of subsistence and travel allowances, health and welfare benefits, pension funds benefits, or other benefits when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.

(e) The Contractor shall provide the Owner with the names, identification, and classification of all workers, their hourly rate of pay, hours worked, and any other information requested by Owner to determine the proper amount of payment.

00197.80 Percentage Allowances:

(a) To the actual costs given and limited above, amounts equal to a percentage of these costs will be allowed and paid to the Contractor as follows for that portion of the extra work performed by the Contractor's own forces:
00197.90 Billings:

(a) Billings for Force Account Work by the Contractor shall be submitted for
the Owner’s Representative’s approval on Owner provided forms or on a form
approved by the Owner’s Representative. Billings for materials (other than
incidental items out of the inventory of the Contractor or subcontractors),
outside rental equipment, and services, shall be accompanied by copies of
invoices for the goods and services. The invoices shall be fully itemized
showing dates, quantities, Unit Prices, and complete description of goods and
services. Invoices for amounts of $10 or less per invoice are not required,
unless requested by the Owner’s Representative.

(b) Contractor and subcontractors shall take advantage of all practicable
discounts on bills for materials and supplies and such discounts shall be
reflected on all bills and invoices submitted to Owner. Freight will be
considered to be part of the cost of materials and supplies and will be paid for
as materials and supplies. Materials and supplies will be paid for as agreed in
writing prior to their production or use. If there is no prior agreement, the
Owner’s Representative shall establish a reasonable price for such materials
and supplies.

(c) Costs billed shall not be greater than those permitted in Section 00197.
Section 00199 - Disagreements, Protests, and Claims

00199.30 Claims Procedure:

(a) This section outlines the exclusive procedure to be followed if the Contractor believes that it is entitled to additional compensation, additional Contract Time or both. This section applies to all Claims for additional compensation and all requests for additional Contract Time, regardless of whether the basis for the Claim for additional compensation, or request for additional Contract Time, or both, stems from the performance of extra work, changed work, excusable delays of any nature, suspension of Contract work, or any other reason whatsoever.

(b) When the Contractor believes it is entitled to be paid more than the Contract Amount, the Contractor shall notify the Owner's Representative in writing before beginning any work for which additional compensation is sought. The written Notice shall include

(1) A description of the event that requires additional compensation;
(2) The estimated amount of the additional cost to the Owner; and
(3) Any Contract provision(s) that support the Claim.

(c) When an event occurs that the Contractor believes entitles it to more time to complete the Work than Contract Time permits, the Contractor shall notify the Owner's Representative in writing when the event occurs. The written Notice shall include

(1) A description of the event that permits additional Contract Time;
(2) An estimate of the delay that the event will cause; and
(3) Any Contract provision(s) that support the request for additional Contract Time.

(d) If the Contractor does not provide written Notice of a Claim for additional compensation or additional Contract Time in the time required, the Claim for additional compensation, additional Contract Time, or both, is waived.

(e) If the Owner agrees with the Contractor's request for additional compensation or Contract Time the parties shall negotiate a Change Order setting forth their agreement. If the Owner disagrees, the Contractor shall do the following

(1) Continue promptly with the work, including any extra work required by the Owner so the Project is not delayed;
(2) Keep complete records of its costs in the manner set forth by the Force Account provisions of this Contract. The Owner also may elect to keep such records to eliminate later confusion. The keeping of such records by either Contractor or Owner does not mean that any Claim is valid;

(3) Submit documentation supporting the request for additional compensation, additional time or both, as required in 00199.30(f) and 00199.30(g).

(f) The Contractor’s request for additional compensation shall be supported by a Claims Package that includes a) all documentation that establishes its right to additional compensation and b) all documentation substantiating the amount of additional compensation to which it is entitled. The documentation shall include the cost records required by 00199.30(e) and all other relevant documentation, such as payroll records, purchase orders, quotations, invoices, estimates, profit and loss statements, daily logs, ledgers and journals.

(1) The documentation shall be submitted within 45 days following completion of any work for which a Claim of additional compensation has been made.

(2) If the Contractor contends that it will incur costs beyond the 45-day time period that should be included in the Claim, the Contractor shall notify the Owner’s Representative of this fact in writing and provide an estimate of that cost. Thereafter the Contractor shall provide the Owner with additional documentation when the remainder of its additional costs is known.

(3) The Owner will rely on the accuracy of the Claims Package to make decisions regarding future expenditures. Failure to submit the Claims Package within 45 days is a conclusive waiver of the Contractor’s right to additional compensation.

(4) The Owner may request additional documentation from the Contractor at any time regarding a Claim. Failure to provide additional documentation when requested and when such documentation exists constitutes a waiver of that portion of the Contractor’s Claim to which the additional documentation relates.

(g) Any request for additional Contract Time shall be supported by documentation that includes a) a description of the event on which the request is based, and b) all information, including a schedule analysis, that shows that the event delayed completion of the Project as a whole.

(1) The Contractor shall submit the documentation within 45 days following the completion of the event that caused the delay and for which additional Contract Time is sought.
The Contractor shall provide additional documentation to support its request within 30 days if requested to do so by the Owner. Failure to provide that information is a conclusive waiver of that portion of the Contractor’s request to which the additional documentation relates.

Following receipt of all required documentation, and after the Owner’s Representative has had sufficient period of time to review it in light of work responsibilities, the Owner’s Representative and the Contractor’s Project Manager shall meet to attempt to resolve the matter if either requests it. If Owner determines that the Contractor has not provided required documentation, the Owner may still meet with Contractor to discuss any claim without waiver of the Owner’s right to later assert that the Contractor’s claim has been waived for failure to submit documentation.

If the Claim cannot be resolved, it shall be referred to persons with higher authority on the part of the Contractor and the Owner, who also shall have the authority to resolve the dispute. Those persons shall meet for negotiations at a mutually agreed upon time and place after having had a sufficient time to review the Claim.

If the Claim is not resolved after this meeting, the Contractor and Owner agree that the matter will be submitted to mediation. The mediator shall be chosen by mutual agreement. If a mediator cannot be agreed upon the Contractor and Owner agree to present the Claim to a mediator selected by the Presiding Judge of Multnomah County, Oregon. The mediation fee shall be borne equally by the Owner and Contractor.

If the matter is not resolved by mediation, the Owner and Contractor may mutually agree to resolve the dispute by arbitration. The Owner and Contractor may mutually agree to any arbitration method. In the event that no agreement is reached as to the method of arbitration, the arbitration shall be as set forth in accordance with the Large, Complex Construction Cases procedures of the American Arbitration Association’s panels of arbitrators for Large, Complex Construction Cases. The Contractor shall pay the arbitration fee required to initiate the arbitration.

a. The Contractor and Owner shall agree upon the appointment of an arbitrator. In the event of disagreement, each party shall appoint one arbitrator within 30 Calendar Days of the disagreement. Those two arbitrators will appoint a third arbitrator to act as the presiding arbitrator.

b. The decision of the arbitration panel shall be final, binding and conclusive upon the parties and subject to appeal only on those grounds for which arbitrations in Oregon are subject to appeal and may be confirmed or embodied in an order or judgment of any court having jurisdiction. The arbitrators appointed pursuant to this Agreement shall not have the power to award punitive damages or attorney fees and shall not have the power to rescind this agreement.
(4) If the matter is not arbitrated and the dispute remains unresolved, either party may pursue resolution through litigation in accordance with the requirements of these Specifications.

(5) The procedures specified in this subsection shall be the sole and exclusive procedures for the resolution for disputes between the Owner and Contractor arising out of or relating to this agreement, except that either may seek preliminary judicial relief or an injunction to avoid irreparable damage. Despite any injunctive relief, the procedures specified in this Contract for the resolution of Claims shall remain applicable.

(i) The Owner is not obligated under the Contract to provide additional Contract Time or additional Compensation unless documentation submitted by the Contractor establishes its entitlement to additional compensation, additional Contract Time, or both. The parties agree that it is not a breach of contract to deny a request for additional compensation or request for additional Contract Time if the Contractor fails to submit adequate documentation substantiating its Claim or request for time.

(j) If the Contractor is entitled to additional compensation, the Contractor shall receive compensation based on the Force Account provisions of Section 00197.

00199.40 Litigation:

(a) Any legal proceeding, of any nature whatsoever, brought by the Contractor against the Owner, that asserts a breach of contract, a claim of quantum meruit, a declaratory judgment proceeding, or any other legal or equitable claim related to, or arising, from work performed pursuant to the Contract Documents, shall be brought within 1 year of the date that Final Payment is made to the Contractor, regardless of whether the Contractor is aware of the legal claim it might have during that time. If the legal proceeding is not brought within that 1 year period, the Contractor expressly waives any and all claims that are in any way related to the Contract.

(b) For purposes of this Subsection payment is considered made when the City of Portland sends a check to the Contractor that contains the Final Payment. The subsequent payment of minor amounts to the Contractor that constitute less than 2% of the total Contract Amount, or the payment of Claims made pursuant to Subsection 00199.30, shall not affect the date when Final Payment is considered to have been made.

(c) The Contractor agrees that any legal proceeding initiated by the Contractor shall be brought only in the Circuit Court of Multnomah County, Oregon.

(d) The Contractor agrees that, as a result of its willingness to do business with the City of Portland, the Contractor shall resolve any dispute with the Owner in Multnomah County, Oregon. All discovery between the parties undertaken pursuant to federal, state, or local rules shall be conducted within that county, including, but not limited to, the production of documents and the appearance of expert and lay witnesses for deposition, if such depositions are permitted by court rules.
(e) In the event of a dispute, the Contractor and the Owner agree to bear the cost of producing their own employees for deposition in Multnomah County, including but not limited to travel costs, per diem expenses and the cost of employee time. The parties further agree that if court rules or the court itself permits the deposition of expert witnesses, the party seeking the testimony of the expert witness will bear that witness’ reasonable costs of travel, reasonable preparation costs and costs for time while in transit.

(f) If litigation has commenced or is expected, the Contractor and its representative, including but not limited to the Contractor's attorneys, agree to make any requests for documents, including Public Records Requests, through the City Attorney's Office of the City of Portland.
Section 00210 - Mobilization

Description

00210.00 Scope - This work consists of operations and preparatory work necessary to become ready to perform the work or an item of work.

Construction

00210.40 Mobilization - Mobilization includes, but is not limited to, the following:

- Move personnel, equipment, supplies, and incidentals to the Project site.
- Establish offices, buildings, and other facilities necessary to work on the Project.
- Perform other work and operations or incur costs as necessary before beginning work on the Project.

Measurement

00210.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00210.90 Payment - Payment for mobilization will be made at the Contract lump sum amount for the item "Mobilization".

The amounts paid for mobilization in the Contract progress payment will be based on the percent of the original Contract amount that is earned from other Contract items, not including advances on materials, and as follows:

- When 5% is earned, either 50% of the amount of mobilization or 5% of the original Contract amount, whichever is the least.
- When 10% is earned, either 100% of mobilization or 10% of the original Contract amount, whichever is the least.
- When all work is completed, amount of mobilization exceeding 10% of the original Contract amount.

This schedule of mobilization progress payments will not limit or prelude progress payments otherwise provided by the Contract.

When the Contract Schedule of Items does not indicate payment for mobilization, no separate or additional payment will be made for mobilization. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00220 - Accommodations for Public Traffic

Description

00220.00 Scope - This work consists of maintaining facilities to accommodate public traffic through and within the Project for the life of the Contract. Public traffic includes motor vehicles, bicycles, and pedestrians.

00220.01 Beginning of Contractor's Responsibility - The Contractor's responsibilities for accommodating public traffic begin on the day any on-site work begins within the Project limits.

00220.02 Public Safety and Convenience - Provide for the safety and convenience of the public and:

- Be responsible for damages according to 00170.80.
- Conduct work at all times so that there is the least possible interference with or hazard to the traveling public and the affected community.
- Locate stockpile materials and park construction equipment and vehicles that are not in active use a minimum of 30 feet from the traveled way. If this is not possible, protect the stockpile materials, the equipment, and vehicles, with barriers or as directed.
- Provide and maintain safe temporary access to business and residence driveways, business and residence entrances during business operating hours, basement vaults as needed, temporary intersections, and temporary connections with roads, streets, and bicycle and pedestrian facilities.
- Provide approved protection and delineation between each work area and public traffic.
- Allow emergency vehicles, incident response units and transit vehicles immediate passage at all times.
- Use portable changeable message signs to provide appropriate work zone information to the public when included in the Contract Schedule of Items.
- For all sidewalk or sidewalk ramp closures, install signs as shown and adhere to the requirements of 00220.40(e).
- Do not impede the flow of traffic or close any lanes of traffic except as listed in 00220.40(h).
- Do not stop or hold vehicles on the traveled way, at intersections, or other connecting roadways with the Project limits for more than 5 minutes.
- Do not block driveways for more than 5 minutes or with open excavation for more than 2 hours unless otherwise authorized in writing.
- Do not close any traffic or bike lane, or street until the area is signed according to the plans or the requirements of this Section and Section 00225.
• Do not perform work which would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time.

• Do not use temporary steel plating within the roadway or shoulder having a preconstruction posted speed zone greater than 35 mph.

• Do not place work zone signs or supports where they will block existing walkways or bikeways.

• Delineate with a tubular or conical marker any silt bags that occupy existing walkways or bikeways.

00220.03 Work Zone Notifications - Provide the following work zone notifications:

(a) Over-Dimensional Vehicle Restrictions - When a project restricts the width, length, height, or weight of vehicles through a work zone or detours trucks around a work zone, notify the Motor Carrier Transportation Division (MCTD) by using the web based electronic version of the "Highway Restriction Notice-Size and/or Weight" form (Form No. 734-2357) and notify the Engineer in writing at least 28 calendar days before the restriction or detour taken effect.

(b) Closures and Modifications - Submit to the Engineer, in writing, for approval, all proposed closure schedules, as follows:

• **Lanes** - A minimum of 7 calendar days before lane closures begin.

• **Roads** - A minimum of 14 calendar days before closure. Also notify in writing, all affected emergency services, school districts, and US Postal Service a minimum of 14 days before any closure.

• **Bicycle and Pedestrian Facilities** - A minimum of 14 calendar days before a bike lane, sidewalk, or multi-use path closure.

• **Signals and Traffic Control Devices** - Provide a minimum of 7 working days notice in advance for any adjustments to existing traffic signals, signs or other traffic control devices. Notify the District Signal Engineer at least 5 working days in advance of traffic signal interruption or modification.

• **Parking** - A minimum of 14 calendar days prior to closure. Contractors must purchase the required permits 14 days in advance from the Permit Center, 503-823-7365. After receiving written approval, provide 48 hour public notification before the closure.

• **Transit Stops** - A minimum of 7 calendar days prior to closure. After receiving written approval, notify TriMet at least 48 hours in advance of any transit stop closures.

• **Transit Detours** - A minimum of 7 calendar days prior to closure. Identify bus routes in the project area and coordinate with TriMet to determine an alternative route, removal of parking requested by TriMet on the alternate route, and advance notification. Submit any traffic control associated with the alternate transit routing.
Construction

00220.40 General Requirements - Provide the following for public traffic in all construction areas:

(a) Traffic Nuisance Abatement - If loose rock or dust exists on roadway surfaces and shoulders, the Engineer may direct one or more of the following:

- Use flaggers or pilot cars and flaggers.
- Apply a fine spray of water to the surface as directed.
- Sweep paved surfaces with power brooms.

(b) Detours and Stage Construction - Construct and remove, if required, detours, stage construction roadways, shoulders, and temporary bridges, including accessory features shown or ordered.

(c) Driveways - Provide reasonable access as follows:

- Replace and maintain business accesses, driveways, approaches, crossings and intersections as needed
- Use reasonably well-graded aggregate material
- Before placing the permanent base, do one of the following:
  - Uniformly spread the temporary aggregate material over the subgrade.
  - Remove and place the temporary aggregate material in the shoulder slope area if it meets quality requirements.
  - Dispose of the temporary aggregate material in a manner satisfactory to the Engineer.

When construction requires the closure of a driveway, contact the property's point of contact 14 days in advance of construction. Coordinate all driveway closures with the property representative to minimize disruption and inconvenience during construction. Parking and delivery access shall be accommodated during construction either on site or on an adjacent street block.

(d) Adjacent to Excavations - Where paved shoulders adjacent to excavations are less than 4 feet wide, protect the traffic as follows:

- At the end of each working day, backfill pavement edge excavations to the elevation of the existing pavement with permanent base material or with a temporary wedge of aggregate as shown on ODOT standard drawings.
- Do not excavate along both edges of the pavement adjacent to traffic at the same time. Before excavating at the edge of the pavement on the opposite side of the roadway, complete the construction to existing pavement elevation on the side which was excavated first.
• Remove the temporary wedge of aggregate material, if used, before placing permanent base material, and place it in the shoulder slope area or spread it uniformly over the subgrade.

(e) Sidewalk Closure - When construction requires the closure of a sidewalk or sidewalk ramp:

• Place Type "W1" "SIDEWALK CLOSED" signs (MUTCD R9-9, 10, 11, 11a) as needed to direct pedestrian traffic. Mount each sign between the panels of a Type II barricade placed across the sidewalk, facing pedestrians approaching the work area.

• Close the sidewalk at a point where there is an alternate way to proceed or provide an alternate pedestrian route. To the maximum extent feasible, the alternate circulation path shall be provided on the same side of the street as the disrupted route. Pave the alternate pedestrian route surface or provide an approved, non-slip 36 inch minimum width surface meeting the requirements of the Americans with Disabilities Act (ADA). If appropriate, delineate this route and protect pedestrians by placing work zone delineation fencing.

• Barricades, channelizing devices and fencing are to remain in place, except as required for actual work, until the sidewalk is reopened to pedestrian traffic. Reopen the sidewalk during non-work hours or continue to provide an alternate route for pedestrians. Reopen the sidewalk when no work is being performed or if no work is scheduled for 2 weeks or more, and if required, place ramps, barrels, and other protective measures to delineate the route.

• Provide alternate pedestrian routes that match existing facilities and provide additional traffic control measures to meet the accessibility requirements in Part VI of the MUTCD.

(f) Doorways - All open doorways in and around the work site shall be clearly marked using cones and caution tape, construction fencing or other measures approved by the engineer. Accessible 48 inch wide walkways of wood or other hard, non-skid surface shall be provided through, over or around work areas to doorways adjacent to construction activities.

(g) Trenches - At the end of each working day, backfill trenches to the elevation of the existing pavement, cover trenches with temporary steel plates, or surround trenches with temporary fencing.

(h) Lane Restrictions - Do not close any traffic lanes and remove all barricades and objects from the roadway during the periods listed below unless approved.

(1) Weekdays:

• Between 7:00 a.m. and 9:00 a.m. and between 4:00 p.m. and 6:00 p.m. Monday through Friday.
(2) **Holidays** - Between 4:00 p.m., on the day preceding a legal holiday or holiday weekend and midnight on a legal holiday or the last day or holiday weekend, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and midnight on the following Sunday.

For the purposes of this Section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

(3) **Special Events** - Between 4:00 p.m., on the day preceding and midnight on the final day of the special event.

**Maintenance**

00220.60 **Surface Maintenance Responsibilities** - Provide adequately maintained accommodations at all times for public traffic through and within the Project according to this Section and Section 00225.

(a) **During Construction** - The responsibility for maintaining all surfaces during construction is as follows:

(1) **Contractor Responsibility** - Do the following at Contractor's expense:

- Keep roads, streets, bikeways, sidewalks, multi-use paths, and shoulders used by public traffic, free of debris, aggregate, dirt, mud, and other materials that impede traffic.
- Repair damage to surfaces caused by the Contractor's operations.
- Maintain all detour or stage construction surfacings not constructed as specified or directed.
Before winter shutdown begins, do the following:

- Provide paved traffic lanes for each direction of traffic.
- Do not leave abrupt edges.
- Remove or cover temporary construction signs unless otherwise directed.
- Clean, install, and reinstall all necessary channelization and pavement markings, as directed.

If this winter shutdown work is not completed and in place, the City may do the work according to 00220.60(d)

(2) **City Responsibility** - The City will be responsible to do the following at City expense:

- Maintain existing surfacings and shoulders that are being used by public traffic at the start of the Project which have not been damaged by Contractor operations.
- Maintain surfaces of detours and intermediate stage construction during the time they are being used by public traffic, but only if constructed according to the plans or as directed.
- Maintain existing surfaces and shoulders of detours located outside the Project limits during the time they are being used by public traffic.
- Sand icy pavements and remove the sand residue.
- Remove snow from traveled ways as required to accommodate public traffic.

The City may authorize the Contractor to perform this work according to Section 00196.

(b) **During Suspensions** - Maintain surfacings for which the Contractor is responsible according to 00220.60(a)(1), the work according to 00170.80, and work zone traffic control according to Section 00225 during suspensions of the work as follows:

(1) **Suspensions Due to Contractor Fault or Neglect** - If the suspension is due to any cause within the control or responsibility of the Contractor, including failure to do the following:

- Perform any provisions of the Contract,
- Correct conditions unsafe for the general public, workers or City employees, or
- Carry out orders given by the Engineer
Then assume sole responsibility for making provisions for traffic acceptable to the Engineer, and be solely responsible for the costs of maintaining surfaces under traffic, the work, and work zone traffic control during the suspension.

(2) Suspensions Due To Other Causes - If the suspension is due to unforeseen circumstances, or causes not included in 00220.60(b)(1), and if the suspension occurs within the Contract time or adjusted Contract time:

- Place uncompleted traveled ways, shoulders, driveways, approaches, connections, and detours necessary for traffic in a maintainable, acceptable condition. Be responsible for the work.
- Be responsible for work zone traffic control.

The City will then assume responsibility for maintenance of the roadway surfaces during the suspension.

(c) Resuming Contract Work after Suspension - After any suspension do not resume Contract work until approved.

(d) Right of City To Perform Work At Contractor Expense - If the Contractor fails to provide adequate accommodations for traffic and to maintain the traveled ways and connections as provided in the Contract, the Engineer may proceed immediately to provide adequate accommodations and maintenance. The cost of this work will be deducted from monies due, or that become due, the Contractor.

00220.65 Existing Traffic Control Device Maintenance Responsibility:

(a) General - Maintain existing regulatory and warning traffic control signs, such as STOP, YIELD, KEEP RIGHT, and ONE-WAY signs, for the duration of the construction in accordance with (b) and (c) below, unless otherwise directed. If the Contractor fails to comply with the provisions below, the City may perform the work at the Contractor's expense.

(b) Sign Relocation - If a permanent sign must be temporarily relocated, the sign shall be adequately mounted, placed as near as possible to the original locations, and remain clearly visible to approaching traffic without creating a traffic hazard as approved by the Engineer.

(c) Damaged/Missing Signs - Damaged, missing or improperly located STOP, YIELD, or ONE-WAY signs shall be replaced or relocated immediately. Provide manual traffic control from the time at which the problem is noted until the time at which it is corrected.
00220.70 Opening Sections to Traffic - When it is in the public interest the Engineer may order any portion of the work opened to traffic. If the portion opened to traffic has been finished in an acceptable manner, it will be designated as "accepted for traffic", and the Contractor will be relieved of maintaining it for legal, public traffic. If the portion of the work to be opened to traffic has not been finished in an acceptable manner, it shall be maintained under traffic by the Contractor in a condition serviceable and adequate for traffic until it is finished in an acceptable manner, except as provided in 00220.60(b).

Maintain portions of the work designated "accepted for traffic" as Extra Work if so ordered. Maintain portions of the work opened to traffic but not "accepted for traffic" at no additional compensation, except watering ordered to protect the work or to alleviate dust will be paid for as provided in Section 00340.

The "accepted for traffic" portion(s) of the work will:

- Be accepted only to the extent the Contractor is relieved of maintaining these portions for legal, public traffic after acceptance.
- Not entitle the Contractor to reduction of Retainage.
- Not relieve the Contractor's responsibility for defective materials or work.
- Not relieve the Contractor's responsibility for damages to the work from causes other than legal, public traffic except as provided in 00170.80.
- Not constitute a waiver of any provision of the Contract.

If the Contractor delays the completion of shoulders, drainage structures, or other feature of the work, the Engineer may order all or any portion of the work to be opened to traffic. In this case, the Contractor shall be responsible for maintenance as described in 00220.60(a)(1), during the period the work is opened to traffic until final acceptance. Conduct the remaining operations to cause the least obstruction to traffic, and pay all additional costs caused by the presence of traffic.

Measurement

00220.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00220.90 Payment - No separate or additional payment will be made for work performed under this Section, unless otherwise provided or pay items are provided under other Sections.
In addition, no payment will be made for costs incurred by the Contractor because of:

- Inconvenience, additional length of travel to conform to established traffic patterns and planned access features; or
- Compliance with laws governing traffic regulations and load limitations.

Costs anticipated because traffic will be using portions of the work will be included in the Contract prices for the various items of work involved.
00225.00  Scope - This work consists of providing temporary traffic control measures (TCM) and furnishing, installing, moving, operating, maintaining, inspecting, and removing traffic control devices (TCD) throughout the Project Area according to the standard drawings, the traffic control plan (TCP) for the Project, these Specifications, or as directed.

00225.01  Abbreviations, Definitions, and Standards:

(a) Abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
</tr>
<tr>
<td>TCD</td>
<td>Traffic Control Devices</td>
</tr>
<tr>
<td>TCM</td>
<td>Traffic Control Measures</td>
</tr>
<tr>
<td>TCP</td>
<td>Traffic Control Plan</td>
</tr>
<tr>
<td>TCS</td>
<td>Traffic Control Supervisor</td>
</tr>
<tr>
<td>TSS</td>
<td>Temporary Sign Support</td>
</tr>
<tr>
<td>PCMS</td>
<td>Portable Changeable Message Sign</td>
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<tr>
<td>PROM</td>
<td>Programmable Read Only Module</td>
</tr>
</tbody>
</table>

(b) Definitions:

<table>
<thead>
<tr>
<th>Traffic Control Devices (TCD)</th>
<th>Signs, signals, markings, and other devices placed on, over or adjacent to a road to regulate, warn, or guide public traffic by authority of a public body or official having jurisdiction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Control Measures (TCM)</td>
<td>Elements of the TCP including, but not limited to, TCD, personnel, materials and equipment used to control public traffic through a work zone.</td>
</tr>
<tr>
<td>Traffic Control Plan (TCP)</td>
<td>A written and drawn plan for providing the safe and efficient movement of public traffic through or around a work zone while protecting workers, incident responders, and equipment.</td>
</tr>
<tr>
<td>Work Zone</td>
<td>An area within highway construction, maintenance, or utility work activities which extends from the first warning sign to the last TCD.</td>
</tr>
</tbody>
</table>

(c) Standards - When designing, applying, installing, maintaining, inspecting, and removing traffic control devices, use and follow the most current versions in effect of the following:

- Oregon Department of Transportation's "Sign Policy and Guidelines for the State Highway System"
- The "Manual on Uniform Control Devices (MUTCD)"
00225.02 General Requirements:

(a) General - Be responsible to provide and maintain all TCM. The Engineer may verbally or in writing require immediate changes to the TCM being used on the Project. Immediately make these changes, as directed. Submit all proposed TCM revisions to the Engineer for approval.

Appoint a trained person on site during normal working hours and on call at all other times who:

- Meets the requirements of 00225.31.
- Is responsible to maintain all TCD in proper position and condition.
- Is equipped with a two-way radio conforming to 00225.28 or cell phone.
- Has the authority to assign and control flagging operations.
- Files his/her name and phone number with the Engineer and local police.

Do not start work on any stage of construction until the TCP has been reviewed and accepted and all TCM are in place and the TCP is operating satisfactorily. During construction, determine if additional TCM are required to those in place and immediately notify the Engineer. Immediately make changes as approved or directed, but do not place or remove devices without prior approval.

Work may be suspended as specified in 00180.70 or the TCM may be performed by the City if the Contractor fails to correct an unsafe condition. Costs for work performed by the City will be deducted from monies due the Contractor.

(b) Horizontal Clearance - When the horizontal clearance for the roadway is less than 19 feet, install "ROAD NARROWS" signs (MUTCD W5-2) signs, identifying the narrowest width of the roadway. Locate these horizontal clearance signs as shown or as directed.

(c) Vertical Clearance - When the vertical clearance is less than 15 feet 3 inches, install low clearance (MUTCD W12-2) signs. The clearance shown on the signs shall be 3 inches less than the shortest height of the opening. Locate these low clearance signs as shown or as directed.

(d) Intersecting Streets - When a through road intersects the work zone, place a 36 inch "ROAD WORK AHEAD" sign in advance of the intersection at sign spacing "A" from the "TCD Spacing Table" shown on the standard drawings. These signs do not require sign flag boards, unless otherwise directed.
(e) Paving Operations - When paving operations create an abrupt edge, protect traffic by installing signing according to the "2-Lane, 2-Way Roadway Overlay Area" detail shown on the standard drawings.

When a cold planed pavement surface is used by traffic, install a 36 inch "BUMP" sign at the transverse paving edge. Install a 36 inch "GROOVED PAVEMENT" sign in advance of the bump sign at sign spacing "A" from the "TCD Spacing Table" shown on the standard drawings. Face both signs toward oncoming traffic and install them before opening the cold planed surface area to active traffic.

(f) Extended Traffic Queues - During flagging operations, monitor the length of traffic queues and when extended traffic queues develop, protect traffic by providing advance flagger(s) and signing according to the "Extended Traffic Queues for Advance Flagging" detail shown on the standard drawings.

00225.03 Traffic Control Outside Project Site - Provide TCM outside the Project Site when required.

00225.04 Regulations and Codes - All electrical equipment, materials, and work shall conform to NEC requirements and all other laws that apply.

00225.05 Contractor Traffic Control Plan - The Contractor will be allowed to use the City's TCP, modify the City's TCP, or use a different TCP. Submit the following, for approval, 5 calendar days before the preconstruction conference:

(a) City's or Contractor TCP - If the City's TCP is used without modification, a written notification indicating that the City's TCP will be used without modification with the proposed order and duration of the TCM and a designated haul route if required.

If the Contractor will be using a modified City TCP, or if the Contractor will not be using the City TCP, include the following:

- Proposed TCP showing all TCM and quantities of all TCD
- Proposed order and duration of the TCM
- A detailed temporary striping plan
- A designated haul route if required

(b) Tourist-Oriented Directional (TOD) and Business Logo Signs - Two copies of a sketch map of the Project showing all existing TOD and business logo signs and a written narrative describing how these signs will be kept in service and protected throughout all the construction stages.

If there are no TOD signs on the project, a written notification that no TOD signs exist within the project limits.
00225.06  **Routing Traffic Over Surfacing** - Control traffic being routed over surfaces as follows:

(a) **Aggregates** - When directed, control traffic over aggregate with flaggers or flaggers and pilot car(s).

(b) **Asphalt Treated Permeable Base (ATPB)** - When directed, control traffic over ATPB with flaggers or flaggers and pilot car(s).

(c) **Asphalt Concrete** - Control traffic over asphalt concrete as follows:

1. **Paving** - When the longitudinal joint is greater than 1 inch in height, install additional TCD according to 00225.02. Complete the placing of HMAC and construction of paving joints according to 0074 4.61 and 0074 4.62.

2. **Cold Plane Pavement Removal** - Complete the pavement removal according to 00620.40. When the area cannot be paved back during the same shift and the depth of pavement removal is greater than 1 inch, install additional TCD according to 00225.02.

(d) **Oil Mats or Chip Seals** - Control traffic over asphalt oil mats or chip seals with flaggers and pilot car(s), unless otherwise directed, until the entire surface has been broomed or bladed after the aggregate was placed as tabulated below:

<table>
<thead>
<tr>
<th>Minimum ADT</th>
<th>Pilot-Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 1500</td>
<td>2</td>
</tr>
<tr>
<td>1500 and less</td>
<td>1</td>
</tr>
</tbody>
</table>

(e) **Sand Seals** - Control traffic with flaggers and pilot car(s) during application of asphalt and until it is covered with aggregate, unless otherwise directed.

(f) **Steel Plates** - When steel plates are installed in travel and bike lanes, appropriate warning signs shall be placed in advance of the plates as shown on the approved TCP.

**Materials**

00225.10  **General** - Evaluate the condition of TCD using the criteria shown in the most current version in effect of the American Traffic Safety Services Association (ATSSA) publication titled "Quality Guidelines for Work Zone Traffic Control Devices". Use new or acceptable TCD for all installations unless otherwise specified. Provide test results, quality compliance certificates, equipment lists and drawings when specified. Acceptance will be by the CPL, test results, quality compliance certificates, equipment lists, drawings and testing as necessary to assure compliance with the Specifications. After TCD have been installed and accepted on the Project, inspect and maintain the condition of the devices.
All work zone TCD shall comply with the crashworthy requirements of National Cooperative Highway Research Program (NCHRP) Report 350.

**00225.11 Temporary Signing** - Furnish new or acceptable temporary signs and accessories meeting the following requirements:

(a) **Signs** - Use materials and fabricate signs conforming to Sections 00940 and 02910 and the following:

1. **Size and Shape** - Use standard size and shape signs meeting the requirements of 00225.01(c) unless otherwise specified or ordered. Double-face signs will not be allowed except for flagger "STOP/SLOW" sign paddles.

2. **Type** - Use Type "O3," "O4," or "O5" signs, unless otherwise indicated in this Section or in the TCP. Fabricate these signs on one of the following materials:
   - New sheet aluminum sign blanks.
   - New extruded aluminum panels.
   - Use sheet aluminum sign blanks that are without bends, tears, holes, or dents and that have been cleaned to bare metal.
   - 3/4 inch high-density overlay plywood.
   - 3/4 inch medium-density overlay plywood.
   - Light-weight sign substrates from the CPL.

3. **Folding or Turning Signs** - Temporary signs on posts may be the folding or turning type as long as they can be locked when not in use so the sign message is not visible to any traffic.

4. **Roll-up Signs** - Use roll-up signs with fluorescent orange roll-up sheeting from the CPL.

(b) **Sign Supports:**

1. **Wood Sign Posts** - Use wood sign posts in the sizes and quantities as shown on the ODOT standard drawings and according to 02110.40, except posts may be untreated.

2. **Portable Sign Supports** - Use portable sign supports from the CPL and conforming to the following:
   - Free standing.
   - Capable of supporting signs in vehicle-caused turbulence and in winds common to the area where they are used. If additional ballast is required to maintain the signs in an upright position, use sandbags to anchor the sign support legs. Place a sandbag filled with loose sand (approximately 25 pounds) across the bottom of each leg as needed.
(3) Concrete Barrier Sign Supports - Use concrete barrier sign supports that meet the following:

- Conform to the ODOT standard drawings.
- Attach securely to the top of the concrete barrier.

(4) Temporary Sign Supports - Fabricate and use TSS as shown on the ODOT standard drawings and according to 02110.40 except posts may be untreated.

(5) Perforated Steel Square Tube Sign Supports - Use perforated steel square tube sign supports from the CPL and as shown on the ODOT standard drawings.

c) Sign Covers:

(1) Temporary Signs - Sign covers for temporary signs shall be:

- One-piece plywood.
- Other sign cover from the CPL.
- Large enough to completely cover the sign.
- Easy to attach to and remove from the sign without damaging the sign face.
- Black, non-reflective and opaque.

(2) Permanent Signs - Sign covers for permanent signs shall conform to Section 00941

d) Sign Flags - Sign flags shall be:

- Fluorescent red-orange.
- 16 inch square or larger.
- Made from an acceptable tightly woven fabric or plastic sheeting.

e) Amber Flashers - Amber flashers shall:

- Be industry standard 8 inch traffic signal head with visors.
- Be visible the full width of the traveled way and shoulders 1,200 feet from the flashers.
- 110/120 volt or 12 volt rechargeable, battery-operated.
- Provide a constant flash rate of one flash per second +10%.
- Provide an illuminated period of each flash of 30% +10% of each flash cycle.

(f) Sign Flag Boards - Use sign flag boards as shown on the ODOT standard drawings.
**00225.13 Temporary Traffic Delineation**  - Furnish temporary traffic delineation items and accessories meeting the following requirements:

(a) **Tubular Markers** - Use tubular markers from the CPL.

(b) **Conical Markers** - Use conical markers from the CPL.

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**00225.12 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing**  - Furnish temporary barricades, guardrail, barrier, attenuators, pedestrian fencing, and accessories shall conform to the following:

(a) **Barricades** - Use barricades from the CPL and as shown on the ODOT standard drawings.

(b) **Guardrail** - Use guardrail meeting the requirements of Section 00810 except posts may be untreated. Use guardrail terminals from the CPL and as shown on the ODOT standard drawings. Reuse salvaged guardrail materials that comply with the requirements of 00810.15.

(c) **Concrete Barrier** - Use concrete barrier meeting the requirements of Section 00820 and have the same cross section, height, and loop configuration within individual runs and the following:

- Pin-and-loop concrete barrier as shown on the ODOT standard drawings (three ASTM A 36 loops, 32 inch height).
- Tall concrete barrier as shown on the ODOT standard drawings (two ASTM A 36 perforated C-shapes, 42 inch height).

Provide concrete barrier for temporary applications that are in acceptable condition, without cracks, chips, spalls, corroded loops or C-shape connectors.

The concrete barrier shall have functioning scuppers, unless otherwise approved.

(d) **Impact Attenuators** - Furnish impact attenuators from the CPL and as shown on the ODOT standard drawings.

(e) **Glare Shields** - Use glare shields from the CPL that are a minimum 24 inches in height.

(f) **Pedestrian Fencing** - Use pedestrian work zone delineation fencing from the CPL.

(g) **Reflective Barrier Panels** - Use reflective barrier panels from the CPL.
(c) **Surface Mounted Tubular Markers** - Use surface mounted tubular markers from the CPL.

(d) **Plastic Drums** - Use plastic drums from the CPL. Use retroreflective drum sheeting meeting the requirements of ASTM D 4956 Type III or Type IV.

(e) **Delineators** - Use new delineators from the CPL or salvaged reflectorized delineators (W-1) or (Y-1), as appropriate, and conforming to the requirements of Section 00840 and the following:

   (1) **Guardrail** - At guardrail locations, use Type 4 delineators.

   (2) **Concrete Barrier** - At concrete barrier locations, use Type 5 delineators.

(f) **Pavement Markers**:

   (1) **Reflective Pavement Markers** - Use new Type 1 reflective pavement markers from the CPL.

   (2) **Flexible Oiling Pavement Markers** - Use new flexible oiling pavement markers from the CPL.

   (3) **Flexible Overlay Pavement Markers** - Use new flexible overlay pavement markers from the CPL.

(g) **Temporary Tape** - Use temporary non-removable, temporary removable, and temporary non-reflective tape, from the CPL.

(h) **Striping**:

   (1) **Paint** - Use striping paint from the CPL.

   (2) **Beads** - Use glass beads from the CPL.

00225.14 **Temporary Illumination** - Furnish materials for temporary illumination meeting the requirements of Sections 00960, 00970, 02920, 02926 and the temporary illumination plans.

00225.15 **Traffic Signals** - Furnish cable, guy wires, hardware, wood poles, wood pole foundations, and guy anchors that are able to support the dead load of the equipment shown and withstand 100 mph, 3-second gust wind speed with an importance factor (ir) equal to 0.71 according to the 4th Edition AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

(a) **Temporary Traffic Signal** - Use materials for temporary traffic signals that conform to Sections 00960, 00990, 02120, 02920, 02925 and the following:
(1) **General** - Used materials are allowed if restored to new condition or have very minor wear that is undetectable without close inspection. Do not use permanent signal equipment as part of the temporary signal installation.

(2) **Cable and Wire** - Use all new cable and wire.

(3) **Wood Poles** - Use poles that are of acceptable condition without visible signs of deterioration or significant longitudinal splits. Poles shall have no more than 8 drilled holes for messenger and tether cable eyebolt attachments. Holes shall not be closer than 6 inches.

(4) **Concrete** - Use commercial grade concrete according to Section 00440.

(5) **Traffic Signal Control Devices** - The controller program, PROM and monitor programming will be furnished by the City. When the temporary signal is removed, return the PROM to the City.

(b) **Portable Traffic Signals** - Use new or like-new portable traffic signals from the CPL.

00225.16 **Temporary Electrical Signs** - Furnish electrical signs meeting the following requirements:

(a) **Sequential Arrow Signs** - Use trailer mounted Type "C" sequential arrow signs from the CPL.

(b) **Portable Changeable Message Signs** - Use trailer mounted PCMS units from the CPL.

00225.17 **Flagger Station Lighting** - Furnish flagger station lighting from the CPL and meeting the following requirements:

- Illuminates the flagger so that the flagger is visible, and is discernable as a flagger, from a distance of 1,000 feet.
- Illuminates the flagger from above at a height of 18 feet +3 feet.
- The light is shielded from approaching traffic.

00225.18 **Temporary Pedestrian Walkways** - Materials for temporary walks shall be constructed using Douglas Fir-Larch No. 2 or better. The walk shall be a minimum of 7 feet wide with 42 inch high hand railing on both sides of the walk. The lumber used shall be a minimum of 2 inches x 8 inches except for the hand railing which shall be a minimum of 2 inches x 4 inches with 4 inches x 4 inches posts. Apply a non-skid material, with a minimum static coefficient of friction of 0.6 (0.8 on slopes greater than 4%) as determined by ASTM C1028, to the walking surfaces.

Submit a design for the proposed walks for review before construction begins.
Equipment

00225.20 General - Equipment will be accepted based on compliance with the Specifications and the Engineer.

00225.27 Flaggers - Provide flaggers with the following:

(a) Flagger Equipment - Equip flaggers with the following:

- Clothing to cover the complete body except head, neck, and arms below the point of the shoulders.
- An ANSI Class II orange, yellow, strong yellow green or fluorescent versions of these colors, retroreflective vest, shirt, or jacket. The vest, shirt, or jacket shall be designed to identify the wearer as a person and be visible through the full range of body motions.
- A fluorescent yellow-green, orange, yellow, or bright white hardhat. Wear hardhats during flagging operations.
- A minimum 18 inch x 18 inch "STOP/SLOW" paddle made of rigid substrate and fabricated using Type "R1"/"O4" sheeting, or a flashing "STOP/SLOW" paddle from the CPL. A 24 inch x 24 inch "STOP/SLOW" paddle is recommended for higher speed situations or where more conspicuity is desired.
- Portable, self contained two-way radio and repeaters, as required, with a range suitable for communications throughout the Project limits.

(b) Flagger Station Lighting - Use flagger station lighting from the CPL and conforming to the following:

- Provide flagger illumination sufficient to ensure the safety of the flagger, motorists, and workers during flagging operations.
- Provide shielding to prevent light beams from being directed toward traffic.

00225.28 Traffic Control Supervisor - Equip the Traffic Control Supervisor (TCS) as follows:

- Clothing, vest, and hard hat or cap equivalent to that of flaggers.
- Portable, self-contained two-way radio with a range suitable for the Project.
- Cellular telephone active 24 hours a day.
- A vehicle that is equipped with a roof or post mounted rotating amber light or strobe light that is visible for 360°.

00225.29 Pilot Cars - Provide pilot cars with the following features:

- No smaller than a compact pickup truck.
- Four wheels.
• A "PILOT CAR FOLLOW ME" (G20-4-18) sign mounted in a conspicuous location on the rear of the vehicle.
• A roof or post mounted rotating amber light or strobe light that is visible for 360°.
• A two-way radio with a range suitable for the Project.

**Labor**

00225.30 **General** - Observe all laws concerning safety, health, and sanitation standards according to 00170.60. Provide flaggers, TCS, signal operators, and pilot car operators, to stop, direct and maintain traffic control through the work zone.

00225.31 **Qualifications** - Use flaggers, TCS, signal operators, and pilot car operators that meet the following requirements:

- Have a valid driver’s license.
- Are at least 18 years old.
- Have the mental and physical ability to provide timely, clear, and positive guidance to the traveling public.
- Have a sense of responsibility for public and work crew safety.
- Have a professional appearance.
- Have a courteous but firm manner.
- Have completed an approved work zone traffic control flagging course within the past 3 years and have in their possession a current, official state Flagger Certification card from either Oregon, Washington, Idaho or Montana.

00225.32 **Traffic Control Supervisor** - The TCS shall possess a current ODOT "Oregon Certified Traffic Control Supervisor" card. A TCS with a current card from another State Department of Transportation or from American Traffic Safety Services Association may obtain an Oregon Certified TCS card upon successful completion of ODOT’s one-day Recertification Class.

The TCS duties include the following:

- Meets the requirements of 00225.31.
- Files his/her name and phone number with the Engineer and local police.
- Notify the Engineer of any corrections being made to the TCP when it is not functioning as required.
- Inspect TCD during each construction work shift for proper function, location, installation, message, cleanliness, and effect on the traveling public.
• Check post-mounted signs once a week. Inspect traffic control devices to be left in place for more than 24 hours during non-working hours immediately following initial placement of TCD. Conduct additional TCD inspections for extended periods, as requested. Check for effectiveness in both daylight and darkness.

• Review and inspect nighttime lighting and its effect on the traveling public.

• Make temporary revisions to the TCP in the event of an emergency. Immediately follow-up with and report any changes to the Engineer.

• Oversee all requirements of the Contract to ensure the convenience, safety and orderly movement of vehicular, bicycle, and pedestrian traffic.

• Have the documents listed in 00225.01 and applicable standards and specifications available on the Project at all times.

• Discussing proposed TCM and coordinating implementation of the TCP with the Engineer.

• Coordinating all TCM, including those of subcontractors, suppliers, and any adjacent construction or maintenance operation.

• Coordinating the Project's activities (such as ramp closures, road closures, and lane closures) with appropriate police, fire control agencies, city or county engineering, medical emergency agencies, school districts, Postmaster and transit companies.

• Prepare and sign a daily Traffic Control inspection report or at another frequency as approved. Submit the report to the Engineer no later than the end of the next working day. As a minimum, include the following items in the report:
  • When sign and TCD are installed and removed.
  • Locations of signs and TCD.
  • Revisions to the TCP (include copy of signed approval by the Engineer).
  • Lighting utilized at night.
  • Observations of traffic conditions.
  • When TCD are damaged or replaced.
  • How TCD were damaged and by whom.
  • Accidents or incidents occurring within the work zone.

• The TCS may make minor revisions to the TCP to accommodate site conditions as long as the original intent of the TCP is maintained and the revision has been approved by the Engineer.

• Attending Project meetings specifically scheduled to discuss the TCP and TCM.

• Providing supervision over all TCM on a 24 hour per day basis.

Do not designate the Project superintendent as the TCS unless approved.

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Maintain a 24-hour telephone number at which the TCS can be contacted. Make arrangements so that the TCS will be available on every working day, on call at all times, and available upon the Engineer's request at other than normal working hours. During non-work periods, the TCS, or authorized representative, shall report to the Project site within 45 minutes after notification in the event of a work zone incident. The TCS shall have appropriate manpower, equipment, and material available at all times to expeditiously correct any deficiency in the TCM for the Project.

Notify the Engineer of an alternate TCS who can assume the duties of the assigned TCS in the event of that person's inability to perform. Alternate TCS shall be adequately trained and certified to the same degree as the assigned TCS. Notify the Engineer within 24 hours of designating the TCS for the following 24-hour period. Make succeeding notifications within 24 hours every time a subsequent TCS is appointed to the Project.

The on-duty TCS shall not act as a flagger except in an emergency.

Construction

00225.40 General - Install, inspect, move, operate, maintain, and remove temporary TCD according to the plans, these Specifications, and the following:

- Install, maintain, and move all TCD by working with the direction of traffic.
- Provide additional TCM, according to 00225.02, when necessary or directed.
- Turn, cover, or remove the existing TCD as directed when they are not necessary or conflict with temporary devices. Remove and obliterate, without damaging the wearing surface, all evidence of all temporary TCD when the Contract is complete.
- Remove TCD in the reverse sequence of the installation.

Temporary TCD are to remain the property of the Contractor.

Existing TCD shall remain in operation throughout the Contract or until replaced by new permanent TCD as appropriate.

00225.41 Temporary Signing - Once temporary signs have been accepted and paid for on the Project, do not remove them from the Project, until directed.

Install all temporary signing according to the plans, Section 00940, the MUTCD, the "Sign Policy and Guidelines for the State Highway System," FHWA "Standard Highway Sign" manual and the following:
(a) **Speed Signs** - Use speed signs as follows:

1. **Advisory Speed Signs** - Install the advisory Type "O4" speed signs as directed.

   When advisory Type "O4" speed signs are used, cover the appropriate Type "W1" speed zone signs with sign covers according to Section 00941. Uncover them when the advisory Type "O4" speed signs are removed or covered. At the trailing end of the Project, install a Type "W1" speed zone sign with the original designated speed. If existing Type "W1" speed signs are 500 feet or less beyond the Project, additional signs are not required.

   When there is no work on the Project or when directed, cover or remove the advisory Type "O4" speed signs and restore the original Type "W1" speed zone signs.

2. **Regulatory Speed Signs** - Install and maintain the regulatory signs as directed and according to the "Temporary Speed Zone Order" signed by the State Traffic Engineer.

   When regulatory Type "W1" speed signs are used, cover the appropriate Type "W1" speed zone signs with sign covers according to Section 00941. When there is no work on the Project or when directed, cover or remove the regulatory Type "W1" speed signs and restore the original speed zone signs.

(b) **Sign Supports**:

1. **Wood Sign Posts** - Except as provided in the following (2) through (5), mount all temporary signs on wood sign posts as shown and as shown on the ODOT standard drawings.

   When sign posts are installed in rock, a shorter post may be used provided the post is installed in a buried concrete footing at least 12 inches in diameter and 2 feet deep.

2. **Portable Sign Supports** - Use portable sign supports as follows:

   - When signs are needed at a single location for no more than 48 consecutive hours.
   - Position the support so the lowest point of the sign is at least 1 foot above the roadway surface.
   - Install flags if required on signs according to 00225.41(c).
   - Remove from road at end of each work shift when the condition is no longer in effect.
   - Use with roll-up signs.
   - Use ballast to prevent blow down.
(3) **Concrete Barrier Sign Supports** - Mount signs on concrete barrier so the:

- Lowest point of the sign is at least 7 feet above the roadway surface.
- Sign and post are held securely with a device that prevents blowdown.
- Sign can be turned and locked parallel to the flow of traffic when not in use.

(4) **Temporary Sign Supports** - Use TSS as follows:

- When signs are needed at a single location for more than 48 consecutive hours.
- When not practical to post mount due to location or when utility conflict exists.
- Do not tip TSS.
- Position the TSS’s behind a Type III barricade if it is placed in the roadway.
- When not in use, locate TSS outside the clear zone and turn away from traffic, or cover sign and retain the Type III barricade for delineation.

(5) **Perforated Steel Square Tube Sign Supports** - Perforated steel square tube sign supports may be used as a substitute for wood sign posts. Install perforated steel square tube sign supports as shown on the ODOT standard drawings.

(c) **Sign Flag Boards and Sign Flags** - Use 2 sign flag boards and flags as follows:

1. **Sign Flag Boards** - Install 2 sign flag boards, as shown on the standard drawings, the plans, and 00225.02.

2. **Sign Flags** - Install at least 2 sign flags above all signs mounted on portable sign supports. Mount flags so the entire sign is visible.

(d) **Amber Flashers** - Use either 110/120 volt flashers or 12 volt rechargeable flashers.

(e) **Roll-up Signs** - Roll-up signs may be used at a single location for no more than 48 consecutive hours.

(f) **Inconsistent Temporary Signs** - Ensure that all temporary signs are properly used and consistent with the work zone. When signage is no longer required for staging or shift work, do the following:
• Remove from the road all temporary signs, supports, and ballast.
• Turn or cover the signs so that the message is not visible to any traffic.
• Remove or cover the sign flag boards.
• Remove or cover flags with an opaque, black, reflective sheath.
• Remove or turn off amber flashers.

When it is determined only minor work remains on the Project and the work area does not encroach on the roadway shoulder, do the following:

• Remove all temporary signs, supports, and ballast including the advance construction signs and sign flag boards.
• Provide signs for minor work on portable sign supports.

(g) Permanent Signing - Install the appropriate permanent signing as required before changing traffic control staging.

00225.42 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing - Install temporary barricades, guardrail, barrier, attenuators, pedestrian fencing, and accessories as follows:

(a) Barricades - Use and place barricades as shown or as directed.
(b) Guardrail - Construct temporary guardrail as shown and according to Section 00810.
(c) Concrete Barrier - When placing barrier adjacent to a road, maintain a minimum of 24 inches from face of barrier to edge of traffic lane. Flare the leading end as shown in the table below and treat ends as shown on the plans.

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Flare Rate</th>
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<tbody>
<tr>
<td>65</td>
<td>19:1</td>
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<tr>
<td>55</td>
<td>16:1</td>
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<tr>
<td>50</td>
<td>14:1</td>
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<td>45</td>
<td>13:1</td>
</tr>
<tr>
<td>40</td>
<td>11:1</td>
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</tbody>
</table>

Pin or restrain temporary concrete barrier when the distance behind the barrier is limited to less than 3 feet. When pinning or restraining barrier, maintain a minimum of 1 foot between the back face of barrier and a drop-off or obstruction. Use the appropriate pinning or restraint detail shown on the ODOT standard drawings.
(d) Impact Attenuators - Assemble and install impact attenuators according to the manufacturer's recommendations and as follows:

- May be placed on pallets, which are no more than 4 inches high, as approved.
- Place and fill the modules with the weight of dry sand as shown on the ODOT standard drawings.
- Mix salt with the sand to the proportions recommended by the manufacturer or at least 5% by volume when no manufacturer recommendations are given.
- Attach an object marker to the lead module as shown on the ODOT standard drawings.
- Use attenuators designed for the original preconstruction posted speed.
- For narrow site systems, pin or restrain the first two barrier sections as shown on the ODOT standard drawings.

(e) Glare Shields - Install glare shields as shown or as directed and according to the following:

- Install at spacing recommended by the manufacturer.
- Install all glare shield blades vertical and true to line.
- Firmly attach the base plate anchor bolts to the concrete barrier to withstand a 1,000 pound vertical pull and to prevent horizontal and rotational displacement. Maximum spacing between anchor bolts or modular units shall be 30 inches.
- Repair any damage to the concrete barrier caused by the Contractor's operations at no additional cost to the City.
- Modular or single element glare shields that are installed in a continuous run shall be of the same manufacture and of like appearance throughout the entire installation.

(f) Temporary Pedestrian Fencing - Install temporary pedestrian work zone delineation fencing as shown or directed.

(g) Reflective Barrier Panels - Install reflective barrier panels on temporary concrete barrier as shown or directed and as follows:

- Install 2 panels on each barrier section.
- Maintain a 4 foot gap between panels on each barrier section.
- Alternate silver-white and fluorescent orange color panels.
- Attach the panels to the face of the concrete barrier with a minimum of 4 anchors.
- Install the bottom edge of panels 20 inches above the bottom of the concrete barrier.
00225.43 Temporary Traffic Delineation - Install and remove temporary traffic delineation items and accessories as follows:

(a) Tubular and Conical Markers - Install tubular or conical markers as shown or directed.

Place tubular or conical markers no more than 10 feet apart along both sides of driveways, streets, and road connections within work areas.

Within individual runs of tubular or conical markers, use one shape for the entire run. Conical markers may substitute for tubular markers.

(b) Surface Mounted Tubular Marker - Install surface mounted tubular markers as shown or directed.

(1) Surface Mounted Tubular Marker Removal - Remove surface mounted tubular marker bases in a manner that leaves any remaining adhesive material with a textured surface condition similar to the texture of the surrounding top lift wearing course pavement surface. Make the surface dull and non-reflective. Remove adhesive from the pavement surface using a method that will not damage the pavement surface.

(c) Plastic Drums - Install plastic drums as shown or as directed.

(d) Delineators - Install traffic delineators as shown on the ODOT standard drawings or as directed. Install delineators on temporary concrete barrier and temporary guardrail as follows:

- Space on 50 foot centers. Closer spacing may be required as directed.
- Use yellow when installed on the left side of traffic.
- Use white when installed on the right side of traffic.
- Use bi-directional markers for median applications.
- Position to face oncoming traffic.

(e) Pavement Markers - Unless shown on the plans, install pavement markers as follows:

- Three single markers spaced 4.5 feet apart to simulate a 9 foot skip line with a gap of 15 feet to the next skip line.
- Single markers spaced 5 feet apart for solid, no passing lines.
- Double markers spaced 5 feet apart for double solid, no passing lines.

Use yellow markers for highway centerline. Use white markers for lines between adjacent lanes in the same direction of traffic.
Flexible pavement markers shall remain in place until the permanent striping is complete. Replace missing markers at no additional cost to the City. Remove the markers from the top lift of pavement within 5 days after the Contractor is notified of the placement of permanent markings through the work area. Remove the flexible paving markers without damaging the roadway surface, or cut the markers off within 1/8 inch of the roadway surface.

(1) **Reflective Pavement Markers** - Use reflective pavement markers when shown according to Section 00855. Establish alignment with control points at 50 foot intervals on tangents and at 25 foot intervals on curves.

(2) **Flexible Oiling Pavement Markers** - Use flexible oiling pavement markers just before applying asphalt for chip seals, sand seals, and oil mats. Remove marker covers before re-opening the roadway to traffic.

If a segment of roadway is not completed when the roadway is re-opened to traffic, install another set of markers just before the next application of asphalt.

(3) **Flexible Overlay Pavement Markers** - Use flexible overlay pavement markers as follows:

- On surfaces that do not require chip seals, sand seals, and oil mats.
- On underlying surfaces that temporarily carry traffic.
- When temporary striping is determined as not practical.

Install markers before opening the roadway to traffic. Remove the markers on underlying surfaces before placing the next surface layer.

(4) **Existing Pavement Marker Removal** - Remove and dispose of existing raised or recessed pavement markers as needed for Stage Construction or as directed. Remove the markers from permanent wearing course surfaces so the roadway surface is not damaged and a surface texture similar to that of the surrounding area remains. Make the surface dull and non-reflective. Remove adhesive from the pavement surface using a method that will not damage the pavement surface.

(f) **Temporary Tape** - Install temporary tape as shown and the following:

(1) **Temporary Removable Tape** - Install removable tape on existing surfaces or wearing course as shown or as directed. When staging across new bridge deck use temporary removable tape.

(2) **Temporary Non-Removable Tape** - Install non-removable tape on base courses as shown or as directed.

(3) **Temporary Non-Reflective Tape** - Install non-reflective tape over durable pavement markings to be retained as shown or directed.
(g) Temporary Striping - Before opening roadways to traffic, unless otherwise allowed, apply temporary painted stripes on pavement base courses and pavement markers on the wearing surface locations designated. Immediately remove all unacceptable striping and replace with acceptable striping at no additional cost to the City.

(1) Base Courses - On pavement base courses apply bead binder at a thickness of 15 mils wet, equivalent to 17 gallons/mile for a 4 inch wide solid line. Apply glass beads at a rate of 5 pounds/gallon of paint. Apply 4 inch wide by 9 foot long stripes with 15 foot gaps for skip striping. Apply 4 inch wide, continuous stripe for edge line striping.

(2) Wearing Course - On pavement wearing courses use pavement markers or temporary removable tape to simulate lane lines. When a travel lane is adjacent to temporary concrete barrier, replace the edge line with temporary removable tape, as directed. When striping the edge line, use a continuous strip of temporary removable tape.

(3) Durable Permanent Pavement Markings - On pavement wearing courses apply temporary striping for lane line delineation until durable permanent pavement markings can be applied, unless otherwise directed. Reduce the application rate to a thickness of 10 mils wet, equivalent to 12 gallons per mile for a 4 inch wide solid stripe. Apply reflective elements at a rate of 5 pounds per gallon of paint. Only one application is required. Place temporary striping directly adjacent to the final location of the durable permanent pavement markings. Place so that the durable permanent pavement markings can be aligned with the existing striping on the adjacent project. Removal of this striping is not required, if aligned as above.

When scheduled installation of durable permanent pavement markings will exceed, or will likely exceed, four weeks after placement of wearing surface, furnish and place temporary striping at the standard rate stated in 00225.43(g)(1). Removal of this striping is not required, if aligned as above.

(h) Pavement Edge Delineation - Place tubular or conical markers to delineate the edge of pavement when construction work obscures the painted shoulder stripe (fog line) or when paving creates an abrupt or sloped edge drop-off 1 inch or more in height along the shoulder. Locate and maintain the markers as follows:

- Between existing delineators.
- Space markers as shown for traffic delineators on the ODOT standard drawings, except do not exceed 50 feet on tangent or 25 feet on curves.
- Patrol daily and restore them to their proper position at least once in the early morning and once in the late afternoon until the tubular or conical markers are no longer required.
• Remove after a new edge stripe has been painted and new delineators are in place.
• Between traffic and the abrupt edge.
• Place delineation immediately.

(i) Stripe and Legend Removal - When removing striping and legends for stage construction, remove them by sandblasting, hydro-blasting, steel shot blasting, or grinding so the pavement surface is not damaged below a depth of 1/8 inch. Remove durable markings and durable legends by steel shot blasting or grinding the pavement surface to a depth no greater than 1/8 inch, or other approved method so the pavement surface is not damaged. Do not use paint or asphalt to cover existing stripes. Repair any damaged surfaces to the Engineer's satisfaction at no additional compensation.

Use vacuum shrouded equipment or other equally effective containment procedures.

Contain and collect all removed paint, durable markings, and spent abrasive and dispose of according to 00290.20.

Remove striping on pavement base courses when a change in striping is necessary and when the pavement will not be covered with an additional base course. Remove striping and pavement markers on the wearing course so that the permanent markings can be applied. Remove all remaining striping and pavement markers from the wearing course after the permanent markings have been applied, as directed.

Coordinate all removal work with the construction activity. Remove striping, legends, and pavement markers during the same day(s) the traffic shift is accomplished unless otherwise approved.

00225.44 Temporary Illumination - Construct and remove temporary illumination according to the plans, and Sections 00950, 00960, 00970, 02920, and 02925.

00225.45 Traffic Signals - Provide traffic signals according to the following:

(a) Temporary Traffic Signals - Construct and remove temporary traffic signals as shown according to the plans, Sections 00950, 00960, 00980, 02920 and 02925 and the following:

(1) Removal - Remove the temporary traffic signal when directed. Remove all wood poles and guy anchors in their entirety. Abandon vehicle detector loops in place. Contractor furnished equipment remains the property of the Contractor.

(2) Power Service - Be responsible for utility coordination, hook-up, and power consumption.

(3) Wood Poles - Backguy wood poles so that they are vertical with all dead loads applied.
(4) **Suspension of Heads** - Adapt signal mounting hardware as needed for mounting on wood poles.

(5) **Testing and Turn-on** - Certify that all traffic signal controllers and related control equipment for temporary signals have passed the Oregon Department of Transportation laboratory tests. Successfully tested controllers and related control equipment will be assigned permanent certification tags and will not require further environmental testing. Deliver controllers to the Traffic Signal Services Unit for functional testing.

(b) **Portable Traffic Signals** - Unless otherwise indicated in the TCP, provide and install portable temporary traffic signals as shown on the standard drawings and the following:

1. **Location and Setup** - Locate and set up portable temporary traffic signals according to the following:
   - Locate the portable temporary traffic signal so that one vehicle signal head is directly over the traveled way with minimum vertical clearances of 17 feet.
   - Provide conflict monitoring of green and yellow field indications.
   - If there are indications in conflict or if there is operational failure, set the default to red flash.
   - Hardwire interconnect the two units for timing and conflict monitoring.
   - Provide cellular or other immediate methods of failure notification.

Do not install portable temporary traffic signals if driveways or road approaches are between the portable temporary traffic signals.

2. **Vehicle Detection** - Provide vehicle detection at the stop line for each direction of traffic.

3. **Testing and Turn-on** - Notify the Engineer 14 calendar days before turning on the portable temporary traffic signal. The Engineer will do the following:
   - Inspect the installation and confirm the date and time the portable traffic signal is to be turned on.
   - Notify the Contractor, in writing, with a list of deficiencies that need correction.
   - Provide timing parameters to the Contractor for input into the portable temporary traffic signal.
Correct all deficiencies identified by the Engineer before turning on the portable temporary traffic signal. Do not change the timing parameters without the approval of the Engineer. Use flaggers to control traffic during initial turn on of the signal. The flaggers shall remain on standby for 2 hours after the signal is turned on and operating properly.

Correct deficiencies at no additional cost to the City.

(c) Existing Traffic Signals - Adjust existing traffic signals according to the plans and Sections 00950, 00960, 00990, 02920, and 02925.

00225.46 Temporary Electrical Items - Provide and install electrical resources as follows:

(a) Sequential Arrow Signs - Use the sequential arrow signs as follows:

- Mount at a height of 7 feet from bottom of sign to ground.
- Do not use on 2-Lane, 2-Way roadway.
- For shoulder work use caution mode only.
- Provide a solar/battery power source.

(b) Portable Changeable Message Signs (PCMS) - Use PCMS as follows:

- Mount at a height of 7 feet from bottom of sign to ground.
- Entire message is displayed within 7.5 seconds.
- Use a maximum of 2 panels to display an entire message.
- Separate 2 PCMS used in sequence by 1,000 feet minimum.
- Messages shall not scroll horizontally or vertically across the face of the sign.
- When the PCMS is not displaying appropriate messages, as directed, remove the PCMS from the roadway and locate the device outside the clear zone.
- Provide a solar/battery power source.
- Use clear, concise messages, approved by the Engineer, that convey applicable work zone information to the motorist.
- Protect PCMS according to the ODOT standard drawings.

(c) Temporary Power Source - Arrange for, provide, and pay for all electrical power.

00225.47 Flaggers and Flagger Station Lighting - Use flaggers and flagger station lighting as follows:

(a) Flaggers - Locate flaggers far enough in advance of the work area to permit adequate time for the motorist to respond to the flagger's instructions. All flaggers, including advance flaggers, shall use a STOP/SLOW paddle. Do not use the roll-up STOP/SLOW paddle for non-emergency flagging operations.
During advance flagging operations, only display the SLOW face of the paddle by covering the STOP face of the paddle with black, opaque, nonreflective material.

Position flaggers, as directed, at locations where traffic can enter the highway within the limits of the work zone. Flaggers shall direct vehicles entering the highway to follow the pilot car line.

Flagging stations shall be staffed continuously or until the Engineer determines flagging is no longer required.

(b) Flagger Station Lighting - Provide continuous flagger station lighting for nighttime flagging as follows:

- Locate the light equipment on the same side of the roadway as the flagger between 5 to 10 feet from the edge of the travel lane, on or beyond the roadway shoulder, or as directed.
- Place the flagger station lighting to direct the lighting away from the approaching traffic in the near lane at approximately a 15° horizontal angle ±10° perpendicular to the centerline of the roadway.
- Aim all of the luminaires directly at the flagger.
- Increase the output wattage or number of luminaires as the luminance from, and number of, surrounding and background lights increases. Do not provide a total output more than 2,500 watts, unless otherwise directed.

00225.48 Traffic Control Supervisor - Supervise the safe operation of traffic control within the construction work zone.

00225.49 Pilot Cars - Operate pilot cars at a safe and prudent speed.

00225.50 Temporary Pedestrian Walkways - Construct temporary pedestrian access shown on the traffic control plans where the crosswalks and sidewalks have been excavated in the Project. Transitions from the temporary walk to the sidewalks shall comply with the Americans with Disabilities (ADA) regulations.

Maintenance

00225.60 Temporary TCD - Evaluate the condition of TCD and maintain them using the criteria shown in the current American Traffic Safety Services Association (ATSSA) publication titled "Quality Guidelines for Work Zone Traffic Control Devices". Except for electrical devices, replace all TCD that are in marginal or unacceptable condition with equal devices, in new or acceptable condition, within a time period agreed upon by the Engineer.

Electrical devices that are in marginal or unacceptable condition may be repaired instead of being replaced, as long as the repairs are satisfactorily completed within a time period agreed upon by the Engineer.
The replacement or repair of TCD, found to be in marginal or unacceptable condition, shall be made at no additional cost to the City except as in 00225.90(a)(1).

Evaluate, maintain, repair or replace TCD, and perform other duties including the following:

- Keep the devices in proper position, clean, and legible at all times.
- Keep lights, reflectors, and flashers clean, visible, and operable during both daylight and darkness.
- Trim or remove vegetative growth or other materials so the devices can be seen.
- Verify by inspection, the effectiveness of the installations at frequent intervals, both in daylight and darkness, at actual travel speeds.
- Repair, replace, or restore damaged or destroyed devices to maintain continuity and effectiveness.
- Maintain temporary TCD during suspensions of work the same as if work were in progress.

00225.61 Signs and Other Existing TCD - Maintain existing guide signs, warning signs, regulatory signs, specific service signs (business logos), TODS, and other existing TCD, in the same manner as temporary signs and devices associated with the Project.

00225.62 Temporary Concrete Barrier, Guardrail and Attenuators - Maintain or replace materials and equipment as follows:

(a) Temporary Concrete Barrier and Guardrail - Immediately repair any concrete barrier segment or guardrail element that is damaged by the Contractor during or after placement. Repair it to the Engineer's satisfaction or replace it with an undamaged section at no additional cost to the City.

(b) Temporary Impact Attenuators - Complete repair of damaged temporary impact attenuators, except for narrow site systems, within 24 hours of being notified of the damage. Complete repair of damaged narrow site systems within 4 hours of discovery of or of being notified of the damage.

When impact attenuator, truck mounted attenuator, or narrow site attenuator systems are used, have enough modules, cartridges, components, and replacement parts on site to replace one complete installation. Re-stock replacement parts within 24 hours of use. All modules, cartridges, components, and replacement parts not used, remain the property of the Contractor.
00225.64

Replace damaged modules, cartridges, components, and replacement parts with modules, cartridges, components, and replacement parts of the same manufacturer and type, and with attenuation capabilities equal to the original, installed system.

00225.64 Illumination and Sign Illumination - Maintain existing illumination and sign illumination after adjusting or working on them until accepted.

Routine maintenance of existing illumination and sign illumination will be performed by the Agency at the Agency's expense before the Contractor works on them and after work on them is completed and accepted.

00225.65 Traffic Signals - Maintain or replace materials and equipment as follows:

(a) Temporary Traffic Signals - After successful turn-on, assume all maintenance of the temporary traffic signal installation until it is removed. After notification by the City, if the Contractor is not able to respond to a maintenance request, City electricians will make repairs at the Contractor's expense.

(b) Portable Traffic Signals - After successful turn-on, perform all required maintenance during operation of the portable traffic signal. Maintain a log for each portable traffic signal that contains at least the following information:

- Dates and times when service and maintenance is performed.
- A description of equipment that was serviced and a brief description of why the service was performed.
- All operational and equipment failures of the unit.
- Repairs made to the unit.
- Past operational history of the unit.
- All timing parameters input into the controller.

The log shall remain with the corresponding portable traffic signal at all times.

The City will not replace or repair any part of portable traffic signals.

If the portable traffic signal fails during operation for any reason, immediately provide flaggers to control traffic until the portable traffic signal is operational. If the portable traffic signal fails a second time within 30 calendar days of the first failure, remove it from the Project and control traffic with flaggers until a replacement portable traffic signal is installed, activated, and working properly. No additional payment will be made for flagging as a result of a portable traffic signal failure.

(c) Existing Traffic Signals - Maintain existing signals after adjusting or working on them until accepted.
Routine maintenance of existing signals will be performed by the City at the City's expense before the Contractor works on them and after work on them is completed and accepted.

**00225.66 Portable Electrical Signs** - Maintain and use the required portable changeable message signs and sequential arrow signs according to the manufacturer's recommendations, traffic control plans, and as required. Do not display or alter any sign message before it is approved.

While portable changeable message signs and sequential arrow signs are in use, have repair equipment and parts on the Project site as recommended by the manufacturer.

When directed, repair or replace sequential arrow signs and portable changeable message signs that are damaged or destroyed before continuing work that requires use of the signs.

**00225.67 Flagger Station Lighting** - Maintain and use the required flagger station lighting according to the manufacturer's recommendation and as required.

When flagger station lighting is in use, have on the Project site, the following:

- Repair equipment and electronic components recommended by the manufacturer.
- At the beginning of each shift, have approved backup flagger station lighting available for immediate use in event of failure.
- Sufficient fuel to maintain continuous operation of the diesel generator.

**00225.68 Temporary Pedestrian Walkways** - Keep walking surfaces clean of debris at all times. Inspect non-skid surfaces weekly for signs of wear and correct as needed. Check slope of transition from walkway to sidewalk for compliance with ADA regulations each time walkway is adjusted or relocated.

**Measurement**

**00225.80 Measurement** - Work covered under this Section will be measured by one of the following methods:

- **Method "A" - Unit Basis** - Under this method, work zone traffic control measures will be measured according to 00225.80(a) through 00225.89.
- **Method "B" - Lump Sum basis** - Under this method, no measurement of quantities will be made.
- **Method "C" - Incidental Basis** - Under this method, no measurement of quantities will be made.
(a) **Quantity Limitations** - The quantities for work zone traffic control measures (TCM) will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.
- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM, except temporary signing, temporary electrical signs, and portable temporary traffic signals, damaged by public traffic and replaced by the Contractor.

Temporary signing, temporary electrical signs, and portable temporary traffic signals damaged by public traffic and replaced or repaired by the Contractor will not be measured.

(b) **Temporary Protection and Direction of Traffic** - No measurement of quantities will be made for this work.

00225.81 **Temporary Signing** - Quantities for temporary signing and flashers will be determined as follows:

(a) **Signs** - Temporary signs will be measured on the area basis upon delivery to the Project. The quantities will be limited to those in the approved TCP including speed zone signage. The sign area will be the nominal area determined by multiplying the width times the length. No deductions will be made for corners or irregular shapes.

Route markers and other signs fastened to the face of larger signs will be measured as separate signs.

(b) **Amber Flashers** - Amber flashers will be measured on a unit basis.

00225.82 **Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing** - The quantities of barricades, attenuators, guardrail, concrete barrier, and pedestrian fencing will be determined as follows:

(a) **Barricades and Attenuators** - Barricades, temporary impact attenuators, and moving temporary impact attenuators will be measured on a unit basis.

(b) **Guardrail, Concrete Barrier, and Pedestrian Fencing**:

1. **Guardrail** - Temporary guardrail will be measured on the length basis of each type complete and in place, determined by one of the following methods:
a. **Count Method** - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a “standard section” is defined as 12 1/2 feet of complete guardrail, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post and added to the total calculated length of the standard sections of each run.

b. **Length Method** - Measurement will be from center to center of end posts, along the line and grade of each run of each type.

2) **Guardrail Terminals, Transitions, and Bridge Connections** - Temporary guardrail terminals, temporary guardrail transitions, and temporary bridge connections will be measured on a unit basis.

3) **Concrete Barrier** - Quantities of temporary concrete barrier and moving temporary concrete barrier will be measured on the length basis determined by one of the following methods:

   a. **Count Method** - The laying length of a standard section, as shown on the applicable ODOT standard drawing, multiplied by the number of standard sections installed in each separate run. Non-standard sections, terminal sections, and transition sections will be measured and added to the total length of standard sections.

   b. **Length Method** - Measurement will be from end to end of the barrier along the line and grade of each run.

4) **Pedestrian Fencing** - When pedestrian fencing is shown, the work will be measured according to Section 00270.

(c) **Glare Shields** - Glare shields and moving glare shields will be measured on the length basis from center to center of the glare shield blades, as installed on concrete barrier for each run.

(d) **Reflective Barrier Panels** - Reflective barrier panels will be measured on the unit basis.

00225.83 **Temporary Traffic Delineation** - Quantities for temporary traffic delineation will be determined as follows:

(a) **Surface Mounted Tubular Markers, Plastic Drums, Delineators, and Pavement Markers** - Surface mounted tubular markers, replacing surface mounted tubular markers, plastic drums, temporary delineators, reflective pavement markers, and flexible pavement markers will be measured on a unit basis.

Flexible pavement markers includes flexible oiling markers and flexible overlay markers.
(b) **Temporary Tape** - Temporary tape will be measured on the length basis, to the nearest foot, as follows:

1. **Removable** - Removable tape will be determined by measuring the actual length of the 4 inch wide tape complete and in place.

2. **Non-Removable Tape** - Non-Removable tape will be determined by measuring the actual length of the 4 inch wide tape complete and in place.

3. **Non Reflective Tape** - Temporary non-reflective tape will be determined by measuring the actual length of the 6 inch wide tape complete and in place.

(c) **Striping** - Painted temporary striping on pavement base courses will be measured on the length basis, to the nearest foot, determined by measuring the actual length of 4 inch wide stripe complete and in place.

Temporary striping required for durable permanent pavement marking installation will be included in the measurement.

Skip intervals will not be included in the measurement.

Temporary striping will be measured on the length basis of lines based on a nominal width of 4 inches. If the plans call for, or the Engineer requires, stripes other than nominal 4 inch width, the measurement will be adjusted by converting to equivalent length of nominal 4 inch width.

(d) **Stripe Removal and Legend Removal** - Stripe removal and legend removal will be measured as follows:

1. **Stripe Removal** - Stripe removal for stage construction will be measured on the length basis, to the nearest foot, determined by measuring the overall length of 4 inch line removed. The quantity of stripe removal will be the computed length of lines removed based on a nominal width of 4 inches. For computation purposes, the following apply:

   - The width of a line is the normal standard line width applied during original placement of solid no-passing lines, broken (skip) lines, edge lines, and any other lines normally 4 inches wide.
   - The length of continuous lines is length of the line.
   - The length of broken (skip) stripes is the standard length of a skip line normally painted during original placement of the lines 9 feet of paint per 24 feet of roadway length.

The length of standard 8 inch or 12 inch wide stripes will be adjusted by converting to equivalent length of 4 inch width line. No conversion or adjustment will be allowed for lines that are wider or longer due to improper placement or retracing deviations.
(2) **Legend Removal** - Pavement legend removal for stage construction will be measured on the area basis, of each legend removed and will be the nominal area determined by multiplying the width times the length of the legend. No deductions will be made for corners or irregular shapes.

(e) **Striping and Stripe Removal Mobilization** - Striping and stripe removal mobilization will be measured on a unit basis for mobilization to perform striping, stripe removal, or durable stripe removal or for mobilization to place or remove temporary flexible pavement markers.

00225.84 **Temporary Illumination** - No measurement of quantities will be made for temporary illumination.

00225.85 **Traffic Signals** - The quantities of traffic signals will be measured as follows:

(a) **Temporary Traffic Signals** - No measurement of quantities will be made for temporary traffic signals.

(b) **Portable Traffic Signals** - Portable traffic signals will be measured on the unit basis, for each complete system. A complete system consists of 2 portable temporary traffic signals and hardwire interconnect between them.

00225.86 **Temporary Electrical Signs** - The quantities for temporary electrical signs will be measured as follows:

(a) **Sequential Arrow Signs** - Sequential arrow signs will be measured on the unit basis, where the devices are initially installed on the Project.

(b) **Portable Changeable Message Signs** - Portable changeable message signs will be measured on the unit basis, where the devices are initially installed on the Project.

00225.87 **Flaggers and Flagger Station Lighting** - The quantities of flaggers and flagger station lighting will be measured as follows:

(a) **Flaggers** - Flaggers will be measured on the time basis, of the actual number of hours flagging stations are staffed. Flagging performed by a TCS will not be measured.

(b) **Flagger Station Lighting** - Flagger station lighting will be measured on the unit basis, where the devices are initially installed on the Project or on the time basis, of the actual number of hours the flagger stations are staffed and flagger station lighting is required. No measurement will be made for the backup unit in event it is used or not.

00225.88 **Traffic Control Supervisor (TCS)** - The quantities of the TCS will be measured on the time basis, of the actual number of hours the TCS is working on the Project.
For the purpose of determining TCS time, TCS hours will be any work shift or portion of a work shift where any of the following operations occur:

- Full lane closures or lane shifts implemented on a daily basis on a City street with an ADT greater than 10,000.
- When TCS is called to respond to a traffic-related issue during non-work hours.
- Other construction operations as requested by the Engineer.

A maximum quantity of 2 TCS construction work shifts will be allowed for each 24 hour period. One TCS will be allowed for a construction work shift unless otherwise approved. Quantities will be limited to time authorized and documented by a daily Traffic Control Report submitted by the end of the next working day.

**00225.89 Pilot Cars and Temporary Pedestrian Walkways** - Quantities for pilot cars and temporary pedestrian walkways will be determined as follows:

(a) **Pilot Cars** - The quantity for pilot cars will be measured on the time basis, of the actual number of hours pilot cars are operated.

(b) **Temporary Pedestrian Walkways** - Quantities of temporary pedestrian walkways will be measured from end to end of the walkway along the line and grade of each run including the wooden transitions on each end of the walkway.

**Payment**

**00225.90 Payment** - Work covered under this Section will be paid by one of the following methods:

(a) **Method "A" - Unit Basis:**

(1) **Pay Quantities** - The accepted quantities, measured according to 00225.80(a) through 00225.89, will be paid for at the Contract lump sum amount or Contract unit price per unit of measurement for each of the pay quantities listed in the Contract Schedule of Items and in approved change orders.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the materials and TCD, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified, except as covered in 00225.90(a)(2).
All TCD damaged by public traffic and replaced by the Contractor, except temporary signing, temporary electrical signs and portable temporary traffic signals will be paid for at the Contract price for the pay items listed in the Contract Schedule of Items or in approved Contract change orders, unless otherwise specified. Replacement temporary impact attenuator component(s) will be paid for according to Section 00196. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.
- The damaged devices are disposed of to the Engineer's satisfaction.

No separate or additional payment will be made for:

- Moving and reinstalling signs, barricades, plastic drums, delineators, sequential arrow signs, and portable changeable message signs required by stage construction.
- Providing TCM, including flaggers, used at material sources and disposal sites that are outside the Contract limits unless specifically called for on the plans or in the Special Provisions.
- Providing portable signs when only minor work is required as indicated in 00225.41(f).
- TCD damaged or destroyed by Contractor's equipment or operations.

(2) Temporary Protection and Direction of Traffic - Temporary protection and direction of traffic will be paid for at the Contract lump sum amount for the item "Temporary Protection and Direction of Traffic" and will be for:

- Positioning all traffic control devices in proper locations at all times.
- Providing and furnishing electrical power.
- Cleaning up and removing devices destroyed or damaged by public traffic.
- Furnishing, placing, maintaining and removing temporary sign covers.
- Moving temporary concrete barrier to and from Contractor's stockpile areas.
- Moving temporary impact attenuators of any type to and from Contractor's stockpile areas.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers.
- Removing existing raised and recessed pavement markers.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers used to delineate the pavement edge because of edge line obliteration.
• Moving and removing existing signs, specific services signs (business logos) and TODS from their existing locations and reinstalling them on any type of support at new locations required by stage construction, as shown or directed.

• Moving, reinstalling, and removing existing post-mounted signs required by stage construction.

• Furnishing, installing, maintaining, moving, and removing pedestrian work zone delineation fencing.

• Providing, surfacing, maintaining, removing, and restoring the alternate pedestrian route.

• Providing, moving, reinstalling, and removing guardrail end pieces and guardrail anchors as required by stage construction.

• Performing routine inspections of the TCD by the TCS.

(b) Method "B" - Lump Sum Basis - Work zone traffic control will be paid for at the Contract lump sum amount for the item "Temporary Work Zone Traffic Control, Complete".

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing materials and TCD, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

(c) Method "C" - Incidental Basis - When the Contract Schedule of Items does not indicate payment for work zone traffic control, all work zone traffic control will be considered Incidental and no separate payment will be made.

00225.91 Temporary Signing - The accepted quantities of temporary signing and appurtenances will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Temporary Signs</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Amber Flashers</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) includes all signs, regardless of type.

No separate or additional payment will be made for flags, sign flag boards, or posts and other supports.

00225.92 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Walkways - The accepted quantities of temporary barricades, guardrail, barrier, attenuators, and appurtenances will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Temporary Barricades, Type</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Temporary Guardrail, Type Reflectorized</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Temporary Guardrail Terminals</td>
<td>Each</td>
</tr>
</tbody>
</table>

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In item (a), the type of barricade will be inserted in the blank.

In items (b) and (c), the type of guardrail or terminal will be inserted in the blank.

Items (d) and (e) includes each device, regardless of size or type.

Items (f) and (g) includes Type 5 delineators. No separate or additional payment will be made for pinning or restraining barrier.

Item (h) includes moving temporary concrete barriers, regardless of size or type, from one location of actual use to another, and for removing and replacing Type 5 delineators on the barriers, as necessary.

In items (i) and (j), the type of attenuator, if applicable, will be inserted in the blank.

Item (j) includes each move of the device from one location of actual use to another.

Item (l) includes moving the devices from one location on the concrete barrier to another.

Item (m) includes panels installed on the concrete barrier and replacing damaged panels.

Item (n) includes transitions. No separate payment will be made for adjusting walkways as needed during construction.

No separate payment will be made for temporary impact attenuator replacements, replacement modules, cartridges, components, or replacement parts.

When temporary pedestrian fencing is installed, the work will be paid for according to Section 00270.

**00225.93 Temporary Traffic Delineation** - The accepted quantities of temporary traffic delineation will be paid for at the Contract unit price, per unit of measurement, for the following items:
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Surface Mounted Tubular Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Replace Surface Mounted Tubular Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Temporary Plastic Drums</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Temporary Delineators</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Temporary Reflective Pavement Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Temporary Flexible Pavement Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Temporary Removable Tape</td>
<td>Foot</td>
</tr>
<tr>
<td>(h) Temporary Non-Removable Tape</td>
<td>Foot</td>
</tr>
<tr>
<td>(i) Temporary Non-Reflective Tape</td>
<td>Foot</td>
</tr>
<tr>
<td>(j) Temporary Striping</td>
<td>Foot</td>
</tr>
<tr>
<td>(k) Stripe Removal</td>
<td>Foot</td>
</tr>
<tr>
<td>(l) Legend Removal</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(m) Stripping and Stripe Removal Mobilization</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) includes furnishing and installing the complete assembly of each device in its initial location and for removing the device from the surface.

Item (b) includes furnishing new or refurbished devices to replace damaged or missing devices.

Item (e) includes temporary pavement markers having either one or two reflective faces.

Item (f) includes removing flexible pavement marker covers.

Item (k) includes removal of painted and durable stripes required for stage construction.

Item (l) includes removal of durable and non-durable legends required for stage construction.

Payment for items (g), (h), (i), and (j) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

Item (m) is for each time the Contractor mobilizes as required for striping or stripe removal.

No separate or additional payment will be made for mobilization to perform legend removal, or for mobilization to place or remove temporary flexible pavement markers.

00225.94 Temporary Illumination - The accepted quantities of temporary illumination will be paid for at the Contract lump sum amount for the item "Temporary Illumination".

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### Traffic Signals
The accepted quantities of traffic signals will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Temporary Traffic Signal</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Portable Traffic Signal</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) includes all required materials called for by the plans and Specifications.

Item (b) includes furnishing, operating, moving, and removing the signals and all required earthwork, bases, surfacings, and hardwire interconnects.

No separate or additional payment will be made for removing and replacing damaged portable traffic signals.

Flagging for initial turn-on and 2 hour standby time will be paid for under the flagger pay item.

### Temporary Electrical Signs
The accepted quantities of temporary electrical signs will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Sequential Arrow Signs</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Portable Changeable Message Signs</td>
<td>Each</td>
</tr>
</tbody>
</table>

Items (a) and (b) includes furnishing, operating, moving, and removing the signs and supports.

No separate or additional payment will be made for removing and replacing damaged signs.

### Flaggers and Flagger Station Lighting
The accepted quantities of flaggers and flagger station lighting will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Flaggers</td>
<td>Hour</td>
</tr>
<tr>
<td>(b) Flagger Station Lighting</td>
<td>Each or Hour</td>
</tr>
</tbody>
</table>

Item (a) includes all necessary equipment, special apparel, flagging equipment, and two-way radios.

Workers performing flagging duties who are not properly equipped or attired will not be considered to be flaggers and will not be eligible for payment under this item.
Flaggers performing work other than flagging will not be considered flaggers and will not be eligible for payment under this item.

Payment for item (a) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

Item (b) includes furnishing, operating, moving, and removing the flagger station lighting.

No separate or additional payment will be made for back-up unit in event it is used or not.

**00225.98 Traffic Control Supervisor** - The accepted quantities of traffic control supervisor will be paid for at the contract unit price, per each for the item of "Traffic Control Supervisor".

Payment includes vehicle and equipment.

Payment for item "Traffic Control Supervisor" performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

When the Contract Schedule of Items does not indicate payment for Traffic Control Supervision work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

**00225.99 Pilot Cars** - The accepted quantities of pilot cars will be paid for at the Contract unit price, per hour for the item "Pilot Cars".

Payment will be payment in full for fully operated pilot cars, two-way radios, the "PILOT CAR FOLLOW ME" sign, and the rotating amber light mounted on the pilot car.

Payment for item "Pilot Cars" performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.
Section 00240 - Temporary Drainage Facilities

Description

00240.00 Scope - This work consists of furnishing, installing, and removing temporary drainage facilities.

Construction

00240.40 General - Furnish and install temporary drainage facilities of sufficient capacity and strength to carry traffic over the facility, and water flow in or under the facility. Determine the actual size, strength and type of facility needed. The sizes of facilities shown on the plans are the minimum only. Submit this determination and its basis to the Engineer for review. Do not install until approved.

Remove temporary drainage facilities when they are no longer needed. The facilities remain the property of the Contractor.

Measurement

00240.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00240.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Temporary Drainage Facilities".

Payment will be payment in full for furnishing, placing, maintaining, and removing temporary drainage facilities, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00270 - Temporary Fences

Description

00270.00  Scope - This work consists of constructing, maintaining, and removing temporary fences, gates, and gateways as shown or directed.

00270.01  Definitions:

Exclusion Zone - An area established by the City, an outside agency, or a private party having jurisdiction or ownership rights to prohibit work related activities from occurring in the specified area. An exclusion zone may include private property, an environmental conservation or protection zone, a waterway, a drainage reserve or a mitigation site.

Materials

00270.10  Material - Furnish materials meeting the following requirements:

- Barbed Wire ............................................................. 03010.10
- Chain Link Fabric...................................................... 03010.30
- Commercial Grade Concrete......................................... 00440
- Concrete Barrier ...................................................00225.12(c)
- Fence Gates .............................................................03010.60
- Fence Posts, Braces, and Appurtenances ................. 02110.30, 03010.50
- Gabion Wire Mesh Fabric......................................03010.70(i)
- Pickets...................................................................... 03010.31
- Wood Fence Posts and Braces ......................... 02110.30
- Woven Wire Fabric ...................................................03010.20

00270.11  Plastic Mesh - Use high-visibility orange colored extruded plastic mesh manufactured from polypropylene with a minimum weight of 4 ounces per square yard.

00270.12  Pedestrian Metal Barricade - Use galvanized metal interlocking vertical bar (bike rack style) barricades with V-foot or similar bases from the CPL. Install orange wooden kickboards on either side of the V-foot base along the length of each barricade to provide a caneable surface for sight impaired pedestrians and to reduce the tripping hazard.

Construction

00270.40  General - Construct temporary fences, gates, and gateways according to the applicable parts of Section 01050.

00270.41  Rock Protection Fence - Construct concrete barrier according to Section 00820. Attach fence to barrier as shown.

00270.42  Restrictions for Exclusion Zones - If the plans depict an exclusion zone adjacent to the project work limits, work is prohibited within this area.

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**Exclusion Zone** - Construct the temporary fencing to establish a visible barrier between the exclusion zone and the work limits. Extend the fencing beyond the limits of the exclusion zone where encroachment could occur as shown on the plans.

**Pedestrian Metal Barricade** - Use pedestrian metal barricades outside the clear zone unless the barricade has a certificate of crashworthiness for work zone devices or is approved.

**Maintenance**

**General** - Maintain temporary fences and appurtenances in good condition. Keep the fences in place until they are no longer needed.

**Exclusion Zones** - Inspect the condition of the exclusion zone fence daily. Maintain the fence for the project duration or until all work activity in the area closest to the encroachment zone is complete.

**Finishing and Cleaning Up**

**General** - When temporary fences and appurtenances are no longer needed remove and dispose of them according to the applicable parts of Section 00310 except fence fabric, fence wire, posts, and braces may be used in permanent fence installations if the following conditions are met:

- The material was new when installed for temporary purposes.
- The material has not been used on previous projects.
- The material meets the requirements of 01050.10.
- The material is undamaged.
- The material is acceptable to the Engineer.

**Measurement**

**Fence and Gateways** - The quantities of temporary fence will be measured on the length basis of each type of temporary fence. Gateways will be considered as fence of the type which adjoins them and will be measured as a continuing part of that type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed exclusive of gates.

**Gates** - The quantities of temporary gates will be measured on a unit basis per each by actual count regardless of size or type.

**Rock Protection Fence** - The quantities of barrier mounted rock protection fence will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run.
Payment

**General** - The accepted quantities of work performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Temporary Type ___ Fence</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Temporary ___ Chain Link Fence</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Temporary Type Orange Plastic Mesh Fence</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) Temporary Gates</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Temporary Rock Protection Fence, Barrier Mounted</td>
<td>Foot</td>
</tr>
<tr>
<td>(f) Temporary Pedestrian Metal Barricade Fence</td>
<td>Foot</td>
</tr>
</tbody>
</table>

In items (a) and (b) the type of fence will be inserted in the blank.

No separate payment will be made for moving and reinstalling fence required by stage construction.

Payment will be payment in full for furnishing, placing, moving, maintaining, and removing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00275 - Trench Protection

Description

00275.00 Scope - This work consists of furnishing, installing, maintaining, and removing temporary plating or fencing for utility trenches and similar work as shown or directed.

Materials

00275.10 Plating - Furnish material meeting the requirements of 02530.20 in grade A-36 or better.

00275.11 Plating Coating - Furnish a plating coating from the CPL.

00275.12 Fencing - Furnish chain link fencing material meeting the requirements of Section 03010.

Construction

00275.40 General - Provide temporary backfill and pavement when excavation are over 12 inches in depth and will be left unattended overnight. If approved, use temporary fencing or steel plating in lieu of temporary backfill and pavement. The use of steel plating shall not exceed one week in any one location.

Install temporary plating such that the roadway or sidewalk is available for access during non-working hours.

Do not use temporary plates if the forecast temperature is to be less than 35 °F or on grades greater than 8% slope unless otherwise directed.

00275.41 Signage - Provide advance warning signage for all motorists, cyclists, and pedestrians warning them that a temporary plate is in use.

00275.42 Plate Thickness and Span - The following table list the minimum plate thickness and maximum trench span for an AASHTO HS20-44 load configuration.

<table>
<thead>
<tr>
<th>Plate Thickness Minimum</th>
<th>Trench Span Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>2 ft - 6 in</td>
</tr>
<tr>
<td>7/8 inch</td>
<td>3 ft - 4 in</td>
</tr>
<tr>
<td>1 inch</td>
<td>4 ft - 5 in</td>
</tr>
<tr>
<td>1 1/4 inch</td>
<td>7 ft - 0 in</td>
</tr>
<tr>
<td>1 1/2 inch</td>
<td>10 ft - 0 in</td>
</tr>
</tbody>
</table>

If the span is greater than 10 feet, submit a stamped, engineered temporary plating plan for review. Multiple stacked plates are not allowed.

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Plate Placement - Install plates in the following manner:

- Pin temporary plates to prevent movement under traffic.
- Ramp edges of temporary plates with asphalt concrete pavement to provide a smooth transition.
- On uneven or crowned streets, shim the temporary plate.
- Plates shall be in full contact with undisturbed ground/surface for a minimum of 2 feet on either side of the trench.

Anti-skid Coating Application - Apply a coating to temporary plates as an anti-skid surface treatment when plates are subject to cyclist or pedestrian traffic.

Maintenance

General - Maintain temporary plating or fencing in good condition. Re-align any plates that have been moved by traffic. Re-apply any missing anti-skid coating.

Measurement

No measurement of quantities will be made for temporary plating or fencing.

Payment

No separate or additional payment will be made for temporary plating or fencing. Payment will be included in payment made for the appropriate items under which this work is required. Advance warning signs will be paid for according to Section 00225.
Section 00280 - Erosion and Sediment Control

Description

00280.00 Scope - This work consists of implementing structural and non-structural Best Management Practices (BMP) for the purpose of controlling soil erosion by wind or water and keeping eroded sediments and other construction-generated pollutants from moving off project sites.

Requirements described in these Specifications and shown on the plans are part of the project Erosion and Sediment Control Plan (ESCP) and are the minimum for all project construction sites and conditions. These Specifications cover all project activities performed under the authority and jurisdiction of the City, including material sources, disposal sites, staging areas, and off-site mitigation areas unless specific project activities are excluded elsewhere in these Specifications or in the City approved documents controlling the work.

00280.01 National Pollutant Discharge Elimination System - Comply with Federal, State, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) 1200 Permit or Permits applicable to the Project. A copy of the City's General Construction 1200 CA, if applicable to the Project, is available from the City.

00280.02 Erosion and Sediment Control Plan on City Control Lands - For work on City-controlled lands, submit signed copies of the following for review and approval 10 days before the preconstruction conference:

- A Contractor-developed "construction" ESCP that incorporates the City's ESCP and all proposed modifications to it that fully comply with NPDES 1200 Permits applicable to the project.
- A narrative as described in the NPDES 1200 Permit and the City Erosion Control Manual.
- Implementation schedules for the ESCP based on each phase of the contractor's construction schedule.

The ESCP and the implementation schedules shall be prepared by an individual who is knowledgeable in erosion and sediment control.

Keep a copy of the approved ESCP on site during all construction activities. During inactive periods longer than 7 calendar days, the ESCP shall be on site.

Do not begin work until the ESCP and the implementation schedules are approved.

Update the ESCP and schedules as needed for unexpected storm events or for other reasons to ensure that sediment-laden water does not leave the construction site. Add approved changes to the ESCP and schedules as soon as possible after changes have been implemented, but no later then 24-hours after implementation.
A City-developed ESCP is typically furnished as part of a conventional contract plan set, which helps fulfill part of the ESCP requirement of the Permit. This initial ESCP, when adopted by the Contractor, may be used as the basis of the construction ESCP. Additional or revised erosion and sediment control features, not shown on the initial ESCP, may be required depending on the Contractor's methods of operation and schedule. To assist in the preparation or modification of the ESCP, refer to the current version of the City's Erosion and Sediment Control Manual along with Title 10 of the City Code.

For each phase of the scheduled work, indicate on the ESCP all the BMP proposed and installed for erosion and sediment control to minimize clearing, stabilize exposed soil, divert or temporarily store flows, limit runoff from exposed areas, and filter transported sediment. Include all temporary slopes, constructed for staging or other reasons, which may not have been identified in the original contract plans. For assistance in preparing or modifying the ESCP, refer to the current City Erosion Control Manual.

Some ESCP required elements typically required by NPDES 1200 Permits:

(a) Narrative Site Description:

- Nature of the construction activity planned for the site
- Estimates of total site area and the areas of the site expected to be disturbed
- Soil types found on the site and their erosion potential
- The types of fill materials to be used
- Timetable for sequence of major construction events
- Off-site dewatering

(b) Site Map:

- All areas of development
- Drainage patterns
- Areas of soil disturbance, including pre-development and post-development elevation contours
- Areas used for storage of soils or wastes
- Areas where vegetative practices are to be implemented
- Location of all erosion and sediment control BMP or structures
- Location of all impervious structures and surfaces after project is completed
- Springs, wetlands, other surface waters, and environmental zoning located on site
- Boundaries of the 100 year floodplain, if determined
- Ordinary High Water line, if determined
- Location of storm drainage outfalls to receiving waters, if applicable
- Details of sediment and erosion controls
• Details of detention ponds, storm drain piping, inflow and outflow details
• Topography of areas greater than 10% slope

(c) Required BMP and Procedures for Erosion Prevention, Runoff Control, and Sediment Control:

• Construction entrances and parking areas
• Unpaved site roads such as haul roads
• Hauling saturated soils from the site
• Water washed from concrete trucks
• Correct installation of erosion and sediment control BMP (contract documents and City references such as these Specifications may be cited as installation standards if applicable)
• Prompt maintenance and repair of BMP
• Clearing and grading practices to minimize area of exposed soil throughout the life of the project
• Schedule of phased clearing operations to limit soils to what can be stabilized
• Vegetative practices including preservation of existing vegetation, seeding, mulching, and buffer strips
• Preventing erosion of exposed areas
• Diverting flows from exposed slopes
• Limiting runoff from exposed areas
• Limiting sediment transport within work sites and keeping it from moving off of project areas
• Perimeter controls for all clearing and grubbing, both planned and installed
• Additional controls for wet season work and temporary work suspensions
• Sensitive areas such as wetlands
• Off site material source and waste areas
• Dust
• Emergency materials stockpiled on site
• Storing flows,\ and filtering sediment
• Stockpiles
• Dewatering

Ensure that the Contractor's construction ESCP and implementation schedules are prepared by an individual who meets qualifications of 00280.30. Furnish a signed copy of the ESCP with individual's name, title, state certifications, and employing firm if different than Contractor's firm.
00280.03 Non-City Controlled Lands ESCP - For work on non-City controlled lands, in addition to the requirements of 00280.02, submit the following for review 10 days before the preconstruction conference:

- A Contractor-developed ESCP for each unique site covered under project NPDES 1200 Permits.
- A description of how the ESCP will be implemented and monitored on these sites.
- A complete list of other applicable permits controlling work on these lands, whether the City is one of the permittees or not, and copies the applicable permits.
- Proof that permits are not required from all pertinent federal, State, county, city, and local agencies.
- Signed letter from the property owner that allows the Contractor access to the property. Include a statement in the letter that holds the City harmless for all consequences related to the Contractor's use of the property.
- Signed agreement with the property owner detailing the Contractor's operation, use of the property, and stating that Contractor will abide by permits, if any.

If the Contractor's operations require work on non-City controlled lands not presented at the preconstruction conference, or if changes to the Contractor's submitted ESCP are necessary, submit a new or revised ESCP to the City for approval before beginning work.

00280.04 Erosion and Sediment Control Manager - Designate and provide a representative, as the Erosion and Sediment Control Manager (ESCM) who meets the qualifications of 00280.30.
00280.05 **Project Signing** - Install number of erosion signs indicated, along with project information and contact number as shown in the Special Provisions. Place and mount the signs according to ODOT Standard Drawing TM670. Orientate the signs so they are visible to traffic, bicyclists, and pedestrians. Install these signs before performing clearing, grading, or other land alteration activities.

**Materials**

00280.14 **Erosion Prevention Materials:**

(a) **Plastic Sheeting** - Furnish plastic sheeting slope protection, anchoring system, flow control, and toe protection meeting the following requirements:

- **Plastic Sheeting** - Minimum 6 mil thick polyethylene plastic sheeting.
- **Anchoring System** - Minimum 65 pounds, non-puncture type anchor weights with cords or ropes of adequate strength to support the weights on the slope or new or used chain link fence conforming to 03010.30.
- **Stakes** - Commercial grade metal posts with a weight of at least 135 pounds per foot.
- **Rock** - Class 50 riprap conforming to Section 00390.
- **Runoff** - Control of flow off of plastic sheeting.

(b) **Chemical Soil Binder** - Furnish a liquid stabilizing emulsion meeting the requirements of 00280.14(c).

(c) **Chemical Dust Control** - Furnish non-toxic materials with no adverse effect on soil structure or establishment and growth of vegetation. Furnish one of the following materials and apply as directed by the manufacturer's instructions:

   (1) **Liquid Stabilizer Emulsion** - A tackifier of liquid and polyvinyl acetate polymers with emulsion resins containing not less than 55% total solids by weight. Do not use tackifiers containing polyacrylates or polyvinyl acrylics.

   (2) **Dry Powder Tackifier** - A tackifier consisting of one or more active hydrocolloids from natural plant sources which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable and consists of a processed organic adhesive derivative of one of the following:

   - Gumbinder derived from guar (Cyamopsis tetragonoloba)
   - Gumbinder derived from plantain (Plantago insularis)

(d) **Temporary Mulching** - Furnish temporary and permanent seeding, fertilizing, and mulching meeting the requirements of Section 01030.
(e) **Slope and Channel Liner Matting** - Matting is organized according to categories from the Texas DOT/TTI Hydraulics and Erosion Control Laboratory. Furnish matting from the CPL that meets the following performance criteria categories:

- **Type A** - Slope protection mat for clay soil slopes 1V:3H or flatter.
- **Type B** - Slope protection mat for sandy soil slopes 1V:3H or flatter.
- **Type C** - Slope protection mat for clay soil slopes steeper than 1V:3H.
- **Type D** - Slope protection mat for sandy soil slopes steeper than 1V:3H.
- **Type E** - Flexible channel liner for shear stress from 0 to 2 pounds per square foot.
- **Type F** - Flexible channel liner for shear stress from 0 to 4 pounds per square foot.
- **Type G** - Flexible channel liner for shear stress from 0 to 6 pounds per square foot.
- **Type H** - Flexible channel liner for shear stress from 0 to 8 pounds per square foot.

(1) **Check Slot:**

- **Channel Application** - Compacted Class 50 riprap meeting the requirements of Section 00390.
- **Slope Application** - Compacted suitable native embankment material

(2) **Fasteners** - U-shaped wire staples or heavy duty pins as follows:

- **Staples** - 14 gauge steel wire staples 1 inch "U" width with a length of 6 inches minimum for cohesive soils and 8 inches minimum for non-cohesive soils.
- **Pins** - 3/16 inch diameter steel pin with a 2 inch diameter steel washer secured at the head of the pin with a length of 18 inches minimum for cohesive soils and 24 inches minimum for non-cohesive soils.

**00280.15 Runoff Control Materials:**

(a) **Check Dams** - Furnish check dam material meeting the following requirements:

- **Type 1: Aggregate** - Aggregate with maximum size between 3 inches and 6 inches meeting the requirements of 00330.16.
- **Type 2: Straw Bales** - Standard rectangular straw bales meeting the requirements of 01030.15.
- **Type 3: Biofilter Bags** - Minimum size 18 inch x 6 inch x 30 inch plastic mesh bags with 1/2 inch openings filled with approximately 45 pounds of clean, non-toxic 100% recycled wood product waste containing no fine materials or sediments, or as shown on ODOT standard drawings for this device.

- **Type 4: Sand Bags** - Durable, weather-resistant bags woven tightly enough to prevent leakage of filler material. Fill bags with at least 75 pounds of firmly-packed fine PCC 3/8" - 0 aggregate, or round 3/8" - 3/16" pea gravel.

- **Type 5: Prefabricated System** - Prefabricated check dam system conforming to the manufacturer's recommendations and on the CPL.

- **Check Dam Stakes** - Stakes meeting the requirements of 00280.14(a).

(b) **Diversion Dikes and Swales** - Furnish diversion dike and swale materials meeting the following requirements:

- **Aggregate** - Aggregate with maximum size between 4 inches and 1 inch meeting the requirements of 00330.16.

- **Seeding, Fertilizing and Mulching** - Permanent or temporary seeding, fertilizing and mulching meeting the requirements of Section 01030.

(c) **Temporary Drainage Curbs** - Furnish temporary drainage curb material meeting the following requirements:

- **Type 1 Curb** - Concrete drainage curb meeting the requirements of 00480.10.

- **Type 2 Curb** - Asphalt concrete drainage curb meeting the requirements of 00480.10.

- **Type 3 Curb** - Sand bags meeting the requirements of 00280.15(a).

(d) **Temporary Slope Drains** - Furnish either plastic pipe meeting the requirements of Section 02410 or metal pipe meeting the requirements of Section 02420. If the runoff contributing area is not established, use 12 inch diameter.

(e) **Flow Spreader** - Furnish aggregate for flow spreaders with a maximum size between 5 inches and 2 inches meeting the requirements of 00330.16.

00280.16 **Sediment Control Materials**:

(a) **Construction Entrances** - Furnish materials meeting the following requirements:
(b) **Tire Wash Facility** - Provide the following materials for tire wash facilities:

- **Aggregate** - Aggregate with a maximum size between 3 inches and 6 inches meeting the requirements of 00330.16.  
- **Geotextile** - Subgrade geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).  

(c) **Sediment Fence** - Provide the following materials for sediment fences:

- **Geotextile** - Sediment fence geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).  
- **Posts** - Posts meeting the following requirements:
  - **Sediment Fence, Supported** - Commercial grade metal posts with a weight of at least 1.35 pounds/ per foot.
  - **Sediment Fence, Unsupported** - 1 1/2 inch x 1 1/2 inch x 48 inch untreated wood posts (wood stain is acceptable).
- **Wire Mesh** - For supported sediment fence, furnish galvanized wire mesh with 2 x 2 opening, horizontally and vertically self-supporting prior to fastening to posts, a minimum tensile strength of 70 ksi, and meeting the requirements of ASTM A 82.

(d) **Inlet Protection** - Furnish inlet protection materials meeting the following requirements:

- **Wire Mesh** - Wire mesh materials as follows:
  - **Type 1 Inlet Protection** - Wire mesh meeting the requirements of 00280.16(c).
  - **Type 2 Inlet Protection** - 19 gauge steel-mesh with 3/8 inch x 3/8 inch openings.
- **Geotextile** - Type 1 sediment fence geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
- **Aggregate** - Aggregate with maximum size between 1 inches and 4 inch meeting the requirements of 00330.16.
• **Stakes** - Stakes meeting the following requirements:
  • **Type 1 Inlet Protection** - Commercial grade metal posts with a weight of at least 135 pounds per foot.
  • **Type 4 Inlet Protection** - Minimum 1 inch x 2 inch x 18 inch wooden posts.

• **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).

• **Prefabricated Filter Inserts** - Prefabricated filter inserts manufactured specifically for collecting sediment in drainage inlets and listed on the CPL. Include handles and fasteners sufficient to keep the insert from falling into the inlet during maintenance and removal of the insert from the inlet.

• **Concrete Masonry Units** - Nominal 8 inch x 8 inch x 16 inch, 29 pound concrete masonry units (CMU).

• **Sod** - Grass sod meeting the requirements of 01040.19(h).

• **Reinforcing Steel** - No. 4 rebar commercial grade reinforcing steel.

(e) **Sediment Barriers** - Furnish sediment barriers and sediment barrier stakes meeting the following requirements:

• **Type 1: Straw Bales** - Standard 45 to 65 pound rectangular straw bales that are wire-bound or string-tied meeting the requirements of 01030.15(b).

• **Type 2: Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).

• **Type 3: Fiber Rolls Wattles** - Fiber rolls made of straw meeting the requirements of 01030.15(b) except use only rice or coconut straw material. Wrap the straw, to a minimum density of 2.75 pounds per cubic foot, in tubular plastic netting meeting the following requirements:
  • 8 inch to 10 inch diameter size
  • Minimum strand thickness of 0.003 inch
  • Knot thickness of 1/16 inch
  • Weight of 0.35 ounces per foot ±10%
  • Made from 85% high density polyethylene, 14% ethyl vinyl acetate, and 1% color for UV inhibition

• **Type 4: Sand Bags** - Sand bags meeting the requirements of 00280.15(a).

• **Type 5: Brush Barrier** - Maximum 6 inch diameter woody debris brush or topsoil strippings for brush barriers. Provide Type 1 sediment fence geotextile meeting the requirements of Section 02320. Provide “Level B” documentation according to 02320.10(c).
- **Type 6: Filter Berm** - Aggregate with maximum size between 4 inches and 1 inch meeting the requirements of 00330.16. Provide subgrade geotextile meeting the requirements of Section 02320. Provide "Level B" geotextile documentation according to 02320.10(c).

- **Type 7: Prefabricated Barrier System** - Prefabricated barriers manufactured specifically for temporarily obstructing the flow of sediment-laden water and listed on the CPL.

- **Stakes** - Sediment barrier stakes as follows:
  - **Biofilter Bags** - Use minimum 1 inch x 2 inch x 18 inch wood stakes
  - **Brush Barrier** - Use minimum 1 inch x 2 inch x 18 inch wood stakes
  - **Straw Bales** - Use minimum 1 1/2 inch x 1 1/2 inch x 36 inch wood stakes
  - **Fiber Rolls** - Use minimum 1 inch x 1 inch x 24 inch wood stakes

- **(f) Sediment Mat** - Furnish sediment mats from the CPL.

- **(g) Temporary Scour Basin** - Furnish class 100 riprap for temporary scour basins meeting the requirements of Section 00390.

- **(h) Temporary Sediment Trap** - Furnish sediment trap materials meeting the following requirements:
  - **Geotextile** - Type 2 drainage geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
  - **Aggregate Base** - 1 1/2" - 0, 1" - 0, or 3/4" - 0 aggregate for aggregate base meeting the requirements of Section 00640.
  - **Aggregate** - Aggregate with maximum size between 6" and 3" meeting the requirements of 00330.16.

**Labor**

- **00280.30 Erosion and Sediment Control Manager** - Designate and provide an ESCM with the following minimum qualifications:
  - Experience in all major disciplines of public infrastructure construction.
  - Knowledgeable in principles of and practice of erosion and sediment controls.
  - Skilled in assessing site conditions and effectiveness of erosion control BMP used.
  - Successful completion of erosion control formal training sponsored by the City or acceptable to the Engineer.
Responsible participation in construction of at least 1 City project with erosion control.
Authority to immediately mobilize necessary personnel to correct and modify erosion control BMP as required.

Duties typically required of ESCM include:

- Manage and ensure proper implementation of the ESCP.
- Accompany the Engineer during field review of the ESCP prior to construction activities.
- Monitor rainfall on and in the vicinity of the Project site.
- Monitor water quality in receiving streams in the vicinity of the Project site.
- Inspect erosion and sediment control on active construction sites weekly.
- Inspect erosion and sediment control on inactive sites every 2 weeks.
- Inspect erosion control BMP on all active and inactive sites at least daily during rainy periods when 5/8 inch or more of rain has fallen within a 24-hour period.
- Mobilize crews to make immediate repairs to BMP or install additional BMP during working and non-working hours.
- Record actions taken to clean up significant amounts of sediment.
- Report potential permit violations to the City in a timely manner.
- Regularly update the approved Erosion Control Monitoring form.
- Update the ESCP monthly and within 24 hours after changes or major BMP modifications are implemented.
- Prepare a contingency plan in preparation for emergencies and the rainy season.
- Accompany the Engineer on inspections and, if required, on inspections by representatives of regulating agencies.

Provide the ESCM name, description of experience and training, qualifying certifications, and contact phone number 10 days before the preconstruction conference. If changes in the appointment of the ESCM occur during the term of the Contract, provide written notice to the Engineer within 5 calendar days.

Construction

00280.40 Installation - Install erosion and sediment control BMP as shown and according to the most current City's Erosion and Sediment Control Manual. Install erosion and sediment control devices before performing clearing, grading, or other land alteration activities. Ensure no visible and measurable sediment or pollutants leave the Project boundaries, enter drainage systems or waterways, or violate applicable water standards.
For purposes of this requirement, "visible and measurable" is defined as:

- Deposits or tracking of mud, dirt, sediment or similar material exceeding 1/2 cubic foot in volume on any private or public street or adjacent property, or into any storm or surface water drainage system, either by direct deposit, dropping or discharge, or as a result of erosion; or
- Evidence of concentrated flows of water over bare soils; turbid or sediment-laden flows; or evidence of on-site erosion, such as rivulets on bare slopes where the flow of water is not filtered or captured on the site; or
- Earth slides, mudflows, earth sloughing, or other earth movement off the Project site.

Included in this work are both non-structural BMP, such as limiting clearing of vegetation, and structural BMP such as various kinds of physical devices or materials like sediment fences. BMP may be temporary or they may be permanent when required to continue functioning after the Contract ends. Coordinate temporary erosion control BMP with permanent BMP and all related project work.

Provide continuous erosion prevention and sediment control throughout the period the Contractor is responsible for project sites under the Contract as determined by the Engineer. Take all reasonable steps to minimize or prevent any erosion and transport of sediment. Install and maintain all erosion and sediment control BMP to function as required. If planned or installed BMP are not effective, modify or change them so they are effective. Effective functioning is defined as preventing erosion, controlling runoff, or controlling sediment in each location where a measure is needed so all erosion-related impacts of site construction are fully mitigated as required.

00280.41 Work Restrictions - The following work restrictions apply:

(a) Disturbance Limits - Flag all construction site clearing limits. Do not disturb areas outside the flagging limits. Maintain the flagging during Project construction.

(b) Perimeter Controls - Perimeter controls include sediment fences, ditches, filters, berms in flatter areas, and other methods for channeling flows. Install all appropriate perimeter controls before beginning.

Install all erosion and sediment control features for soil disturbing activities that are within 300 feet horizontal distance of the 2 year flood elevation before beginning work.
(c) **Wet Season Work and Temporary Work Suspension** - Wet season work is defined as work between October 1 and April 30. Update the ESCP and schedule for work proposed during the wet season to ensure that all appropriate controls, including work suspension controls, are implemented and maintained. Submit the updated ESCP and schedule to the City and receive approval before beginning any work during the wet season. The City may not approve work on critical sites with high erosion potential if controls are not properly installed or have a likelihood of failure.

During the wet season work, stabilize soil stockpiles at the end of each workday by diverting flows, placing covers, or installing sediment barriers at the stockpiles. Also, limit excavation and bare ground activities to only that which is required for immediate operations.

(d) **Disturbance Restrictions** - If soil erosion and sediment resulting from construction activities is not effectively controlled, the City will limit the amount of disturbed areas to that which can be effectively controlled. Incorporate erosion and sediment control measures into the Project at the earliest practicable time. Install all erosion and sediment control devices according to the approved implementation schedule and these Specifications. If the Contractor fails to control erosion, the City will stop all construction work according to 00180.70.

00280.42 **Stabilization** - Protect exposed soils from erosion by water, wind, or vehicles when required by permits or directed by the Engineer. At a minimum, stabilize soil areas as follows:

(a) **Soil Exposure Limitations** - Stabilize all soils which are exposed and disturbed during construction related activities according to the following:

- **October 1 through April 30** - Stabilize all areas immediately, but no later than within 24 hours of exposure.
- **May 1 through September 30** - Stabilize all areas as soon as practical, but no later than within 7 days of exposure.

(b) **Temporary Stabilization** - Temporarily stabilize exposed soils:

- Every 14 days or more frequently if needed or directed.
- Upon approval, active work areas scheduled for re-disturbance may be left unstabilized for 14 day periods if erosion by wind, water, or vehicles is not occurring or imminent.
- A minimum of one day before expected rain events.
- During wet periods and when not actively raining, at the end of each day.
- As an emergency measure when rain is falling on unprotected areas.
- When wind or vehicle traffic is visibly causing more than minor dust.
- Soil surfaces at finish grade when working outside the permanent seeding dates.
Temporary stabilization includes, but is not limited to, chemical soil binders, mulching and tacking, erosion control matting, plastic sheeting, and temporary seeding or other BMP required to achieve the necessary stabilization.

Document all implemented BMP on the ESCP. Ensure that permanent slope stabilization is achieved before removing temporary BMP.

(c) Permanent Stabilization - Permanently stabilize exposed soil surfaces at finished grade. Permanent stabilization methods include, but are not limited to, seeding, mulching, structural surface coverings such as riprap, and vegetative stabilization. Permanent stabilization includes stabilization of temporary structures such as detours and staged earthwork. Immediately perform permanent stabilization at each completed excavation and embankment area except for areas that are scheduled to be redisturbed.

If areas are not sufficiently stabilized by an established stand of vegetation according to 01030.60, or if the soil surface is not sufficiently protected with temporary stabilization BMP by November 1 of each year, do the following:

- Use BMP's necessary to redirect water away from the disturbed areas.
- Re-grade disturbed areas to finished grade.
- Apply permanent seeding at the original specified rate.
- Apply temporary mulching or matting.

If areas for temporary stabilization are too steep or lack access for effective straw mulch application, apply, upon approval, another effective measures such as chemical soil binder.

Incorporate permanent erosion control features into the Project at the earliest practicable time. Use temporary erosion control features for the following situations:

- To correct conditions that occur during construction activities that were not foreseen during the design stage of the Project.
- That are needed prior to installing permanent erosion control features.
- To temporarily control erosion that develops during normal construction activities.

Where potential for erosion exists and if construction permits, construct permanent erosion control features immediately after clearing and grubbing and grading operations are complete. If permanent erosion control BMP are not practicable to construct, furnish and install temporary erosion control BMP.

00280.43 Area Preparation - Prepare areas according to 01040.48(d) and track all fill slopes at finished grade steeper than 1V:3H and flatter than 1V:1.5H so that track impressions run parallel to slope contours. Maintain at least 1 3/8 inch tall track grousers.
00280.44  **Erosion Prevention BMP** - Install erosion and sediment control devices as shown and according to the following:

(a) **Plastic Sheeting** - Place plastic sheeting on disturbed, temporary slopes or stockpiles where immediate protection is required and mulching or other methods of soil stabilization are not feasible. Temporary slopes include vertical excavations for retaining walls and other temporary soil excavations and embankments related to structural work.

Cover exposed soil with plastic sheeting and secure tightly using an anchoring system of sand bags, chain link fence, or other approved methods. Do not allow the anchoring system to puncture the plastic sheeting. Trench plastic sheeting at the top of slope and secure adequately to keep in place during any conditions that can be reasonably expected in the area. Direct runoff away from areas above plastic sheeting to prevent undermining. Control runoff from plastic sheeting so water discharges into protected drainage.

(b) **Chemical Soil Binder** - Hydraulically apply a liquid stabilization emulsion at the following rates unless the manufacturer recommends a greater rate of application:

- **Long Term Control of Exposed Soil Surfaces** - Apply 35 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 20 parts water.
- **Steep Slopes with Raveling Small Rock** - Apply 45 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 10 parts water.

(c) **Chemical Dust Control** - Apply appropriate dust control for wind or equipment-caused erosion according to the following:

- **Water** - Apply water according to Section 00340.
- **Liquid Stabilizer Emulsions** - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at the rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.
- **Dry Powder Tackifier** - Apply at a rate of 140 pounds per acre unless the manufacturer recommends a greater rate of application. Watering for dust control may also be covered under Section 00340.

(d) **Temporary Mulching** - Evenly apply dry mulch and tackifier material to form a cohesive surface cover that is resistant to displacement by wind and water. In areas not accessible to heavy equipment, mulch by hand or by other approved methods. Areas not prepared according to 01040.48(d) will require greater rates of application at no additional cost to the City.
(1) **Dry Mulch** - Apply straw mulch on slopes 1V:15H or flatter. Spread straw mulch by hand or blower. Place approximately 2 inch deep, in loose condition, at a rate between 2 to 3 tons per acre of dry mulch. Place straw mulch so that it is loose enough for sunlight to penetrate and air to circulate, but dense enough to shade the ground, reduce water evaporation, and materially reduce soil erosion. Anchor using hydraulically applied tackifier, crimping disc, or sheep's-foot roller approved by the City or methods specified in the Special Provisions.

Provide blower equipment that uses air pressure with an adjustable spout that uniformly applies dry mulch at constantly measured rates. Apply the materials using a sweeping, horizontal motion of the nozzle.

(2) **Tacking** - Straw mulch may be tackified using hydraulically applied tacking agents or mechanical methods at the following rates of application:

<table>
<thead>
<tr>
<th>a. <strong>Hydraulically Applied Tacking Agents:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Liquid Stabilizer Emulsions</strong> - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at the rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.</td>
</tr>
<tr>
<td>• <strong>Dry Powder Tackifier</strong> - Apply at 80 pounds per acre with 2,000 pounds of hydromulch fiber unless the manufacturer recommends a greater rate of application.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b. <strong>Mechanical Methods</strong> - Straw mulch may be mechanically tackified using a crimping disk or sheep's-foot roller.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Crimping Disc</strong> - A heavy disk with flat, scalloped discs approximately 1/4 inch thick, having dull edges and spaced no more than 9 inches apart.</td>
</tr>
<tr>
<td>• <strong>Sheep's-Foot Roller</strong> - Modified sheep's-foot roller equipped with straight studs, made of approximately 3/4 inch steel plate, placed approximately 8 inches apart and staggered. Ensure that the studs are not less than 6 inches long or more than 6 inches wide, and rounded to prevent withdrawing the straw from the soil. Use a roller with enough weight to incorporate the straw sufficiently into the soil providing a uniform surface cover.</td>
</tr>
</tbody>
</table>

(e) **Slope and Channel Liner Matting** - Ensure that the matting is installed according to the plans, these Specifications, or the manufacturer's recommendations, whichever is more stringent. Within 25 feet of water resources or as indicated, install only matting that is fully biodegradable (photodegradable is not acceptable).
(1) **Area Preparation** - Remove all materials (vegetation, rocks, wood, etc) larger than 2 inches in size. Smooth the surface and remove undulations sufficient to allow the matting to be placed in complete contact with the soil.

(2) **Seeding** - Apply seeding to all disturbed areas, including the area where matting is required, according to one of the following:

a. **Seeding Prior to Matting Installation** - Apply according to Section 01030. This method is preferred.

b. **Seeding After Matting Installation** - This method is allowed only when specified or approved. Apply according to Section 01030 at double the application rate for seed.

c. **Single Application - Matting and Seed**:

   - **Hydraulically Applied Matting** - Apply seed at double the rate specified in Section 01030. Thoroughly mix seed, fertilizer, and matting material.

   - **Manually Applied (Pre-seeded) Matting** - Pre-seed the matting at double the rate specified with the seed mix specified in Section 01030.

(3) **Matting Placement** - Apply matting loosely so it is in complete contact with the soil to prevent erosion occurring beneath it. Apply mat and fasteners as shown. Construct check slots on all channel applications and on slope applications when shown or specified.

**00280.45 Runoff Control BMP** - Install runoff control BMP as shown and according to the following:

(a) **Check Dams** - Construct check dams as shown or directed.

   - **Type 1: Aggregate** - Place aggregate in the ditch section with the center low point below the outside edge.

   - **Type 2: Straw Bales** - Straw bales are not acceptable for use as check dams except in emergency situations and when approved at each location. If straw bales are used as check dams, replace with another acceptable check dam as soon as practicable but no longer than 7 calendar days.

   - **Type 3: Biofilter Bags** - Place aggregate in ditch section and extend check dam with biofilter bags sufficient to direct flow over aggregate weir. Aggregate weir may be replaced with additional biofilter bags if approved.

   - **Type 4: Sand Bags** - Place aggregate in ditch section and extend check dam with sand bags sufficient to direct flow over aggregate weir. Aggregate weir may be replaced with additional sand bags if approved.
• **Type 5: Prefabricated System** - Install prefabricated systems according to the plans, Special Provisions, and the manufacturer's recommendations. Field fabricated systems are not acceptable.

**(b) Diversion Dikes and Swales** - Construct diversion dikes and swales above the cut slope to divert runoff from undisturbed areas away from disturbed slope areas. Convey runoff to an undisturbed area and discharge in a non-erosive manner.

Construct diversion dikes and swales at the toe of fill slopes to divert and convey sediment laden water to a sediment control facility. Compact dike material according to the Agency Manual of Field Test Procedures.

Immediately after construction of diversion dikes and swales, place temporary seed and mulch according to Section 01030, or place erosion matting and seed as directed.

**(c) Temporary Drainage Curbs** - Construct temporary drainage curbs as shown or directed.

**(d) Temporary Slope Drains** - Construct watertight slope drains and extend as the embankment height increases. Construct temporary slope berms at the top of embankment slopes to direct water into the drains until permanent drainage structures are completed.

**(e) Flow Spreader** - A flow spreader is a device that receives channeled runoff and uniformly disperses it along the length of the spreader. It may be constructed of clean aggregate in a berm or trench or lumber or similar materials. Place the flow spreader to discharge water into a stabilized area at non-erosive velocities. See the plans for details and locations of this device.

**00280.46 Sediment Control BMP** - Install sediment control BMP as shown and according to the following:

**(a) Construction Entrances** - Install construction entrances at every point of access onto paved surfaces.

When construction entrances are in use and mud and dirt tracking is still evident, take additional steps to eliminate tracking by hosing off tires before vehicles leave the site, or by modifying construction techniques or work operation. Perform tire washing on gravel pads. Use silt-trapping structures to collect and drain wash water before it leaves the construction site.

**(b) Tire Wash Facility** - Excavate the area for installation of the tire wash facility. Install subgrade geotextile, aggregate base coarse, reinforced concrete, and water as shown.
(c) Sediment Fence - Construct supported (mesh and metal posts) and unsupported (no mesh) as follows:

- When installing geotextile and mesh, or geotextile alone, use a continuous roll of geotextile cut to the length of the barrier to avoid joints.
- Manufacturer’s factory seams are acceptable Field sewn seams are not acceptable.
- Drive posts into undisturbed soil as shown.
- Securely fasten the geotextile (and mesh) to the upslope side of the posts. Securely fasten each end of the geotextile (and mesh) to the end posts.
- Use stitched loops over posts for unsupported sediment fence.
- Excavate a trench on the upslope side of the fence and place geotextile to the bottom of the trench Backfill the trench with native material and compact.
- Attach the supported sediment geotextile to the wire mesh.
- Install the manufactured sediment fence system according to the plans, Special Provisions, and manufacturer’s recommendations. Connect end of rolls as shown.

(d) Inlet Protection - Construct inlet protection that directs flows through the control and into the inlet.

- **Type 1: Sediment Fence** - Install supported sediment fence around the perimeter of the inlet according to 00280.46(c).
- **Type 2: Geotextile/Wire Mesh Aggregate** - Place wire mesh over the inlet grate. Place sediment fence geotextile over the wire mesh and perimeter area near the inlet. Install aggregate over the geotextile fabric.
- **Type 3: Prefabricated Filter Inserts** - Install prefabricated filter inserts according to the plans, Special Provisions, and manufacturer’s recommendations. Prefabricated inserts with provisions for overflow are allowed only when accompanied by additional BMP to prevent the potential of sediments entering project storm systems. Field fabricated inserts are not allowed.
- **Type 4: Biofilter Bags** - Install biofilter bags according to the plans.
- **Type 5: Masonry** - Install concrete masonry units around the perimeter of the inlet. Place sediment fence geotextile around the outside perimeter, up the outside face, and on the top of masonry units. Place aggregate over the geotextile fabric and flush with the top of masonry units.
- **Type 6: Sod** - Install sod around the perimeter of inlets within 36 hours of harvest of the sod.
### (e) Sediment Barriers:

- **Type 1: Straw Bales** - Straw bales are only acceptable for use as short-term emergency containment. Receive approval before each use of straw bales and remove within 30 calendar days of installation unless directed to replace with new bales.

- **Type 2: Biofilter Bags** - Place and arrange biofilter bags as shown or directed.

- **Type 3: Wattles** - Place and arrange wattles as shown or directed.

- **Type 4: Sand Bags** - Place and arrange sand bags as shown or directed.

- **Type 5: Brush Barrier** - Place brush barrier as shown or directed. Place woody debris in a linear pile.

- **Type 6: Filter Berm** - Place and arrange filter berms as shown or directed. Place rock in an evenly spread, trapezoidal berm.

- **Type 7: Prefabricated Barrier System** - Install prefabricated barrier systems according to the plans, Special Provisions, and manufacturer's recommendations. Field fabricated systems are not allowed.

### (f) Sediment Mat - Place sediment mats a minimum of 20 feet downstream of work areas. Install mats individually or in groups on the stream bottom. Remove the mats not later than 48 hours after stream activities are complete. Remove them from the Project site, or if approved, place them on the stream bank and cover with permanent seeding.

### (g) Temporary Scour Basin - Construct temporary scour basins at the outfall ends of temporary slope drains or as shown.

### (h) Temporary Sediment Trap - The trap may be formed by constructing a berm or by partial or complete excavation. Direct the discharge flow to a stabilized conveyance outlet or level spreader.

### 00280.47 Work Quality - Protect areas according to 01030.49.

### 00280.48 Emergency Materials - Provide, stockpile, and protect emergency materials on site for unknown weather or erosion conditions. A list of emergency materials will be listed in the Special Provisions. Replenish emergency materials as they are used.

The emergency materials are in addition to the other erosion control materials required to implement and maintain the ESCP.

Remove all unused emergency materials from the Project site at the completion of the Project.

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**00280.60 General** - Maintain installed erosion and sediment control devices in good working order at all times. Keep the devices in place until the City issues notification of acceptance of stabilization. All maintenance and repairs are at no additional cost to the City.

**00280.61 Ineffective Controls** - If a control feature does not function effectively, immediately repair, replace, or provide additional devices. Devices repaired, replaced, or added due to improper installation, insufficient maintenance, or damage from Contractor operations will be at no additional cost to the City.

**00280.62 Inspection and Monitoring** - Ensure that regular site inspection and monitoring is performed according to the schedule and record keeping requirements of the NPDS permit.

(a) **Inspection** - Perform general site inspection, complete all applicable parts of the ODOT Erosion Control Monitoring Form, and submit the Form to the City as follows:

- Weekly for active sites
- Every 2 weeks for inactive sites
- When directed by the Engineer

(b) **Rainfall** - Furnish and install a rain gauge at the Project site. Notify the City if 5/8 inch or more of rainfall occurs within a 24-hour period. As soon as practicable, but not later than 24 hours, after 5/8 inch or more of rainfall occurs, including weekends and holidays, inspect the entire Project to determine the condition of all erosion and pollution control devices.

(c) **Monitoring Receiving Stream** - Observe and record color and turbidity or clarity within 30 feet upstream and downstream of locations where surface waters from the construction site enter the receiving stream. Note whether sheen and floating matter are present or absent. Describe any apparent color and the clarity of the discharge, and any observable difference in comparison with the receiving stream.

**00280.64 Sediment Removal** - Remove sediment and upgrade or repair the devices as needed as soon as practicable, but not later than 2 days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment needed for repair operations. If rainfall continues over a 24-hour period, or other circumstances that preclude equipment operation in the area, hand carry and install additional sediment control devices with best management practices and approved by the City.

(a) **Catch Basins** - Maintain catch basin inserts and other forms of inlet protection by removing trapped sediment when storage capacity has been reduced by 33%. Do not flush sediment into the inserts or other forms of inlet protection for the drainage system.
(b) **Sediment Controls** - Remove sediment from sediment fences, sediment barriers, check dams, and sediment traps once it has reached one third of the exposed height of the device or storage depth. Replace aggregate and rock filter material with new aggregate material when the sediment reduces the filtering capacity of the device by one half. Replace biofilter bags with clean, washed bags when removing sediment from them. Wash bags in an approved sediment control area.

(c) **Paved Areas** - Keep all paved areas clean for the duration of the Project. Use cleaning methods that do not transport sediment-laden water to receiving streams and storm or sanitary facilities.

(d) **Construction Entrances** - Add and remove aggregate or other specified material as needed to maintain the proper function of the construction entrances.

(e) **Permanent Stabilization** - Re-stabilize within 2 calendar days of disturbance all areas disturbed by the Contractor's operations or other causes including wind, water, and vandalism.

(f) **Straw Bales** - Replace straw bales when they become non-functional or, at a minimum, on an annual basis or at the beginning of each construction season as appropriate.

00280.65 **Sweeping** - Sweeping shall be done using a regenerative air or vacuum pickup sweeper together with proper dust control methods to assure sediments and pollutants do not leave the Project. Mechanical sweepers may be used only for debris pickup after cold plane pavement removal. Clean and sweep the Project to remove sediment, particulate matter and erosion accumulation. Adjust the frequency of sweeping to ensure compliance with the ESCP.

**Finishing and Clean Up**

00280.70 **Removal** - Within 30 days of the notification of acceptance of permanent stabilization, remove temporary erosion and sediment control devices, materials, and erosion control signing from the area. Remove accumulated sediment before removing the devices and materials. Immediately shape and permanently stabilize areas affected by the removal process. All temporary erosion and sediment control features that are not incorporated into the permanent work remain the property of the Contractor. Do not remove temporary erosion and sediment control devices before permanent stabilization is accepted.

00280.71 **Sediment Disposal** - Re-grade removed sediment into slopes or remove and dispose of off-site according to 00290.20. Do not flush sediment-laden water into waterways or drainage systems.

**Measurement**

00280.80 **Measurement** - Quantities of work performed under this Section will be measured according to the following:

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(a) **Lump Sum Basis** - No measurement of quantities will be made for lump sum items.

(b) **Unit Basis** - Unit basis items will be measured on the unit basis of each device or location where the device is constructed or placed.

(c) **Length Basis** - Length basis items will be measured on the length basis along the line and grade of the item or device constructed or placed.

- Flow spreaders and diversion dike/swale will be measured along the long axis.
- Sediment barrier, when measured on the length basis, will be measured along the long axis of the barrier regardless of type.
- Temporary slope drains will be measured from the beginning of the metal end pieces to the end of the drain. Measurement will be made when each installation is at its maximum length.

(d) **Area Basis** - Area basis items will be measured on the area basis along the ground surface, and computed to the square foot or acre as applicable.

(e) **Limitations** - The quantities of emergency materials listed in 00280.48 of the Special Provisions are included in the items listed in the Contract Schedule of Items.

### Payment

00280.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Erosion Control</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Plastic Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Chemical Soil Binder</td>
<td>Acre</td>
</tr>
<tr>
<td>(d) Chemical Dust Control</td>
<td>Acre</td>
</tr>
<tr>
<td>(e) Temporary Mulching</td>
<td>Acre</td>
</tr>
<tr>
<td>(f) Matting</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

**Erosion Prevention**

**Runoff Control**

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(g) Check Dams</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Temporary Diversion Dike/Swale</td>
<td>Foot</td>
</tr>
<tr>
<td>(i) Temporary Slope Drains</td>
<td>Each or Foot</td>
</tr>
<tr>
<td>(j) Flow Spreader</td>
<td>Foot</td>
</tr>
</tbody>
</table>
### Sediment Control

- **(k)** Construction Entrances .......................................................... Each
- **(l)** Tire Wash Facility ................................................................. Each
- **(m)** Sediment Fence, ______ ......................................................... Foot
- **(n)** Inlet Protection ........................................................................ Each
- **(o)** Sediment Barrier ................................................................. Each
- **(p)** Sediment Mat ........................................................................ Square Yard
- **(q)** Temporary Scour Holes ............................................................ Each
- **(r)** Temporary Sediment Traps ..................................................... Each

**Item (a) includes:**

- providing the Erosion and Sediment Control Manager
- developing, revising, and documenting the ESCP
- mobilization
- monitoring activities
- furnishing, stockpiling, protecting, restocking, and removing emergency materials
- preparing Project for winter shut-down
- inspecting, maintaining, and removing erosion control devices
- restoring, mulching, tacking, and seeding all disturbed ground, work, and storage areas not otherwise covered
- erosion control signs

When only Item (a) is listed in the Contract Schedule of Items, no separate or additional payment will be made for modifications or additions to the BMP that become necessary for permit compliance during construction.

**Partial payments for item (a) will be made as follows:**

- When the initial Contractor developed ESCP, narrative, and schedule are complete and accepted, and the initial erosion control devices are installed ........................................... 25%
- When 50% of the Contract is complete, excluding advances on materials ....................................................... 25%
- When 75% of the Contract is complete, excluding advances on materials ....................................................... 25%
- At completion of the Contract and all erosion control devices are either removed from the Project site or are fully functioning as permanent BMP ........................................... 25%

**Item (b) includes** protecting exposed slopes with plastic sheets, anchoring devices, and toe protection maintenance.

**Item (f) includes** preparing the slope surface and stabilizing exposed soil with erosion matting material.
Items (g), (n), and (o) includes the biofilter bags, sand bags, and sediment fence as applicable.

Emergency materials that are incorporated into the Project will be paid for under the appropriate items listed in the Contract Schedule of items.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- removing and disposing of sediment build up behind sediment fences and sediment barriers
- removing and reinstalling required appurtenances to modify temporary slope drains as the embankment slopes are changed
- constructing and removing temporary slope berms
- applying dust control
- erosion control for work outside the construction limits including but not limited to borrow pits, haul roads, disposal sites, and equipment storage sites
Section 00290 - Environmental Protection

Description

00290.00 Scope - This Section describes the Contractor's duties and obligations with respect to protection of the land, waters, air, wildlife and other environmental resources of the State.

Comply with all applicable federal, State and local environmental, health, safety and other laws, acts, statutes, regulations, administrative rules, ordinances, orders and permits, as they may be amended from time to time (referred to in this Section as "Laws"). Comply with all applicable Laws, whether or not specifically referenced in this Section or elsewhere in the Contract.

Federal, State and local agencies known to have enacted ordinances and regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract are listed in 00170.01.

If any provision of these Specifications appears to conflict with one or more Laws, the more stringent requirement shall apply, unless the Engineer directs otherwise in situations where these Specifications are more stringent.

Comply with all additional requirements or Laws imposed by any agency or governmental unit having authority to enforce the Endangered Species Act (ESA) and other Laws.

All penalties assessed against the City because of the Contractor's violation of Laws referenced above, or permits applicable to the Project, will be withheld from the progress or final payments according to 00195.50(e).

No Condition of the Contract releases the Contractor from any responsibility or requirement under any environmental or other Law.

00290.10 Staging and Disposal Sites - Locate staging areas and disposal sites in previously improved or disturbed sites including existing roadways, pullouts, turnouts, parking lots, and storage yards that have been compacted, graveled and paved, unless otherwise approved, in writing, by the Engineer.

00290.11 Water Conservation - Minimize use of water by maintaining equipment, immediately fixing water line and container leaks, ensuring water valves are turned off promptly, and using recycled water when feasible.

00290.20 Waste, Hazardous Waste and Hazardous Substances - Comply with all applicable federal, State and local laws and regulations as they pertain to the storage, handling, management, transportation, disposal and documentation of waste, hazardous waste, and hazardous substances.
(a) **Hazard Communication** - Ensure the following documents are readily available on site to employees, subcontractors and inspectors:

- Material Safety Data Sheets (MSDS) for all hazardous substances stored or used on site.
- Written hazard communication program, including employee training documentation.
- The Oregon Occupational Safety and Health Division (OR-OSHA) provides guidance to meet these requirements in their publication "Hazard Communication: A Safe-Work-Practice Guide".

(b) **Fuel Storage** - Store fuel according to the current edition of the International Fire Code applicable federal, State, and local laws.

If total fuel and petroleum storage, in containers 55 gallons or larger, exceeds 1,320 gallons, comply with the applicable spill prevention control and countermeasures (SPCC) requirements of 40 CFR 112. If applicable, submit the professional engineer stamped SPCC plan, 10 days before the preconstruction conference. Comply with the plan and keep a copy on site and readily available. The SPCC plan may be combined with the Pollution Control Plan required under 00290.30(b).

(c) **Waste Management:**

1. **General** - Prepare a hazardous waste determination for all waste generated on site to determine whether the waste is classified as hazardous waste, universal waste excluded. The City may provide initial analytical results for some wastes such as lead-based paint and asbestos containing material. Conduct additional testing necessary for waste characterization and disposal using an Oregon Environmental Laboratory Accreditation Program (ORELAP) accredited laboratory, under chain of custody procedures.

   Segregate all demolition debris according to its intended end use (reuse, recycle, or dispose). If required, store in designated areas in a manner that prevents contamination to soil and water and prevents fugitive dust emissions. Remove all waste materials recovered from the site unless otherwise approved, in writing. Retain disposal and recycling facility receipts for wastes generated on site for at least 1 year after completion of the Project. Provide copies of the receipts to the Engineer within 7 calendar days of the disposal or recycling.

   Dispose of noxious weeds and Specified Weeds according to Section 01030.

   Do not reuse demolition material, coated or treated materials, or concrete and masonry materials in waters of the State or US.

2. **Clean Fill** - Clean fill, defined by OAR 340-093-0030(13), becomes the property of the Contractor at the place of origin.
(3) Reuse, Recycle, and Dispose of Materials - Waste materials become the property of the Contractor at the place of origin. Unless prohibited by Law, treat waste materials according to the following priority:

- Reuse demolition debris on site.
- Recycle demolition debris.
- If it is not feasible to reuse or recycle, ("feasible" is defined as a facility that is capable of handling the material, will take the material and the cost of transportation plus the cost to reuse or recycle the material is equal to or less than the costs of disposal) dispose of waste material according to the following:

  a. Burnable Materials - Dispose of burnable material, that cannot be reused or recycled, according to 00290.30(c)(3).

  b. Woody Matter - Woody matter may be burned according to 00290.30(c)(3) or may be chipped to a size of no more than 3 inches in any direction then uniformly spread over selected landscape areas, as directed, in loose layers not more than 3 inches thick. Burying wood, stumps, or other woody material is not allowed.

  c. Preserved and Coated Wood - Dispose of chemically preserved wood, pressure treated wood, and wood coated with latex paint that does not contain lead according to the following:

    - Reused whole.
    - Provided to others to reuse.
    - Burned as fuel at an energy recovery facility with a DEQ stationary source permit.
    - Delivered to a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

    Dispose of wood coated with lead-containing paint at a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

    Test wood as required by the receiving facility.

  d. Concrete and Masonry - Concrete and masonry, when not recycled, may be reused to fill basements or be buried in embankments on site, provided that the materials are broken into pieces not exceeding 15 inches in any dimension, and placed so that:
• No part of any piece is within 2 feet of the top, side or end surface of the basement, embankment, or other structures.
• The fill or embankment is constructed and compacted according to 00330.42 and 00330.43.

If the Engineer provides written approval, concrete may be reused as aggregate if it meets the requirements of Section 02610 through Section 02690.

e. Disposal on City-Owned Lands - Do not dispose of waste materials on City-owned or City-controlled lands, except when shown, specified, or allowed in writing to be used as fill. If allowed, place waste materials only at specified locations, as directed.

f. Off-Site Disposal - Dispose of waste at an energy recovery facility with a DEQ or LRAPA Stationary Source Permit, at a permitted landfill, or at other waste disposal facilities as required depending on that type of waste.

Subject to local zoning codes and the requirements of 00280.03, materials that meet the definition of clean fill may be placed on other properties in a manner consistent with environmental requirements, and with written permission of the property owner. Furnish the Engineer a copy of the signed agreement with the owner before placement of the clean fill material. Do not place the clean fill material at locations that are visible from a public highway, road, or street unless the site is zoned and licensed for landfill.

(d) Hazardous Waste Management - Determine the generator category for the Project, based on the amount and type of hazardous waste generated. Use the following definitions. If they differ from current Laws, use the current Laws. For all waste streams classified as hazardous waste under 00290.20(d), use an EPA ID number obtained by the Owner for waste characterization and disposal. Conduct all additional testing necessary to characterize the waste for disposal purposes.

• Conditionally Exempt Generator - A conditionally exempt generator (CEG) generates 220 pounds or less of hazardous waste per month or 22 pounds or less of acutely hazardous waste per month and accumulates up to 2,200 pounds hazardous waste or 22 pounds acutely hazardous waste on site.

• Small Quantity Generator - A small quantity generator (SQG) generates 220 pounds to 2,200 pounds hazardous waste per month, can accumulate up to 13,200 pounds hazardous waste on site (or more with a permit), and ship hazardous waste off-site within 180 days of generation.
- **Large Quantity Generator** - A large quantity generator (LQG) generates more than 2,200 pounds hazardous waste per month or more than 22 pounds acutely hazardous waste per month, has no accumulation limit, but ship all hazardous waste off-site within 90 days of generation.

In addition to current Laws, comply with the following:

- If the Project generator category is SQG or LQG, or if it requires a hazardous waste identification number, obtain a Resource Conservation and Recovery Act (RCRA) site identification number from the DEQ. Pay all fees and complete the RCRA application form as follows:
  - List the Contractor as the Site Contact, the Site Operator, the Hazardous Waste Form Contact, and the Hazardous Waste Fee Contact.
  - List the City as the Site Location, the Land Owner, and the Legal Owner.
  - Fill in the Comments section with the following statement:
    
    "[Contractor name] is responsible for the following: All hazardous waste management on site for the duration of this construction project, for delivery of the waste to a permitted recycling or disposal facility, and for all forms and fees associated with the hazardous waste management including cancellation of the RCRA site identification number at the end of the Project. The City is the owner of the waste and maintains long term responsibility for the waste as required by RCRA, excluding all wastes generated solely from materials brought to the site by the Contractor, which remain the property of the Contractor".
  - The Contractor may sign hazardous waste manifests for the off-site shipment of hazardous wastes as the “offeror” rather than as the “generator”.

- Maintain all required waste management records, including monthly hazardous waste generation records, manifests, recycling and disposal receipts, test results, and annual DEQ reports. Submit monthly records to the Engineer by the fifteenth day of the following month and submit DEQ reports to the Engineer concurrently with DEQ. Keep copies for at least 3 years following completion of the Project and resolution of any regulatory violations or citations.

- If the quantity of hazardous waste projected to be generated meets the requirements for a CEG, store hazardous wastes on site for no more than 180 days.

- If the quantity of hazardous waste projected to be generated meets the requirements for a SQG or for a LQG, prepare a Hazardous Waste Contingency Plan according to 40 CFR 26551. Maintain a copy of the Contingency Plan on site at all times during construction activities, readily available to employees and inspectors.
• If the project is SQG or LQG, retain a Certified Hazardous Materials Manager (CHMM) in good standing and with experience managing the hazardous wastes associated with the Project to oversee waste management at the site.

• All employees involved in the handling and management of CEG hazardous waste shall comply with the federal and State Laws for hazardous waste management. All employees involved in the handling of SQG and LQG hazardous waste shall be trained according to federal and State Laws For LQC hazardous waste projects, keep employee training records on site and readily available.

• If the quantity of hazardous waste generated in a month changes the generator category, immediately implement the requirements for the new category and comply with them for the remainder of the year. Complete the new documentation and training requirements within 30 calendar days of the change.

• Ensure hazardous waste containers are clearly and visibly labeled with the contents and accumulation start date, compatible with the contents and in good condition. Store them in a designated weather-protected area that is secured from public access, has secondary containment adequate to contain a release, and has sufficient aisle space to safely maneuver containers and respond to spills (minimum 30 inches).

• If hazardous waste will be treated on site, obtain approval from DEQ and the Engineer for each specific treatment or recycling process, treat wastes within accumulation tanks or closed containers that meet RCRA requirements, conduct treatment within the storage time for the applicable generator category, maintain current copies of all required notifications and waste analysis plans readily available on site and request DEQ technical assistance prior to starting any on site recycling or treatment.

(e) Hazardous Substance Transportation - Comply with the following requirements for transportation of hazardous substances and hazardous waste:

• Train all employees involved in transportation and shipping as required by US DOT.

• Use drivers who have a commercial driver's license with a hazardous materials endorsement when required.

• Ship hazardous wastes from SQG and LQG projects using a DEQ registered hazardous waste transporter under a hazardous waste manifest.

• Ensure shipments are appropriately packaged and labeled, and vehicles are appropriately placarded.

• Submit copies of the completed manifests and documentation to the Engineer and retain copies for at least 1 year.

(f) Unexpected Contamination - If, during construction, unanticipated hazardous substances are discovered that threaten the health and safety of workers, the public, or the environment, do the following:
• Immediately remove all affected employees and secure the area to prevent access.
• Notify the Engineer immediately and provide written notification within 24 hours, setting forth description of the hazardous substances encountered.

The Engineer will attempt to resolve the unanticipated situation expeditiously according to 00140.40. Delays to work due to the discovery of unexpected contamination shall be considered for exclusion from Contract time according to 00180.80(d)(1).

(g) Spills and Releases - Obtain a response agreement with a professional on-call spill response team. The professional on-call spill response team, identified in the PCP, agrees to be available and respond to spills that cannot be cleaned up with on-site resources. A professional spill response team is a company or section of a company specifically dedicated to hazardous materials emergency spill response, insured, and bonded for hazardous materials cleanup, and employing experienced personnel certified according to 29 CFR 1920120.

In the event of a spill or release of hazardous substance or hazardous waste, do the following:

• Immediately commence response actions to protect human health and the environment. Follow the PCP, SPCC and Contingency Plan, as appropriate. If any of the provisions in these plans conflict, implement the actions providing the greatest protection of public health and safety and the environment.
• If the spill can not be safely contained and cleaned up with on-site resources, activate the professional on-call spill response team.
• Immediately notify the Engineer.
• If the quantity released exceeds the State or Federal reportable quantity, or if the release impacts or threatens to impact any surface water body, immediately notify DEQ by the Oregon Emergency Response System (OERS) at 1-800-452-0311 and the EPA and the USCG through the National Response Center at 1-800-424-8802 (Federal reportable quantities or spills impacting or potentially impacting water only). If the quantity released is unknown, proceed with OERS and NRC notifications. Reportable quantities are listed at 40 CFR 302.4 and OAR 340-142-0040 to OAR 340-142-0050.
• Conduct cleanup of the released material according to all applicable Laws and DEQ requirements. Cleanup to background levels unless otherwise agreed to by the City in writing.
00290.30 **Provide a written report to the Engineer, using the DEQ Spill/Release Report form, within 10 calendar days of completing spill response, but no more than 30 calendar days after the initial event. If the spill was reported to DE, submit the report to DEQ concurrently. Include a description of how future releases will be prevented.**

00290.29 **Health and Safety** - Comply with all applicable health and safety Laws as they pertain to the hazardous substances and wastes used, stored and generated on site. If any of these requirements are in conflict, the more stringent requirements apply.

00290.30 **Pollution Control** - Prevent, control and abate pollution of the environment. Comply with new or amended environmental pollution Laws, not contemplated at the time of bid preparation according to 00140.50 and ORS 279C.525.

<table>
<thead>
<tr>
<th>(a) Pollution Control Measures</th>
<th>Comply with the following requirements:</th>
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</thead>
<tbody>
<tr>
<td>(1) General</td>
<td></td>
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<tr>
<td>• Allow no pollutant of any kind (e.g., petroleum products or fresh &quot;green&quot; concrete) to come in contact with an active flowing stream or waters of the State and U.S.</td>
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<tr>
<td>• Comply with the erosion prevention and sediment control requirements of Section 00280 and all applicable DEQ NPDES 1200 Permit requirements.</td>
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<tr>
<td>• Do not cause turbidity to waters of the State and U.S. outside of regulated levels.</td>
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<td>• Protect potable water system from contamination.</td>
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<td>(2) Materials and Waste Management:</td>
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<tr>
<td>• Store construction equipment, materials and debris in a manner that prevents contamination of water and soil and prevents fugitive dust.</td>
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<tr>
<td>• Store hazardous substances in the original containers or labeled compatible containers according to State Fire Marshal's regulations, International Fire Code and product MSDS.</td>
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<tr>
<td>• Locate areas for storing fuels and other potentially hazardous materials at least 150 feet away from any waters of the State and US or storm inlet, unless otherwise approved by the Engineer.</td>
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<tr>
<td>• Dispose of material waste according to 00290.20.</td>
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<tr>
<td>• Do not use treated timbers within any waters of the State and US.</td>
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</tbody>
</table>
(3) Equipment Fueling, Repair and Maintenance:

- Promptly correct or repair operational procedures, leaks, or equipment problems that may cause pollution at the Project Site. If soils or other media become contaminated as a result of operational procedures or equipment problems, remove and dispose of them according to applicable Laws and 00290.20(g).
- Locate areas for parking, refueling and servicing mobile equipment and vehicles at least 150 feet away from any waters of the State and US or storm inlet, unless otherwise approved by the Engineer.
- For large equipment that is not easily moved, prevent fuel and operating fluids from reaching any waters of the State and US or storm inlet by, at a minimum, using spill containment systems designed to completely contain potential spills during all refueling and equipment repair operations.

(4) Equipment Cleaning and Washouts:

- Inspect and clean all equipment prior to operating it within 150 feet of any waters of the State and US or storm inlet. Check for fluid leaks and remove all external oil, grease, weed seed, and dirt.
- Do not discharge untreated wash and rinse water into the any waters of the State and US or storm inlet.
- Establish wash areas that contain all fluids and debris, at least 150 feet from any waters of the State and US or storm inlet, such that untreated waste water does not impact those systems.
- Clean concrete equipment in washout areas that contain all fluids and debris. Recycle washout materials into fresh mixes or dispose of according to applicable permits.

(5) Off Site Tracking:

- Limit water leakage from trucks carrying saturated soils to less than 1 gallon per hour before allowing them to leave the Project Site.
- Remove all loose dirt and debris from trucks prior to leaving the Project Site.

(6) Other Spill Prevention and Response Measures:

- Inspect heavy equipment, storage containers, staging areas and other potential sources of hazardous substances daily to identify and prevent potential releases.
- If flooding of the Project site is expected to occur within 24 hours, evacuate areas used for staging, access roads, or storage and remove materials, equipment, and fuel.
• Immediately contain and repair leaking equipment or containers and cleanup any releases according to 00290.20(g).

• Maintain hazardous material containment kits and spill containment kits on site to facilitate the cleanup of hazardous material spills on dry land and waters of the State and US.

(b) Pollution Control Plan (PCP) - Develop and submit a PCP to prevent pollution related to Contractor operations for approval 10 days before the preconstruction conference. Maintain a copy of the PCP on site at all times during construction activities, readily available to employees and inspectors. Ensure that all employees comply with the provisions of the PCP.

Include the following information in the PCP:

• Identify a professional on-call spill response team.
• Identify all contractor activities, hazardous substances used and wastes generated.
• Describe how hazardous substances and wastes will be stored, used, contained, monitored, disposed of and documented. Include pollution prevention, spill response, waste reduction, dust prevention, off site tracking prevention, washout facility design, vehicle and equipment fueling and maintenance procedures, employee training and emergency contact information.
• Include the waste determination results from 00290.20(c)(1). Provide reuse, recycle, and disposal options, the reason for selecting that alternative, and estimated quantities for each reuse, recycle, and disposal option.
• Include or refer to the SPCC plan and the hazardous waste contingency plan, if required.
• Include scaled site plans showing locations for hazardous substance storage, spill response equipment, communications equipment and fire suppression equipment.

A "Pollution Control Plan Contractor Packet" is available from the City.

(c) Air Pollution Control Measures - Comply with ORS 468, 468A, OAR 340-014, 340-200 through OAR 340-268, and all other applicable Laws.

(1) Vehicle and Equipment Idling - Establish truck staging areas for diesel-powered vehicles located where the truck emissions have a minimum impact on sensitive populations, such as residences, schools, hospitals and nursing homes.

Limited idling of trucks and other diesel powered equipment to 5 minutes, when the equipment is not in use or in motion, except as follows:

• When traffic conditions or mechanical difficulties, over which the operator has no control, force the equipment to remain motionless.
• When operating the equipment's heating, cooling or auxiliary systems is necessary to accomplish the equipment's intended use.
• To bring the equipment to the manufacturer's recommended operating temperature.
• When the outdoor temperature is below 20 °F.
• When needed to repair equipment.
• Under other circumstances specifically authorized by the Engineer.

(2) Dust Control and Permitting - Prevent airborne dust and fugitive dust emissions from construction activities including rock, concrete, and asphalt crushing operations and obtain permits according to 00160.70. Do not use oil, waste, waste water, or other illegal materials as dust suppressants.

(3) Burn Restrictions - Burn wastes only if open burning is allowed by State, LRAPA, and local burning Laws. Obtain and comply with all required permits including DEQ permits required by OAR 340-264-0010 through OAR 340-264-0020, LRAPA permits, and local fire district permits. Provide copies of all permits to the Engineer prior to burning. Do not conduct burning within riparian areas. Conduct burning at locations where existing structures will not be damaged and where smoke will not impact traffic. Do not burn the following materials on site:

• Rubber products
• Tires
• Plastic
• Wet garbage
• Petroleum and petroleum treated materials
• Asphalt or industrial waste
• Any material that creates dense or noxious odors
• Painted materials
• Asbestos, mercury or PCB containing materials or equipment
• Hazardous wastes
• Scrap wiring or electrical equipment
• Painted or treated wood

Buildings intended for demolition may be burned by the local fire department for training purposes. Contact the local fire department for applicable restrictions.

00290.32 Noise Control - Comply with ORS 467, OAR 340-035, City Code 18.10.060, all other applicable Laws, and the following construction noise abatement measures:
• Perform construction and pile driving with equipment that complies with City Code 18.10.060.
• Use equipment with sound control devices no less effective than those provided on the original equipment. Equipment with un-muffled exhausts is prohibited.
• Use equipment complying with pertinent equipment noise standards of the EPA.
• Perform blasting operations in compliance with Fire and Water Bureau requirements.
• Mitigate the noise from rock crushing or screening operations performed within 3,000 feet of all occupied dwellings by placing material stockpiles between the operation and the affected dwellings, or by other means approved by the Engineer.

If a specific noise impact complaint occurs during the construction of the Project, one or more of the following noise mitigation measures may be required, at no additional cost to the City, as directed by the Engineer:

• Locate stationary construction equipment as far from nearby noise sensitive properties as feasible.
• Shut off idling equipment.
• Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
• Notify nearby residents whenever extremely noisy work will be occurring.
• Install temporary or portable acoustic barriers around stationary construction noise sources.
• Operate electric-powered equipment using line voltage power or solar power.

Protection of Fish and Fish Habitat - Comply with the Laws of the Oregon Department of Fish and Wildlife, National Marine Fisheries Service, and US Fish and Wildlife Service, and the rules and practices developed through the Oregon Plan for Salmon and Watersheds. Conduct operations to avoid any hazards to the safety and propagation of fish and shellfish in waters of the State and US.

(a) Regulated Work Areas - Perform work within regulated work areas only within the regulated in-water work periods. Do not allow equipment to enter any waters of the State or US or the regulated work area except as allowed in permits issued for the Project.

(b) Prohibited Operations - Except where allowed by the Contract or by permit, do not:

The regulated work area, if any, will be identified in the Special Provisions.
• Blast underwater.
• Use water jetting.
• Release petroleum products or chemicals in the water.
• Disturb spawning beds.
• Obstruct stream channels.
• Cause silting or sedimentation of waters of the State and US.
• Use treated timbers within the regulated work area.
• Impede adult and juvenile fish passage, including intermittent streams.

00290.36 Protection of Wildlife and Wildlife Habitat - Comply with the Laws of the Oregon Department of Fish and Wildlife and US Fish and Wildlife Service. Conduct operations to avoid any hazards to the safety and propagation of wildlife.

(a) Migratory Birds - Comply with the Migratory Bird Treaty Act (16 USC 703-712) which protects most species of birds in Oregon and prohibits the removal of nests containing eggs and dependent young. Migratory birds include most birds in Oregon, except pigeons, house sparrows, and starlings. Except where allowed by the Contract and by permit, do not disturb a migratory bird nest containing eggs or dependent young, or the surface the nest is built on.

If migratory bird nests are encountered that contain eggs or dependent young, stop all actions that may disrupt the nest and contact the Engineer. Do not resume work, which may disrupt nesting, until approved by the Engineer.

(b) Bats - Avoid destruction of bat colonies as shown.

00290.38 Protection of Plants - Plant habitats to be protected will be shown with the plant habitat boundaries flagged by the Engineer. Avoid destruction of plant habitats by ensuring construction personnel, equipment, and associated pollutants, including sediment, chemical contaminants, discharge water, non-native grass and weed seed, do not enter the habitat.

00290.40 Protection of Forests - Obtain necessary permits according to ORS 477.625 and ORS 527.670, and comply with the Laws of any authority having jurisdiction for protection of forests.

00290.41 Protection of Wetlands - Comply with and require that all the Contractor's employees, agents, and subcontractors on the Project Site comply with the following:

• Clean Water Act Section 404 (33 USC 1344); Federal Rivers and Harbors Act of 1899, Section 10 (33 USC 403 et seq).
• ORS 196800 to ORS 196990 (Oregon Removal-Fill law).
• ORS 390805 to ORS 390925 (Oregon Removal and Filling in Scenic Waterways law).
• All other applicable Laws governing preservation of wetland resources.
For the purposes of this Section, "wetland" or "wetlands" shall be understood to include wetlands as defined in 0011020, as well as other jurisdictional waters of the State and U.S.

Willful violation of permit conditions and applicable laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to, the offender's sole liability for all costs associated with site restoration, maintenance and additional mitigation work required by federal or State authorities.

(a) **Identifying Wetlands** - Wetlands known to be on the Project Site will be shown and identified either as "permanently filled or excavated" or as "temporarily impacted" Wetlands to be protected will be shown as "no work zones".

(b) **Disturbing Wetlands** - If wetlands are shown, meet with the City Wetland Specialist, the Engineer, and inspector on site prior to moving equipment onto the site or beginning any work, to ensure that all parties understand the locations of wetlands and the measures that shall be taken to protect them.

Ensure protection of no work zones as follows:

- Fence off no work zones using pedestrian safety fence or approved equivalent.
- Except as authorized by the Engineer for the purpose of installing or maintaining approved wetland protective measures, keep all persons, equipment and materials off no work zones.
- The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

Install all site protection for wetlands required by the Plans and Special Provisions prior to staging equipment or starting work near the site(s).

The Engineer may suspend work until the Contractor, Engineer, City Wetland Specialist, and other required federal and State personnel, if any, meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before work resumes.

**00290.50 Protection of Cultural Resources** - Comply with all Laws governing preservation of cultural resources. Cultural resources may include, but are not limited to, dwellings, bridges, trails, fossils, and artifacts.

If cultural resources are encountered on the Project area or in material sources, and their disposition is not addressed in the Special Provisions:
00290.51 Protection of Sensitive Cultural Sites - Comply with and require that all the Contractor's employees, agents, and subcontractors on the Project Site comply with all Laws applicable to the preservation and protection of sensitive cultural sites. The existence of any sensitive cultural sites affecting the Project, and the mandatory preservation and protection measures applicable to the sites, are determined in accordance with the Laws including, but not limited to the following:

- ORS 97.740 to 97.760 and 97.990(5) and (6) (Indian Graves and Protected Objects).
- ORS 358.905 to 358.955 (Archaeological Objects and Sites).
- ORS 390.235 to 390.240 (Archaeological Sites and Historical Material).

Ensure protection for sensitive cultural sites according to the following:

- Except as authorized by the Engineer for the purpose of installing or maintaining approved sensitive cultural site protective measures, keep all persons, equipment, and materials off known sensitive cultural sites.
- Install all sensitive cultural site protection required by the plans and Special Provisions prior to staging equipment or starting work near the site(s).
- Instruct all Contractor and subcontractor personnel to regard the locations of these sites and their contents as confidential.

The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

If sensitive cultural sites are known to be on the Project, further information will be provided in the Special Provisions.
(a) **Disturbing Known Sensitive Cultural Sites** - Willful violation of Laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to, the offender’s sole liability for all costs associated with monitoring, recovery, site restoration or other archaeological work required by Tribal, federal, and State authorities. Costs can exceed $100,000.

The Engineer may suspend work until the Contractor and the Engineer meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before work resumes.

(b) **Disturbing Unknown Sensitive Cultural Sites** - If the Contractor finds a previously undiscovered sensitive cultural site, immediately cease all activities at that site, follow procedures listed in 00290.50, and notify the Engineer. If the Contractor inadvertently disturbs unknown sensitive cultural sites, but immediately ceases all activities and follows the procedures listed in 00290.50, the City, to the extent permitted by Article XI, section 7 of the Oregon Constitution and by the Oregon Tort Claims Act, will indemnify, within the limits of the Tort Claims Act, the Contractor for costs associated with monitoring, recovery, site restoration or other required archaeological work, provided neither the City nor the State shall be required to indemnify the Contractor for such costs resulting from, arising out of or relating to the willful misconduct, negligence or other wrongful acts attributable to the Contractor or other persons on the Project site.

Delays to work due to new cultural resource finds will be considered for exclusion from contract time according to 00180.50(e).

Work required for monitoring and site restoration for newly discovered sensitive cultural sites encountered by the Contractor will be paid according to Section 00197.

**Measurement**

00290.80 **Measurement** - There will be no separate measurement of work performed under this Section.

**Payment**

00290.90 **Payment** - The accepted quantities for work performed this Section will be paid for at the Contract lump sum amount for the pay item "Pollution Control Plan".
Partial Payments will be made as follow:

- When the initial PCP is approved ............................................ 20%
- When 30% of the Contract is complete, excluding advances on materials ............................................................20%
- When 60% of the Contract is complete, excluding advances on materials ............................................20%
- When 90% of the Contract is complete, excluding advances on materials ............................................20%
- At completion of the Contract and all waste is removed from the Project site and all reports, receipts, and documents have been submitted ............................................................20%

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment includes, but is not limited to, the following:

- Contractor’s Pollution Control plan (PCP)
- Spill Prevention Control and Countermeasures (SPCC) plan
- Hazardous Waste Contingency plan
- Hazardous waste determination
- Determination of generator category
- The Certified Hazardous Materials Manager
- The Professional on-call Spill Response Team
Section 00291 – Contaminated Media

Description

00291.00 Scope - This work consists of the preparation of specific work plans and the excavation, handling, and disposal of Contaminated Media. Work shall include, but is not limited to the following:

- Developing the Health and Safety Plan.
- Development of the Contaminated Media Disposal Plan.
- Record Keeping.
- Site Excavation Monitoring.
- Material Excavation, Handling and Disposal.

00291.02 Environmental Site Assessment Report - When an environmental site assessment report has been performed that evaluated the area for on-site environmental contamination, the environmental sampling and data interpretation reports will be available for review upon request for the Contractor. The City makes no representation or guarantees concerning any reports, assessments or investigations concerning site conditions, or any information contained therein.

00291.03 Abbreviations and Definitions:

(a) Abbreviations:

- CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
- CMDP - Contaminated Media Disposal Plan
- CMMZ - Contaminated Media Management Zone
- CPR - Cardiopulmonary Resuscitation
- HASP - Health and Safety Plan
- PCB - Polychlorinated biphenyl
- RCRA - Resource, Conservation, and Recovery Act
- UST - Underground Storage Tanks

(b) Definitions:

Contaminated Media - Soil, water, sludge, free product, UST, buried abandoned utility lines containing residual or free product, solid waste, treated wood waste, chemical containers, asbestos containing material, lead based paint, PCB containing, materials, or other solid, liquid or gas substances with hazardous substance levels above background levels. Note: The background concentration of organic hazardous substances is zero. The background concentrations of inorganic substances (i.e., metals) are site specific.
Contaminated Media Management Zone - The CMMZ is a restricted area within the project site where Contaminated Media is managed. The CMMZ includes the following zones: CM-Loading, and other related zone(s). The CMDP defines the activities allowed in each of these zones.

Environmental Laws - Any applicable statute, law, ordinance, order, consent decree, judgment, permit, license, code, covenant, deed, common law, treaty, convention, or other requirement pertaining to the protection of the environment, health or safety, natural resource, conservation, wildlife, waste management or disposal, contaminated media, hazardous substances or pollution including, but not limited to, regulation of releases to air, land, water, and groundwater.

Hazardous Substances - Those substances or materials as defined in the Environmental Protection Agency Region 9 Preliminary Remediation Goals and in the Oregon Revised Statutes 340-122, as amended. Hazardous Substances are defined by the Oregon Department of Environmental Quality (DEQ) Rules (OAR Chapter 340, Division 122) as:

- Substances defined as hazardous substances in Section 101 (14) of the Federal CERCLA.
- Oil, including gasoline, fuel oil, diesel, lubricating oil, petroleum hydrocarbons or other petroleum products.

Identified Contaminated Area - Any project areas shown or described in the Special Provisions where Contaminated Media has been identified.


RCRA Hazardous Waste - All waste material, including excavation spoils, which requires management, handling, transport, treatment, storage or disposal according to the requirements of the Federal RCRA and associated regulations (42 U.S.C.§ 6901 et seq. and 40 CFR Parts 260 and 261 et seq.).

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, or threat thereof.

Solid Waste Disposal or Treatment Facility - Defined as a solid waste landfill or other facilities permitted by federal, state, and local agencies to receive and dispose or treat contaminated media.

Disposal Facilities - Only transport contaminated media to facilities, listed in the Special Provisions or approved equal, for disposal of contaminated media after receiving confirmation from the facility operator that will accept the media.
Only permitted disposal facilities, Subtitle-D- Landfill for contaminated media or Subtitle-C-Landfill for hazardous waste or approved equal shall be used for offsite disposal. Unless otherwise stated the Contractor will contact the approved disposal facility, arrange for the disposal permits and all associated permitting, including any required manifesting.

**00291.05 Submittals** - Provide one complete submittal package prior to commencing work within the Contaminated Media areas that includes the following:

- The proposed HASP for the project meeting the terms and conditions of this Section within 30 days of the Notice of Award.
- All modifications to the HASP and any task-specific HASP’s developed for this project.
- The proposed CMDP for the project meeting the terms and conditions of this Section within 30 days of the Notice of Award.
- Name and qualifications of the competent person that prepared the HASP, and Contractor’s Health and Safety Representative.
- Updated Traffic Control Plan to include contaminated media management activities.
- Worker training certifications and related records.
- Security and training logs and worker compliance agreements.
- Safety inspection logs, daily health and safety reports, and a closeout safety report.
- Closeout CMDP.
- Emergency and accident reports.

**00291.06 Environmental Laws and Hazardous Substances Encountered During Construction** - Comply with all Environmental Laws and all federal, state, and local laws regarding Hazardous Substances. In the event of a conflict between the Contract Documents and those laws, the more stringent shall apply. In the event the Contractor, during the course of construction or during any other activities authorized under this Contract, should encounter Hazardous Substances or any other materials suspected of posing a threat to employees, the public, or the environment, do the following:

- Immediately cease all work activities in and around any area of the Project where Hazardous Substances have been encountered or discovered, and take appropriate measures in compliance with all applicable Environmental Laws to stop or minimize the immediate spread or release of any Hazardous Substances.
- Remove the affected employees and secure access to the area.
- Immediately contact the Engineer and deliver an oral assessment of the site conditions. Within 48 hours of the incident, deliver to the Engineer a written assessment of the occurrence, current site conditions and all actions taken.
In order to prevent rain or stormwater runoff from contacting the suspected Hazardous Substances, immediately place appropriate control measures or devices on or adjacent to the affected area in such a manner that does not disturb the site or the suspected Hazardous Substance.

Subcontracting of work does not relieve the Contractor of any of its obligations, including the Contractor’s obligation to comply with all Environmental Laws as defined herein. The Contract Documents do not authorize the Contractor to remove, remediate, handle, transport, treat, or dispose of Hazardous Substances unless such activities are specifically required by the Contract.

Properly handle, store, use and dispose of any Hazardous Substances brought onto the work site in accordance with all applicable Environmental Laws as defined herein. In the event of a spill or release of any Hazardous Substances brought on to the work site by the Contractor, the Contractor shall follow the procedures set forth above.

Comply with Oregon law and Oregon DEQ requirements regarding PCB's, radioactive waste, UST, and actions to abate health hazards.

Comply with Oregon law, DEQ requirements and federal, state and local laws regarding air pollution, noise control, water pollution, oil spillage and used-oil disposal and asbestos abatement.

Prevent, control and abate pollution of federal, state, county and municipal waters as required by the Contract Plans and Specifications and local, state and federal regulations and requirements. No condition of this Contract releases the Contractor from any responsibilities or requirements under any environmental statutes, regulations or Permits. In the event of conflict between the Contract requirements and pollution control laws, rules or regulations, the more restrictive laws apply.

Comply with federal, state and local laws and regulations regarding Environmental Laws, including, but not limited to, those regarding employee health and safety and endangered and threatened species.

Complete a City BES Chain of Custody Form whenever a soil sample is collected for the purpose of laboratory chemical analysis. Completed forms shall be provided to the Engineer with all samples. Samples shall be stored in closed, waterproof plastic bags.

Work Plans

00291.07 Health and Safety Plan - Prepare a project HASP to protect workers, the public and the environment while constructing the project in areas with known or discovered Contaminated Media. The HASP shall be developed and implemented in association with the Contractor’s normal construction safety program.
Submit to the Engineer within 30 days of the Notice of Award. Submission to the City does not relieve the Contractor of its safety responsibilities nor does it impose responsibility or legal liability upon the City for safety.

The HASP shall be distributed to all on-site workers and employees. Workers and employees are required to read the HASP, sign a compliance agreement, and abide by all of its provisions. The HASP shall be displayed or made available at the site at all times.

Revised the HASP as needed whenever new information about Contaminated Media or other potential site hazards is obtained. The Contractor's Health and Safety Representative, as appropriate shall certify any changes, deletions, or additions to the HASP. All proposed changes, deletions or additions to the HASP shall be submitted to the City prior to implementation.

The HASP shall conform to the requirements of 29 CFR 1926.65 and all applicable federal, state, and local statutes, rules, regulations and ordinances. The HASP may be more stringent than, but shall be in accordance with the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

The HASP shall include, but is not limited to, the following:

(a) **Key Personnel** - Identification of key personnel authorized to be responsible for site safety and delegation of responsibilities for ensuring compliance with the HASP. Provide the name and qualifications of:

   - Contractor’s Health and Safety Representative(s)

(b) **Site Description and Location** - Site address or location description.

(c) **Site Control Measures** - Site control measures will be defined and identified on a site map.

(d) **Pre-Entry Briefings** - Descriptions of pre-entry briefings to be held prior to initiation of work in areas with known contamination at the construction site, and at such other times as necessary to ensure that workers are appraised of HASP provisions and that such plan is adequate and being followed.

(e) **Chemical Hazard Analysis** - Identify and establish appropriate procedures for addressing suspected conditions or activities that may pose routine occupational hazards or immediate danger to life or health of site personnel. The HASP must describe the risks associated with each task and the actions to be taken to mitigate existing hazards and to make the work environment less hazardous.

(f) **Contaminated Media Management Zones** - Designate work zone(s) including Contaminated Media Management, contamination reduction, and support zone(s) to reduce the potential for contaminant migration and minimize personnel exposure to Contaminated Media. Describe the procedures for informing all persons at the site about CMMZ requirements. The plan must set forth the specific criteria and thresholds for designation of work zones.
(g) Personal Protective Equipment - Address levels of personal protection to be employed during work, setting forth specific criteria and thresholds for choices of protective clothing, equipment, and respirators based upon the types and concentrations of contaminants and exposure pathways that may be encountered by site workers during various site operations.

(h) Environmental Monitoring - Set forth a program for the determination of personal exposure monitoring requirements including air monitoring in the work area(s) as needed. List and describe equipment to be used.

(i) Decontamination Procedures - Set forth procedures for decontamination of personnel, materials, and equipment as needed.

(j) Spill Prevention and Cleanup - Describe the equipment and procedures to prevent releases of hazardous substances to the soil and water from the construction equipment and materials. The plan shall also describe the equipment and procedures to be used to immediately cleanup any such releases, if they occur.

(k) Storage and Handling - With information from 00291.42, develop and coordinate procedures for storage, handling and disposal of any Contaminated Media or contaminated debris to promote safe working conditions in accordance with the HASP and all applicable federal, state, and local statutes, rules, regulations and ordinances.

(l) Emergency Response - Develop an Emergency Response Plan for safe and effective response to emergencies which establishes emergency procedures including, but not limited to escape routes, signals for evacuation workers, emergency communications, procedures for communication with personnel, and response to fire and explosions. Describe emergency equipment that will be available on site, such as portable extinguishers, first aid kit, etc.

(m) Training Requirements - Define appropriate levels of training and training procedures to promote a safe working environment in accordance with the HASP.

(n) Medical Monitoring - If the employees meet the requirements of 29 CFR 1926(f)(2)(i)-(iv), include a medical surveillance program consistent with 29 CFR 1926.65(f).

00291.08 Contaminated Media Disposal Plan - The CMDP shall contain the following:

- Site Map
- Name of Contaminated Media Disposal Facility
- Contaminated Media Management Zone
- Contaminated media handling (container, bagged, dump truck, etc.)
• On-site hauling routes, entrance and exit locations, standby areas, etc.
• Decontamination and best house keeping practices

Refer to any Environmental Reports or Contaminated Media stations listed in the special provisions and on the construction plans.

As new information is discovered and as otherwise required, update and maintain the CMDP to reflect the most current Contaminated Media information throughout the duration of the contract.

List the haul routes that will be used to transport the contaminated media to the approved disposal site.

Describe in the Plan, the facilities and location where any contaminated groundwater will be treated. If contaminated groundwater goes to the sanitary system include the City Industrial Batch Discharge Permit, and documentation of off-site disposal facility acceptance for sludge or solids created by on-site treatment processes (e.g. settling tanks).

On-site excavation work shall not begin until the CMDP has been approved.

Materials

00291.10 Materials - Furnish materials meeting the following requirements:

Plastic Sheeting ................................................00280.10(k)
Straw Bales.......................................................00280.10(n)

00291.11 Truck Liners - Furnish plastic, 6 mil minimum, truck liners that are watertight and designed to transport contaminated media.

Labor

00291.30 General - Submit certificates demonstrating individual personnel have been properly trained to handle the excavation and disposal of contaminated media. Training shall include the 40 hour Hazardous Waste Operations and Emergency Response Training Program, and associated 8 hour annual refresher in accordance with 29 CFR 1910.120 and 1910.134. Appropriate training is required for all personnel who come in contact with, or operate equipment that handles contaminated media.

00291.32 Safety Representative - Submit certificates demonstrating the Safety Representative(s) meets the requirements stated below for all work relating to hazardous substances or Contaminated Media.

00291.33 Contractor Safety Representative Authorization - All contractor personnel, subcontractors, services vendors, sales personnel, or anyone else entering the construction site must be authorized by the Contractor's Health and Safety Representative.
(a) Qualifications of Safety Representative(s):

- **Training** - Have completed all required OSHA Training in accordance with 29 CFR 1910.120, including completion of 40 hour + 8 hour supervisory training updated annually and completion of 3 days on-site training by a qualified instructor.

- **Experience** - Have a minimum of 3 years experience in hazardous substance or hazardous waste site remediation or related work.

- **Certification** - Are currently certified in first aid and CPR.

- **Knowledge** - Have demonstrated knowledge of federal, state, and local occupational health and safety regulations.

- **Pollution Control Requirements** - Be familiar with and follow all pollution control requirements during implementation of the HASP.

(b) Responsibilities:

- **On-Site** - Be on site and present during work in contaminated media zones identified in the HASP, in areas where Contaminated Media is encountered, and during the handling, transportation, or disposal of Contaminated Media and all work related to the presence or potential for unknown hazardous substances.

- **HASP Requirements** - Develop, implement, enforce, modify and monitor the HASP requirements.

- **Training** - Conduct the preconstruction training and other periodic training of all on site personnel with regard to contents of the HASP(s) and other safety Requirements to be observed during construction.

- **Monitoring** - Perform all air monitoring if required by the HASP(s).

- **Compaction Testing** - All personnel testing for compaction entering the excavation shall meet the HASP requirements.

(c) Authority:

- **Work Suspension** - Suspend field activities if health and safety of Contractor personnel, Project personnel, or the public are endangered.

- **Individual Suspension** - Suspend individual(s) from field activities due to infractions of the HASP(s).

**Construction**

00291.40 Record Keeping - Maintain the following records on an on-going basis. Provide copies to the Engineer upon request or as identified herein.

(a) Daily Reports - Prepare reports on the same day in which any Contaminated Media management activity occurs and submit to the Engineer the next business day by 9:00 a.m. These reports shall document all monitoring...
and management of Contaminated Media. The report(s) shall include, as applicable, the following:

- Location and depth where Contaminated Media was excavated, pumped or removed.
- Estimated volumes of Contaminated Media excavated, pumped or removed.
- The locations of any temporary contaminated media stockpiles or storage and the volume of contaminated media placed in, or removed from, the stockpiles, and how it is stored.
- The location, depth, and nature of any potential unanticipated Contaminated Media encountered or observed and the response taken by the Contractor.

(b) Contaminated Media Bills of Lading and Weigh Slips - Use a bill of lading for each offsite shipment of Contaminated Media. The bill of lading shall include the date and time of shipment, the name of the hauling company, the name of the truck driver, the disposal site, the Owner's project number, the removal location, and a brief description of the Contaminated Media. A copy of the bill of lading and the associated weigh slip showing the weight/volume of the Contaminated Media shall be provided to the Engineer within 24 hours of shipment of the Contaminated Media.

(c) Hazardous Waste Manifests - If RCRA, Oregon State-Only and other Hazardous Waste is encountered, follow the procedures described below:

Prepare waste manifest forms (EPA Form 8700-22) for each shipment of hazardous waste from the site. The manifest shall describe the contents of each truck carrying materials to the hazardous waste facility, including as applicable the appropriate unit of measure of the waste materials.

The Contractor’s hauler shall sign and date the manifest indicating that the load has been accepted as the load described in the manifest on that particular day. The Contractor’s hauler shall carry a hazardous waste manifest with each truckload. Prior to truck departure, the Engineer will sign and keep appropriate copies of the manifest and give the remaining copies to the Contractor’s hauler. Provide the Engineer with the Generator's copy.

The Engineer will provide a hazardous waste generator identification number for use on the manifest while the Contractor shall provide a hazardous waste transporter's identification number and telephone number.

Within 2 days of receiving a completed waste manifest, provide a copy to the Engineer confirming the receipt of the shipment at a permitted disposal facility.
Should any waste manifest not be returned within 35 days of shipment, initiate follow-up efforts to determine what happened to the shipment, document its effort in writing with an Exception Report as required by 40 CFR 262.42 and provide a copy to the Engineer. A copy of the completed waste manifest shall be provided to the Engineer indicating each waste shipment has been received at the Solid Waste Disposal or Treatment Facility within 2 days of their return to the Contractor.

**00291.41 Site Excavation Monitoring** - Monitor all excavations required by the contract, including those outside areas of known contamination, for the possible presence of contaminated media using the procedures described in this Section. At all times observe for visual, olfactory, or texture indications of contamination during all excavation activities. These indications may include, but are not limited to: petroleum, oil, fuel, or gasoline odor, other unusual odors, mottled or gray appearance, unusual color, sheen, staining, debris, or other non-native material. Observations are to be recorded in reports submitted daily to the Engineer.

Notify Engineer when groundwater is encountered within excavated areas.

Immediately notify the Engineer if observations indicate the presence of contaminated media outside the areas of known contamination, and follow the procedures described in the following subsections.

**00291.42 Known or Anticipated Contaminated Media** - Any known or anticipated contaminated media will be shown and listed in the Special Provisions.

**00291.43 Contaminated Media Management Zones and Decontamination** - Before beginning excavation of contaminated media, establish a CMMZ around the excavation area where contaminated media is located. Entrance/exit locations to the CMMZ shall be established by the Contractor and described in the CMDP and HASP.

Equipment may move freely within the CMMZ. Decontamination between specific excavation areas shall consist of brooming off loose soil and removal of significant quantities of adhered soil with hand tools. Washing of equipment is not required for movement of equipment within the CMMZ.

If practicable, truck-loading areas shall be located at the boundary of the CMMZ so that trucks will not enter the CMMZ and will not require decontamination.

Trucks shall be broom cleaned before leaving the loading area.

Personnel exiting the CMMZ shall decontaminate according to the decontamination procedures to be specified in HASP.
After beginning excavation, the Engineer will take media samples at increasing distances from the area where contamination was identified and test the sampled media for contamination. If contaminated media is found, continue to follow the protocol for managing and contaminated media. If through this additional sampling and testing it is determined that media is not contaminated, then follow the direction of the Engineer regarding use or disposal of this material.

00291.44 Excavation and Handling - All known contaminated media excavated or removed shall be excavated and loaded using the following requirements and procedures described in the CMDP:

- Notify the Engineer no less than 24 hours prior to beginning excavation of contaminated media.
- Control surface water runoff, to minimize entry or collection of water in excavations and storm drains.
- Initiate applicable provisions of the HASP to restrict and protect workers, and the public from exposure to contaminated media. Modify the HASP as necessary, to address new contaminants, hazards, and other contaminated media concerns discovered during construction. All modifications to the HASP shall be submitted to the Engineer no sooner than 24 hours prior to working in the area affected by the modifications. Meet all requirements necessary to provide adequate security, staging, characterization, removal, cleanup, handling, and disposal of unknown and unanticipated contaminated media.
- Excavate media in a manner that prevents commingling of contaminated and uncontaminated media. Minimize movement of excavation equipment over or through contaminated media to prevent movement of contaminated media into areas where no contaminated media exists.
- Maintain excavation equipment in good working order. Prevent spillage of oil, fuel, or hazardous substances from equipment. Promptly repair oil leaks from equipment and clean up any contaminated media.
- Select a location for contaminated media stockpile. Supply drop box or sheeting and hay bales. Stockpile soil or other contaminated media in covered drop box or on 10-mil plastic sheeting bermed by hay bales. Cover contaminated media stockpile with plastic sheeting and maintain, as necessary, until removed.
- Loading areas for contaminated media will be located in the CMMZ.
- Load contaminated soil into trucks or approved containers in a manner that prevents spilling or tracking of contaminated media into areas of the site with uncontaminated soil. Soil will not be accepted in drums.
- Remove loose material falling onto truck during loading before truck leaves loading area. Broom trucks clean before leaving the loading area. Any contaminated material collected in loading area shall either be placed into truck or back onto soil stockpile.
• If loading area is unpaved, notify Engineer when loading activities are complete so Engineer can determine if collecting surface soil samples from area is required to confirm that contaminated media is not present. If loading area is paved, clean any loose soil from pavement by sweeping at conclusion of each day’s loading activities.

• Cover all trucks before they leave the loading area.

• All vehicles leaving a CMMZ and entering right-of-way shall be cleaned of any suspected contaminated media on wheels, frames, or other non-covered areas.

• If free liquid is present in excavated contaminated media, provide liquid tight liners for the trucks hauling the material to the disposal/treatment facility.

• Establish specific truck haul routes before beginning offsite contaminated media transport to reduce risk of releases of contaminated media and impact on local traffic. Establish onsite truck routes to minimize or prevent movement of trucks over contaminated media.

• Ensure that loaded truck weights are within acceptable limits.

• Personnel exiting a CMMZ shall decontaminate according to the decontamination procedures specified in the HASP.

• Comply with all applicable federal, state, and local laws, codes, and ordinances that govern or regulate contaminated media or hazardous waste/material transportation.

• Ensure that all drivers of vehicles transporting contaminated media or hazardous waste/material have in their possession during transport all applicable Oregon State and local vehicle insurance requirements, valid drivers’ license, and vehicle registration and license. Responsible for informing all drivers of transport vehicles about:

  • Nature of material transported in the form of a written manifest or disposal permit.

  • Required routes to and from the offsite disposal facility.

  • Applicable City street regulations and requirements, and State of Oregon Department of Transportation codes, regulations and requirements.

  • Contaminated Media shall not be spilled or tracked offsite at any time during project.

  • Trucks shall be substance compatible, licensed, insured, and permitted pursuant to federal, state, and local statutes, rules, regulations and ordinances for transportation of Contaminated Media or hazardous substances offsite.

  • Copies of approved disposal/acceptance permit and disposal manifests shall be provided by Engineer (disposal/treatment facility requires driver to have copies of permit or disposal manifests).
**00291.45 Discovery of Unanticipated Contaminated Media** - Follow procedures described in 00291.06 and comply with the following in response to unanticipated and unknown Contaminated Media. Upon notification, the Engineer will make a determination whether unanticipated and unknown Contaminated Media has been encountered. While making this determination:

- Immediately cease all work activity in and around any area where suspected Contaminated Media is encountered.
- Remove employees from the immediate area and secure the site.
- Immediately contact the Engineer and deliver an oral assessment of the site conditions.
- Do not move, haul or dispose any unknown media until the determination is made.
- Take appropriate measures in compliances with all applicable Environmental Laws to stop or minimize the immediate spread or release of any contamination.
- Immediately place appropriate control measures or devices on or adjacent to the affected area in such a manner that does not disturb the site or the suspected media. Prevent rain or stormwater runoff from contacting media and becoming contaminated.
- Upon notification, the Engineer will collect and analyze test samples for laboratory analysis and make a determination whether unanticipated and unknown and Contaminated Media has been encountered.
- During analysis, cease excavation and dewatering activities at the sample location(s). Do not move, haul or dispose of any suspected media. Maintain and secure the construction site until the final determination is made.
- The Engineer will provide analysis results to the Contractor within 72 hours after a sample is taken.
- Update the CMDP to address this new information. All document modifications shall be reviewed by the Engineer.
- Until a determination is made, any excavated media which is suspected of contamination shall be temporarily stored in a pre-approved secure, covered, water tight location shown in the CMDP that limits possible cross contamination with other non contaminated media. Temporary storage locations shall be placed within the public rights of way and adjacent to the excavation pit. Incorporate storage locations into traffic control plans.
- Within 48 hours of discovery of unanticipated Contaminated Media deliver to the Engineer a written assessment of the occurrence, current site conditions and all actions taken.
Update the HASP, the CMDP, and Spill Prevention and Cleanup Plan as necessary, to address new contaminations, hazards, and other Contaminated Media concerns associated with the unanticipated and unknown contamination. The Engineer will provide the Contractor unanticipated and unknown Contaminated Media sampling and analysis results to assist the Contractor in updating the CMDP and other document modifications. All document modifications shall be reviewed by the Engineer.

**Discovery of Active or Abandoned Leaking Underground Utilities or Tanks** - Report discovery of leaking abandoned buried pipelines, utility conduits, or tanks to the Engineer immediately. Manage and properly dispose of associated Contaminated Media per these specifications. If encountered, Engineer may collect sample of abandoned utility (tank) discharge. If sampled, Engineer will provide Contractor results of sample characterization, and guidance on disposal options within 96 hours of sampling.

**Management of Contaminated Media** - Unless approved, contaminated media excavated from the contaminated areas described in any Environmental Report, construction plans, Special Provisions and CMDP shall not be temporarily stockpiled or stored on site at any time. Contaminated media excavated from sections illustrated in the CMDP shall be directly loaded and hauled off site to the approved facility, or if approved by the Engineer, immediately used as fill material. The CMDP will be shown in the Special Provisions.

**Treatment of Contaminated Media** - Unless approved, contaminated media shall not be treated on site.

Contaminated construction dewatering effluent may be treated on site so long as effluent meets the City Batch Discharge standards. Contaminated construction dewatering effluent may be pretreated within a suspended solid settling tank, such as a baker tank or other approved treatment method. Contaminated construction dewatering effluent determined to contain soluble forms of hazardous materials shall not be discharged directly into the City’s sewer system unless approved. Contaminated construction dewatering effluent treatment guidelines include, but are not limited to, the following:

- If sampling is necessary to determine disposal options, the Engineer will collect a sample of containerized water, wait 24 hours for excavation to recharge, and re-sample water from the excavation.
- Propose a location for storage of pumped groundwater. The Engineer will approve final location.
- Supply the pump, hosing, and the holding tank or other appropriate containers.
- Evacuate water from excavation, containerize, and treat at the direction of the Engineer. Treatment options will be determined based on the type and amount of contamination.
The Engineer will submit water samples to the City BES Water Pollution Laboratory for analysis. The Laboratory requires a minimum of 96 hours for processing sample and returning data.

- The Engineer will select a disposal method.
- Discharge of contaminated excavation de-watering effluent to the City sewer line requires Permit from the City BES Water Pollution Lab-Source Control Division. This permit shall be obtained by the Contractor before commencement of dewatering activities.
- If batch discharge to the City’s sewer system is permissible, provide all labor, equipment and materials necessary to complete the work.
- Concentration of effluent from the settling tank shall meet City discharge
- Transport contaminated sludge from the pretreatment to an approved disposal or treatment facility.
- Provide the Engineer with the contaminated sludge disposal receipt or a copy.

00291.49 Environmental Construction Oversight - Environmental construction oversight includes the specific environmental construction oversight tasks that will be used during the construction of this project.

The Contractor’s Safety Officer’s responsibilities as part of the oversight team are as follows:

- Monitor excavated media for evidence of unanticipated and unknown conditions. Notify the Engineer if potential unanticipated and unknown Contaminated Media conditions are observed.
- Remove, manage, and dispose of the known Contaminated Media in accordance with these specifications.
- Collect and analyze water discharge sample to monitor compliance with the wastewater batch discharge permit.
Measurement

00291.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

- **Lump Sum Basis** - Under this method, no measurement of quantities will be made.
- **Separate Item Basis** - Under this method, the quantities of work performed on a separate item basis will be measured as follows:
  - **Volume Earthwork** - Computed by the average end area method from cross section measurements, or other methods of equivalent accuracy.
  - **Volume Water** - In tanks or tank trucks of predetermined capacity or approved meters.
  - **Weight** - Quantities will be measured in the hauling vehicle.
  - **Each** - Items will be measured on a unit basis.

Payment

00291.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum or separate item basis for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
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</thead>
<tbody>
<tr>
<td>(a) Contaminated Media Disposal</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(b) Stockpile Berm</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Decontamination of Equipment</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Truck Liners</td>
<td>Each</td>
</tr>
<tr>
<td>(e) HASP/CMDP Work Plans</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) Contaminated Groundwater Disposal</td>
<td>M-Gallon</td>
</tr>
<tr>
<td>(g) Contaminated Water Storage Tank</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Drop Boxes</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) will be payment in full for stockpiling in a berm for testing, reloading, and disposal of the material. Payment for excavation of Contaminated Media will be paid under the appropriate pay items in Sections 00330 and 00405.

Item (b) will be payment in full for constructing an impervious barrier and berm to contain contaminated material for testing and material to cover stockpile to prevent rainfall from coming into contact with contaminated material.

Item (c) will be to properly clean all equipment used to handle stockpile to prevent contaminated material. No payment will be made until a written report is submitted detailing the decontamination performed on the equipment.

Item (d) will be payment in full for the liner regardless of how many times the liner is reused.
Item (f) is for contaminated groundwater disposal and includes settling tanks, permit fees, and all work, equipment and materials required to estimate, handle, store, process, and dispose of contaminated groundwater.

Item (g) are storage tanks similar to Baker Tanks.

Item (h) includes a cover over the drop box.

Loading and disposal of material shown by testing to be non-contaminated media will be considered incidental with no additional payment.

Unanticipated Contaminated Media, as outlined in 00291.45 and 00291.46 will be paid according to Section 00196.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
PART 00300 - ROADWORK

Section 00310 - Removal of Structures and Obstructions

Description

00310.00 Scope - This work consists of removing and disposing of man-made materials and cleaning up areas they occupy. See Section 00501 for removal of bridges.

00310.01 Areas of Work - Perform removal work in the same areas as specified in 00320.01.

If a building to be removed lies partly within the right-of-way, remove the entire building unless otherwise shown or directed.

00310.02 Exclusions - Removal work does not include removal or disposal of materials which are:

- Designated to remain.
- Included in earthwork as given in 00330.41.
- Specifically indicated by the Specifications, plans, or Special Provisions to be removed incidental to other items of work under the Contract.
- Owned or controlled by third parties.

00310.03 Definitions:

Tie - One of the transverse supports to which railroad rails are fastened to keep them in line.

Track - The parallel rails of a railroad.

Construction

00310.40 Restrictions on Removal Work:

(a) Guardrail, Median Rail, and Concrete Barrier - In those areas where guardrail, median rail or concrete barrier are to be removed and replaced with new or salvaged rail or barrier, do one of the following:

- Install the new or salvaged units the same working shift the existing unit is removed.
- Protect the area with temporary, precast concrete barrier units with appropriate end treatment satisfactory to the Engineer, until the new or salvaged unit is installed.
(b) Milepost Markers - Throughout construction, protect and maintain all milepost markers on State highways affected by the work at locations visible to the traveling public. This may require removing and relocating the milepost markers to maintain visibility throughout construction. When construction is completed, reinstall the milepost markers in their original location in a manner satisfactory to the Engineer, unless new milepost markers are to be installed according to Section 00840.

00310.41 Removal Work:

(a) General - Where an abutting structure or a part of a structure is to be left in place, make cuts that protect remaining structures and allow for specified connections. When removing pavements, curbs, sidewalks and other similar structures, all cuts where an abutting structure is to be left in place shall be clean, smooth, vertical cuts made with a concrete saw or other approved cutting device to the lines as established. **Vacuum the slurry from the saw cutting.**

Do not remove sidewalk corners until any historic dates or street names are documented for replacement under 00759.50(d).

(b) Guard Rail Posts - Remove posts completely and backfill holes with selected granular backfill material meeting the requirements of 00330.14.

(c) Drainage Structures - Remove drainage structures, such as box culverts, down to a depth 2 feet below ground, slope or waterway bed. Remove culverts, sewers, siphons, and other conduits according to 00330.41(a)(7).

(d) Materials Within Construction Areas:

(1) General - Remove materials within construction areas entirely or break down the materials to an elevation at least 2 feet below subgrade or slope surface as allowed below.

(2) Bituminous Treated Surfaces - Scarify and break up existing bituminous treated surface when it lies under subgrade and is not salvaged. Incorporate the scarified material into the embankment. Pieces of existing pavement shall not exceed 15 inches in any dimension.

(3) Concrete Floors, Slabs and Walls - Before placing material in basements or over concrete slabs, remove or break through the floors, slabs and walls so no fragments of the floors, slabs, and walls have a dimension in excess of 15 inches and there is no protruding reinforcement.

(4) Railroad Track and Ties - Break up existing grout or concrete between and below the ties when it lies under the subgrade. Pieces of grout or concrete shall not exceed 15 inches in any dimension. Provide written documentation of where the ties were disposed.
(5) Cobblestones (Belgian Paving Blocks) - Salvage quantities of 150 or more of Belgian Paving Blocks, commonly known as cobblestones, which may be removed in the course of excavation. The cobblestones shall be cleaned and delivered to Chimney Park at 9360 N Columbia Blvd. or other designated site. Notify the Operations Division of the Bureau of Parks and Recreation at 503-823-3643 a minimum of 48 hours prior to delivery. Assume ownership of quantities less than 150 cobblestones.

(6) Horse Rings - Salvage any metal horse rings encountered during curb removal. Reinstall horse ring assembly back at the same project stationing or as close as practical. If no new curb is constructed, deliver horse ring assemblies to the City's Maintenance Bureau at Stanton Yard located at 2835 N Kerby Ave.

(e) Materials Outside of Construction Areas - Remove materials which lie outside of construction areas to an elevation at least 2 feet below the surface elevation to which the affected area is to be finished.

00310.42 Salvaging Drainage Structure Fittings - Metal grates, frames, rings, covers, and other metal fixtures or fittings for drainage structures may be salvaged and used on new structures if the Engineer determines they are reusable. Any excess materials not needed on the Project, but deemed usable, shall be delivered to the City's Maintenance Bureau located at 2929 N Kerby Avenue.

00310.43 Disposal of Material - Dispose of materials according to 00290.20(c).

00310.44 Earthwork in Connection with Removal - Excavation required to perform removal of structures and obstructions will be considered Incidental to the removal work, unless it is within the measurement limits for an excavation Contract pay item.

Backfill holes according to 00330.45. The backfill will be measured for payment according to 00330.82, when there is an embankment measure basis pay item for earthwork and that material is used for backfilling, otherwise no separate payment will be made for this work.

Maintenance

00310.60 Repair of Damages - Repair promptly any breakage or damage to materials or items not intended to be removed. Complete replacement of the affected materials may be required if the Engineer determines it is necessary. Make all repairs and replacements at no additional cost to the City.

Measurement

00310.80 Measurement - The quantities of removal of structures and obstructions work performed under this Section will be measured according to the following:
• **Lump Sum Basis** - Under this method, no measurement of quantities will be made. Estimated quantities of man-made materials will be listed in the Special Provisions.

• **Separate Item Basis** - Under this method, the quantities of work performed on a separate item basis will be measured as follows:
  - **Length and Area** - The length or area of the structure or item actually removed, will be measured along the line and grade of the structure or item for each continuous structure or item removed. Measurement will be by the foot and be limited to the neat lines shown or directed. Area will be calculated to the square yard.
  - **Each** - Items will be measured on a unit basis of units removed.

### Payment

**00310.90 Payment** - The accepted quantities of work done under this Section will be paid for at the lump sum basis or separate item basis according to 00310.91 and 00310.92 as applicable:

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for barriers used for temporary protection where guardrail, median rail, or concrete barriers have been removed.

No separate or additional payment will be made for protecting and maintaining milepost markers and reinstall them at their original location.

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

**00310.91 Lump Sum Basis** - The accepted quantities of removal work done on a lump sum basis will be paid at the Contract lump sum amount for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Removal of Structures and Obstructions</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Removal of _____________________________</td>
<td>________________</td>
</tr>
</tbody>
</table>

Item (a) includes all removal work done on a lump sum basis, except as covered under pay items given in the form of (b).

In item (b), the specific kind or description of removal work will be inserted in the blank.
00310.92 **Separate Unit Basis** - The accepted quantities of removal work done on a separate item basis will be paid for at the Contract price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Removal of Pipes</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Removal of Curbs</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Removal of Walks and Driveways</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(d) Removal of Surfacings</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(e) Removal of Inlets</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Removal of Manholes</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Removal of Concrete Stairs</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(h) Removal of Railroad Track and Ties</td>
<td>Foot</td>
</tr>
<tr>
<td>(i) Salvaging and Stockpiling of Cobblestones</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(j) Remove and Reinstall Horse Rings</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (d) applies to removal of all surfacings, except for walks and driveways, as defined in 00110.20 under "Existing Surfacings".

Item (g) includes removal of handrail.

Item (h) includes all track and tie appurtenances.

Item (i) applies to the separation, cleaning, delivering and stockpiling of the cobblestones as specified.

Item (j) applies to horse ring assemblies remove from existing curb and reinstalled in new curb or delivered as specified.
Section 00320 - Clearing and Grubbing

Description

00320.00 Scope - This work consists of removing and disposing of vegetation and buried matter within a specified area or as directed. The work also includes preserving vegetation and objects designated to remain in place and cleanup of the work area.

00320.01 Areas of Work - The areas to be cleared and grubbed are shown on the plans, or if not shown on the plans, the clearing lines are 1 foot outside the following:

- Top of side slopes of ditches and channel changes.
- Top of cut slope.
- Top of cutbank rounding if rounded.
- Toe of fill slope.
- Outside edge of structure.
- Other work areas shown on the plans, such as material sources, borrow areas and road connections.
- Tree, plant, or natural areas to be preserved.

00320.02 Definitions:

Active nest - A nest containing eggs or young migratory birds.

Certified Arborist - Holding a current certification from the International Society of Arboriculture.

Clearing - Clearing consists of:

- Preserving trees and other vegetation designated to remain in place.
- Salvaging marketable timber, when required by the Special Provisions.
- Cutting and removing vegetation, such as weeds, grasses, crops, brush, and trees.
- Removing down timber and other vegetative debris.

Clear Zone - The clear zone is the roadside border area, starting at the edge of the traveled way, available for safe use by an errant vehicle. The minimum clear zone line, for purposes of this Section, is 10 feet from the edge of the traveled way or 18 inches behind the curb, whichever is greater. However this distance may vary depending on design speed, horizontal alignment and side slope requirements.
Grubbing - Grubbing consists of removing:

- Brush stems remaining above the ground surface after the clearing work.
- Tree stumps.
- Roots and other vegetation found below ground surface.
- Partially buried natural objects.

Materials

00320.10 Plastic Mesh - Furnish plastic mesh meeting the requirement of 00270.11.

Labor

00320.30 Labor - Tree trimming and tree root removal shall be performed under the direction of a certified arborist.

Construction

00320.40 Clearing Operations:

(a) Clearing Trees and Other Vegetation - Remove and dispose of noxious weeds and Specified Weeds according to Section 01030 prior to beginning clearing of trees and other vegetation.

Cut trees and brush so they fall into the areas specified to be cleared.

Cut off tree stumps, not required to be grubbed under 00320.41 as follows:

- Flush with the ground surface if within the clear zone.
- No higher than 4 inches above the ground surface if between the clear zone and the clearing line.

Remove all evidence of clearing matter and debris. This work includes removal of:

- Sod, weeds and dead vegetation.
- Down timber, brush and other vegetation.
- Sticks and branches with diameters greater than 1/2 inch.
- Dead trees, down timber, stumps, and specified trimmings from areas where live trees and other vegetation are designated to remain.

(b) Preserving and Trimming Vegetation:

(1) Within the Work Areas - Avoid injuring vegetation designated to remain in place. Preservation of this vegetation includes protection and special care.
(2) **Outside the Work Areas** - Avoid injuring any vegetation. Confine operations which may injure vegetation to areas that have no vegetation or to the work areas.

Remove hazardous, dead and damaged trees outside the clearing limit as directed.

(3) **Tree Trimming** - Trim trees *under the direction of a certified arborist* according to good tree surgery practices and as directed to remove safety hazards such as:

- Unsound branches of trees to remain in place.
- Branches over roadways and bridges to provide at least 20 feet of clearance above the roadway surface.
- Branches over walks to provide at least 8 feet of clearance above the walk surface.
- Branches obstructing sight distance at intersections or impairing visibility of signs.

Preserving vegetation includes keeping equipment and materials off of the critical root zone as directed.

(4) **Tree Protection** - Trees noted on the plans to remain will be marked to be protected within the work areas. Install orange plastic mesh fencing around the critical root zones of marked trees or tree groups as shown or directed. Do not begin construction activity or move equipment into tree areas until plastic mesh fencing is in place. Any necessary work within the critical root zone shall be done only with written approval. Be responsible for any damage to marked trees. Tree damage will be determined by a certified arborist selected by the Engineer.

(c) **Timber Salvage** - The property owner has the right to any trees 6 inches in caliper or larger felled in the right-of-way adjacent to owner's property. Notify the property owner(s) by mail or door hanger at least 48 hours prior to felling the trees. *The notice shall state that* the property owner(s) have 7 calendar days after timber is felled to remove timber from the right-of-way. If timber is not removed after 7 calendar days, the ownership of the timber shall revert to the Contractor.

(d) **Tree Limb Removal Limitations** - The nesting season is March 15 to August 31. Schedule tree limb removal outside the nesting season when possible. Removal of tree limbs during the nesting season will require inspection of the trees for nests. If an active nest is found, a determination will be made on whether to obtain a permit for the removal of the nest. Nest removal shall only be performed by a trained, United States Fish and Wildlife Service permitted specialist. Otherwise, the removal of any tree limb with an active nest shall not be allowed until after the nesting season.

00320.41 **Grubbing Operations** - Within excavation limits, remove tree stumps, roots, and other vegetation to a depth of at least 6 inches below excavation subgrade or sloped surfaces.
Within embankment limits, remove tree stumps, roots, and other vegetation.

**00320.42 Ownership and Disposal of Matter** - All matter and debris accumulated from clearing and grubbing operations become the Contractor's property. Dispose of this matter and debris according to 00290.20(c).

**00320.43 Backfilling Holes** - Except in areas to be excavated, backfill holes remaining after grubbing operations with clean fill (see 00290.20(c)(2)) according to 00330.45.

**Measurement**

**00320.80 Measurement** - The quantities of clearing and grubbing work performed under this Section will be measured according to the following:

- **Lump Sum Basis** - Under this method, no measurement will be made.

- **Area Basis** - Under this method, measurement will be the ground surface, limited to the areas shown on the plans or directed.

- **Hour Basis** - Under this method, measurement will be by the number of authorized hours regardless of the number of people and equipment used.

- **Each Basis** - Under this method, measurement will be by the number of trees directed to be removed.

**Payment**

**00320.90 Lump Sum Basis** - The accepted quantities of clearing, grubbing, disposal, and cleanup work will be paid for at the Contract lump sum amount for the item "Clearing and Grubbing".

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

**00320.91 Separate Unit Basis** - The accepted quantities of removal work done on a unit basis will be paid at the Contract price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Clearing and Grubbing</td>
<td>Acre</td>
</tr>
<tr>
<td>(b) Tree Root Removal</td>
<td>Hour</td>
</tr>
<tr>
<td>(c) Tree Trimming</td>
<td>Hour</td>
</tr>
<tr>
<td>(d) Tree Removal, ___ Inch</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) includes disposal and cleanup work.
Item (d) includes trees shown to be saved, but after excavation work directed to be removed.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

00320.92 **Incidental Basis** - When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work required.

Plastic mesh fencing required in 00320.40(b)(4) and seeding and mulching required in 00320.42(c)(1) are considered Incidental to the work and no separate or additional payment will be made.
Section 00330 - Earthwork

Description

00330.00 Scope - This work consists of excavation, ditching, backfilling, embankment construction, grading, leveling, borrow, and other earth-moving work required in the construction of the Project, excepting such work specifically included and provided for as:

- A pay item elsewhere in the Contract Specifications.
- Incidental work in the detailed Specifications for other Contract pay items.

The term "earthwork" will be used as a general term to designate the work included within the scope of this Section.

00330.01 Lines, Grades and Cross Sections - All earthwork shall conform to the lines, grades and cross sections established.

Roadbed cross sections shall be subject to variation from the typical sections shown on the plans, if directed, to:

- Provide superelevation on curves.
- Take care of special conditions at intersections and elsewhere.
- Balance earthwork quantities.

00330.02 Definitions:

Abandoned Pipes and Miscellaneous Matter - Sewers, pipes, conduits, logs, timbers, concrete and other structures, materials, objects, and matter encountered in the work, excepting only items identified for removal or preservation.

General Excavation - All excavation covered by this Section, except foundation, toe trench, and borrow excavation.

Overbreak - Material beyond and outside of the slope limits established by the Engineer, which becomes displaced or loosened during excavation and is excavated.

Selected Materials - Those materials with pertinent characteristics that are preserved and sorted as directed from specified excavations and handled for specific uses.

Stone Embankment Material - Rock used in specific embankment applications including buttresses, inlays, shear keys, and erosion control applications.
00330.03 Basis of Performance:

(a) General - Except as provided in 00330.00, all earthwork shall be performed on either an excavation basis or on an embankment basis. The basis of performance for each earthwork pay item will be indicated in the Special Provisions and the Contract Schedule of Items. The estimated quantities of excavation and embankment are as shown.

(b) Excavation Basis - Earthwork performed under this provision including excavation, haul, and embankment construction, unless otherwise specified, will be paid for by excavation measurement. (see 00330.80 and 00330.81)

(c) Embankment Basis - Earthwork performed under this provision, including excavation, haul and embankment construction, unless otherwise specified, will be paid for by embankment measurement. (see 00330.80 and 00330.82)

00330.04 Sources of Borrow:

(a) City Furnished Borrow - Use materials obtained from City furnished sources lying outside of, separated from and independent of planned roadbed excavations, or other required excavations within the Project limits, only when called for by the Contract or when specifically directed. See 00330.41(d).

(b) Contractor Furnished Borrow - Unless otherwise specified or directed, all borrow shall be furnished by the Contractor. Sources shall lie wholly outside of and beyond the limits of City-controlled lands. Acquire at Contractor's own expense. The provision of 00160.60 shall apply.

Materials

00330.10 Selected Materials - When the Contract contains a pay item "Extra for Selected ________ Material", furnish the material from required excavations. The Specifications for the selected materials will be in the Special Provisions, if different than specified in these Specifications. If other provisions of this Section call for selecting or sorting material for various parts of the work, select and sort the materials to meet the directed requirements.

00330.11 Selected Topsoil - Furnish topsoil selected for use according to 00330.10 shall meet the requirements of 01040.14.

00330.12 Borrow Material - Borrow materials provided for general embankment construction shall be soil that is free of unsuitable materials or other characteristics detrimental to the construction of firm, dense and sound embankments. Borrow materials provided for other uses shall meet the specified requirements for the use intended.

00330.13 Selected General Backfill - Soil, selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches, or other unsuitable material.
00330.14 Selected Granular Backfill - Durable sand, gravel or combinations of these, selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches, or other unsuitable material.

00330.15 Selected Stone Backfill - A combination of durable sand, gravel and cobbles, selected as directed from specified excavations, which contains no particle with any dimension greater than 6 inches, and no unsuitable material.

00330.16 Stone Embankment Material:

(a) Requirements - An unweathered, hard, angular, durable, free draining material, visibly well graded from coarse to fine with the maximum size between 15 inches and 3 inches. Rock fragments larger than 15 inches but not larger than 36 inches may be included if placed as directed in 00330.42(c)(2). If the 1" - 0 portion exceeds 10% of the total volume by the Engineer's visual examination, the 1" - 0 material will be randomly sampled for testing. The wet sieve test according to AASHTO T 11 will be performed on the sampled material. The amount of material passing the No. 200 sieve shall not exceed 5.0% by weight.

(b) Control Sample - Provide, at a location acceptable to the Engineer, in close proximity to the Project, at least a 5 cubic yards sample of stone embankment meeting the gradation specified. This sample will be used as a frequent reference for judging the gradation of the material supplied.

(c) Sampling and Testing Assistance - If the Engineer visibly determines the material furnished justifies sampling and testing, dump and check the gradation of two random loads of stone embankment material. Provide a sorting site, mechanical equipment and labor to assist in checking gradation at no additional cost to the City.

00330.17 Quality Control - Provide quality control according to Section 00165.

Equipment

00330.20 Tamping Foot Rollers - If specified, use tamping-foot rollers with a weight of at least 15 tons, with each tamping-foot protruding from the drum at least 4 inches.

00330.21 Vibratory Rollers - If specified, use vibratory rollers having a smooth drum and exerting a dynamic force of at least 30,000 pounds per impact and operating at a frequency of at least 1000 vibration per minute. Limit roller speed to no more than 1 1/2 mph.

Labor

00330.30 Quality Control Personnel - Provide certified technicians in the following fields:
00330.40

- CEBT
- CDT

Construction

00330.40 General:

(a) Quantities - Quantities and locations of earthwork materials shown are approximate only. Make sure there is enough suitable material available to complete embankments and other required fillings before disposing of any excavated materials. Make up any shortage of materials caused by premature disposal at no additional cost to the City.

The City makes no guarantee or representation by implication or otherwise, that any material available on the Project site is suitable for incorporation into any portion of the Project. No material will be considered unsuitable on the sole basis that special or additional processing or handling is required to make it suitable for incorporation into the Project.

(b) Preservation of Existing Surfacings - In addition to the cautions in Sections 00150 and 00170, protect existing surfacings of all types which are to remain in place from being damaged or fouled with undesirable material. Repair or replace damaged or fouled surfaces as directed at no additional cost to the City.

(c) Avoidance and Correction of Detrimental Operations - Perform all operations involved in excavating, hauling and placing of earthwork materials so no damage or detriment to the completed or partially completed work results. At all times provide sufficient drainage of completed or partially completed earthwork to prevent damage or loss due to rainfall, surface water or any other cause. In all cases, take proper precautions to ensure that embankment construction and filling does not move, endanger or cause undue strain or stress to any structure or adjacent ground. Temporary and final embankment slopes within any cross section shall not be constructed steeper than the slope staked for that cross section.

Recondition or remove unstable materials resulting from improper operations, inadequate drainage or over watering, and restore or replace with stable material at no additional cost to the City.

00330.41 Excavations - Perform excavation of earthwork as shown or as directed and according to the following:
(a) General:

1. **Selection and Sorting of Excavated Materials** - All materials available from excavations, including borrow materials, are subject to selection and separate handling for their best utilization in various parts of the work. Select the types of materials to be used according to 00330.42, 00330.44, 00330.45, 00330.47, the Special Provisions and as directed. Select and sort excavated materials, as necessary, to meet Contract requirements.

2. **Selected Topsoil** - Stockpile and place selected topsoil according to 01040.43.

3. **Unsuitable Materials** - Unsuitable materials encountered in required excavations shall be classed as waste material and disposed of according to 00330.41(a)(5).

4. **Excess Materials** - If the quantities of excavated materials are greater than required to construct embankments and to do all filling and backfilling, the remaining materials shall be classed as waste materials and be disposed of according to 00330.41(a)(5).

5. **Waste Materials** - Waste materials under 00330.41(a)(3) and 00330.41(a)(4) become the property of the Contractor at the point of origin. Unless otherwise specifically allowed and subject to the requirements of 00280.03, dispose of waste materials outside and beyond the limits of the Project and City controlled property, according to 00290.20(c). Do not dispose of any materials on any wetland, either public or private or within 300 feet of any river or stream.

6. **Excavation of Existing Surfaces** - Unless otherwise specified, earthwork includes excavating, hauling and depositing of existing surfacings which are within the limits of the excavation work.

If an abutting roadway or structure, or part of a roadway or structure, is to be left in place, make cuts according to 00310.41(a).

7. **Abandoned Pipes and Miscellaneous Matter** - Remove and dispose of abandoned pipes and miscellaneous matter encountered in the work as a part of the earthwork, unless otherwise specified.

Remove ends of remaining abandoned pipe or portions of other miscellaneous matter remaining exposed in slopes or at subgrade after excavation work to at least 2 feet back of the finished slope or below subgrade.

For sewers and other drainages pipes, fill and plug pipes according to 00490.44. Place a watertight cap or plug in the inlet and outlet ends of abandoned pipes. Take measures, as directed, to allow for free passage of drainage at outlet ends. Shape and finish the affected area so no evidence of their existence is apparent upon completion of the work.
For out-of-service potable water pipe and fittings, remove or abandon according to 01140.49 or as directed.

(8) Ditches, Channel Changes, Approaches, Connection, etc. - Perform excavations to construct ditches and channel changes, approach roadways, road connections, and other items, as required.

(9) Excavation Below Grade:

- **Rock** - If directed, excavate rock found in roadbed excavation to a depth of 12 inches below subgrade or as directed. Backfill to subgrade elevation with selected granular backfill material as directed.

- **Selected Material** - Where the plans indicate the placement of a selected material below subgrade in excavation areas, excavate to the depth necessary to place the material to its specified compacted thickness.

- **Unstable Subgrade Material** - Where unstable material is encountered below subgrade in roadbed excavations, excavate such material below subgrade as directed. Dispose of these unstable materials according to 00330.41(a)(5). Backfill with selected general backfill, or selected granular backfill material to provide a firm roadbed as directed. A geotextile may be required before backfilling.

(10) Protection of Excavation Side Slopes - Use methods in making roadbed excavations that will not shatter or loosen excavation slopes, avoid overbreaks, and leave slopes accurately and smoothly trimmed. As far as practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line. Overbreak is Incidental to the work except in cases where the Engineer determines that such overbreak was unavoidable.

After the main excavation in rock or rocky cuts is completed, thoroughly test the slopes with bars or by other approved means and remove all loose, detached, broken, or otherwise unstable material. Remove jutting points, scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat and stable condition. Dispose of the materials removed under this provision in the same manner as other excavated material. Remove all exposed roots, debris and all stones more than 3 inches in size which are loose or could become loosened.

(11) Rounding of Cutbanks - As part of the earthwork, blend the tops of cutbanks with the adjacent ground by rounding as shown. Rounding will not be required when rock requiring blasting to excavate extends to the top of cutbanks, and makes rounding impractical.
(12) **Outside Earthwork Limits** - Outside earthwork limits but within the clear zone, (See 00320.02(c)), remove partially buried natural objects, such as boulders, which the Engineer determines would be dangerous to an errant vehicle. Place them within embankments as specified or dispose of them as directed.

(b) **Foundation Excavation** - Excavate unsuitable materials in embankment foundations and elsewhere as designated. This work will be classed as "Foundation Excavation". Dispose of these materials according to 00330.41(a)(5) and replace with selected general backfill, selected granular backfill or other suitable materials as directed.

(c) **Toe Trench Excavation** - Excavate trenches at the toe of slopes that are to be protected with stone embankment, riprap or other protective material, as shown or directed, to provide a suitable foundation. Maintain the toe trenches until the geotextile or filter blanket, if any, and stone embankment, riprap or other protective materials are placed.

(d) **Borrow Excavation** - Whenever the Specifications or Contract plans call for a City furnished borrow source for earthwork materials, the material excavated from such source and used in the work as earthwork materials will be classed as "Borrow Excavation". Excavate and use these materials according to the Contract provisions, or as directed.

(e) **Blasting** - Avoid the use of explosives as far as practical. If blasting must be done and is not included in the Contract Schedule of Items or covered in the Special Provisions, perform blasting as follows:

1. **General** - Use blasting methods that do not shatter or loosen the backslopes, that produce smooth and uniform excavation slopes at the specified slope angles, and satisfactorily loosen the rock for excavation. Do not use tunnel blasting methods.

2. **Methods** - Follow the requirements of 00335.40(b) through 00335.40(h) and 00335.43.

3. **Preblast Survey** - Conduct a preblast survey of nearby buildings, structures, and utilities which could be at risk of damage from the blasting. Notify occupants and owners of those facilities at least 48 hours before drilling and blasting begins, and again on the day of the blast before its occurrence.

4. **Blasting Plan** - Provide a blasting plan prepared by a person qualified and experienced in blasting work. Submit the blasting plan for the Engineer's review at least 7 calendar days before beginning drilling and blasting work. Review of the plan by the Engineer does not relieve the Contractor of responsibility for accuracy and adequacy of the plan of the operation.

The blasting plan shall contain full details of the drilling and blasting patterns, explosives information, loading information, and blasting delays.
(5) Test Section - When blasting is done on an area over 300 feet in length, demonstrate the adequacy of the blasting plan by performing a test blast on a section not exceeding 100 feet in length. If results of the test blast are unacceptable, revise the blasting plan, review with the Engineer, and perform another test blast. Acceptable test blast results shall be demonstrated before the Engineer will allow the remaining drilling and blasting to occur.

(6) Scaling - Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials.

00330.42 Embankment, Fills and Backfills - Consider the nature, characteristics, and qualities of the materials to be selected before performing embankment, fill, and backfill work. Select and use excavated materials in various parts of the work according to 00330.41(a). Use all materials originating from required excavations, as far as practical, in the formation of embankments and subgrade, and for bedding, backfilling and other purposes shown on the plans, as directed, and according to the following:

(a) Embankment Foundation Preparation - In addition to the excavation and replacement of unsuitable materials as provided in 00330.41(b), and before constructing embankments, prepare the areas on which embankments are to be constructed as follows:

(1) Unstable Areas - Where the embankment foundation will not support hauling or compaction equipment and only if directed, place an initial layer of selected materials. Place the initial layer by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the equipment and not greater than 3 feet, unless otherwise authorized. Do not place the initial layer higher than 3 feet below subgrade. Commence consolidation of the initial layer by routing construction equipment uniformly over the entire layer. The initial layer shall meet the compaction requirements of 00330.43 except for layer thickness. Subsequent layers shall meet all requirements of 00330.43.

(2) Ends of Abandoned Pipe - Place a watertight cap or plug in the inlet ends of remaining abandoned sanitary, storm or culvert pipes. Place a screen over the outlet ends of remaining abandoned pipes, and if directed, place free draining cover material or take other measures as directed to allow for free passage of drainage.

(3) Drainage - Provide drainage and drainage structures as shown or as directed.

(4) Backfilling Inside Roadbed Limits - Break up concrete or asphalt floors, slabs, or walls, as specified in 00310.41(d), before backfilling or placing embankment. Backfill basements, trenches and holes within embankment limits with selected stone backfill material. Backfill material placed in basements may include pieces of broken concrete and masonry not exceeding 15 inches in any dimension provided they are placed and compacted according to 00330.42(c). The broken concrete and masonry shall not have protruding reinforcement.
(5) **Existing Surfacings** - Scarify and break up existing surfacings according to 00310.41(d) before placing embankment material.

(6) **Roughen Ground Surface** - Break up, roughen or scarify the ground surface if the slope is 1V:5H, or less, to positively bond embankment materials with the existing ground with benching permitted as a supplement.

(7) **Foundation Benching** - If existing ground surfaces or existing embankment surfaces are steeper than 1V:5H, bench the existing ground or embankment.

Make the bottom bench at least 10 feet wide. Each succeeding bench shall penetrate the slope at least 3 feet horizontally beyond the vertical side of the previous bench, and be wide enough to operate placing and compaction equipment. Each bench and embankment layer surface shall be brought to a slope flatter than 1V:10H. The benching, placing and compaction operation shall be performed simultaneously from the bottom up.

Place and compact the bench excavation material combined with new embankment material in layers to the thickness and compaction required in 00330.43.

(8) **Compact Existing Ground** - After roughening the existing ground surface or benching, compact the top 1 foot of existing ground and embankment in place to the density specified and with compaction equipment specified, according to 00330.43.

(b) **Excess Moisture** - Do not place material in final position in embankments or as backfill until excess moisture has been removed to within minus 4% to plus 2% of optimum moisture as required in 00330.43. Remove excess moisture by manipulation, aeration, drainage, rehandling or other means, at no additional cost to the City.

(c) **Embankment Construction:**

(1) **General** - Except as provided in 00330.42(a)(1), do not construct embankments or fillings when the embankment material, the foundation or the embankment on which it would be placed is frozen, not stable or not compacted, unless otherwise directed.

Make roadbed embankment slopes as smooth, safe and sightly as practical with the materials used to construct the embankments.

Route hauling equipment over the full width of embankments. Traveling over the same areas repeatedly will not be allowed unless approved by the Engineer as unavoidable.
Place embankments and all fillings in nearly horizontal layers not more than 8 inches thick, except as provided in 00330.42(c)(2). Compact each layer separately and to the density required in 00330.43.

Place slope berms, if required, according to Section 00280.

(2) Rock in Embankment Construction:

a. **General** - Retrieve cobbles and boulders that fall or roll outside embankment limits and place them within embankments as specified, or dispose of them as directed.

b. **Limited Quantities of Rock** - If embankment materials contain up to 50% rock, sort the materials until they can either be placed in 8 inches layers, or meet the requirements of and be placed according to 00330.42(c)(2)(c).

c. **Oversize Durable Rock Fragments** - Placing isolated individual durable rock fragments having dimensions greater than the specified layer thickness will be permitted if:
   - Clearance between adjacent fragments provides adequate space for placement and compaction equipment between rock fragments to place materials in horizontal layers as specified and for compaction according to 00330.43.
   - No part of the fragment comes within 36 inches of subgrade.

d. **Durable Rock** - If embankment materials contain more than 50% durable rock, distribute and manipulate the rock so that the voids between the larger pieces are filled with smaller pieces forming a dense and compact mass. Durable rock is defined in 00110.20. In the absence of two-cycle slake durability test results, the rock durability will be visually evaluated.

When such embankments cannot be placed in 8 inches horizontal layers, place the embankment in nearly horizontal layers of the thickness directed, but not more than 15 inches.

If the visible quantity of silt and clay materials (passing the No. 200 screen) is less than 20% by volume, as determined by the Engineer, the maximum rock fragment size and layer thickness may be increased to 36 inches, but the layer thickness shall not exceed the average maximum size of the rock fragments.

e. **Nondurable Rock** - In the absence of two-cycle slake durability test results, the Engineer will visually evaluate if the rock is potentially degradable. If embankment materials contain more than 50% nondurable rock, as defined in 00110.20, process the material as follows:
• Pulverize nondurable rock to 12" - 0 size and place in nearly horizontal layers not more than 12 inches thick.
• Water to promote slaking and breakdown of the nondurable material according to Section 00340.
• The moisture content of the material at the time of compaction shall be within the requirements of 00330.43.
• Compact the material to density/deflection requirements specified in 00330.43 with a tamping-foot roller that meets the requirements of 00330.20. Each embankment layer shall receive a minimum of 3 coverages with the tamping-foot roller. Operate the roller at a uniform speed not exceeding 3 mph. No additional compensation will be made for additional roller coverages to meet the requirements of 00330.43.

(3) Embankment Slope Protection - Construct outer portions of embankments exposed to erosion by stream flow or other erosive action with rock fragments, or other desirable materials, if directed, and such are available in the excavations. Also, if directed, place similar material as a protective layer on the outside of the regular embankment slopes as embankment widening. Placement shall closely follow construction of the embankment when directed. Protective materials placed as embankment widening need not be compacted but shall present a reasonably smooth surface, resistant to washout or slippage.

(4) Embankments for Approaches, Connections, Etc. - Construct embankments as required and as directed to provide a complete Project. Construct according to 00330.42(c) and 00330.42(d).

(5) Embankment Construction Around Minor Structures - Backfill prior excavations in the vicinity of curbs, walks, driveways, inlets, manholes and other such minor structures with selected general backfill, or selected granular backfill material as directed with no particles larger than 1 inch and that is compatible with the adjacent material, unless otherwise specified. The material shall have a moisture content as specified in 00330.43, be placed in layers according to 00330.42(c)(1) and compacted according to 00330.43.

(6) Embankment Construction at Pipes - Before installing any pipes with 72 inch or smaller, inside nominal diameter that will protrude above the existing ground surface:

• Provide temporary drainage at no additional cost to the City, unless provided for in Section 00240.
• Construct specification embankments at least 5 pipe diameters each direction from the pipe centerline and to a height equal to the following:
12 inches minimum above the outside top of pipe elevation.

- A higher height if called for on the plans or directed.
- Then trench, bed, and install the pipe, and backfill around all pipes according to Section 00405.

(7) Embankment Construction at Bridge Ends - At the ends of bridges and for a distance of at least 100 feet from the bridge, place and compact the embankments before beginning bridge construction, unless otherwise directed. Unless the embankment is constructed according to 00330.42(c)(8), provide and place selected stone backfill material, meeting the requirements of 00330.15 when such is available from excavations, in all embankments within 100 feet of bridges, or as directed.

(8) Engineered Fills - In areas designated on the plans as "Engineered Fills", place selected stone backfill material in maximum 8 inch lifts from the existing ground up to the base of granular structure backfill. Compact to 95% maximum density according to 00330.43.

If the existing ground line is within the limits of the granular structure backfill, subexcavate the area beneath the footing in order to place the full depth of granular structure backfill shown or specified.

Place the granular structure backfill, meeting the requirements of 00510.13, in maximum 6 inch lifts and compact to 100% maximum density from the top of the selected stone backfill to the footing elevation shown. The thickness and extent of these materials shall be according to the details shown or as directed.

The foundation compaction requirements in 00330.43 shall be subject to the higher requirements of this provision. Compact according to the percentages required above.

(d) Stone Embankment - If the Contract plans or Specifications require embankments, or parts of embankments, to be constructed of stone embankment material, furnish and place the stone embankment material according to this provision and as directed. Furnish materials from Contractor provided sources which conform to the requirements of 00330.16, unless otherwise specified.

Construct these embankments according to the other provisions of 00330.42, unless otherwise specified or directed, and as follows:

- Material placed in the upper 1 foot of embankments or within 1 foot of a culvert or other structure, shall not be more than 3 inches in size.
- If placement in water is allowed, construct the first layer of embankment to an elevation 2 feet above water. Continue thereafter as specified or directed.
- Some rock fragments larger than 15 inches, but not larger than 36 inches may be placed provided they are placed and compacted according to 00330.42(c)(2)(c).
00330.43 Earthwork Compaction Requirements:

(a) **General** - Compact natural ground, embankment foundations, foundations for structures, each layer of embankment, fills, and backfills, the upper 1 foot of roadbeds in cuts and other earthwork which is to support any part of the roadbed prism according to this subsection.

Unless otherwise specified, compact in place the entire surface of each layer of all specified materials with a minimum of 3 coverages, using equipment made specifically for compaction. Select compaction equipment based on the type of material being compacted and the layer thickness. Normal compaction equipment consists of sheepsfoot rollers, tamping-foot rollers, grid rollers, pneumatic-tired rollers, and vibratory rollers. Routing of hauling and grading equipment will not be accepted as adequate to achieve compaction, except as provided in 00330.42(a)(1).

In the immediate vicinity of minor structures as provided in 00330.42(c)(5), in holes, around and under isolated individual rock fragments, and elsewhere where embankment and filling materials can or cannot be reached by normal compaction equipment, compact with machine-operated pneumatic or mechanical tampers, or by hand methods if allowed, as required to ensure intimate contact between the backfill material and the structure or fragment and provide thorough compaction.

(b) **Moisture-Density Testable Materials:**

1. Test in-place materials for compaction according to the MFTP.

2. In-place materials shall meet the following moisture content, density, and deflection requirements, each of which has equal weight and each of which shall be satisfied:

   a. **Moisture Content** - Moisture content at the time of compacting the materials shall be prepared to within minus 4% to plus 2% of optimum moisture content. Material which does not contain sufficient moisture to obtain proper compaction shall be wetted and thoroughly mixed as directed. Material containing an excess of moisture shall be dried by manipulation, aeration, drainage or other means before being compacted.

   b. **Density** - After compaction of each layer the density shall be at least:

   - 95% of maximum density in roadbed cuts, to a depth of 1 foot below established subgrade elevation.
   - 95% of maximum density in embankments, fills, backfills, and specified portions of existing ground.
c. **Deflection Requirement** - In addition to moisture density testing, conduct at least one deflection test according to ODOT TM 158 for each 3 feet, or portion of 3 feet, of embankment placed. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

Conduct deflection tests, witnessed by the Engineer, on the finish grade of all subgrades. During placement of subbase or base aggregates or HMAC, if deflection is observed, remove the HMAC, base and subbase aggregates and correct the deflecting areas at no additional cost to the City.

Provide a signed test report to the Engineer at the end of each shift after completing the required testing. At no additional cost to the City, remove and replace embankment constructed thicker than 3 feet that was not deflection tested.

(c) **Non-Moisture-Density Testable Materials** - When material is not moisture-density testable because rock fragments in the material prevent moisture-density testing, place and compact the material as follows:

- Place non-moisture density testable material in nearly horizontal layers with thickness not exceeding 12 inches.
- Water or aerate the material to ensure each layer can be compacted to form a dense mass, free of pumping.
- Compact each layer uniformly with a minimum of 4 full coverages using a smooth drum vibratory roller.
- Conduct at least one deflection test for each layer of embankment placed according to ODOT TM 158. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

(d) **Small, Irregular Fill Areas** - The Density requirements of 00330.43 do not apply to irregular fill areas that have total volume of no more than 150 cubic yard outside of the travel lanes. Construct these areas according to the following:

- Place embankment material in nearly horizontal layers with thickness not exceeding 8 inches.
- Water or aerate the material to ensure each layer does not deflect under the action of the roller used for compaction.
- Compact each layer using a roller appropriate to the material being placed and as directed. Use a smooth drum vibratory roller for sands and gravels; use a sheepfoot or tamping foot roller for silts and clays. The Engineer will determine the classification of the embankment soil.
• Compact each layer uniformly with a minimum of 5 full coverages of the specified roller.

• In areas not accessible to rollers, use compaction equipment suitable for the area and compact each layer with sufficient coverages to produce a firm unyielding surface.

00330.44 Buttress, Inlay or Shear Key - Remove the designated materials and construct the buttress, inlay or shear key as follows:

(a) Preparation - Do not start excavation for each segment until a stockpile of stone embankment material is immediately available at or near the site. Locate the stockpile at a site approved by the Engineer. The size of the stockpile shall be sufficient to fill one excavated segment.

(b) Sequence of Construction - Excavate the area according to 00330.40 and 00330.41 to provide a backslope to the lines, slopes and details indicated on the plans or as directed. Excavate and backfill in segments to minimize aggravating stability conditions. Each segment shall not exceed 75 feet in length as measured across the top of each open excavation segment, unless otherwise specified or directed.

(c) Unsuitable Materials - Sort and dispose of unsuitable materials as waste material according to 00330.41(a)(5).

(d) Foundation - Excavate to a depth of at least 5 feet into firm, stable, undisturbed materials as shown on the plans or as directed. Remove soft or loose materials. The Engineer will verify sufficient excavation into firm, stable, undisturbed materials in each segment before allowing the backfill. Where called for in the plans or as directed, place riprap geotextile against the excavated backslope. Remove water from the excavation before placing stone embankment material.

(e) Drainage - Provide drainage as shown or as directed.

(f) Placement of Stone Embankment - After excavation of each segment according to 00330.44(b) and 00330.44(d), place the stone embankment material to fill the excavated segment before excavating the next segment. Backfill all segments on the same day they are excavated. Place and manipulate the stone embankment material in the buttress, inlay or shear key to provide a dense and well-filled mass to the lines, slopes and cross-sections indicated on the plans or as directed.

00330.45 Filling of Holes - Backfill holes outside the limits of required excavation or embankment construction that result from grubbing and removal work, basements, trenches and other such holes as directed. Smooth and shape to blend with the surrounding area. Payment for this work will be made on the same basis as for required roadway earthwork.

00330.46 Watering of Materials - Water materials as directed to provide compaction and required density to embankments and backfills and to alleviate dust nuisance according to Section 00340.
00330.47 Specified Selected Courses or Layers of Materials - In addition to the requirements of 00330.42, select, sort, and place courses or layers of materials if called for by the plans or Special Provisions. Select and sort the materials obtained from required excavations to meet the requirements of the Special Provisions, and place in locations and thicknesses specified or as directed.

Place and construct selected courses or layers to conform to the requirements of 00330.42 and 00330.43, unless otherwise specified.

The work covered by this provision may include, but is not limited to:

- Selected Embankment Material
- Selected Subgrade Material
- Selected Stone Embankment Material
- Selected Topsoil

00330.49 Construction Slide Removal and Repair - Remove construction slide materials and repair construction slide damages to the work according to Specifications, or as directed, and as follows:

(a) Definition - For the purposes of this provision:

(1) Slide - A slide is a lateral movement of earth materials.

(2) Construction Slide - A slide outside the designated limits of excavations, or below the foundation within designed limits of embankments or within embankments, which occur after excavation or embankment construction starts and before final acceptance of the Contract.

(3) Slide Materials - Materials displaced as the result of a slide.

(b) Remove Construction Slide Materials - Within the limits of established or reestablished lines, grades and slopes, do the following:

- Excavate and remove construction slide materials.
- Sort and dispose of unsuitable materials.
- Use excavated slide materials, to the extent practical, in embankments, fills, backfills, widenings, and for flattening slopes within the Project limits.
- Dispose of excess material according to 00330.41(a)(4).

(c) Construction Slide Repair - Reconstruct or restore subgrade and slopes to the established or reestablished lines, grades and slopes. Reconstruct or repair damaged structures or facilities within construction slide areas.
(d) **Responsibility for Construction Slide Removal and Repair:**

(1) **Contractor Responsibility** - Perform construction slide removal and repair work at Contractor's expense when caused by any of the following:

- Embankment foundation conditions or pre-existing subsurface conditions that were reasonably anticipated in the Contract.
- Contractor's method and manner of operations.
- Contractor's failure to perform or to protect the work according to plans and Specifications.

(2) **City Responsibility** - Slide removal and repair work will be paid for according to 00330.90 when all of the following apply:

- Caused by embankment foundation conditions or pre-existing subsurface conditions that were not reasonably anticipated in the Contract.
- Not caused by Contractor's method and manner of operation.
- Not caused by Contractor's failure to perform or to protect the work according to plans and Specifications.

**Finishing and Cleaning Up**

00330.70 **General** - Immediately before completing the earthwork:

- Blend the tops of cutbanks with the adjacent terrain.
- Trim and finish all roadbeds, ditches, waterway channels, and other excavations and embankments to the lines, grades, and cross sections established.
- Clean up debris and foreign matter of all kinds on the entire right-of-way area. Dispose of materials as directed.
- Finish the subgrade to be within a tolerance of ±3/4 inch and to be free of ruts, depressions and irregularities.
- In planting and seeding areas, remove all rocks, boulders, and vegetative matter.
- Remove all litter, debris and obstructions.

00330.71 **Daily Progress Reports** - For projects that have more then 2,500 cubic yards of embankment material, regardless of the basis of performance, (excavation or embankment), provide daily progress reports documenting the quantities of materials placed and a summary of tests performed. Use report forms approved by the City. Submit the reports to the Engineer at least weekly.
Measurement

00330.80 Measurement - The quantities of earthwork will be measured as follows:

- Volume basis, computed by the average end area method from cross section measurements, or by other methods of equivalent accuracy. When the Special Provisions so state, corrections for curvature will be made.
- Volume basis, of materials handled and placed in the work as required and as directed.

Measurement will only be for those items listed in 00330.93 and 00330.94 that are actually included as an item in the Contract Schedule of Items.

Structure excavation will be measured according to 00510.80(b).

Materials subexcavated from beneath footings as required by 00330.42(c)(8) will be measured according to 00510.80(b).

Granular structure backfill will be measured according to 00510.80(d).

Watering of materials required by 00330.46 will be measured according to 00340.80.

00330.81 Excavation Basis Measurement - When the payment for earthwork Contract items is on the excavation basis, the materials will be measured in their original positions before excavation. Measurement will be limited to the lines, grades, and slopes as established.

The quantities of excavation measured for payment will include:

- Abandoned pipe and miscellaneous matter within excavation limits.
- Materials removed below subgrade in roadbed excavations according to 00330.41(a)(9) and 00330.91(e).
- Overbreak determined to be unavoidable according to 00330.41(a)(10).

The following earthwork items, if included in the Schedule of Items, will be measured on the excavation basis:

- Borrow Excavation
- Ditch Excavation
- Foundation Excavation
- General Excavation
- Toe Trench Excavation

Embankments required or necessary to perform earthwork on the excavation basis are Incidental to the excavation and will not be measured separately.
00330.82  **Embarkment Basis Measurement** - When the payment for earthwork Contract items is on the embankment basis, the materials will be measured in their final embankment position. Measurement will be limited to the lines, grades, and slopes of the original ground contours after clearing and grubbing and compaction is performed according to 00330.43(a) before embankment construction begins.

The quantities of embankment measured for payment will include the volumes of materials used to backfill excavations below subgrade and holes when called for or directed.

The quantities of embankment measured for payment will not include the volumes of:

- Any additional quantities required due to subsidence, settlement of the ground or base, settlement within embankments, or to shrinkage, settlement, washout, slippage, or loss regardless of cause, subject however to 00170.80 or 00170.82.
- Any additional quantities required due to compaction efforts that are required in 00330.43.
- Slide materials paid for as Extra Work.
- Any materials for which payment is made for completed embankments or backfills under other Contract provisions.

The following earthwork items will be measured on the embankment basis:

- Embankment In Place
- Stone Embankment
- Extra For Selected ______ Material

Excavations, including cutbank rounding, overbreak whether avoidable or not, and foundation benching, required or necessary to perform earthwork on the embankment basis, and retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a) will not be separately measured.

When an excavation basis item is included in the Contract Schedule of Items and selected materials are obtained from the excavation for use as "Extra for Selected ______ Material", measurement will be made for both items.

**Payment**

00330.90  **Payment** - The accepted quantities of earthwork performed under this Section will be paid for at the Contract unit price, per unit of measurement, for each item that appears in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Structure excavation will be paid for according to 00510.90(b).

Materials subexcavated from beneath footings as required by 00330.42(c-8) will be paid for according to 00510.90(b).

Granular structure backfill will be paid for according to 00510.90(d).

Watering of materials required by 00330.46 will be paid for according to 00340.90.

Slide removal and repair work determined under 00330.49(d-2) to be Agency responsibility will be paid for as Extra Work under Section 00196.

No separate or additional payment will be made for work that is required to be done under these Specifications that does not appear as a separately listed item in the Contract Schedule of Items.

No separate or additional payment will be made for blasting done according 00330.41(e) unless a blasting item is listed in the Contract Schedule of Items.

00330.91 Kinds of Pay Excavation - The kinds of pay excavation on a Project will be indicated by the items listed in the Contract Schedule of Items and are defined as follows:

(a) Ditch Excavation:

- Limited to the lines, grades, and cross sections shown or established with bottom widths of 8 feet and less that lie outside of and separate from roadbed cross sections
- Includes canals, channels, and inlet, outlet, diversion, drain, and other open ditches to carry water

(b) Foundation Excavation:

- Limited to the lines, grades, and cross sections shown on the plans or established
- To remove soft materials for preparation and stabilization of areas below embankments

(c) Toe Trench Excavation:

- At the toe of riprap slopes as shown on the plans and elsewhere as directed to provide a suitable foundation toe trench on which to place riprap geotextile or filter blanket, and riprap material
(d) General Excavation:

- Other than ditch, trench, structure, foundation, toe trench, and borrow excavation
- Includes cut ditches, borrow ditches, and roadside ditches in the roadway section as staked or established, or shown as being a part of the typical roadway cross sections
- Includes other ditches with bottom widths greater than 8 feet
- Includes unsuitable material excavated below subgrade in roadbed excavations according to 00330.41(a)(9), when determined that such excavation is neither more nor less difficult to remove than the material above subgrade in the whole of the cut. When determined that such excavation is either more or less difficult to remove than the material above subgrade in the whole of the cut, payment will be according to Section 00196.

(e) Borrow Excavation:

- Obtained from specifically designated and authorized sources lying outside of, separated from, independent of, and beyond the roadway cross sections, unless otherwise directed

00330.92 Kinds of Incidental Earthwork - No separate or additional payment will be made for the following:

- Removal of overburden from pits and quarries.
- Excavation of rock and other material for use in surfacings or structures.
- Excavation for haul roads.
- Other excavation (borrow excavation excepted) which is not directly a part of the finished work.
- Blend tops of cutbanks with adjacent ground according to 00330.41(a)(11).
- If shown on the plans.
- Overbreak, except on excavation basis earthwork and the Engineer determines that overbreak was unavoidable.
- Foundation benching performed according to 00330.42(a)(7).
- Rock excavated below the excavation plane established by 00330.41(a)(9) and the specified backfill required to fill up to the excavation plane, to the satisfaction of the Engineer.
- Smooth and maintain foundations, roadbeds, and haul roads.
- Material handled, removed, placed, or used contrary to Specifications or directions.
- Rehandling and reshaping of materials previously excavated, except where called for in the Specifications, Plans, or Contract change orders.
- Excavation for forms to construct curbs, gutters, walks and other similar structures unless specified.
- The volume of any free water or liquid.
- Hauling, moving, or transporting earthwork materials.
- Removal of excess moisture according to 00330.42(b).
- Retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a).
- Constructing outer portions of embankment with suitable material for slope stabilization.

**00330.93 Excavation Basis Payment** - When listed in the Contract Schedule of Items, the following pay items will be paid for on the excavation basis:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Ditch Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(b) Foundation Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(c) Toe Trench Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(d) General Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(e) Borrow Excavation</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

These items include excavating, selecting, handling, hauling, placing, and compacting the materials as specified.

**00330.94 Embankment Basis Payment** - When listed in the Contract Schedule of Items, the following pay items will be paid for on the embankment basis:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Embankment In Place</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(b) Stone Embankment</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(c) Extra For Selected _______ Material</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

Item (a) includes excavating, selecting, handling, hauling, placing, and compacting of the materials as specified and all other costs incurred in furnishing required embankment materials.

Item (b) includes furnishing, selecting, handling, hauling, placing, and compacting the material as specified.

In item (c), the type of material will be inserted in the blank.

Item (c) includes preserving, sorting, stockpiling, and handling of the specified selected materials as described in 00330.41(a)(1) and 00330.41(a)(2), selected and placed according to 00330.42, 00330.47 and the Special Provisions.
Unless a specific pay item in the form of item (c) appears in the Contract Schedule of Items, no separate or additional payment will be made for preserving, sorting and handling selected materials. However, earthwork materials obtained from excavations and incorporated into specified embankments will be paid for at the applicable item, if listed in the Contract Schedule of Items.

Excavation of unstable material that is below subgrade in roadbed excavation areas, according to 00330.41(a)(9), will be paid for according to 00195.20.
Section 00331 - Subgrade Stabilization

Description

00331.00 Scope - This work consists of excavating and disposing of unstable materials in excavation areas only and, placing subgrade geotextiles and stone embankment, and aggregate backfill to the lines and grades as shown or directed.

Materials

00331.10 Materials - Furnish materials meeting the following requirements:

| Aggregate Base ............................................................. 02630 |
| Aggregate Subbase .............................................. 00640.10(b) |
| Stone Embankment .................................................. 00330.16 |
| Subgrade Geotextile, Certification Level B ................. 02320 |
| Water ............................................................................. 00340 |

00331.16 Acceptance of Backfill - The backfill material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00331.20 General - Provide all equipment necessary to perform the work according to Sections 00330, 00340, 00350, and 00640.

Construction

00331.40 Excavation - Excavate unstable material to the lines and grades as shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00331.41 Geotextile - Place geotextile as shown.

00331.42 Backfill - Place the backfill material to lines and grades as shown or directed, to provide a homogeneous mixture. Compact the backfill until there is no reaction or yielding under the compactor.

Measurement

00331.80 Measurement - The quantities of subgrade stabilization will be measured on the area basis of subgrade surface area stabilized to the full depth as shown. The surface area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.
Payment

00331.90  Payment - The accepted quantities of subgrade stabilization will be paid for at the Contract unit price per square yard for the item "____ inch Subgrade Stabilization".

The depth of stabilization will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, geotextile, stone embankment or aggregate backfill material, or water.
Section 00335 - Blasting Methods and Protection of Excavation Backslopes

Description

00335.00 Scope - This work consists of excavating in rock using controlled blasting methods to achieve smooth, unfractured backslopes and produce a free surface or shear plane in the rock along the specified excavation backslope, and production blasting to facilitate excavation.

00335.01 Definitions:

- **Buffer Row** - In multiple row blasts in which perimeter control blasting techniques are used, the first row of production holes immediately adjacent to and drilled on a plane parallel to the perimeter control blast line. The buffer row is located between the production holes and the perimeter controlled blast line.

- **Perimeter Controlled Blasting** - The use of explosives and blasting accessories in carefully spaced and aligned drill holes. Controlled blasting techniques include presplitting and trim (cushion) blasting.

- **Presplitting** - A perimeter control blasting method in which the perimeter row of blast holes are drilled along the plane of the specified final excavation backslope and which utilizes reduced drill hole spacing and reduced diameter explosives decoupled from the drill hole wall, and whose initiation precedes the initiation of the adjacent production holes by a minimum of 25 milliseconds.

- **Production Blasting** - Fragmentation blasting in the main excavation area, usually using more widely spaced drill holes than controlled blast holes.

- **Trim (Cushion) Blasting** - A perimeter control blasting method in which the initiation of the perimeter row of blast holes drilled along the plane of the specified final excavation backslope follows the initiation of the adjacent production holes within 25 to 75 milliseconds, if production holes are being employed in the blast.

Materials

00335.10 Materials - Furnish all explosives and blasting caps that are no more than one year old. Each blasting cap period shall come from one lot number.

Construction

00335.40 Blasting Methods:

- **General** - Use methods in making excavations that do not shatter or loosen the backslopes and that produce smooth and uniform excavation slopes at the specified slopes angles. These include:
- **Perimeter Controlled Blasting** - Use on the entire length of cut section in rock or cemented materials which have backslopes of 1V:0.75H or steeper, even if the main excavation can be ripped.

- **Production Blasting** - Blasting in the mass of rock to be excavated shall be designed to control flyrock, minimize ground vibration and air blast, and result in loosened and fragmented in-place rock of a size that can be removed, transported, or crushed to produce specified products. Lay out production blast holes in a consistent pattern that does not affect the perimeter control blast holes. Where production blast holes are made adjacent to roadways with specified closure restrictions, the volume of material blasted shall not exceed the Contractor’s ability to remove the blasted material from the adjacent roadway within the specified closure time.

(b) **Safety and Flyrock Control** - Use techniques that effectively limit control flyrock. Clear the site of all boulders or other material as directed prior to beginning blasting work. Following every blast, observe the entire blast area for a minimum of 5 minutes before reentering or commencing work in the area.

Be responsible for the storage, transportation, and handling of explosives, their use, and the results of all blasting operations according to 00170.94.

Cover all blast areas that are within 200 feet of residences, facilities or above ground utilities using appropriate blast containment mats or an approved equivalent method.

Discontinue blasting operations, as directed, if it is apparent that the methods employed are not producing acceptable results or the safety of the public, the Contractor's employees or adjacent property is being jeopardized.

(c) **Preblast Survey** - Offer, in writing, to perform a preblast survey for owners and occupants of all buildings, structures and utilities within the distance of the blast specified in 00335.40(d). If the offer is accepted, use the City approved survey form, signed and completed by an independent third part, and submitted to the Engineer and Contractor at least 72 hours before blasting begins. Deliver a copy of the survey form and copies of any photos taken to the owners and occupants.

Notify occupants of the buildings and owners of structures and utilities which have been identified in the preblast survey, a minimum of 48 hours before drilling or blasting begins, and notify again on the same day of the blast before its occurrence.

(d) **Blasting Notification** - Notify all owners and occupants of buildings, structures, and utilities that are within the following distances of the blasting areas:
- 300 feet for shots using less than 50 pounds of explosives per time delay of 15 milliseconds.
- 600 feet for shots using between 50 and 250 pounds of explosives per time delay of 15 milliseconds.
- 1,250 feet for shots using more than 250 pounds of explosives per time delay of 15 milliseconds.

Provide notification, in writing, once, at least 48 hours before blasting begins, and again on the day the blasting operations occur.

(e) Blasting Plan - Provide a separate blasting plan for each cut that requires blasting, prepared by a person qualified and experienced in blasting work. Each plan shall cover individual major rock cut areas or rock production from a material source. Similar minor rock cut areas of less than 50 cubic yards, as well as utility and culvert trenches, may be covered as a group in one generalized blasting plan.

Submit the blasting plans for the Engineer review at least 7 calendar days before beginning drilling and blasting work for excavation of 3,000 cubic yards or smaller, and 14 calendar days for drilling and blasting work requiring any perimeter controlled blasting and or excavations of more than 3,000 cubic yard.

The blasting plan(s) will be reviewed for conformance with the Specifications and any concerns will be discussed with the Contractor as soon as possible. Submit any proposed changes to the blasting plan in writing to the Engineer for review before implementation. Submittal of blasting plan is for quality control and record keeping purposes.

Review of blasting plan by the Engineer does not relieve the Contractor of full responsibility for the accuracy and adequacy of the plans and the resulting safety when implemented in the field.

Each blasting plan shall contain the full details of the drilling and blasting patterns, vibration, flyrock, noise reduction methods, blast area security measures and traffic control that the Contractor proposes to use, and the following information:

- Station limits of proposed shot.
- Removal of overburden.
- Plan and cross section diagrams of proposed drill pattern for controlled and production blast holes including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height and subdrill depth. Accurately draw to scale and show each cut area to be blasted.
- Loading diagram showing the type, amount and specific gravity of explosives, primers, and initiators, and location depth, and type of stemming.
- Initiation sequence of production and controlled blast holes including delay times and delay system.
• Manufacturer's product data sheets for all explosives, primers and initiators to be used in the work.

(f) Blasting Test Section(s) - Demonstrate the adequacy of each proposed blasting plan by means of test shot in each cut or excavation before beginning full scale blasting. Do not proceed with remaining drilling and blasting until acceptable test blast results have demonstrated to the satisfaction of the Engineer.

In areas where perimeter controlled blasting techniques are being employed, drill and blast short representative test sections not exceeding 100 feet in length. Excavate a section not less than 20 feet wide exposing the full height of the lift for examination. In areas where no perimeter controlled blasting techniques are being employed, determine effectiveness of the test section based on the material placement, cut slope stability, fragmentation and control of ground vibration, air blast and fly rock.

Do not drill ahead of the test blast area, except as provided in 00335.41(a)(6), until the test section has been evaluated. The Contractor may be directed to use test section lengths less than 100 feet.

If the results of the test shot are unacceptable revise the methods, techniques and procedures at no additional cost to the City, so that the results achieved will be acceptable. No further drilling and blasting will be allowed until the revised methods are reviewed according to 00335.40(d) and verified by additional test shot(s).

If, during the progress of the work, the methods of drilling and blasting do not produce acceptable results within the tolerances specified, drill, blast and excavate additional test sections until a technique is determined that will produce acceptable results.

(g) Blasting According To Plan - After the Engineer has reviewed the blasting plan and determined that test sections have demonstrated acceptable results, perform all perimeter controlled and production blasting according to the plan that produced acceptable results. Notify the Engineer when any changes in conditions or results are observed. On the day of each blasting occurrence and before detonation of the blast, the supervisor or blasting specialist in charge shall certify, in writing, that the shots being carried out are consistent with the reviewed blasting plan.

(h) Blasting Report - Submit a blasting report detailing the blast outcome within 48 hours of making each blast. Include in the report the following:

• Drill logs, drilling remarks, loading, and timing variables used in the blast.
• All blast monitoring documentation.
• A comment section that includes the Contractor's evaluation of the blast performance.
• All damage incurred and details of all neighbor's complaints or comments.
00335.41 Controlled Blasting Methods:

(a) Presplitting:

(1) Attach mechanical devices to all drilling equipment used to drill the presplit holes to determine, within an accuracy of 1 degree, the angle at which the drill steel enters the rock.

(2) Do not drill presplit holes more than 3 inches in diameter.

(3) Start presplit drill holes along the presplit line within 3 inches of the dimensions shown on the blasting plan. Holes located beyond this tolerance will be rejected. Completely fill the rejected holes with stemming material at no additional cost to the City. Drill new presplit holes with the proper spacing. Rejected holes will not be measured for payment.

(4) Control the drilling operations to ensure that presplit hole alignment does not vary from the plane of the planned slope by more than 9 inches either parallel or normal to the slope. Presplit holes exceeding these limits will not be paid for unless, in the Engineer's opinion, satisfactory slopes are being obtained.

(5) The length of presplit holes for any individual lift shall not exceed 30 feet unless the Contractor can demonstrate to the Engineer's satisfaction that hole alignment can be maintained within the above tolerances. Upon satisfactory demonstration, and with written permission of the Engineer, the length of holes may be increased to a maximum of 60 feet. If more than 5% of the presplit holes are misaligned in any one lift, reduce the height of the lifts until the 9 inch alignment tolerance is met.

(6) Drill presplit holes a minimum of 30 feet longitudinally beyond the limits of the production holes to be detonated or to the end of the cut. Unless otherwise allowed by the Engineer in writing, remove all overburden, including any loose or decomposed rock, before drilling the presplitting holes.

(7) When the cut height will require more than one lift, a maximum offset of 18 inches between lifts will be allowed to allow for drill equipment clearance. Adjust the slope angle of lower lifts to compensate for drill offsets and any drift which may have occurred in upper lifts.

(8) Use only explosives manufactured specifically made for presplitting in the presplit holes. The maximum diameter of explosives used in presplit holes shall not be greater than half the diameter of the presplit hole. Bulk ammonium nitrate and fuel oil (ANFO) will not be allowed in the presplit holes.

(9) Determine that the presplit hole is free of obstructions for its entire depth before placing charges. Exercise all necessary precautions so the placing of the charges will not cause caving of material from the walls of the holes.
Detonation of explosives in each hole in a presplit shot may be delayed, providing the hole-to-hole delay is no more than 25 milliseconds.

(b) Trim (Cushion) Blasting - When the horizontal distance from the new proposed slope face to the existing rock face is less than 15 feet, the Contractor may trim blast instead of presplitting. The requirements in 00335.41(a) for presplitting also apply to trim blasting, by changing the words presplit and presplitting to trim blasting. If trim blasting (burdens are less than 6 feet) or zones of weakness in the rock are observed, submit a hole loading diagram that reflects the side conditions.

c) Buffer Row - Locate the buffer hole line a minimum of 3 feet away from the perimeter control blast line, or 1 foot for every inch of buffer hole diameter, whichever is greater. Space buffer row holes 3 to 5 feet center to center. The explosive load in buffer holes shall not exceed 50% of the full explosive load that could be placed in a 3 inch production hole. Initiation of the buffer holes shall be on a delayed sequence toward a free face.

00335.42 Production Blasting - Do not drill any row of production blast holes closer than 6 feet to the controlled perimeter blast line. Where necessary to minimize damage to the rock backslope, a row of buffer holes may be drilled between the perimeter controlled blast line and the product blast holes. Except for the bottom lift, do not extend production holes below the bottom of the controlled blast holes. Do not exceed 6 inch diameter for production holes. Detonate production holes on a delay sequence documented in the blasting plan.

00335.43 Scaling - Remove all loose, hanging or potentially dangerous rock on the excavated surface by scaling during the completion of the excavation of each lift. Do not begin drilling the next lift until this work has been completed, as directed.

Scale the slopes throughout the Contract at the frequency required to remove loose or overhanging material.

Use a suitable standard steel mine scaling rod to hand scale the slopes. Other methods such as machine scaling, hydraulic splitters or light blasting may be used instead of, or to supplement, hand scaling, if allowed.

Measurement

00335.80 Measurement - The quantities of perimeter controlled blast holes will be measured on the length basis and will be determined by dividing the cut slope surface area by the perimeter controlled blast hole spacing. The cut slope surface area will be determined by cross section measurement from the top of the blasted rock to the finished ditch bottom elevation.

The quantities shown in the Contract Schedule of Items have been computed from a theoretical plan length using a 30 inch hole spacing. The actual quantities will depend on field conditions and results from blasting test sections.
Payment

Payment - The accepted quantities of perimeter controlled blast holes will be paid for at the Contract unit price per foot for the item "Perimeter Controlled Blast Holes."

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for blasting, scaling or loosening materials for excavation.

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00340 - Watering

Description

00340.00 Scope - This work consists of furnishing and applying water or combinations of water and additives for:

- Compacting and preparing roadbed excavations, roadbed embankments, backfills, subgrades, subbases, bases and surfacings.
- Preventing or alleviating dust nuisance originating within the highway right-of-way and the Project limits, which is not caused by Contractor operations at the Contractor's plants or plant setups.
- Other watering when ordered, except for Extra Work.

00340.01 Definitions:

Additives - Emulsified asphalt, magnesium chloride or other materials added to water for the purpose of aggregate binder or dust control.

00340.02 Exclusions - Watering which is specified as Incidental and included in payment for other items or parts of work is excluded from measurement under this Section.

Materials

00340.10 Water - Furnish water free of silts and other matter harmful to the quality of the material to which it is applied or with which it is mixed.

Comply with Chapter 537 of the "Oregon Water Laws", which is administered by the Water Resources Department, covering the appropriation of water.

Most adjudicated water may be limited to agricultural uses, so it should not be assumed that there may not be any water sources in the immediate area of the Project available for the Contractor's use.

00340.11 Water Mixtures:

(a) Use of Additives - When called for by the Special Provisions, or ordered, perform watering with a mixture of water and additives. Use an additive from the CPL and mix according to the manufacturer's recommendations.

(b) Magnesium Chloride - When required, furnish Magnesium Chloride (MgCl₂) in brine solution at 28% to 35% concentration by weight.
Equipment

00340.20 Watering Equipment - Perform uniform and controlled application of watering by one or more of the following methods:

- Tank trucks equipped with spray bars
- Hose and nozzle
- Wetting materials in stockpile or in excavation areas before excavating
- Other means, as directed

The use of splash boards will not be allowed without prior approval. When required, provide a metering device for water measurement.

Construction

00340.40 Watering:

(a) General - Make all necessary arrangements to obtain water and pay all costs involved in its procurement. Maintain an adequate supply of water at all times.

Perform watering only when and where directed at an approved rate and manner of application. Water at any hour of the day, and on any day of the week, as directed, for proper performance or protection of the work and for alleviation of dust nuisance.

(b) Use of Additives - If an additive is combined with water in the watering work, mix it in the proportions and manner specified, and use in the work as directed.

Maintenance

00340.60 Avoidance of Detrimental Operations - Avoid wasting water or watering detrimental to other work. Cease such operations until corrective measures are directed.

Measurement

00340.80 Measurement - The pay quantities of water will be determined by any of the following measurements:

- Weight or volume, or both
- In tanks or tank trucks of predetermined capacity
- By approved meters

Measurement will be M-gallons (1000 gallons = 1 M-gallon) not including the additives used in the watering as specified or ordered. For conversion purposes, water weighs 8.34 pounds/gallon or 62.4 pounds/cubic foot. Only quantities acceptably used in the work, as specified, will be measured for payment.

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Quantities of additives combined with water for watering purposes will be determined separately from the water and will be measured on the volume basis in gallons.

### Payment

**00340.90 Payment** - The accepted quantities of water and additives will be paid for at the Contract unit price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Watering ............................................ M-gallon</td>
<td></td>
</tr>
<tr>
<td>(b) ________ in Watering ................................ M-gallon</td>
<td></td>
</tr>
</tbody>
</table>

**Item (a)** includes furnishing and developing the water supply, hauling and applying the water, and for all materials.

In **item (b)**, the name of the additive will be inserted in the blank.

**Item (b)** includes furnishing the specified additive, for combining and mixing it with the water, and for all extra costs involved in the use of the additive in the watering work not included in item (a).

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for obtaining permits, water rights, or any other costs related to complying with the "Oregon Water Laws".

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

**00340.91 Quantity Variations** - Payment for watering pay items performed beyond 25% of the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.
Section 00350 - Geosynthetic Installation

Description

00350.00 Scope - This work consists of furnishing and placing geotextile in drains, under embankments, for embankment reinforcement, under riprap, buttresses, inlays, shear keys, over roadbed subgrades, and beneath pavement overlays as shown or directed.

00350.01 Definitions - Terms not defined in this subsection may be found in ASTM D 123 and ASTM D 4439. If there is a conflict, definitions in this subsection take precedence.

Cross-Machine Direction - The direction in the plane of the fabric perpendicular to the direction of manufacture.

Drainage Geotextile - For installation as a filter in subsurface drains or other drainage locations.

Embankment Geotextile - For installation as a reinforcement within embankments or as a separator under embankments.

Geogrid - A geosynthetic used for reinforcement which is formed by a regular network of tensile elements with apertures of sufficient size to allow strike-through of surrounding soil, rock or other geotechnical material.

Geomembrane - For installation as a liner in a swale or other stormwater facility to prevent contaminated stormwater runoff from entering the groundwater.

Geosynthetics - A planar product manufactured from polymeric material used with soil, rock, earth or other geotechnical, engineering related material as an integral part of a man-made product, structure or system.

Geotextile - A permeable geosynthetic comprised solely of textiles.

- Nonwoven Geotextile - A textile produced by bonding or interlocking of fibers by mechanical, heat or chemical means.
- Woven Geotextile - A textile comprising of two or more sets of filaments or yarns interlaced in such a way that they result in a uniform pattern.

Machine Direction - The direction in the plane of the fabric parallel to the direction of manufacture.

Pavement Overlay Geotextile - For installation as a reinforcement beneath an asphalt concrete overlay.

Riprap Geotextile - For installation as a filter and separator behind or beneath riprap, buttresses, inlays, shear keys and erosion control applications.

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Roll - Unit of continuous geosynthetic without transverse seams as furnished by the manufacturer. Roll sizes may vary between manufacturers and types of geosynthetics.

Roll Values:

- **Average Roll Value** - The average roll value for each property is determined by testing a representative number of samples in a roll according to the test methods specified in Section 02320. An average of these tests becomes the average roll value for each roll tested.

- **Minimum Average Roll Value** - The minimum average roll value for each property is the mean of the average roll values for all rolls tested minus two standard deviations, all as determined by the manufacturer. The minimum average roll value for each property is determined by testing a representative number of rolls in a production run according to ASTM D 4354 sampling procedures and the test methods specified in Section 02320.

- **Minimum Value** - The minimum value is the specified value for each geosynthetic property that shall be met or exceeded by the manufacturer’s minimum average roll value for the production run and, if sampled and tested by the City, by the average roll value for any roll.

Seam Allowance - The minimum distance from the edge of a geotextile to the stitch line nearest to that edge.

Seam Type - A designation relating to the essential characteristics of geotextile positioning and rows of stitching in a specified sewn seam as shown on the plans.

Selvage - The finished edge of a geotextile parallel to the machine direction.

Stitch Type - A designation relating to the essential characteristics of the interlacing of sewn thread(s) in a specified seam as shown on the plans.

Subgrade Geotextile - For installation as a separator or reinforcement on subgrades and in other material separation applications.

Ultraviolet Stability - The ability of a geosynthetic to resist deterioration when exposed to UV radiation.

Ultraviolet (UV) Rays - Direct radiation from the sun during daylight hours, even on cloudy days.

Materials

| 00350.10 | Materials - Furnish materials conforming to Section 02320. | 311 | City of Portland 2010 |
Equipment

00350.20 Field Seam Stitching Equipment - Use field seam stitching equipment that provides an acceptable lock-type stitch as recommended by the geotextile manufacturer and approved by the Engineer.

00350.21 Asphalt Distributor - Design, equip, maintain and operate the asphalt distributor according to 00730.22.

Construction

00350.40 General - Provide geosynthetic as furnished by the manufacturer and protect against damage and deterioration. Prevent excessive mud, wet concrete, epoxy and like materials from coming in contact with the geosynthetic. Store all geosynthetics in a dry place and off the ground at all times according to ASTM D 4873. Cover all geosynthetics with a dark protective covering when received. The geosynthetic will be rejected for use if the Engineer determines it has defects or deterioration, or has been damaged.

00350.41 Geotextile Installation Requirements:

(a) General:

(1) Placement:

   a. Surface Preparation - Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle in any way.

   Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.

   b. On Slopes - Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the lower sheets. When the geotextile is placed on a slope steeper than 6V:1H, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent the slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

   c. Where Exposed To Water - If geotextiles are placed under water or in areas where water will flow, the geotextile may be placed with the machine direction parallel to the direction of water flow instead of the placement direction specified in 00350.41(a-1-b). Overlap sheets so the upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place geotextile more than 50 feet ahead of the specified cover material.
(2) **Overlaps** - Minimum overlap requirements for geotextiles are:

<table>
<thead>
<tr>
<th>Application</th>
<th>Minimum Overlap Requirements, inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drains</td>
<td>12</td>
</tr>
<tr>
<td>Embankment Stabilization</td>
<td>24</td>
</tr>
<tr>
<td>Pavement Overlays</td>
<td>*</td>
</tr>
<tr>
<td>Riprap and Rock Buttresses</td>
<td>24</td>
</tr>
<tr>
<td>Roadbed Subgrade Stabilization</td>
<td>24</td>
</tr>
</tbody>
</table>

* Use sufficient overlap to ensure closure, but not more than 6 inches.

If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or, if approved by the Engineer, sew the geotextile together in the field. If field sewn, the provisions of 00350.20 and 00350.41(a)(3) apply.

(3) **Field Seams:**

a. **General** - When field sewn seams are required, make them as follows:

Sew field seams with polymeric thread consisting of polypropylene, polyester or kevlar, and as resistant to deterioration as the geotextile being sewn. Use a color of thread that contrasts with the geotextile being sewn so the stitches are exposed for inspection when the geotextile is placed. Seams shall meet the testing requirements of 02320.11(b).

b. **Stitch Requirements** - Use 2 rows of lock-type stitching, Type 401, to make the seams, as shown. The 2 rows of stitching shall be 1/2 inch apart with a tolerance of plus or minus 1/4 inch and not cross except for restitching.

c. **Minimum Seam Allowance** - The minimum seam allowance (the minimum distance from the edge of geotextile to the nearest stitching) is:

<table>
<thead>
<tr>
<th>Seam Type (See Plans)</th>
<th>Minimum Seam Allowance, inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat or Prayer Seam, Type SSa-1</td>
<td>1 1/2</td>
</tr>
<tr>
<td>&quot;J&quot; Seam, Type SSn-1</td>
<td>1</td>
</tr>
<tr>
<td>Butterfly-folded Seam, Type Ssd-1</td>
<td>1</td>
</tr>
</tbody>
</table>

d. **Seam Type** - Obtain the geotextile manufacturer’s recommendation for the type of seam and stitch to be used. If the Contractor does not obtain and provide the foregoing technical information use a "J" seam with at least 3 stitches per 1 inch. The flat, or prayer, seam may be used for repair of damaged in-place geotextile.
(4) Protection of Geotextile - Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff and construction activities.

Traffic or construction equipment will not be permitted directly on the geotextile except as authorized in 00350.41(f)(5) or as directed.

During installation cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than 5 days, except when used with temporary, wrap-faced, mechanically stabilized earth walls and asphalt overlays as required in Section 00596 and 0350.41(f), respectively.

Place cover material on the geotextile in such a manner that the geotextile is not torn, punctured or shifted. Use a minimum 6 inch thick cover layer or twice the maximum aggregate size, whichever is thicker. Do not end-dump cover material directly on geotextiles other than riprap geotextile.

Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than 3 inches deep or half the layer thickness, whichever is lesser. Do not turn vehicles on the first layer.

(5) Repair of Geotextile - Repair or replace all torn, punctured or contaminated geotextiles during construction at no cost to the City. Repair by placing a patch of the specified geotextile over the affected area. Overlap the existing geotextile with the patch according to 00350.41(a)(1). Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or Special Provisions, or as directed.

(b) Drainage Geotextile - When used in trenches for drains, place the geotextile in the trench as shown on the plans to loosely conform to the shape of the trench with no wrinkles or folds.

(c) Embankment Geotextile - Construct embankment stabilization according to details shown on the plans. Place the geotextile layers so the geotextile machine direction is transverse to the embankment centerline. Spread the geotextile so all slack and wrinkles are eliminated. Construct embankment in uniform layers according to Section 00330.

(d) Riprap Geotextile - Place geotextile behind and beneath riprap, buttresses, inlays, shear keys and erosion control applications according to the details shown. Demonstrate to the satisfaction of the Engineer that the combination of the rock-fill drop height and the thickness of any aggregate cushion, when specified or required, is adequate to prevent puncturing or damaging the geotextile when placing the riprap or stone embankment material. If an aggregate cushion is used, place according to 00350.41(a)(4). In addition, the following limits apply:
<table>
<thead>
<tr>
<th>Size of Rock</th>
<th>On Geotextile Material</th>
<th>On an Aggregate Cushion Blanket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 200 lbs</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>200 lbs</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

After placing the riprap, backfill all voids in the riprap face so the geotextile is completely covered and not visible.

(e) **Subgrade Geotextile** - For roadbed subgrade separation, prepare the subgrade according to Section 00330.

Correct geotextile failures, as evidenced by soil pumping or roadbed distortion, by removing any covering material in the affected area and placing a geotextile patch on the exposed geotextile according to 00350.41(a)(5). Cover the patch with the specified cover material and compact before proceeding.

(f) **Pavement Overlay Geotextile:**

(1) **General** - Place geotextile and pavement overlay in four basic steps:

- Surface preparation
- Sealant application
- Geotextile placement
- Overlay placement

(2) **Weather Limitations** - Do not place sealant and geotextile unless the weather limitations of 00745.40 are met, as appropriate, except the minimum air temperature shall be 50°F for paving grade asphalt sealant placement and 60°F for asphalt emulsion sealant placement.

(3) **Surface Preparation** - Prepare the pavement surface on which the sealant is to be placed according to 00730.42 and the following:

- Clean and fill cracks exceeding 1/8 inch width with a bituminous crack filler from the CPL.
- Repair minor irregularities or depressions as directed.
- Allow crack filling material to cure before placing Geotextile.
- Where the pavement is severely cracked, rutted, deformed or otherwise distressed, place a leveling course as directed instead of extensive surface preparation.

(4) **Sealant Application** - Use a normal paving grade asphalt. A cationic or anionic emulsion may be used as approved. Do not use cutbacks or emulsions that contain solvents.
Uniformly spray the asphalt sealant at normal application temperature by means of a pressure distributor conforming to 00350.21 on the prepared dry pavement surface. Apply at the rate of 0.20 - 0.30 gallons per square yard, or as recommended by the geotextile manufacturer or as directed.

If using emulsions, increase the application rate 50% or as directed. Some underlying surfaces may require a higher application rate. Within street intersections, on steep grades or in other zones where vehicle speed changes are commonplace, reduce the normal application rate by 20% or as directed.

The target width of the sealant application shall be the geotextile width plus 6 inches. Apply the sealant only as far in advance of the geotextile installation as appropriate to ensure a tacky surface at the time of geotextile placement. Place the geotextile the same day as the sealant. Do not allow traffic on the sealant. Clean excess asphalt from the road surface.

(5) Geotextile Placement - Place the geotextile into the sealant using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding from the water (break) before placing the geotextile.

Slit wrinkles or folds exceeding 1 inch and lay flat. Shingle-lap not more than 6 inches in the direction of the paving. Broom or pneumatic roll to maximize geotextile contact with the pavement surface. Additional hand-placed sealant material may be required at laps as determined.

Limit traffic to necessary construction equipment and emergency vehicles on the geotextile before and during paving unless otherwise directed. Turn the paver and other vehicles gradually. Keep turning to a minimum to avoid geotextile movement and damage. Avoid abrupt starts and stops.

(6) Overlay Placement - Place the overlay the same day the geotextile is placed. Remove sealant that bleeds through the geotextile. Do not windrow asphalt concrete material on the geotextile ahead of the paving machine. Do not use an asphalt concrete material pickup machine.

(g) Geomembrane Deployment:

(1) Preparation - Prior to installing the geomembrane, inspect the subgrade, remove all foreign matter and sharp, protruding or loose material that could penetrate or otherwise damage the geomembrane, and compact the subgrade to specifications.

(2) Inspection - During installation, visually inspect the geomembrane for imperfections, defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Mark and repair faulty or suspect areas.
(3) **Cuts and Welds** - Perform all cuts, welds and penetrations per manufacturer’s specifications. Shingled overlaps shall be a minimum of 3 feet in the downslope direction.

(4) **Cover** - Cover fill material shall be free of foreign objects or sharp material that could penetrate or otherwise damage the geomembrane. Place and spread over the geomembrane in a manner that prevents punctures or other damage to the geomembrane.

**Measurement**

The quantities of each geosynthetic installation will be measured on the area basis along the lines and grades of the surface area actually covered as shown or as required, except for drainage applications.

The quantities of drainage geotextile will be measured on the area basis computed by multiplying the length of the trench where geotextile is used by the perimeter of the trench as determined from the neat lines shown, or as directed.

**Payment**

The accepted quantities for geosynthetics will be paid for at the Contract unit price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Drainage Geotextile, Type ____</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(b) Embankment Geotextile</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(c) Riprap Geotextile, Type ____</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(d) Subgrade Geotextile</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(e) Pavement Overlay Geotextile</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(f) Geomembrane</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(g) Geogrid</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

In items (a) and (c), the type of geotextile will be inserted in the blank, with a separate pay item provided for each type.

Item (e) includes preparation work, sealant, and geotextile.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for constructing laps, seams, joints, and patches unless the Engineer orders additional amounts over the minimum. For laps wider than the minimum or specified width, payment will be made for the added lap width at the Contract unit price.
If the Engineer orders geosynthetics with properties more stringent than specified, a price adjustment will be allowed only for the difference in material cost.
Section 00360 - Drainage Blankets

Description

00360.00 Scope - This work consists of furnishing and placing drainage blanket material to the lines, grades and dimensions shown on the plans or as directed.

Materials

00360.10 Sand Drainage Blanket - Furnish sand drainage blanket material meeting the following gradation limits determined by AASHTO T 27 and AASHTO T 11:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 10</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 40</td>
<td>50 - 100</td>
</tr>
<tr>
<td>No. 60</td>
<td>20 - 40</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

00360.11 Granular Drainage Blanket - Furnish granular drainage blanket material that is clean, free draining, durable crushed or uncrushed rock, meeting the following gradation limits determined by AASHTO T 27:

(a) General:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>100</td>
</tr>
<tr>
<td>4&quot;</td>
<td>90 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60 - 80</td>
</tr>
<tr>
<td>No. 10</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

(b) Pervious Pavement - Under pervious pavement, furnish crushed rock conforming to the following gradation limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>35 - 70</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>10 - 30</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

Granular drainage blanket material will be accepted without testing if the Engineer visually determines the material meets the above requirements.

00360.15 Quality Control - Provide quality control according to Section 00165.
Equipment

00360.20 **General** - Use equipment capable of hauling, spreading and compacting the material to specified density without segregation.

If drainage blanket material is used to drain areas described in 00360.41, hauling with end dump trucks and spreading with bulldozers and other appropriate equipment will be allowed.

Labor

00360.30 **Quality Control Personnel** - Provide certified technicians in the following fields:

- CEBT
- CAgT
- CDT

Construction

00360.40 **Planned Locations** - On prepared excavations or embankments constructed as shown on the plans or as directed, place the drainage blanket as follows:

- Spread and compact to required depth with no layer exceeding 3 feet
- If a subsurface drain system is installed immediately under or adjacent to the drainage blanket, place the drainage blanket directly against the subsurface drain system
- Prevent contamination of drainage blanket material

00360.41 **Other Locations** - When used to drain an unstable or wet area, excavate or trench the existing low areas as directed for positive drainage before placement of drainage blanket material.

00360.42 **Compaction and Density Requirements** - Compact the drainage blanket according to 00330.43.

Measurement

00360.80 **Measurement** - The quantities of sand or granular drainage blanket material will be measured on the volume basis in place and be limited to the neat lines, grades and dimensions shown on the plans or as directed, or on the weight basis.
Payment

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Sand Drainage Blanket</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(b) Granular Drainage Blanket</td>
<td>Ton or Cubic Yard</td>
</tr>
</tbody>
</table>

- The accepted quantities of sand and granular drainage blankets will be paid for at the Contract unit price, per unit of measurement for the following items:
Section 00390 - Riprap Protection

Description

00390.00 Scope - This work consists of furnishing and placing an erosion resistant cover material for protecting slopes and basins at locations shown or as directed.

00390.01 Definitions:

Filter Blanket - A layer of graded granular material placed between the area prepared for it and the riprap.

Grouted Riprap - Loose riprap with all or part of the spaces filled with Portland cement mortar.

Keyed Riprap - Loose riprap placed on prepared slope, riprap geotextile or filter blanket, as specified, and keyed in place by slapping the surface with a piece of armor plating.

Loose Riprap - Specified classes of graded rock placed on prepared slope, riprap geotextile or filter blanket, as specified.

Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.

Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.

Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

Materials

00390.10 Riprap Geotextile - Furnish riprap geotextile meeting the requirements of 02320.

00390.11 Riprap Requirements:

(a) General - Furnish rock for loose riprap meeting the following requirements:

- Meet the test requirements of 00390.11(b).
- Be angular in shape. Thickness of a single rock shall not be less than 1/3 its length. Rounded rock will not be accepted unless authorized by the Engineer.
- Meet the gradation requirements for the class specified.
- Be free from overburden, spoil, shale and organic material. Non-durable rock, shale or rock with shale seams is not acceptable.
(b) Test Requirements - Furnish the rock meeting the following test requirements:

<table>
<thead>
<tr>
<th>Material Test</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Specific Gravity (AASHTO T 85)</td>
<td>2.50 Min.</td>
</tr>
<tr>
<td>% Absorption (AASHTO T 85)</td>
<td>6.0 Max.</td>
</tr>
<tr>
<td>Degradation (ODOT TM 208A)</td>
<td></td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td>35.0% Max.</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>8.0“ Max</td>
</tr>
<tr>
<td>Soundness (AASHTO T 104)</td>
<td></td>
</tr>
<tr>
<td>Average Loss of 2 1/2“ - 1 1/2“ and 1 1/2“ - 3/4“ fraction after 5 alternations</td>
<td>16.0% Max.</td>
</tr>
</tbody>
</table>

(c) Gradation Requirements - Grade loose riprap by class and weight of rock according to the following:

<table>
<thead>
<tr>
<th>Class 50</th>
<th>Class 100</th>
<th>Class 200</th>
<th>Class 700</th>
<th>Class 2000</th>
<th>Weight of Rock (pounds)</th>
<th>Percent (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 - 30</td>
<td>100 - 60</td>
<td>200 -</td>
<td>700 -</td>
<td>2000 -</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>30 - 15</td>
<td>60 - 25</td>
<td>140 -</td>
<td>500 -</td>
<td>1400 -</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>15 - 2</td>
<td>25 - 2</td>
<td>140 - 80</td>
<td>500 -</td>
<td>1400 -</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td>2 - 0</td>
<td>2 - 0</td>
<td>80 - 8</td>
<td>200 -</td>
<td>700 -</td>
<td>10.0 - 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 - 0</td>
<td>200 - 20</td>
<td>700 - 40</td>
<td>20 - 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40 - 0</td>
<td></td>
</tr>
</tbody>
</table>

Uniformly grade each load of riprap from the smallest to the largest weight specified. Control of gradation will be by visual inspection.

(1) Control Sample - If directed, provide, at a satisfactory location near the Project, a rock sample of at least 5 tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.

(2) Sampling and Testing Assistance - Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two random truck loads of rock. Mechanical equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the City.
00390.12 **Grouted Riprap** - Furnish rock for grouted riprap meeting the requirements of 00390.11, and furnish the Portland cement grout meeting the requirements of 02080.40.

00390.13 **Filter Blanket** - Furnish filter blanket material meeting the following requirements according to riprap class:

<table>
<thead>
<tr>
<th>Riprap Class</th>
<th>Filter Blanket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2000</td>
<td>16 inch layer of Class 50 riprap conforming to 00390.11</td>
</tr>
<tr>
<td>Class 700</td>
<td>9 inch layer of 6&quot; - 0 stone embankment meeting the test requirements of 00330.16</td>
</tr>
<tr>
<td>Class 200</td>
<td>6 inch layer of 4&quot; - 0 stone embankment meeting the test requirements of 00330.16</td>
</tr>
<tr>
<td>Class 100</td>
<td>No filter blanket required</td>
</tr>
<tr>
<td>Class 50</td>
<td>No filter blanket required</td>
</tr>
</tbody>
</table>

**Construction**

00390.40 **Preparation** - Remove brush, trees, stumps and other organic material from slopes to be protected by riprap and dress to a smooth surface. Remove all unsuitable material to the depth shown or directed and replace with approved material. Compact filled areas as specified in Section 00330.

Provide riprap protection as early as the structure foundation construction permits. Prepare the surfaces to be protected as shown. Maintain the trench slopes, riprap geotextile or filter blanket until the riprap is placed.

00390.41 **Riprap Geotextile** - If required, install riprap geotextile according to the requirements of Section 00350 and as shown or directed.

00390.42 **Filter Blanket Construction** - If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation. The surface of the finished layer shall be reasonably even.

00390.43 **Riprap Backing** - When allowed in the Special Provisions or indicated on the plans, the Contractor shall have the option of placing either riprap geotextile or a filter blanket behind the riprap. Install the backing according to 00390.41 or 00390.42.
00390.44 Riprap:

(a) General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.

(b) Loose Riprap - Place riprap on the prepared area:

- With a clam-shell, orange-peel bucket, skip or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed.
- To its full course thickness in one operation.
- According to 00350.43, if riprap is placed on geotextile.
- By methods that do not cause segregation of riprap or displace the underlying material.
- To produce a compact riprap protection in which all sizes of material are placed in their proper proportion.
- With some hand placing, or rearranging of individual stones by mechanical equipment, or some other approved means to provide a smooth finished surface.

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

(c) Keyed Riprap - After placing loose riprap material according to 00390.44(a), and 00390.44(b), key the riprap into place by slapping the surface with a piece of armor plating (approximately 4 feet x 5 feet in size with a weight of approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.

(d) Grouted Riprap - Place loose riprap material according to 00390.44(a) and 00390.44(b). If the depth specified for grouting is more than 12 inches, place the riprap in lifts of 12 inches or less and grout each lift before placing the next lift. Construct and grout the succeeding lifts before the grout in the previous lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the plans. If a rough surface is specified, brush the stone until 25% to 50% of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8 inch of the surface.

Provide weep holes through the riprap as shown or as directed.
00390.60

Place and cure grout according to 00440.40(d) and (e) except as provided above.

(e) Riprap Basins - Excavate, backfill and construct riprap basins, without a riprap geotextile or filter blanket, at pipe outlets with Class 50 riprap as shown or as directed.

Maintenance

00390.60 General - Maintain the riprap protection until accepted. Replace any material displaced by any cause at no additional cost to the City.

Measurement

00390.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Filter Blank - Filter blanket will be measured on the area basis of the finished surface limited to the neat lines shown or directed.

(b) Riprap Backing - Riprap backing, will be measured on the area basis of the finished geotextile or filter blanket surface, limited to the neat lines shown or directed.

(c) Riprap - Riprap will be measured on the volume basis in place or on the weight basis.

When measurement of riprap is on the volume basis in place and the Engineer determines that this basis is impractical, the pay volume will be determined by loose measure in the hauling vehicles on the basis that 1.00 cubic yard, vehicle measure, is equivalent to 0.70 cubic yard in place.

(d) Riprap Basins - Riprap basins will be measured on a unit basis of basins constructed.

Payment

00390.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Filter Blank</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(b) Riprap Backing</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(c) Loose Riprap, Class</td>
<td>Cubic Yard or Ton</td>
</tr>
<tr>
<td>(d) Grouted Riprap, Class</td>
<td>Cubic Yard or Ton</td>
</tr>
<tr>
<td>(e) Keyed Riprap, Class</td>
<td>Cubic Yard or Ton</td>
</tr>
<tr>
<td>(f) Riprap Basins</td>
<td>Each</td>
</tr>
</tbody>
</table>

In items (c), (d) and (e), the class of riprap will be inserted in the blank.
Item (d) includes the grout.

Riprap geotextile will be paid for according to 00350.90, except when it is included in item (b).

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00396 - Shotcrete Slope Stabilization

Description

00396.00 Scope - This work consists of constructing pneumatically applied shotcrete stabilization blankets onto slope surfaces at locations shown or as directed.

00396.01 Definitions, Standards, and Requirements:

Requirements - Design the shotcrete mix and be responsible for the quality of shotcrete used in the work.

Shotcrete - Either dry-mixed or wet-mixed material composed of Portland cement, fine and coarse aggregate, water and reinforced with either welded wire fabric or steel fibers.

Standards - Construct shotcrete according to these Specifications and applicable sections of the latest edition of the American Concrete Institute's "Guide to Shotcrete" (ACI 506).

Materials

00396.10 Materials - Furnish materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Reinforcement</td>
<td>02510.10</td>
</tr>
<tr>
<td>Cement (Type I or II)</td>
<td>02010.10</td>
</tr>
<tr>
<td>Chemical Admixtures</td>
<td>02040</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>02690.20</td>
</tr>
<tr>
<td>Curing Materials</td>
<td>02050.10</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>02690.30</td>
</tr>
<tr>
<td>Grout</td>
<td>02080.20</td>
</tr>
<tr>
<td>PVC Pipe</td>
<td>02410.70</td>
</tr>
<tr>
<td>Water</td>
<td>02020</td>
</tr>
<tr>
<td>Welded Wire Fabric</td>
<td>02510.40</td>
</tr>
</tbody>
</table>

00396.11 Prepackaged Product - Premixed and prepackaged concrete products, with or without steel fibers, manufactured as a shotcrete product may be used for on-site mixed shotcrete if the materials meet this specification and if approved.

00396.12 Aggregates - Combined fine and coarse aggregates shall meet the following grading requirements as determined by AASHTO T 27:
### 00396.13 Steel Fiber Reinforcement
- If steel fiber reinforced shotcrete is required, the steel fibers shall:
  - Be between 1/2 inch and 1 1/2 inches long.
  - Meet the requirements of ASTM A 820 Type 1, Deformed.
  - Have a length to diameter ratio of less than 80.
  - Have a minimum tensile strength of 160,000 psi.

Only steel fibers manufactured specifically for use in shotcrete applications will be allowed. The steel fiber content shall not be less than 100 pounds per cubic yard of shotcrete.

### 00396.14 Acceptance Sampling and Testing:

(a) **General** - Prepare shotcrete test panels on vertically supported open face molds. The molds shall:
  - Have internal dimensions of at least 18 inches x 18 inches x 4 inches.
  - Be rigid, nonabsorbent and nonreactive with cement.

Place the shotcrete in the molds utilizing the same shotcrete mix, air and water pressure, and nozzle tip that will be used in the actual placement of shotcrete on production surfaces. Protect the panels for at least 24 hours or until final set has taken place.

1. **Preproduction Testing** - Prepare at least 2 test panels for each mix design for testing. Cure the test panels in a manner similar to the anticipated field conditions. Provide a copy of the mix design and the compressive strength test results at least 7 calendar days before starting any production work. Do not begin production shotcrete work until satisfactory test results are obtained.

2. **Production Testing** - Prepare, in the presence of the Engineer, at least 2 test panels daily for each nozzleperson during shotcrete operations, plus 1 test panel shot whenever the nozzle equipment is changed during the daily work period. Cure the shotcrete panels under the same conditions as the production shotcrete.

---

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>90 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>70 - 85</td>
</tr>
<tr>
<td>No. 8</td>
<td>50 - 70</td>
</tr>
<tr>
<td>No. 16</td>
<td>35 - 55</td>
</tr>
<tr>
<td>No. 30</td>
<td>20 - 35</td>
</tr>
<tr>
<td>No. 50</td>
<td>8 - 20</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 - 10</td>
</tr>
</tbody>
</table>
(b) Compressive Strength Tests:

1. **Compressive Test Cores** - Obtain 3 inch diameter test cores from the cured shotcrete test panels prepared according to 00396.14(a)(1) and 00396.14(a)(2). Use a 3 inch inside diameter core bit to obtain cores.

2. **Shotcrete Compressive Strength** - The shotcrete cores shall attain 2,500 psi compressive strength at 7 calendar days (1,800 psi at 3 calendar days) as determined by AASHTO T 22. The production testing cores obtained by the Contractor will be tested by the City.

(c) Failure Of Shotcrete - If any shotcrete section is deficient in any of the specified criteria, remedy that section as directed at no additional cost to the City. The remedies may include, but are not limited to, removal and replacement of the deficient section.

Equipment

00396.20  **General** - Provide mixing equipment capable of thoroughly mixing the materials in sufficient quantity to maintain uniform and continuous application.

00396.21  **Pump System** - The pump system that conveys premixed shotcrete ingredients shall deliver a uniform and continuous flow of material, without segregation or loss of the ingredients.

00396.22  **Air Compressor** - The air compressor shall be capable of providing:

- A supply of clean air adequate for maintaining sufficient nozzle velocity for all parts of the work and for the simultaneous operation of a blow pipe for clearing away rebound.
- A minimum of 250 cubic feet per minute per operating nozzle.

00396.23  **Dry-Mix Delivery Equipment** - Dry-mix delivery equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and deliver a continuous stream of uniformly mixed material to the discharge nozzle. Equip the discharge nozzle with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and be convenient to the nozzleperson. Provide greater water pressure than the operating air pressure at the discharge nozzle to assure that the water is thoroughly mixed with the other materials. Use steady, nonpulsating water pressure. Regularly inspect and replace equipment parts, especially the nozzle liner and water ring, as necessary or directed.

When prepackaged material is used, predampening (also referred to as premoisturizing) equipment shall be used.
00396.24  **Wet-Mix Delivery Equipment** - Wet-mix delivery equipment shall be capable of discharging the premixed materials into the delivery hose and delivering a continuous stream of uniformly mixed material to the discharge nozzle. Follow the manufacturer’s recommendations on the type and size of nozzle to be used, and on cleaning, inspection and maintenance of the equipment.

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**Labor**

00396.30  **Qualifications** - At least 7 calendar days before beginning shotcrete work, provide written evidence that the on-site supervisor, nozzle operator, and delivery equipment operator have performed satisfactory work in similar capacities elsewhere for a sufficient length of time to be fully qualified to perform their duties.

The on-site supervisor shall have not less than 2 year's full-time experience as a shotcrete nozzle operator. The nozzle operator and delivery equipment operator shall have served at least one year of full-time apprenticeship on similar applications with the same type of equipment. Before starting shotcrete work, the nozzle operator shall, in the presence of the Engineer, demonstrate their ability to apply shotcrete on a mold for a test panel according to 00396.14. The nozzle operator, before permission is given to place shotcrete in permanent construction, shall make one satisfactory test panel for each mix used during the course of the work.

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**Construction**

00396.40  **Surface Preparation** - Before applying shotcrete to rock surfaces, remove all loose material and vegetation and clean with air, water jets or other approved means. Remove loose material from soil surfaces with air jets.

Do not place shotcrete on any surface which is frozen, spongy or where there is free water. Dampen the surface before applying shotcrete.

00396.41  **Shotcrete Blanket Thickness Control** - Control shotcrete blanket thickness by installing noncorrosive pins, nails or other gauging devices normal to the face so that they protrude the required shotcrete thickness outside the face. Place the pins on a maximum 5 foot square pattern. When welded wire fabric reinforcement is used, place at least a 1 inch cover of shotcrete over the wire fabric.

00396.42  **Anchor Bars** - Clean and blow clear all drilled holes before installing the anchor bars. Fill drilled holes using a grout tube extending to the bottom of the hole.

00396.43  **Welded Wire Fabric** - Place welded wire fabric as shown or directed. Overlap sheets at least 8 inches and secure with tie wire.
Weep Holes - Do not drill holes larger than 3 inches in diameter. Install the drain pipe before applying shotcrete. Extend the end of the pipe 1 inch to 3 inches outside the slope. Protect pipe ends during shotcreting and clean weep holes after shotcrete is placed.

Batching and Mixing Shotcrete:

(a) Dry-Mix Process - Batch cement/aggregate mix by weight or volume. Predampen the dry-mix after it flows out of the packaging but before it flows into the main hopper in order to ensure that the premix will flow at a uniform rate. Do not use predampened cement/aggregate mix in the work if it is allowed to stand more than 45 minutes.

(b) Wet-Mix Process - Batch and mix wet-mix shotcrete according to ASTM C 94.

Batching and Mixing Steel Fibers - Determine the procedure for adding steel fibers to the shotcrete. Obtain Engineer's approval. Demonstrate the procedure in the field for approval before production operation begins. If fibers are added at the nozzle, uniformly distribute the fibers throughout the mortar matrix without isolated concentrations. If fibers are added to the dry or wet mix process, use a screen having a mesh of 1 1/2 inch to 2 1/2 inches to prevent any fiber balls from entering the shotcrete line, unless it is demonstrated that fiber balls are not being formed without a screen. Do not add fibers to the dry or wet mix at a rate faster than can be blended with the other ingredients without forming balls or clumps. Bulk fibers that have a tendency to tangle together shall pass through a vibrating screen or be sifted into the mix so they enter it as individual elements and not as clumps.

Shotcrete Application - Apply shotcrete from the lower portion of the area to the top so rebound does not accumulate on the portion of the surface that still has to be covered. Hold the nozzle at a distance and at an angle approximately perpendicular to the working face so rebound material will be minimal and compaction will be maximized. Shotcrete shall emerge from the nozzle in a uniform and continuous flow. When, for any reason, the flow becomes intermittent, divert the nozzle from the work until uniform and continuous flow resumes. A nozzleperson's helper, equipped with an air blowout jet, shall attend the nozzleperson at all times during the placement of shotcrete to keep the working area free from rebound.

Do not work rebound material into the finished product. Rebound is defined as the shotcrete constituents which fail to adhere to the surface to which the shotcrete is being applied. Do not salvage it or include it in later batches.

Shooting will be suspended if:

- High wind prevents the nozzleperson from proper application of the material.
- The temperature is below 40° F.
- External factors, such as rain, wash cement out of the freshly placed material or cause sloughs in the work.
Taper construction joints over a distance of at least 12 inches to a thin edge. Thoroughly wet the surface of such joints before any adjacent section of shotcrete is placed. Do not use square construction joints.

Remove dummy areas, sags, or other defects and replace with a new layer, at no additional cost to the City. Replace any fabric reinforcement that is damaged with lapped and tied wire fabric.

Allow previous layers of shotcrete to take initial set before applying additional layers of shotcrete. Clean all loose material before applying additional layers.

**00396.48 Finishing and Curing** - Leave the shotcrete surface in a natural gun finish.

Apply Type 2, white-pigmented curing compound immediately after gunning to cure the shotcrete. Keep shotcrete surfaces from freezing for at least seven calendar days after application. Any curing compound in contact with exposed welded wire fabric, anchor bars and previous shotcrete surfaces shall be sandblasted before placing subsequent shotcrete.

**Measurement**

**00396.80 Measurement** - The quantities of shotcrete will be measured on the area basis along the finished shotcrete surface area.

**Payment**

**00396.90 Payment** - The accepted quantities of shotcrete will be paid for at the Contract unit price, per square yard, for the item "Shotcrete Slope Stabilization".
Section 00398 - Rock Slope Stabilization and Reinforcement

Description

00398.00 Scope - This work consists of furnishing and installing rock slope stabilization and reinforcement items as shown or specified in close conformity to the lines, grades, and dimensions shown or established.

Definitions

00398.02 Definitions:

Barrier Mounted Rock Protection Screen - A system of screening and concrete barrier designed to intercept small falling rocks.

Post-Supported Rock Protection Screen Behind Barrier/Guardrail - A gabion wire mesh screen placed at the highway shoulder edge and supported by posts up to 8 feet high to intercept rocks generally less than 2 feet in diameter.

Post-Supported Wire Mesh Slope Protection - Gabion wire mesh suspended above the ground with support posts and draped over a rockfall slope area. Post-supported wire mesh is used to intercept occasional falling rock generally less than 2 feet in diameter from slopes above the installation and the draped portion is used to prevent rocks from reaching the travel lanes.

Rock Reinforcing Bolts - Steel rods inserted into predrilled holes in rock and tensioned to a required load and bonded in place with grout.

Rock Reinforcing Dowels - Untensioned steel rods inserted into predrilled holes in rock and bonded in place with grout or polyester resin.

Rockfall Net System - A proprietary rockfall system constructed of interlocking steel rings or interlaced cable panels suspended from wide-flange support posts and incorporating braking elements. The system is designed to withstand high energy rockfall with minor maintenance required.

Wire Mesh Slope Protection - Gabion wire mesh draped over a rockfall slope area and anchored with soil or rock anchors. Wire mesh is used where rocks are generally less than 2 feet in diameter and to prevent rocks from reaching travel lanes.

00398.03 Rockfall Net System Submittals - Submit unstamped working drawings, field construction manuals, and product brochures prepared by the manufacturer of proprietary rockfall net systems, as necessary, according to 00150.35. Submit this information at least 30 calendar days before beginning fabrication or construction of the rockfall net system. Do not begin installation prior to receipt of written approval.
(a) Working Drawings - Provide working drawings that included at least the following information:

- **General Notes** - Necessary information on the design and construction of the rockfall net system.
- **Materials and Quantity Summary List** - All items of each net system.
- **Plan and Elevation Views** - The net system alignment and offsets to construction centerline, locations of support posts and footings, all end, lateral, top and bottom support ropes, anchor ropes and braking elements, net height, and section lengths.
- **Typical Sections** - Net system footings, footing-to-post connections, net connections, anchor type, retaining rope and braking element connections, and anchor locations.
- **Structural and Geometric Details** - The following minimum structural and geometric details:
  - Footing and leveling pad details
  - Rock and soil footing details
  - Anchor details
  - End, lateral, and intermediate support rope details
  - Support column details, including column plate details, breakaway connections and cable guide assemblies

(b) Field Construction Manual - Provide a field construction manual, prepared by the manufacturer of the proprietary rockfall net system, including step-by-step directions for constructing the rockfall net system.

00398.04 Rock Reinforcing Bolts and Rock Reinforcing Dowels Submittals - Submit a detailed work plan 10 calendar days prior to the preconstruction conference. Include the following:

- Construction schedule and sequence.
- Drilling methods and equipment.
- Components for rock reinforcing bolts and rock reinforcing dowels, couplers, bearing plates, rock reinforcing bolt mechanical anchorage system (if used), flat washers, and beveled washer specifications including the manufacturer's data sheets.
- Drill hole diameter.
- Grout mix or polyester resin from the CPL or approved equal, including manufacturer's data sheets. Include the procedures for placing the grout and resin.
- Corrosion protection, either galvanizing or epoxy coating, for the rock reinforcing bolts and rock reinforcing dowels.
Installation, stressing procedures, torque wrench, test jack, and pressure gauge to be used.

Calibration data for each torque wrench, test jack, and pressure gauge to be used. An independent testing laboratory shall have performed the calibration tests within 60 calendar days of the date submitted. The torque wrenches shall have a capacity at least 20% greater than the rock reinforcing bolt manufacturer's recommended torque to achieve the design and test loads. The torque wrench shall have an accuracy of at least ± 2% of the full-scale reading, and a resolution of at least 1% of the full-scale reading.

The Engineer will respond within 21 calendar days after receipt of the work plan. Do not proceed with the work until receipt of the approved work plan in writing.

Materials

(a) Steel Anchor Bolts - Furnish 1 inch diameter continuously threaded or deformed, Grade 75 steel anchor bolts, complete with keyhole plate, grout tube, washer and nut, meeting the requirements of AASHTO M 31 (ASTM A 615). Provide anchor bolts made of one continuous bar. Welding and couplers will not be allowed. Galvanize all steel anchor bolts according to AASHTO M 232 (ASTM A 153). Provide grout tubes, grout sealers, and other grouting accessories for grouting anchor bolts of type recommended by the manufacturer and as approved.

(b) Steel Plates, Washers, and Nuts - Furnish steel plates, washers, and nuts for steel anchor bolts meeting the requirements of ASTM F 432. Provide 3/8 inch flat steel plates that provide not less than 6 inch by 6 inch area for each bolt. Provide steel or malleable iron beveled washers and hardened steel machine washers. Provide heavy-hexagonal type nuts. Galvanize all plates, washers, and nuts according to AASHTO M 232 (ASTM A 153), Class C, except castings shall be Class A and forgings shall be Class B.

(c) Wire Rope Anchors - Furnish cable for wire rope anchors meeting the current requirements of Federal Specification RR-W-410 and ASTM A 1023. Provide general purpose, 3/4 inch diameter, 6 x 19 IWRC, galvanized wire rope, with the wire rope core made from extra improved plow steel. Minimum breaking force shall be 58,800 pounds. Attach ferrules to the cable to prevent pullout of the cable from the encapsulating concrete during testing as described in 00398.42(e). Galvanize all ferrules and thimbles according to AASHTO M 232 (ASTM A 153).

(d) Concrete - Furnish concrete for anchors, support posts, and brace footings meeting the requirements of Section 00440 except the minimum strength shall be 4,000 psi.
(e) **Cement Grout** - Furnish non-epoxy cement grout for anchors in rock from section 02080.20 of the CPL, or an approved equal. Follow the manufacturer's recommendations for water-cement ratio, mixing and set times.

(f) **Polyester Resin** - Furnish high strength (HS) or low strength (LS) polyester resin for post anchors in rock from section 00535 of the CPL, or an approved equal.

00398.11 **Posts, Braces, and Appurtenances** - Furnish 4 inch outside diameter, Schedule 40, hot-dip galvanized post and braces made from steel pipe according to ASTM A 53, Grade B. Furnish 4.5 inch O.D. pipe size (to accommodate post), Schedule 40, hot-dip galvanized post sleeves made from steel pipe according to ASTM A 53, Grade B. Furnish post caps, strap clamps, bolts, and nuts that are hot-dip galvanized according to AASHTO M 232 (ASTM A 153). Repair all cutting, welding, and drilling as well as other damage to the galvanizing according to 02420.10(d).

00398.12 **Top Horizontal Support Rope and Support Post Retaining Rope** - Furnish top horizontal support rope and support post retaining rope of the sizes shown and meeting the current requirements of Federal Specification RR-W-410 and ASTM A 1023. Provide Type 1, general purpose, Class 2, 6 x 19 IWRC, galvanized wire rope, with the wire rope core made from extra improved plow steel.

00398.13 **Hardware** - Furnish all rings and eyes of drop-forged steel that has been heat treated after forging. Furnish wire rope thimbles and clips that are sized for the wire rope shown. Galvanize all rings, eyes, thimbles, wire rope clips, U-bolts and miscellaneous hardware according to AASHTO M 232 (ASTM A 153), Class C, except castings shall be Class A and forgings shall be Class B.

00398.14 **Wire Mesh Materials:**

(a) **Gabion Wire Mesh Fabric** - Furnish gabion wire mesh fabric meeting the requirements of ASTM A 975, Style 1, 8 by 10 mesh type with Class 3 coating, soft temper.

(b) **PVC Coated Gabion Wire Mesh Fabric** - Furnish PVC coated gabion wire mesh fabric meeting the requirements of ASTM A 975, Style 3, 8 by 10 mesh type with Class 3 coating, soft temper. The color of the PVC coating shall be approved.

(c) **Gabion Wire High Tensile Steel Fasteners and Lacing Wire** - Furnish 11 gauge high tensile steel fasteners meeting the requirements of ASTM A 975 and ASTM A 764. Provide Class 3 zinc coating according to ASTM A 641. Install the fasteners as shown and as recommended by the manufacturer. Provide minimum panel to panel connection strengths meeting the requirements of ASTM A 975.

If stainless steel fasteners are required for corrosive environmental conditions, provide them according to ASTM A 313, Type 302.
Provide lacing wire with the same coating material as the gabion wire mesh fabric furnished on the order and conforming to ASTM A 641 and ASTM A 975. If PVC coating is required, provide the same color as the gabion wire mesh fabric.

**00398.15 Rock Reinforcing Bolts and Rock Reinforcing Dowels**

Furnish rock reinforcing bolts, rock reinforcing dowels, and all hardware that is galvanized or epoxy coated prior to installation. Cement grout or polyester resin will not be allowed as a substitute for the required protective coatings.

**(a) Rock Reinforcing Bolts**

Provide rock reinforcing bolts, including mechanical anchorage system, plates, washers, and nuts from section 00398 of the CPL or an approved equal. If mechanical anchorage is not selected, use a rock reinforcing bolt system from a manufacturer regularly engaged in the manufacturer of rock reinforcing bolts.

Provide grout tubes, grout sealers, and other grouting accessories for grouting rock reinforcing bolts of types recommended by the manufacturer and as approved.

**(b) Rock Reinforcing Dowels**

Provide rock reinforcing dowels, plates, washers, and nuts from a manufacturer regularly engaged in the manufacturer of rock reinforcing dowels. Provide grout or polyester resin meeting the requirements of this Section.

If polyester resin is selected, use a proven non-shrink polyester resin for rock reinforcing dowels capable of permanently developing the bond and internal strength between the rock reinforcing dowel and rock. Use a single speed cartridge system to anchor the dowel in rock. Select the cartridge diameter as recommended by the manufacturer to ensure complete encapsulation of the rock reinforcing dowel and satisfactory in-hole mixing. Select a polyester resin with a gel time which is consistent with rapid installation. Polyester resin to be incorporated into the rock reinforcing dowel installation shall be within the shelf-life period stated by the manufacturer. Provide samples of the polyester resins for testing upon request of the Engineer. Store polyester resins according to the manufacturer's recommendations.

**00398.16 Rockfall Net Systems**

For proprietary rockfall net systems, provide products from the selected company according to the company’s specifications and these applicable material Specifications. If there is a conflict between the company’s specifications and the City’s Specifications, the City’s Specifications will take precedence. Obtain all materials for the selected proprietary rockfall net system from the same company. Use only one proprietary rockfall net system on the Project unless different proprietary rockfall net systems are specified.
Equipment

00398.20 Anchor, Bolt, and Dowel Equipment - Provide all equipment necessary to establish the steel bolt anchors, wire rope anchors, rock reinforcing bolts, and rock reinforcing dowels in the holes at the locations and depths shown or directed, and to tighten nuts, eyes and other hardware to the required tension according to the instructions of the manufacturer subject to approval.

Provide and maintain in good working condition the necessary torque wrenches and related equipment for the installation of steel bolt and wire rope anchors, rock reinforcing bolts, and rock reinforcing dowels.

Labor

00398.30 Measurement Assistance - Furnish labor, at no additional cost to the City, to assist with the measurement of actual quantities of wire mesh slope protection, post-supported wire mesh slope protection, and shotcrete slope stabilization placed on the slopes.

00398.32 Rock Reinforcing Bolts and Rock Reinforcing Dowels Personnel Qualification - Furnish personnel skilled in the installation of rock reinforcing bolts and rock reinforcing dowels. Experience shall be relevant to anticipated rock conditions and size of rock reinforcing bolts and rock reinforcing dowels being installed. The on-site supervisor and drill operator shall have no less than two years of demonstrated experience in rock reinforcing bolt and rock reinforcing dowel installation. Submit experience documentation 10 calendar days prior to the preconstruction conference. Include current reference names and phone numbers, project names, locations, and the year of actual construction.

Response will provided within 21 calendar days after receipt of the submittal. If, after checking references submitted, it is in the judgment of the Engineer that the proposed employees are not qualified; they will not be allowed to work on the Project. Do not proceed with the work until approval of the submittal in writing.

Construction

00398.40 Lines, Grades, and Preparation Work - Clear, grub, and prepare the area of slope protection. Remove all shrubs, brush, snags, downed timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with construction. If directed, preserve trees and geographic features at the top of the wire mesh and cable mesh by varying the post and anchor locations to miss them.

Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil or rock. Do not disturb the original ground at the sides and bottom of the excavation.

Dispose of materials, including excess excavation, according to 00290.20.
00398.41  **Rock Slope Protection** - Construct the kinds and types of rock slope protection at the locations shown or directed. Verify existing ground elevations, anchor locations, footing locations, elevations, and alignments prior to construction. A variety of foundation conditions may be encountered during construction of the rock slope protection items. Be prepared to install rock slope protection items in all types of materials including soil, mixed rock and soil, and solid rock.

00398.42  **Support Posts, Sleeves, Braces, and Footings** - Space support posts equidistant at intervals not exceeding those shown. Measure the interval parallel to the grade of the post line and in the line of the posts from center to center of the posts. Set the end support posts at the beginning and end of each continuous length and at abrupt changes in vertical and horizontal alignments. Place all support posts in a vertical position, plumb and in line unless otherwise directed.

Securely fasten diagonal braces to the end support posts or intermediate support posts as shown. Excavate and place concrete as shown for the brace footing.

Dimension, place, backfill, and strike off support post sleeves according to 00398.45.

00398.43  **Centralizers** - Install centralizers that adequately support the bolt or cable in the center of the hole and place within 1 foot of each end of the anchor according to the following:

(a)  **Wire Mesh Slope Protection** - Use centralizers in all anchor holes.

(b)  **Post-Supported Wire Mesh Slope Protection** - Use centralizers in all end anchor holes.

(c)  **Post-Supported Rock Protection Screen Behind Barrier/Guardrail** - Use centralizers in all end anchor holes.

00398.44  **Anchors in Solid Rock** - Where solid rock is encountered without an overburden of soil, install steel anchor bolts and wire rope anchors according to the following:

(a)  **Wire Mesh Slope Protection** - 6 feet into the solid rock or as shown for all anchors.

(b)  **Post-Supported Wire Mesh Slope Protection** - 3 feet into solid rock or as shown for post anchors. 6 feet into solid rock or as shown for end anchors and support post retaining rope anchors.

(c)  **Post-Supported Rock Protection Screen Behind Barrier/Guardrail** - 6 feet into solid rock or as shown for all anchors.

Place grout according to the manufacturer's recommendations and as directed.
00398.45 Anchors in Soil and Mixed Soil and Rock - Where an overburden of soil, loose rock, or surfacing materials covers solid rock, install the anchors according to the following:

(a) Wire Mesh Slope Protection - 6 feet for all anchors. If solid rock is encountered before this depth is reached, install anchors in the solid rock according to 00398.44(a) unless otherwise directed.

(b) Post-Supported Wire Mesh Slope Protection - 3 feet for post anchors. 6 feet for end anchors and support post retaining rope anchors. If solid rock is encountered before these depths are reached install anchors in the solid rock according to 00398.44(b) unless otherwise directed.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - 6 feet for all anchors. If solid rock is encountered before these depths are reached install anchors in the solid rock according to 00398.44(c) unless otherwise directed.

Place grout according to the manufacturer's recommendations and as directed.

Dimensions of footings shall not be less than shown and shall fill the excavated areas. Moisten the sides of the excavation to a depth of 2 inches and remove all loose soil and rock in the hole prior to placement of concrete. If the hole is over-excavated fill the entire cavity with concrete. Place the concrete with contact against firm soil at the sides and bottom and tamp around the steel anchor bolts, wire rope anchors, or post sleeves while the steel anchor bolts, wire rope anchors, or post sleeves are held firmly in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water.

Allow concrete to cure for at least 5 calendar days before the support ropes and retaining ropes are attached and subjected to strain.

00398.46 Anchor Testing - Anchors shall have a minimum pullout capacity of 20,000 pounds per foot. Field verify pullout capacity by testing not less than 25% of the total number of anchors installed. The Engineer will determine which anchors will be tested. Replace failed anchors at no additional cost to the City.

Perform testing against a temporary yoke or load frame. Do not allow any part of the yoke or load frame to bear within 3 feet of the anchor. Determine applied test loads with either a calibrated pressure gauge or a load cell. Use pressure gauges or load cells commonly used in the testing of rock bolts and anchors.

A pullout test consists of loading the anchor assembly to the minimum pullout capacity. The anchor is acceptable if it sustains this load for 10 minutes with no loss of load.

00398.47 Gabion Wire Mesh Installation - Install gabion wire mesh so that the bottom of the fabric rests on the slope as shown and according to the following:
(a) **Wire Mesh Slope Protection** - Place gabion wire mesh with the fabric curl toward the slope. Loop the fabric over the top horizontal support rope and attach to itself with high tensile steel fasteners or lacing wire as shown. Do not tension the fabric in any direction. It is to remain loose to increase its dampening effect on rolling rocks.

Lap the gabion wire mesh fabric as shown. If horizontal laps are needed, overlap the lower fabric so it is on top and away from the slope to avoid the possibility of falling material hanging up. Locate the bottom of the fabric so material dislodged under the fabric can drain freely from the bottom, yet will not flow or bounce onto the roadway. Secure the ends of all lacing wires to the fabric with a minimum of 1.5 turns.

(b) **Post-Supported Wire Mesh Slope Protection** - Place gabion wire mesh for post supported wire mesh slope protection according to 00398.44(a). In addition, adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

(c) **Post-Supported Rock Protection Screen Behind Barrier/Guardrail** - Attach the gabion wire mesh to the support posts and top horizontal support rope as shown. Lap the gabion wire mesh fabric as shown. Do not tension the fabric in any direction. Adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

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**00398.48 Top Horizontal Support Rope and Support Post Retaining Rope Attachment** - For post-supported wire mesh slope protection and post-supported rock protection screen behind barrier/guardrail, install top horizontal support ropes on the posts as shown. Ensure that the top horizontal support rope will move freely in the U-bolt hangers. Use one continuous length of cable for each complete section of screen. Attach the top horizontal support rope to the end anchors as shown. Tension the rope so that when the gabion wire mesh fabric is in place, it will be fully supported. Take up additional tension with turnbuckles. Ensure that a minimum of 4 inches of take-up remains in the turnbuckle when full tension has been applied.

In addition, for post supported wire mesh protection, install the post retaining ropes to the anchors and support posts as shown. Tension the ropes with the turnbuckles so that the cable is taut but does not bend the support post toward the slope when the gabion wire mesh fabric is installed. Ensure that a minimum of 2 inches of take-up remains in the turnbuckle when full tension has been applied.

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**00398.49 Barrier Mounted Rock Protection Screen** - Install concrete barrier according to Section 00820 and as shown. Attach protective screen to the concrete barrier as shown.

**00398.50 Rock Reinforcing Bolts and Rock Reinforcing Dowels** - Protect rock reinforcing bolts and rock reinforcing dowels at all times from damage and corrosion. Corrosion, pitting or damage to the rock reinforcing bolt may be cause for rejection. Damage includes, but is not limited to, abrasions, cuts, nicks, welds, and weld splatter. Prior to installation, remove all mill scale, flaking rust, and grease.
Drill holes to the diameter and depth recommended by the manufacturer. Unless otherwise directed, align drill holes normal to the rock face or as specified. Clean the drill holes of all drill cuttings and debris prior to installing the rock reinforcing bolts and rock reinforcing dowels and install and proof test as follows:

(a) Rock Reinforcing Bolts:

(1) Installing Bolts - Install and tension each rock reinforcing bolt to the design load before grouting. Conduct proof testing of each bolt as described below. Place grout in the drill hole to ensure the filling of the entire space between the bolt and sides of the drill hole, and the full encapsulation of the bolt. If necessary, control leakage of grout into rock seams using accepted methods and as directed. Pump the grout to the far end of the drill hole and continue pumping until grout is forced out of the de-airing tube at the face of the hole. After testing and grouting, cut the bolt off, if necessary, so that no more than 3 inches extends beyond the nut.

(2) Proof Testing Bolts - Tension each production rock reinforcing bolt installed to 120% of the design load using a calibrated hollow ram hydraulic jack. Hold that tension for a minimum of 10 minutes. The Engineer will analyze the rock reinforcing bolt test results and determine whether the rock reinforcing bolt is acceptable. If no loss of load occurs in this time period, the rock reinforcing bolt is accepted. If a rock reinforcing bolt fails this test, the rock reinforcing bolt will be rejected and a replacement bolt installed in a separate hole adjacent to the failed bolt. Test the new rock reinforcing bolt. The Additional proof testing, if any rock reinforcing bolts fail, may be required. No additional payment will be made for failed rock reinforcing bolts or for additional proof testing.

After tensioning and testing, lock off at 100% of the design load and grout the bolt. Carry out grouting within three days of tensioning the rock bolt to provide corrosion protection and lock the tension stress permanently into the system.

(b) Rock Reinforcing Dowels:

(1) Installing Dowels - Place the grout mix or resin cartridges in the drill hole according to the manufacturer's recommendations. Ensure that resin cartridges are placed at a sufficient spacing to cause excess resin to be forced out the face of the hole when the rock reinforcing dowel is spun into place. Failure of resin to be extruded from the face of the hole may be cause for rejection of the bolt installation. After installation of the plate and nut, torque the nut to a nominal 100 foot-pounds to ensure proper seating against the rock surface. Conduct proof testing of rock reinforcing dowels as described below. After testing, cut the bolt off, if necessary, so that no more than 3 inches extends beyond the nut.

(2) Proof Testing Dowels - Proof test at least 10%, but not less than three each, of installed rock reinforcing dowels. The proof test shall be conducted by the Contractor and the Engineer will interpret the results.
Tension the rock reinforcing dowel to 10 kips with a calibrated hollow ram hydraulic jack. Hold the load for 10 minutes with no loss of load. A rock reinforcing dowel will be considered to have failed if any movement of the dowel occurs. Additional proof testing beyond the 10%, if any rock reinforcing dowels fail, may be required. Replace failed rock reinforcing dowels with a separate rock reinforcing dowel installed in a separate hole. No additional payment will be made for failed rock reinforcing dowels or for additional proof testing.

00398.51 Rockfall Net Systems - Provide for a field representative from the selected proprietary rockfall net system to be present at the start of the rockfall net system construction. Supervisory personnel of the Contractor, the company field representative, and any subcontractors who are involved in the construction of the rockfall net system shall meet with the Engineer for a rockfall net system preconstruction conference. At this conference, discuss methods of accomplishing all phases of the work required to construct the rockfall net system. If all representatives are not in attendance the rockfall net system preconstruction conference and start of net construction will be rescheduled.

In addition to the rockfall net system preconstruction conference, the company field representative shall be available as needed during the construction of the rockfall net system to provide instructions and recommendations, and to assist the Contractor or Engineer. Follow instructions and recommendations of the representative if approved.

Measurement

00398.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Wire Mesh Slope Protection - Wire mesh slope protection will be measured on the area basis, along the surface area of wire mesh fabric on the slope.

(b) Post-Supported Wire Mesh Slope Protection - Post-supported wire mesh slope protection will be measured on the area basis, along the surface of the wire mesh from center to center of end posts.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Post-supported rock protection screen behind concrete barrier and guardrail will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.

(d) Barrier Mounted Rock Protection Screen - Barrier mounted rock protection screen will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.
(e) **Rock Reinforcing Bolts and Rock Reinforcing Dowels** - Rock reinforcing bolts and rock reinforcing dowels will be measured on the length basis, along the entire length of each rock reinforcing bolt and rock reinforcing dowel (embedded and protruding).

(f) **Rockfall Net Systems** - Rockfall net systems will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.

**Payment**

00398.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

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<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Wire Mesh Slope Protection</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Post-Supported Wire Mesh Slope Protection</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Rock Protection Screen Behind Concrete</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) Barrier and Guardrail</td>
<td>Foot</td>
</tr>
<tr>
<td>(e) Barrier Mounted Rock Protection Screen</td>
<td>Foot</td>
</tr>
<tr>
<td>(f) Rock Reinforcing Bolt</td>
<td>Foot</td>
</tr>
<tr>
<td>(g) Rockfall Net System</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Item (d) includes the concrete barrier.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for rock and soil anchors, wire rope, rail, concrete, grout, polyester resin, steel posts, and hardware.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
PART 00400 - DRAINAGE AND SEWERS

Section 00401 - Video and Electronic Inspection of Sewers

Description

00401.00 Scope - This work consists of the cleaning and inspection of sewers using video and related electronic equipment. The work may include locating live connections, documenting existing conditions and providing information about sewer conditions that may require repair work.

00401.01 Abbreviations:

- CCTV - Closed Circuit Television
- CD-ROM - Compact Disc Read Only Memory
- DVD - Digital Video Disc or Digital Versatile Disc
- MPEG - Moving Pictures Expert Group
- SVCD - Super Video Compact Disc
- VCD - Video Compact Disc

Equipment

00401.20 Mainline Inspection Equipment:

(a) Camera and Lighting - Use a digital color video camera equipped with high-intensity lighting that is appropriate for the sewer pipe size and material type and that is capable of operating in 100% humidity conditions with ability to pan and tilt in all directions (360°).

The lighting and camera shall provide a clear, in-focus color picture of the sewer for a length of three pipe diameters. The camera lighting shall be free from shadows or hot spots. The camera lighting shall be fixed in intensity prior to commencing the inspection and adjusted during the inspection as needed to optimize the image quality displayed on the video monitor.

(b) Footage Meter - The recorded video shall have an information banner that displays a footage meter displaying footage in tenths of feet and indicating the camera's position from its starting point. The banner area shall not obstruct the forward camera view. The footage information on the recorded video shall correspond to the footage references in the written video inspection log.

(c) Reference Device - For concrete pipe, the video camera shall have a 1 inch steel reference ball suspended with a chain, or other approved reference device, mounted approximately one foot in front of the camera lens. The device shall maintain continuous contact with the pipe invert to serve as a depth reference as the camera travels in the pipe. The reference device shall be clearly visible at all times yet be positioned so as not to obstruct more than 10% of the forward camera view. The reference device is to be stopped at every joint to allow for comparison of the device to the joint width.
00401.21 Lateral Inspection Equipment:

(a) Push Camera - A portable camera system that can be manually extended into lateral sewers for inspection purposes. The push camera shall have imaging capabilities similar to the camera used to inspect sewer mains.

(b) Lateral Launch Camera - A secondary camera component of a mainline sewer video inspection system that can be launched into a lateral connection while inspecting mainline sewers. The lateral launch camera must be capable of inspecting the length of the lateral from the mainline connection to beyond the edge of the right-of-way. The lateral launch camera shall have imaging capabilities similar to the mainline camera.

(c) Electronic Location Device - A radio transmitter designed to travel inside a non-metallic pipe that can be detected from the surface and determine the horizontal and vertical position of the sewers below ground.

Labor

00401.30 Video Personnel Qualifications - Perform video inspection work with experienced personnel trained or certified in using remotely operated video equipment to recognize, locate and accurately document sewer breaks, obstacles, bellies, defects, and service connections.

Construction

00401.40 General Video Inspection:

(a) Notice and Access - Provide notice a minimum of 48 hours before beginning cleaning or video inspection. Do not proceed with cleaning or video work without prior approval of the Traffic Control Plan according to Section 00225 and Sewer Diversion Plan according to Section 00490 and as directed. Allow access to the video truck at all times to observe the video monitor and all other operations.

(b) Cleaning - Install a screen to catch debris at the downstream end of the pipe run. Clean the sewer pipe of obstructions that will impede video inspection. Avoid causing damage to pipe while completing the cleaning operation. Remove and properly dispose of solid debris resulting from the cleaning operation. Do not move the debris from manhole section to manhole section.

(c) Inspection - After cleaning, pre-charge the sewer with clean water to assist in locating bellies and deformations of the pipe. Control the flow into the segment to be inspected. Perform continuous video inspection as soon as possible after cleaning the pipe. Video inspect sewers one segment at a time. Do not move the camera at a speed greater than 30 feet per minute. Move the camera through the line in either direction stopping, panning or tilting as necessary to permit proper documentation of the sewer’s condition including the location of all lateral connections, additional connections to the mainline and other characteristics.
Use tractors, manual winches, power winches, video cable, powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions and that allow the camera to be maintained at the approximate center of the pipe at all times. If, during the inspection operation, the camera will not pass through the entire pipe run, set up equipment so that the inspection can be performed from the opposite manhole. If, on second try, the camera fails to pass through the entire manhole section, ask for direction.

(d) Narrative and Extent of Inspection - Provide a running narrative description on each video inspection recording. Include the following minimum information in the narrative: the beginning and the end of the video, the site location, manhole identifications, the total footage of the sewer inspected, the company name, the operator's name and the date and time. Make note of all joints, lateral connections, and other noteworthy features within the sewer.

(e) Footage Metering - Before beginning video inspection, restore the footage meter to zero beginning from the middle of the manhole or provide a means to convert the meter reading to accurate aboveground distances. Provide accurate on-screen distance measurements in the video recording.

(f) Recording Format, Storage Box and Labeling - Record using high-quality video media such as DVD, CD-ROM or other approved media. Submit recordings playable on consumer DVD players and Microsoft Windows-based personal computers at resolutions of 352x240 or higher. Submit DVD recordings in standard MPEG-1 or MPEG-2 format. Submit CD-ROM recordings in standard VCD or SVCD format. Recordings shall be submitted in a plastic protective box, labeled to indicate the project number and name, date of inspection, sewer segment number, Contractor's name and whether it is a pre-construction or post-construction video. Label both copies of the video media and the boxes.

(g) Continuity, Image and Audio - Record video continuously, without editing or starts and stops, in color from the beginning to the end of each sewer segment. The sewer image shall be free of visual distortions and appear level and centered in the sewer being inspected. The audio portion of the composite video recording shall be sufficiently free from electrical interference and background noise to provide complete clarity of the narrative description.

(h) Video Inspection Logs - Provide one copy of all pre- and post-inspection video inspection logs and video recordings promptly after completing the inspection. Provide print location records that clearly show the location in relation to an adjacent manhole for each feature observed during inspection. Include other points of significance such as locations of building sewers, unusual conditions, roots, location and depth of pipe sags, all connections, pipe material and size, and broken pipe.
(i) Disposition of Report - Deliver the video inspection recordings of each sewer segment immediately after such work is completed. All accepted video recordings, operator logs, and any related information become the property of the City.

00401.41 Pre-Construction Video Inspection:

(a) Mainline Inspection - Clean and complete video inspection of all existing mainline sewers and positively locate each service connection to the mainline sewer.

(b) Lateral Inspection and Field Location - Locate and video inspect each lateral from its mainline connection to the edge of the right-of-way or to a distance as specified or directed. Use an electronic location device such as the Aqua-Tronics Snooper to verify the path of the lateral. Use marker paint to record the alignment of the lateral on the ground. Indicate where the lateral connects to a building connection.

For open-trench work, inspect laterals using a hand-held push camera. Have a hand-held push camera and a locator device on site for the project duration, whether or not it is used to complete the service lateral inspection.

For trenchless work in mains with a diameter of 18 inches and less, use a side launch lateral camera or another approved method. The Engineer must be present to view inspection as it is performed. For mains larger than 18 inches, use an approved method.

Record all information about its condition, service status (e.g. live or abandoned), length, distances to surface features, fittings and any obstructions.

Finishing and Clean-up

00401.70 Post-Construction Video Inspection:

(a) Inspection of Completed Work - Video inspect all completed work according to 00401.40. Provide the original copy of the post-construction video recording.

(b) Corrections to Deficiencies in Work - Each delivered video recording will be reviewed and any deficiencies noted. A written notice will be issued to correct any identified deficiencies. Correct any identified deficiencies within 48 hours after receiving notification. Re-perform the video inspection of the sewer and submit the new video recordings for review and acceptance at no additional cost to the City.

Measurement

00401.80 Measurement - The quantities of all video inspection will be measured on the unit basis as follows:

(a) Video Inspection of Mainline Sewers - Measure a mainline sewer from center of manhole to center of manhole.
(b) Video inspection of Lateral Sewers - Measurement of "live" lateral sewers connected to the mainline will be measured on the unit (Each) basis. Multiple private lateral sewers connected at the mainline by means of a single existing connection will each be counted if the existing alignment is fully documented.

Payment

00401.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Video Inspection of Sewers, Mainline</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Video Inspection of Sewers, Lateral Launch Camera</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Video Inspection of Sewers, Push Camera</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Video Inspection of Sewers, Special</td>
<td>Foot or Each</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for providing a hand-held push camera and locator device on site at all times.

No separate or additional payment will be made for:

- excavation
- restoration work
Section 00405 - Trench Excavation, Bedding and Backfill

Description

00405.00 Scope - This work consists of excavating trenches, constructing trench foundations, and placing bedding, pipe zone material and backfill.

00405.01 General - Excavate, backfill and dispose of excess excavated materials in connection with minor structures and conduits such as subsurface drain, culvert, siphon, irrigation and storm and sanitary sewer pipe, and potable water pipe.

Trench excavation does not include earthwork covered under any other section, or any earthwork that may be specifically included and provided for as Incidental work in the Specifications for other pay items of the Contract. Dispose of excess excavated materials and perform other matters not covered in this Section according to Section 00330.

00405.02 Definitions:

Boulder Excavation - The removal of pieces of boulders larger than 1 cubic yard in volume that requires drilling and blasting or other approved splitting and breaking methods, or necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench.

Concrete Excavation - The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling and blasting or other approved splitting and breaking methods, or necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete Excavation includes materials composed of Portland cement that are not identified in another Bid item other than manholes, structures, sewer pipe, or other appurtenances all of which are classified as Common Excavation.

Discharge Concentration - The tested non-water concentration of sampled wastewater before discharge.

Exploratory Excavation - The removal and replacement of material from locations shown on the Plans, or as directed, for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed facilities.

Flexible Pipe - For the purpose of these Specifications, potable water pipes and pipes constructed of PVC, fiber reinforced plastic, ductile iron, steel, concrete cylinder, and high density polyethylene are considered flexible pipes.

Gravel - Rounded fragments of rock.

Pipe Bedding - Furnishing, placing and compacting specified materials on the trench foundation so as to uniformly support the barrel of the pipe.
Pipe Zone - The area from the bottom of the bedding to a point 12 inches, minimum, above the top outside of the pipe barrel for the full width of the trench.

Pothole Excavation - Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as Exploratory Excavation, for the purposes of locating an underground utility and to investigate underground conditions.

Prior day Total Pumped Discharge - The total wastewater flow discharged at each sample location during the preceding workday.

Rigid Pipe - For the purpose of these Specifications, pipes constructed of concrete or clay are considered rigid pipes.

Rock Excavation - Rock Excavation indicates a method of removal and not a geologic formation. Rock Excavation is the removal of all materials which, by demonstration, cannot be excavated with equipment weighing at least 50,000 pounds and having at least 140 net horsepower equipped with a ripper or similar approved equipment without prior systematic drilling and blasting or breaking with power-operated rock excavation tools. The Engineer may waive the demonstration if the material encountered is well defined rock.

Sewers, Pipes and Mains - Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.

Standard Proctor - A laboratory test used to determine the optimum water for a given compaction energy for a given soil.

Surface Removal - The removal of surface material such as topsoil, sod, pavement, sidewalks, or gravel which requires different equipment or methods than those used for trench excavation.

Trench Backfill - Furnishing, placing, and compacting material in the trench, between the top of the pipe zone material and the bottom of the pavement base rock, ground surface or surface material.

Trench Excavation - The removal of all material encountered in the trench to the depths as shown or as directed. Trench excavation is classified as common, boulder, concrete, or rock excavation.

Trench Foundation - The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

Trench Foundation Stabilization - Trench foundation stabilization is removal of unsuitable material in the bottom of a trench or other excavation and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.
Wastewater Discharge – Delivery of water, wastewater or uncontaminated waterborne waste comprised of rainwater, process wastewater, non-storm or ground water originating from construction site activities.

00405.03 Lines, Grades, and Cross Sections - Excavate trenches to the lines, depths, grades and cross sections shown on the plans or as established. Variations will be permitted only when necessary to ensure firm foundations and when such variations will not be detrimental to the work.

00405.04 Compaction and Density Measurement - In-place density of soil and aggregate will be determined in accordance with ASTM D 2922 and D 3017, or ASTM D6938, or AASHTO T 310 (Density and Moisture content of Soil and Soil-Aggregates by Nuclear Methods).

Maximum laboratory density and optimum moisture content will be determined in accordance with ASTM D 698, or AASHTO T 99 (Standard Proctor); or in accordance with ASTM D 1557, or AASHTO T 180 (Modified Proctor), as specified, using Method A or D. Coarse particle correction shall be made in accordance with, and to the limits defined in AASHTO T 224 (Correction for Coarse Particles in the Soil Compaction Test).

Materials

00405.10 General - Trench backfill shall be classified as either native backfill material or imported granular backfill material. Native backfill shall not be used for trenches within the public right-of-way unless pre-approved prior to permitting or beginning of excavation.

00405.11 Trench Foundation Stabilization - Use trench foundation stabilization material consisting of 6" - 3/4" aggregate, or as directed. The material shall be free from clay or organic material and shall be well graded from coarse to fine.

00405.12 Bedding - Furnish one of the following bedding materials as prescribed below for the particular type of facility to be constructed:

(a) Sewer Pipe:
   - Commercially available 1" - 0 or 3/4" - 0 crushed aggregate.
   - A continuous cradle of concrete conforming to Section 00440.

(b) Water Pipe – Bedding material and pipe zone material shall be the same unless otherwise directed.
   - 1" - 0 or 3/4" - 0 aggregate conforming to 02630.10
   - Medium sand conforming to 00405.14(c).
   - Fine sand conforming to 00405.14(c).

00405.13 Pipe Zone Material - For flexible pipes, backfill the pipe zone with bedding material as described in 00405.12.
For rigid pipes, unless otherwise directed, use either:

- 1" - 0 or 3/4" - 0 base aggregate conforming to 02630.10 or
- Commercially available 1" - 0 or 3/4" - 0 aggregate
- Medium sand in accordance with 00405.14(c).
- Fine sand in accordance with 00405.14(c).

**00405.14 Trench Backfill** - Use the following materials where shown or required:

- Outside of the public right-of-way, use approved selected native backfill material (Class A) or imported granular backfill material (Class B, C, or D).
- Within the public right-of-way, use imported granular backfill material (Class B, C, or D).
- Within paved areas in a public right-of-way with a trench width of 12 inches or less use Controlled Low-Strength Material (CLSM) for backfill material (Class E).

Place and compact backfill as shown.

(a) **Class A Backfill** - Use approved native material excavated from within limits of the project, free from vegetation and other deleterious material, and containing no frozen ground. Maximum particle size shall be 3 inches. If the Engineer determines native material is not suitable, use another class of backfill as directed.

(b) **Class B Backfill** - Use granular material consisting of aggregate meeting the requirements of Section 00640.

(c) **Class C Backfill** - When specified, use sand consisting of granular material, naturally produced or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash and other deleterious substances.
The grading of sand shall be as follows:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Coarse Sand</th>
<th>Medium Sand</th>
<th>Fine Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>95-100</td>
<td>95-100</td>
<td>---</td>
</tr>
<tr>
<td>#4</td>
<td>80-100</td>
<td>70-95</td>
<td>90-100</td>
</tr>
<tr>
<td>#30</td>
<td>10-30</td>
<td>10-45</td>
<td>---</td>
</tr>
<tr>
<td>#100</td>
<td>---</td>
<td>2-10</td>
<td>2-10</td>
</tr>
<tr>
<td>#200</td>
<td>0-8</td>
<td>0-7</td>
<td>0-4</td>
</tr>
<tr>
<td>Sand</td>
<td>50 min.</td>
<td>50 min.</td>
<td>50 min.</td>
</tr>
</tbody>
</table>

When using sand as imported granular trench backfill material, material shall be able to stand on a minimum 60 degrees angle from horizontal following compaction to specified density unless otherwise approved. Specified density will be a minimum of 95% of Standard Proctor maximum density.

(d) **Class D Backfill** - Use pit run or bar run material, well graded from coarse to fine. The maximum dimension shall be 3 inches. Material shall be free from organic material. **Classification** will be determined according to requirements of ASTM D 2487.

(e) **Class E Backfill** - Use Controlled Low-Strength Material conforming to Section 00442.

Do not use CLSM as a replacement course for paved sections, unless a pavement section design is submitted and approved.

When excavation exposes existing metal pipes, provide adequate protection to separate the pipe from direct contact with the CLSM. Re-establish the original pipe zone bedding and backfill around the pipe, or, at the direction of the Engineer, provide pipe protection, such as pipe coating, tape wrap or casing, according to the Engineer’s requirements.

(f) **Class F Backfill** - Use impervious backfill material of the following soil types as defined by ASTM D 2487 or as approved.

SC: Clayey sands, sand-silt mixtures
GC: Clayey gravels, gravel-sand-clay mixtures
CL: Inorganic clays of low to medium plasticity, gravelly/sand/silt/lean clays

**00405.15 Quality Control** - Provide quality control according to Section 00165.

**00405.16 Temporary Plating** - Temporary plating shall conform to Section 00275.
Labor

00405.30 Quality Control Personnel - Provide certified technicians in the following fields when required by Section 00165:

- CEBT
- CAgT
- CDT

Construction

00405.40 General - Excavate, remove and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within limits defined or as specified in the Contract Documents, necessary for construction of the project. Perform all excavation and backfilling according to the following requirements:

(a) Limitation on Commencement - Do not commence excavation until the undisturbed or existing ground has been measured and the measurements have been approved by the Engineer.

(b) Natural Stream Protection - Hold to a minimum excavation in, or adjacent to, natural streambeds. Comply with 00290.30(a). Restore the streambed according to 00405.46(f).

(c) Partial Embankment Construction for Exposed Pipe - Construct partial embankment according to 00330.42(c)(6) and the plans, before excavating trenches. Place compacted fill to a minimum depth of 3 feet above top of pipe before other trenches are excavated for installation.

(d) Temporary Handling of Water or Other Conditions - Provide temporary measures according to 00405.43.

00405.41 Trench Excavation - Excavate trenches according to the following:

(a) Within Paved Areas to Be Preserved - Excavate trenches for pipe installation by the open excavation method, unless otherwise directed. Do not disturb the adjoining pavement more than necessary.

(1) Preservation of Existing Improvements - Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed, at no expense to City.
Use hand excavation methods when normal methods cannot be utilized without endangering existing or new structures or other facilities. When the precise location of subsurface structures is unknown, locate such structures by hand excavation prior to utilizing mechanical excavation equipment.

Protect temporary facilities, until they are no longer required, and when temporary supports and other protective means are no longer required, remove and dispose of as directed.

(2) **Limits of Excavation** - Excavate to the depths and widths designated as shown, allowing for forms, shoring, working space, gravel or sand base, and finish topsoil where required. Do not excavate deeper than elevation shown without approval.

(b) **Open Trench Limit** - The length of trench excavated in advance of a pipe laying operation shall be kept to a minimum, and in no case shall it exceed 100 feet unless otherwise authorized. Related resurfacing shall be completed within 800 feet of the associated open trench limit for each main pipe laying operation. The Engineer will have sole discretion to consider two or more main pipe laying operations as one if they are adjacent or cause a disturbance to the same neighborhood. If the unfinished trench or restoration exceeds 800 feet in length, the main pipe construction operation shall be suspended and not resumed until authorized.

(1) **Unfinished trench** - A section of trench will be considered unfinished for the purpose of establishing work limits, until all the following have been completed:

- Surface removal
- Excavation
- Main line and service lateral construction
- Backfilling
- Backfill compaction
- Gravel road restoration
- Pavement base construction
- Portland cement concrete paving
- Asphalitic concrete paving
- Sidewalk and driveway construction
- Landscaping
- Property restoration
- Cleanup operations
- Pipe acceptance testing

(2) **Cleanup** - Cleanup of the construction area shall include all work necessary to allow use of the construction area for normal use. Perform temporary resurfacing per Section 00495.
(c) **Trench Width** - Keep the trench width at the ground surface to the minimum necessary to install the pipe in a safe manner. In all cases, make trenches of sufficient width to allow for shoring and to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Refer to the following table for minimum trench widths for various diameter pipes.

<table>
<thead>
<tr>
<th>Size of Sewer Pipe</th>
<th>Width of Sewer Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 10 inches</td>
<td>30 inches</td>
</tr>
<tr>
<td>12 to 21 inches</td>
<td>OD plus 18 inches</td>
</tr>
<tr>
<td>24 to 36 inches</td>
<td>OD plus 22 inches</td>
</tr>
<tr>
<td>42 to 54 inches</td>
<td>OD plus 42 inches</td>
</tr>
<tr>
<td>60 inches and larger</td>
<td>OD plus 46 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size of Water Pipe</th>
<th>Width of Water Pipe Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 16 inches</td>
<td>OD plus 18 inches</td>
</tr>
<tr>
<td>24 inches or larger</td>
<td>OD plus 24 inches</td>
</tr>
</tbody>
</table>

Make excavations for manholes and other structures wide enough to provide a minimum of 12 inches between the structure surface and the sides of the excavation. Do not exceed the right-of-way easement, or permit limits without prior approval.

Do not exceed any maximum trench width. If there is a maximum width shown and said width is exceeded without authorization, provide pipe of a higher strength designation, a higher class of bedding, or both, as directed at no additional cost to the City. Excavate all trenches with vertical walls unless otherwise specified.

(d) **Trench Grade** - Excavate trenches to the lines and grades shown or as established, with proper allowance for pipe thickness, pipe bedding and trench foundation stabilization. Place pipe bedding on a firm, undisturbed, foundation, true to grade. If the trench is excavated below grade without authorization, restore to grade with material of the type specified for pipe bedding or trench foundation stabilization as directed at no cost to the City. Place the material over the full width of the trench, in compacted layers not exceeding 6 inches.

(e) **Disposal of Excavated Material** - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of materials according to 00310.43 unless special site(s) are specified in the Special Provisions.

Make arrangements for and dispose of all excess material not required elsewhere on the Project in an approved manner, at no cost to the City, and according to 00310.43(d).
(1) Reprocessing or Recycling Requested - Subject to approval, the Contractor is requested, but not required, to reprocess materials that are created by excavation or demolition and would otherwise be unsuitable for reuse on the site. Contractor is also requested, but not required, to recycle materials that are created by excavation or demolition and are suitable for reuse on the site. Recycling may be possible at the sites listed in the Special Provisions. It is the responsibility of the Contractor to verify the information in the Special Provisions. This information may change without notification to the City.

(2) Disposal on Pre-designated Sites - City will secure all necessary disposal permits for required work performed unless otherwise specified.

(3) Sites Provided by Contractor - Dispose of all excess material not required for pre-designated sites. Within the City limits, do not deposit excess excavated material on an unimproved dedicated street area without approval and a valid street use permit from the City of Portland. Do not deposit excess excavated material on any private property without approval and a valid fill permit.

(4) Temporary Placement of Usable Excavated Materials - Place excavated material that is suitable for use in embankment or backfill, and not excess material, only within construction easements, rights-of-way, or other approved working area. Place in a manner that will not cause an inconvenience to the public. Provide unobstructed access to all fire hydrants, water valves, and meters, and leave clearance to enable free flow of stormwater in all gutters, conduits, and natural watercourses. Submit a copy of the written approval from each property owner prior to stockpiling material on private property.

(f) Trench Protection - Install and maintain shielding, shoring, sheeting, bracing, and trench support systems, hereinafter called “shoring”, to prevent caving and to protect adjacent structures, property, utilities, workers, and the public. Remove shoring during backfilling in a manner that will not damage adjacent structures, property, utilities, or the pipe, permit voids in the backfill, or disturb the compacted pipe bedding material between the pipe and the undisturbed trench wall. Maintain design information for shoring onsite at all times. Make this information available for the Engineer’s review upon request. A utility protection plan is required as outlined in 00406.41(a)(17).

(1) Engineered Systems - Engineered Shoring is required for temporary earth support systems for trenches or excavations greater than 20 feet deep including bore pits, jacking pits, receiving pits, and shafts. Engineered Shoring is also required for areas subject to vibration, groundwater, utility crossings, or where required on the Drawings. Submit the following for each area where Engineered Shoring is required:

- Detailed construction sequence descriptions. The sequence shall detail installation, excavation, maintenance, backfill, and removal requirements.
• Design calculations. Calculations shall be prepared and sealed by a State of Oregon licensed Professional Engineer and include design criteria, analysis assumptions, construction sequence requirements, and detailed design for each system and structural element of the proposed shoring system.

• Drawings shall be prepared and sealed by a State of Oregon licensed Professional Engineer. Drawings shall present an explicit representation of the character, extent, and details of the proposed shoring in relation to the project site.

Working Drawings shall show the following:

• Details, arrangement and method of assembly, method of disassembly of the proposed system and sequence of construction.
• Method of pre-loading the bracing and pre-load values.
• Full excavation depth.
• Loads on the support system for various stages of excavation, bracing, and / or tieback installation and removal and concrete placement.
• Expected equipment loads.
• Maximum design load to be carried by the various members of the support system.
• The depth below the main excavation to which the support system is to be installed.
• Existing utilities and facilities: After checking locations by field investigation, revise drawings to show actual locations of facilities and excavation supports, interference with proposed work, and measures proposed to overcome such interference.
• Allowable shoring deflections and proposed method of monitoring shoring movements.
• Equipment used for installation.

(2) Other Systems - Shoring systems using tabulated data may be substituted for those approved in the initial submittal (not including Engineered Shoring). Tabulated data for the substituted systems shall be provided to the Contractor's competent person and the Engineer before installation. If shoring system is changed, re-submit tabulated data for the proposed new system. The shoring system submittal shall address, at a minimum, the following items:

• Pipe installation
• Manhole installation
• Structure installation
• Support and protection of existing utilities
• Lateral connections
00405.42

- Miters
- Other non-linear areas

**(g) Existing Abandoned Facilities** - Remove and dispose of existing abandoned pipe, structures and other facilities as necessary to construct the trench according to 00310.41(c).

**00405.42 Rock Excavation** - Where rock excavation is required, remove the rock to provide the minimum clearances shown. Excavate and remove the overburden and expose the rock to allow the Engineer to measure the rock prior to removal.

**00405.43 Dewatering** - Promptly remove and dispose of all excess water entering the trench from the time the trench is being prepared for the pipe laying until the backfill at the pipe zone has been completed. Dispose of the water in an approved manner without damage to adjacent property.

Control groundwater to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils". Design and operate dewatering systems to prevent removal of the natural soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

When dewatering near a river, lake, or stream, conform to the requirements of 00290.30(a) and Section 00280. When the presence of water or other conditions in the excavated area would be detrimental to the purpose of the work, obtain approval of the Engineer for the temporary measures required to correct or care for the condition.

If water or other conditions encountered require permanent correction or care not anticipated by the Contract and not due to the Contractor’s neglect or method of operation, perform the work according to 00140.60.

At all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages. Have available at all times competent workmen for operation of the pumping equipment. Control surface runoff to prevent entry or collection of water in excavations. Keep all excavations free of water when concrete is being deposited or during placement of backfill.

Before dewatering is started, submit to the Engineer a Discharge Plan in accordance with 00405.49. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below static water table unless authorized.

Release ground water to its static level in such a manner as to maintain the undisturbed state of natural foundation soils. Prevent disturbance of compacted backfill and flotation or movement of structures, water mains, sewers, and other utilities.

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00405.45 **Trench Foundation Stabilization** - Make the full length and width of completed trench bottoms firm. Do not place bedding material before the trench foundation is inspected and approved. If bell and spigot pipe is used, recess the trench bottom to accommodate the bell.

When, in the judgment of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, excavate below grade, as directed. Replace the excavated material with imported trench foundation stabilization material conforming to 00405.11. Place the backfill material in 6 inch layers and compact according to 00330.43. Place the backfill material to the elevation established.

00405.45 **Pipe Bedding** - Spread the bedding smoothly to the proper grade so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length.

(a) **Bedding for Rigid Sewer Pipe** - Construct bedding in conformance with drawings to approximate limits for various classes of bedding as shown. The Engineer may change bedding classifications and limits thereof as necessary during construction.

Place bedding full width of the excavated trench from the bottom of trench or top of foundation stabilization material to the top of bedding.

1. **Class A Bedding** - Class A bedding consists of a pipe cradle of Portland cement concrete as shown. When a flexible joint cannot be located within 18 inches of the outside wall of a structure, install reinforcing steel into the concrete bedding. Provide #5 rebar at 6 inches O.C. longitudinally up to the pipe springline. Bottom of trench shall be fully compacted before placement of pipe or cradle. Place concrete in such a manner that no dirt, water, or foreign material becomes mixed with the concrete. Allow concrete sufficient time to reach initial set before any additional backfill material is placed in the trench.

2. **Class B Bedding** - Class B bedding consists of leveling the bottom of trench or top of foundation material and placing bedding material to the horizontal centerline (springline) of the pipe. Use bedding material as specified herein and as shown. Place first lift to provide minimum depth of bedding material. Spread smoothly to proper grade and compact bedding to minimum 90% of Standard Proctor maximum density or as directed so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Place subsequent lifts of not more than 6 inches thickness up to the horizontal centerline of the pipe. Bring lifts up together on both sides of pipe and carefully work under pipe haunches using appropriate methods to ensure the bedding material is compacted as specified.

3. **Class C Bedding** - Class C bedding shall conform to requirements for Class B bedding except that bedding material shall be placed only to approximately the lower quadrant of pipe as shown.
(b) Bedding for Flexible Sewer Pipe (Class D Bedding) - Unless otherwise specified, bed flexible sewer pipe in 3/4" – 0 aggregate placed a minimum of 4 inches under the pipe, between the sides of the pipe and the undisturbed trench walls, and to the top of the pipe zone which is 12 inches above the top of the pipe.

Spread the first lift of material so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Install subsequent lifts of not more than 6 inch thickness to the top of the pipe zone. Compact to 95% of Standard Proctor maximum density.

Bring lifts up together on both sides of pipe and carefully work under pipe haunches by using appropriate methods to ensure bedding material is compacted as specified.

(c) Bedding for Water Pipe - Place uniform bedding to a minimum thickness of 6 inches below the outside bottom of the pipe or conduit and compact as directed.

00405.46 Backfilling - Backfill with material conforming to the details shown, or as directed.

(a) General - Begin backfilling when:

- The foundation has been prepared, if required
- The bedding has been prepared
- The drainage facilities and fittings are installed
- The installation has been inspected and approved

Thoroughly tamp and compact all trench backfill with machine or pneumatic operated tampers of a size and type that will obtain the required density.

Backfill either to the top of the trench, the surrounding ground level, or the upper limit of excavation, as directed. Dispose of excess excavated material not used in backfill work according to 00330.41(a)(4) and (a)(5).

(b) Pipe Zone - Place 1" – 0, 3/4" – 0, or sand if approved, in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes pressure on the structure and minimizes stress. Place specified pipe zone backfill carefully around the pipe. Do not allow sharp, heavy pieces of material to drop directly onto or contact the pipe. Prevent pipe from movement both horizontally and vertically.

As required under the haunches of pipe and in areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure intimate contact between the backfill material and the pipe or structure. Provide thorough compaction.
Ponding or jetting will not be permitted within the pipe zone.

(1) **Sewer Pipes** - Compact pipe zone backfill to a minimum of 95% of Standard Proctor maximum density or as specified.

(2) **Water Pipes** - Backfill and compact to a total depth of 12 inches above the pipe.

(c) **Trench Backfill** - Condition backfill material to within 2% of optimum moisture content required for compaction, as determined by ASTM D 698 throughout each lift of the fill.

(1) **General** - Use Class B trench backfill unless otherwise specified or approved.

The Engineer may sample excavated material to determine the suitability of the Class A material for use as backfill. If the material is approved, the Contractor may elect to use the material in place of the specified backfill. Prevent excavated material from becoming saturated beyond the critical moisture limits, and replace any saturated Class A material with Class B, C or D material, as specified, at no additional cost to the City.

(2) **Class A, B, C, or D Backfill** - Backfill trench above the pipe zone to the specified grade, or as shown on the Plans, in lifts of 8 inch loose depth to 3 feet loose depth depending on compaction equipment and material, unless water settling combined with mechanical compaction is allowed as provided herein. Compact all trench backfill to a minimum of 95% of Standard Proctor maximum density in paved areas and in street rights-of-ways or 90% in other areas, or as specified, with mechanical vibrating or impact tampers. Then place and compact aggregate base material or topsoil as specified.

When the backfilling is complete, finish the surface area as specified. In paved or graveled areas, maintain the surface of the trench backfill level with the existing grade with 3/4" - 0 or 1" - 0 aggregate material, or asphalt concrete if directed, until final pavement replacement is complete and accepted.

- Maintain all temporary trench surfaces in a safe condition, to the satisfaction of the City. Maintain backfilled trench surfaces between any two successive manholes until the following operations have been completed and approved.
- Service connections installed, backfilled, and compacted, including water settling when required.
- Valves, valve boxes, and hydrants installed.
- Construction of manholes and appurtenances.
- Hydrostatic or air testing.
- Flushing and disinfection.
- Cleanup and restoration of all physical features.

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• Utilities restored to their original condition or better.
• All work between the two manholes has been completed.

(3) **Class E Backfill** - Backfill the trench above the pipe zone with CLSM. If the CLSM is to be used as a temporary surfacing, backfill the CLSM to the top of the trench and strike it off to provide a smooth surface. If the CLSM is not to be used as a temporary surfacing, backfill the CLSM up to the bottom of the proposed resurfacing. No compaction of CLSM is allowed. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

(4) **Density Testing** - Test for density according to 00405.04. Excavate test pits in the backfill as directed to demonstrate that the specified compaction has been obtained for the entire depth of the backfill. At the option of the Engineer, density tests may be taken in a lift of compacted backfill immediately before placing the next lift. In general, 1 successful test for the entire backfill depth and 3 successful tests at lesser depths per 400 linear feet of pipe installed will be required. Additional successful tests at lateral crossings at various depths may also be required.

a. **Un-testable Backfill** - All materials and areas which are not susceptible to testing for density, as determined by the Engineer, shall be compacted in place by whatever equipment and method is practicable or specified, and as approved. Compaction shall be performed at such moisture content as is required to produce well filled, dense and firm material in place showing no appreciable deflection or reaction under the compacting equipment used.

b. **Inadequate Density** - If required compaction density has not been obtained, remove the backfill from trench, replace with approved backfill, and recompact to the specified density. Then, should routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, modify the backfill compaction procedure. In no case will excavation and pipe-laying operations be allowed to proceed until the specified compaction is attained. The Engineer will have the right to require changes in methods to accommodate changes in soil conditions.

c. **Subsequent Settlement** - Any subsequent settlement of trench and adjacent pavement areas during the maintenance warranty period shall be considered to be the result of improper compaction and shall be promptly corrected.

(d) **Ponding or Jetting of Backfill Materials** - Ponding or jetting will not be permitted within roadbed limits. Ponding or jetting will be permitted outside roadbeds when approved by the Engineer in writing.
Use Class C or D trench backfill material at the Contractor's expense. Provide drainage at the bottom of the trench to remove water from the jetting operation. Compact to the density and deflection requirements of 00405.48(c)(2).

Furnish equipment that provides a minimum gauge pressure of 35 psi at the discharge nozzle. Use a rigid pipe that will reach within 1 foot of the bottom of the backfill. Insert the pipe at intervals not exceeding 4 feet throughout the entire width and length of the trench backfill.

Push backfill material onto the slope of backfill previously placed and allow to slide down into the trench. Do not push backfill into the trench in such a way as to permit free fall of material until at least 2 feet of cover is provided over the top of pipe. Under no circumstances allow sharp, heavy pieces of material to drop directly onto the pipe or tamped material around the pipe. Do not use backfill material of consolidated masses larger than 1/2 cubic foot. The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be designated. Said test section shall not exceed 200 feet in length.

Determine procedures and provide the quantity of water required in every case to effect complete water settlement of backfilled materials. Do not, under any circumstances, insert the jetting pipe closer than 2 feet above top of pipeline.

(e) Temporary Trench Plating - Install temporary plating according to Section 00275.

(f) Restoration of Streambeds - Comply with 00290.30(a) and Section 00280. Upon completion of the work:

- Restore the streambed to its former condition of resistance to scour.
- Remove all matter that has come into the stream due to the Contractor's activities.
- Backfill under-crossing of water-courses with approved Class F impervious material in the top 2 feet of stream bed and 2 feet into stream banks.
- Compact to a minimum of 95% of maximum density as determined by ASTM D 698-78 (delete paragraph 5.1).

00405.48 Surface Removal:

(a) General - For trench resurfacing see Section 00495.

(b) Topsoil - Where trenches cross lawns, garden areas, pastures, cultivated fields or other areas on which topsoil exists, remove the topsoil to a minimum 12 inch depth and place the material in a stockpile. Do not mix the topsoil with other excavated material. After the trench has been backfilled, replace the topsoil.

In lieu of stockpiling the topsoil, approved imported topsoil may be substituted, to a depth specified or approved, at no cost to the City.
Maintain the finished grade of the topsoil level with the area adjacent to the trench until final acceptance by the Engineer, and repair damage to adjacent topsoil caused by the Contractor’s operations. Remove all rock, gravel, clay and other foreign materials from the surface. Regrade and add topsoil as required.

(c) **Pavement, Curb, Driveways, and Sidewalk** - Use saws to cut portland cement concrete pavement, curbs, driveways and sidewalks, regardless of thickness. In bituminous pavement, when no pavement overlay will occur, sawcut the pavement along each edge of the area to be removed. In any case, a jackhammer shall not be used to remove asphaltic pavement if there is concrete pavement underneath.

Sawcut Portland cement concrete pavement to a minimum of 75% of total depth. Saw curbs and sidewalks to a minimum depth of 4 inches. Subsequent removal may be accomplished by using a jackhammer or other approved method. Full depth cut by pavement saw can be made at the option of the Contractor at no additional cost to the City. Use of any machine utilizing a falling or swinging weight will not be permitted.

Upon completion of backfill and just prior to pavement re-surfacing, saw the surfacing on both sides of the trench a minimum of 6 inches wider than each top of the trench. In areas of any undermined or damaged surfacing, re-saw to a width outside these areas. When sawcutting, follow lines parallel to the pipe centerline. All slurry developed during the sawcutting process is to be removed using a vacuum continuously during operation.

In removing pavements, curbs, driveways and similar structures, all cuts where an abutting structure or a part of a structure is to be left in place shall be clean, smooth, vertical cuts made with a concrete saw or other approved cutting device to lines as established.

(d) **Minimum Width** - Where the width changes in areas of asphalt pavement re-surfacing, cut the transition between the different widths at 45°. When the pipe line changes direction, or there is a connecting pipe line that requires the sawcut alignment to change at an angle greater than 60°, make a minimum 24 inch transition sawcut. If there is damaged or undermined surfacing at the transition point, make the transition sawcut beyond the damaged or undermined surfacing. Make the transition sawcut angle half the angle change in the direction of the pipeline or connecting line.

If the asphalt surfacing is to be overlaid, the second sawcut will only be required to firm subgrade.

A second sawcut for concrete sidewalks, driveways and pavements will not be required unless needed to reach firm subgrade.

Remove and dispose of pavement lying within the limits of the cuts and from any adjoining areas damaged by the cutting and removal operations according to Section 00310.
When trenching within improved streets, sidewalks, driveways or other improved areas to be restored or protected, the pavement, walk, or drive shall be removed 6 inches wider on each side than the remaining trench width, unless otherwise specified.

Remove all loose, undermined or damaged pavements. If the edge of the pavement replacement (not the trench) is less than 2 feet from the edge of another patch, curb, or construction joint, the pavement between the two shall be replaced. If there is more than one edge within the 2 foot zone, remove pavement to the far edge or as directed.

If at least one edge of the trench resurfacing falls within a marked bike lane, replace the top surface of pavement within the entire bike lane. Fully restore all striping and pavement markings to their original layout and material, or as directed. Sawcut, remove, and replace any concrete not scheduled for removal that has been damaged by construction activities.

00405.49 Discharge of Construction-Generated Wastewater - Manage discharge of construction-generated wastewater into a public sewer, public sump or body of surface water for a duration of 6 months or less. Plans to discharge wastewater for a duration exceeding 6 months will be required to undergo a more intensive application, review and operations process. Plans shall cover all work necessary to design, permit, provide, operate, maintain, monitor, restore and remove all machinery, appliances and equipment required to perform this work.

(a) Discharge Permit - Apply for and obtain a wastewater Discharge Permit(s) from BES before discharging any wastewater into a public sewer, public sump or body of surface water. Do not begin discharge until BES or the State of Oregon has reviewed the Discharge Permit application and has issued written authorization to proceed including any specific conditions that apply. Obtain from the Engineer a Construction Dewatering Permit Application form. All applications shall include a copy of the proposed discharge plan and, if applicable, a copy of the project environmental site assessment.

The approved Discharge Permit may restrict discharge of wastewater to a quantity containing less than a specified maximum daily load for a distinct set of parameters such as Total Dissolved Solids (TDS) or Total Suspended Solids (TSS). Any specified daily load limits will apply to the project as a whole and not to individual discharge location(s) unless otherwise specified. Limits specified by the Discharge Permit will be determined based on likely site pollutants or pollutants of concern for the receiving system. Design, operate, and maintain a containment and discharge system to control the flow rate, solids or other pollutants in accordance with limitations specified by the applicable Discharge Permit.
(b) **Discharge Plan (DP)** - Prepare and submit a DP for completing the Work.

- Describe the proposed discharge system including: wastewater source and character, collection method, equipment, and pipelines including capacity, installation details, power supply and standby equipment, monitoring facilities and procedure, storage facilities, and measuring systems proposed to safely deliver the wastewater to the approved discharge location(s).
- Clearly describe the equipment and method proposed to accurately log and record daily total flow rates and volumes and monitor pollutant loads or concentrations discharged to the receiving system.
- Provide above ground storage to temporarily hold all wastewater for sampling and pretreatment before discharge, unless otherwise directed.
- Pipe all wastewater discharge(s) to the identified discharge location(s). Follow the approved DP without variance unless non-compliance with the Discharge Permit requires DP modification. If sampling and testing should indicate contaminant concentrations exceed Discharge Permit limitations, immediately stop discharging wastewater and modify the DP to provide additional storage or pretreatment to meet these limitations. Submit all proposed modifications for review.
- Before initiating wastewater discharge at approved discharge locations(s), test the entire system under planned operating conditions. The Engineer will observe all startup tests and review the system for use. Correct all identified deficiencies and review with Engineer before initiating wastewater discharge.
- Discharge wastewater only at the approved discharge location(s) shown or as otherwise permitted. Each discharge location will have a specified maximum discharge rate in gallons per minute (gpm). The receiving public sewer(s), public sump(s) or water body(s) capacity will determine the maximum Permitted discharge rate(s). Do not exceed specified flow rates at any time during the performance of the Work.
- Refer to the Contract Documents for information regarding project-specific discharge location(s) and maximum discharge rate(s).

(c) **Discharge Plan Modifications** - Upon discovery or receipt of notice that any discharge exceeds Discharge Permit limitations, immediately stop all discharge, modify the process described in the DP and submit a DP modification proposal for review. If breakdown, accident, acts of God, or any other condition cause the release of any pollutant, excessive solids load or wastewater volume:
Immediately take action to stop, contain, and correct the problem.
Immediately notify the Engineer and contact the BES Duty Officer.
Within 5 calendar days after such a non-compliance event, submit a detailed written report describing the breakdown, the actual quantity of resultant wastewater discharged, the corrective action taken, the steps taken to prevent recurrence, proposed DP modifications, if necessary, and any other pertinent information.

Implement all approved corrective measures and retest the discharge system before restarting any operations. The Engineer will observe all retesting and review the system for use. If necessary, modify discharge operations during unusually severe weather conditions or as directed.

(d) **Design and Construction** - Design and select materials and equipment for implementing the DP in a manner that will yield compliance with the Discharge Permit. Incorporate equipment or procedures to record total daily discharges:

- Install properly sized totalizing flow meters on all pumps to accurately log the total daily discharge volume. Do not install flow meters closer than 4 feet from any bend in the pump discharge line.
- As an alternative, record the total number and volume of all storage tanks filled throughout a workday. Calculate average flow rate by recording the time, in minutes, to empty each tank after it has been filled and the contents have been sampled. Make sure there is adequate number of storage facilities on site to assure that none of the wastewater is directly discharged without being held for sampling.

Install and maintain fittings for sampling purposes in all of the discharge line(s). Locate fittings downstream of storage facilities but upstream from the approved disposal locations(s). Fittings shall be fully accessible and provide the Engineer opportunity to safely obtain one liter samples of wastewater. Detail sampling locations in the DP.

(e) **Operation** - Give 1 calendar day notice before initiating discharge operations. Record daily total amount of wastewater discharged at all location(s). Submit a weekly report to the Engineer summarizing discharge rates and volumes at each location(s) for the previous 7 calendar days. Submit this information on a City of Portland Discharge Report Form. A sample of this Form is in the project’s Special Provisions. If not, a sample will be provided upon request.

From time to time, the Engineer will collect and analyze representative samples from all discharge location(s). Samples will be taken downstream from any storage or treatment facility. Sampling will continue throughout wastewater discharge. Samples will be taken on random occasions and frequency will change without notice. Provide the previous day total discharge at each sample location(s). The Engineer will report sample analyses to the Contractor within 72 hours after sample results are available. During this time, do not modify the discharge method or its operation without approval.
Retain all records relating to the Discharge Permit for a minimum of 3 years after Acceptance and Final Payment. Extend this retention throughout the course of any unresolved litigation pertaining to the discharge of pollutants, or when the BES or other regulatory authority, such as the DEQ or EPA, requests this information.

Pretreat all wastewater containing solids or pollutant concentrations exceeding the specified maximum Daily Load limit(s). Dispose of all wastewater in such manner as to prevent injury to public or private property or nuisance or menace to the public. Control the entry or collection of surface runoff to prevent contamination of discharged wastewater. Pipe all wastewater from the site to the approved discharge point(s). Do not convey any wastewater in open ditches or trenches. Protect all pipe outlets to avoid damage at the discharge location.

(f) Enforcement - The Discharge Permittee will be solely responsible for any civil penalties that may be assessed for any gross violation of the Discharge Permit or Discharge Authorization conditions.

Finishing and Cleaning Up

00405.70 General - Clean roadway surfaces with restrictions and methods detailed in 00280.64(a) and 00280.65.

Measurement

00405.80 Trench Excavation - Volume for trench excavation and backfill will be measured and computed on the following bases for length, width, and depth of trench

(a) Length - Length for calculating excavation and backfill volume for pipe will be the entire horizontal distance measured along centerline of trench, including measurement through valves, fittings, couplings, manholes, or structures, except that measurement through such structures will be deducted if the Contract contains a separate measurement provision for trench excavation and backfill that is applicable to those structures.

Length of service line pipes will be measured horizontally along the centerline of the trench from the centerline of the mainline pipe to the end of the service line pipe, including all fittings. Measurement will be from center-to-center of valves, fittings, couplings, manholes, structures, or end of pipe, whichever is applicable.

(b) Width - Width for calculating excavation and backfill volume for pipe will be based on the diameter of the pipe barrel or width of the conduit, as follows:
<table>
<thead>
<tr>
<th>Size of Sewer Pipe</th>
<th>Pay Width of Sewer Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 10 inches</td>
<td>30 inches</td>
</tr>
<tr>
<td>12 to 21 inches</td>
<td>OD plus 18 inches</td>
</tr>
<tr>
<td>24 to 36 inches</td>
<td>OD plus 22 inches</td>
</tr>
<tr>
<td>42 to 54 inches</td>
<td>OD plus 42 inches</td>
</tr>
<tr>
<td>60 inches and larger</td>
<td>OD plus 46 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size of Water Pipe</th>
<th>Width of Water Pipe Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 16 inches</td>
<td>OD plus 18 inches</td>
</tr>
<tr>
<td>24 inches or larger</td>
<td>OD plus 24 inches</td>
</tr>
</tbody>
</table>

(c) Depth:

(1) Sewer Pipe - Depth for calculating excavation volume for pipes will be measured vertically from the invert of the pipe to original grade or new road subgrade whichever is lower. No measurement will be made for the extra excavation required for placement of pipe bedding. Backfill for pipe will be measured from the top of the pipe zone to the original ground or bottom of the new road subgrade whichever is less.

(2) Water Pipe - Depth is measured to the bottom of the pipe zone bedding.

(d) Concrete Roadbed - Concrete roadbed encountered in trench excavation shall be defined as trench excavation and measured accordingly.

(e) Exploratory Excavation - Exploratory excavation will be measured on a volume basis.

(f) Pothole Excavation - Pothole excavation will be measured on an each basis for each location shown or specifically directed.

00405.81 Sawcutting - Sawcutting will not be measured separately.

00405.82 Rock, Concrete, and Boulder Excavation:

(a) Rock Excavation - Rock excavation will be measured on the volume basis. Measurement will be of the actual dimensions of rock removed within the following limits:

(1) Length - The length will be the horizontal distance measured along the centerline of the trench. The measurement will exclude manholes and other structures, which will be measured separately.

(2) Width - The width for payment of trench Rock Excavation will conform to the applicable provisions of 00405.80. There will be no additional measurement for additional trench width or restoration resulting from this work.
(3) **Depth** - Depth will be the vertical distance from the top of rock, to the bottom of rock, or a depth that is 6 inches below the sewer pipe, whichever is less. Measure depth at intervals of 25 feet along the trench centerline beginning at the first location where rock starts. Use the average depth between measuring points for computing the rock depth.

Compute the excavated material volume for manholes and other structures using the depth as determined using the method described in the previous paragraph, and multiplied by an area within a line parallel with, and 12 inches outside of, the actual dimensions of the manhole or structure.

The following will not be measured for payment:

- Soft or disintegrated rock
- Hardpan or cemented gravel that can be removed with a hand pick or power-operated excavator or shovel
- Loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere
- Rock outside of the minimum limits of measurement allowed, which may fall into the excavation

(b) **Concrete/Boulder Excavation** - Measurement will be on the volume basis for material that complies with definition of trench Concrete/Boulder Excavation in 00405.02. When approved, additional payment for trench Concrete/Boulder Excavation will be made for depths greater than 6 inches below the specified sewer invert. There will be no measurement of additional trench width, or restoration for trench Concrete/Boulder Excavation outside the limits defined in 00405.82(b).

00405.83 **Trench Protection** - Shoring, mobile trench shields, over-break and other trench protection measures will be considered incidental work.

(a) **Shoring, Sheetin and Bracing** - When the item “Engineered Shoring” is not included in the Contract Schedule of Items, providing shoring, sheeting and bracing of trenches and other trench protection measures will be considered incidental work. When the item “Engineered Shoring” is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.

(b) **Dewatering** - When the item “Dewatering” is not included in the Contract Schedule of Items, the cost to collect excess water and remove it from all excavations will be considered incidental to the Work. When the item “Dewatering” is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.
(c) **Construction Generated Wastewater Discharge** - When the item “Construction Generated Wastewater Discharge” is not included in the Contract Schedule of Items, the cost to collect, convey, store and dispose of the wastewater, including permitting, will be considered incidental to the Work. When the pay item “Construction Generated Wastewater Discharge” is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.

00405.84 **Trench Foundation Stabilization** - Trench foundation removed and replaced with trench foundation stabilization material according to 00405.44 will be measured on a volume basis, as directed.

(a) **Volume Basis** - Trench foundation stabilization will be measured on the volume basis, computed using the following dimensions:

1. **Length** - Length will be the feet of trench foundation used in the trench.
2. **Width** - Width shall conform to pay limits for trench excavation and backfill set forth in 00405.80(b).
3. **Depth** - The depth will be the vertical distance from the bottom of the pipe bedding to the bottom of the excavated unsuitable material. The depth will be measured at intervals of 25 feet, or as directed, along the centerline of the trench and the average depth between points will be used for the volume computation.

(b) **Extra Work Basis** - When not listed in the Contract Schedule of Items, trench foundation stabilization will be paid for as Extra Work.

00405.85 **Pipe Bedding**:

(a) **Sewer Pipe** - No measurement will be made for pipe bedding conforming to 00405.12, including the reinforcement in Class A bedding.

(b) **Water Pipe** - Measurement for pipe bedding will be made according to 00405.86(b).

00405.86 **Pipe Zone Material**:

(a) **Sewer Pipe** - No measurement will be made for pipe zone material conforming to 00405.13.

(b) **Water Pipe** - Measurement for Water Pipe Zone Material will be on the volume basis and exclude the volume of the pipe measured using the outside pipe diameter.

00405.87 **Trench Backfill Material**:

(a) **Trench Backfill Material** - Measurement of trench backfill material above the pipe zone will be made on the volume basis. Volume will be calculated from the following length, width, and depth for granular trench backfill:
Length and width will conform to pay limits for trench excavation and backfill set forth in 00405.80(a) and (b).

Depth of granular backfill will be the actual vertical depth placed from the top of the pipe zone to the top of the trench, road subgrade, or as directed.

Measurement of the volume in cubic yards will be determined by using the pay limits contained above.

(b) CLSM Backfill - Measurement of CLSM backfill material will be made on the volume basis. The volume will be computed as set forth in 00405.87(a) above.

00405.88 Imported Topsoil - Imported topsoil will be measured according to Section 1040.

Payment

00405.90 Payment - The accepted quantities of trench work will be paid at the Contract price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Trench Excavation, ____ ......................... Foot or Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(b) Exploratory Excavation ...................................... Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(c) Pothole Excavation ............................................ Each</td>
<td></td>
</tr>
<tr>
<td>(d) Trench Foundation Stabilization ..................... Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(e) Trench Backfill, Class ____ ............................. Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(f) Engineered Shoring ............................................. Lump Sum</td>
<td></td>
</tr>
<tr>
<td>(g) Dewatering ..................................................... Lump Sum</td>
<td></td>
</tr>
<tr>
<td>(h) Construction-Generated Wastewater Discharge. Lump Sum</td>
<td></td>
</tr>
<tr>
<td>(i) Water Pipe Zone Bedding and Backfill................. Cubic Yard</td>
<td></td>
</tr>
</tbody>
</table>

For item (a), the type of excavation will be inserted in the blank (Common, Rock, Boulder or Concrete). This work includes any additional excavation required for installation of manholes, inlets, pipe or other structures in rock or concrete. Other than as provided in 00405.82(a) and (b), such additional excavation is considered incidental to the work and no separate or additional payment will be made.

Item (b), includes pavement restoration. All other exploratory excavation work performed by the Contractor for its sole use is considered incidental to the work with no additional payment.

Under item (c), if another method is used than described, no additional payment will be made. All other pothole excavation work performed by the Contractor for its sole use is considered incidental to the work with no additional payment.
Payment for item (d) includes removal of unsuitable material and replacement as necessary to provide a stable foundation for the pipe.

For item (e), the class of backfill will be inserted in the blank according to 00405.14.

Item (f) includes designing, providing, constructing, maintaining, and removing the shoring system.

Item (h) includes all costs to collect excess water and remove it from all excavations and all costs to permit, collect, convey, store and dispose of the wastewater, including mobilization, construction, operation, disassembly, and demobilization of the collection, storage, and disposal system.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

00405.91 Imported Topsoil - Imported topsoil will be paid for according to Section 01040.

00405.92 Incidental Basis - When there is no pay item in the Contract Schedule of Items for trench excavation or trench backfill, perform the work as incidental work for which no separate payment will be made.

Bedding, pipe zone material, and trench sawcutting are incidental work for which no separate payment will be made.

Excavation, bedding, and backfill for pipes 4 inches or less in diameter will be incidental to the pipe pay item(s), and no separate payment will be made.
Section 00406 - Tunneling, Boring and Jacking

Description

00406.00  Scope - This work consists of tunneling, boring, or jacking casings or carrier pipes or other conduits without excavating the overlying surface.

00406.01  Definitions:

**Annular Space** - The void between the outside diameter of a carrier pipe or conduit and the inside surface of the tunnel liner or casing previously installed by tunneling, boring or jacking.

**Backfill Space** - The void created between the extreme outer limit of excavation and either the outside diameter of a casing or pipe being jacked into place or a tunnel liner being erected.

**Boring and Jacking** - A trenchless method of underground pipe construction wherein a pipe or series of pipe sections is pushed into place while excavation is performed at the head of the pipe string.

- **Manned Tunneling and Boring and Jacking** - Boring and jacking where the excavation size and method allows the stationing of a worker within the casing or direct-jacked pipe without stopping or removing the excavation equipment.

- **Unmanned Boring and Jacking** - Boring and jacking operation where the excavation size or method precludes the stationing of a worker within the casing or direct-jacked pipe without first stopping or removing the excavation equipment.

**Boring Equipment** - Tunnel boring machine, which includes: the boring head, mechanical shield, digger head, or other excavation equipment located at face of a jacked pipe or casing, including all excavation support and muck handling equipment and equipment used for any pipe insertion, placement, and backfill.

**Carrier Pipe** - A permanent material-carrying pipe or conduit installed either by direct jacking or by insertion into a casing pipe or primary tunnel support liner.

**Casing** - A pipe or other conduit that is jacked into place in a boring and jacking operation, provides initial ground support for pipe insertion, and, in the case of direct-jacked pipe, may also be the carrier pipe furnishing its own permanent ground support.

**Direct-Jacked Pipe** - Pipe installed by boring and jacking that serves as a casing or carrier pipe.

**Full Face Control** - Complete support and control of the excavation face at all times for all loading conditions throughout the course of a tunneling or boring and jacking operation.
Jacking - All methods by which a direct-jacked pipe is pushed into place behind or ahead of an excavation face.

Micro-tunneling - A remote-controlled boring and jacking operation to install a pipe or casing headed by a remotely operated tunnel boring machine. Micro-tunneling operations are not covered by these Specifications.

Muck – All material of whatever nature that is excavated, removed, and disposed of during the course of a tunneling or boring and jacking operation.

Permitter - The owner of land, or other facilities with prior rights, under which a conduit is to be tunneled, bored or jacked.

Pipe Lubricant - A substance applied in order to fill the backfill space and minimize friction between a jacked conduit and the outer limit of excavation.

Pipe Ramming - A special case of boring and jacking where a pipe string is jacked forward without excavation at the head of the string. Muck is removed after jacking is completed or only as needed to limit jacking force. Pipe ramming operations are not covered by these Specifications.

Tunneling - All methods by which an underground opening is first excavated before lining materials or pipe or conduit are brought in and placed.

00406.02 Responsibility for Methods and Equipment - Unless otherwise specified, select the methods and equipment used in tunneling and boring and jacking. Information on the proposed method and equipment shall be submitted as specified herein and accepted prior to the start of the work. Acceptance will not relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein.

00406.03 Safety - Conduct operations in strict accord with all applicable requirements of the U.S. Department of Labor, OSHA, all Federal, State and local safety codes and statutes, and these Specifications. The Contractor is fully responsible and obligated to use procedures that assure the safety of all workers and equipment involved in the project, other project personnel, the public, and the adjacent property, whether public or private.

Materials

00406.10 Inserted Pipe - Conform to 00406.12 Casing for the strength, class and type specified or shown.

00406.11 Direct-Jacked Pipe - At the Contractor's option, either select pipe from available standard classes and types, or design and fabricate pipe to specifically suit the methods and equipment chosen for jacking the pipe into place. The design of direct-jacked pipe must be based upon the superimposed loads and not upon the loads that may be placed upon the pipe as a result of the jacking operations. Any increase in pipe strength needed to withstand jacking loads is the responsibility of the Contractor and shall be provided at no additional cost to the City.
(a) **Pipe Loading** - Pipe selection or design shall take into account the loading criteria defined in the Plans and geotechnical data referenced in the Contract Documents. Such criteria shall include but not be limited to: long-term earth and hydrostatic loads, construction loads such as erection and jacking forces, surcharges from stockpiles and construction equipment, rigging and handling loads, and loads from all other sources.

(b) **Pipe Design** - Determine the design criteria for longitudinal or axial loading on the pipe and joints based on the selected methods and equipment. Be responsible for design of the pipe and pipe joints to carry the thrusts of the jacking equipment without damage or distortion. If used, propulsion jacks on the shield shall be configured so that the thrust is uniformly distributed and will not cause pipe damage or distortion.

(c) **Maximum Bearing Stresses** - Thrust jack configuration and concrete strengths for concrete pipe and yield strength of steel for steel pipe shall be coordinated. The maximum bearing stresses imposed upon the pipe by the jacking effort shall:

1. not exceed 33% of the ultimate strength (28-day) of the concrete for concrete pipe or
2. not exceed 33% of the yield strength of the steel for steel pipe.

(d) **Injection Nipples** - Equip 36 inch and larger direct-jacked pipe with nipples for lubricant injection or pressure grouting on 10 foot centers located at the crown and on each side 60° above invert.

(e) **Cushioning Material** - When approved for use, place cushioning material in the joints between successive pipes to provide uniform thrust distribution across the pipe joint. The initial thickness of the cushioning material shall not exceed the joint gap allowance determined from the approved pipe joint design.

00406.12 **Casing Pipe** - Use smooth welded steel pipe or other pre-approved pipe material for casing in bored and jacked applications where specified or approved. Provide casing of a size to permit proper construction to the required lines and grades of the carrier pipe to be inserted and allow filling the backfill space with the specified material. Provide casing of such strength as to withstand all boring and jacking loads.

(a) **Wall Thickness** - Use casing of adequate strength and wall thickness for all loads which may be imposed including ground and hydrostatic loads, jacking thrust, slurry and grout pressures, external loads such as construction equipment, stockpiles, railroads, highway traffic, and any other loads that may be anticipated. Submit details of selected casing along with design calculations in accordance with submittal requirements herein. Identify and provide any additional wall thickness needed to comply with additional requirements of the Permitter without additional cost to the City. Use a gauge or wall thickness corresponding to the size of casing selected from the following for the type of pipe being installed:
### Steel Pipe Casing Wall Thickness

<table>
<thead>
<tr>
<th>Diameter in Inches</th>
<th>Smooth Steel Pipe Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-24</td>
<td>0.250&quot; per ASTM A 53 Grade B or ASTM A 252 Grade 2</td>
</tr>
<tr>
<td>24-36</td>
<td>0.313&quot; per ASTM A 53 Grade B or ASTM A 252 Grade 2</td>
</tr>
<tr>
<td>Over 36</td>
<td>As Specified</td>
</tr>
</tbody>
</table>

### Domestic Water Pipe Casing Wall Thickness

<table>
<thead>
<tr>
<th>Diameter of Casing Pipe</th>
<th>Smooth Steel Pipe Minimum Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; or less</td>
<td>1/4&quot; (0.2500&quot;)</td>
</tr>
<tr>
<td>Over 12&quot; - 18&quot;</td>
<td>5/16&quot; (0.3125&quot;)</td>
</tr>
<tr>
<td>Over 18&quot; - 22&quot;</td>
<td>3/8&quot; (0.3750&quot;)</td>
</tr>
<tr>
<td>Over 22&quot; - 28&quot;</td>
<td>7/16&quot; (0.4375&quot;)</td>
</tr>
<tr>
<td>Over 28&quot; - 34&quot;</td>
<td>1/2&quot; (0.5000&quot;)</td>
</tr>
<tr>
<td>Over 34&quot; - 42&quot;</td>
<td>9/16&quot; (0.5625&quot;)</td>
</tr>
<tr>
<td>Over 42&quot; - 48&quot;</td>
<td>5/8&quot; (0.6250&quot;)</td>
</tr>
<tr>
<td>Larger than 48</td>
<td>Casing pipes larger than 48&quot; diameter or with any portion deeper than 20 feet shall be submitted for approval</td>
</tr>
</tbody>
</table>

For wall thicknesses less than those prescribed above, provide complete structural calculations demonstrating the adequacy of the submitted casing and wall thickness. Such calculations shall be stamped by a structural or geotechnical Engineer licensed to practice in the State of Oregon.

(b) **Liner Plate Casing** - Construct steel casing of hot-dipped galvanized steel standard offset tunnel liner plate with gauge and section modulus per inch of width as approved. Plates shall meet ASTM 139 Grade BB requirements. Fabricate each plate from a single piece of steel plate and provide flanges for both circumferential and longitudinal joints. Provide a sufficient number of bolt holes in joints to fully develop the design strength of the individual liner plates. Locate bolt holes so that all liner plates with the same curvature are interchangeable and can be easily moved from place to place in the tunnel.

(c) **Injection Nipples** - Equip casing with nipples for lubricant injection and pressure grouting on 10 foot centers, at obstructions encountered, and at voids encountered. For pipes 36 inches to 42 inches place grout port at crown. For casings 48 inches and larger, place grout ports at the crown and on each side, 60° from crown.

**Grout** - If specified for filling the annular space between inserted pipe and casing or tunnel liner, provide flowable, non-shrinking, non-expanding manufactured grout that will take a permanent set. Grout shall be recommended by the manufacturer for the particular application. Submit details of grout before use.
00406.14 **Lubricant** - Lubricant for backfill space lubrication of initial casing shall be a non-toxic bentonite or polymer material at the Contractor's discretion. Lubricant shall be of a composition and consistency to reduce skin friction between the outer wall of casing and the excavated surface.

00406.15 **Cradles, Spacers, and Isolators for Inserted Sewer and Stormwater Pipe** - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, provide spacers or isolators around the carrier pipe as specified or approved. Spacers and isolators shall be manufactured from pressure treated wood, polyethylene, or other suitable synthetic material and sized appropriately for the casing material. Bands shall be manufactured from stainless steel, steel, polyethylene or other suitable material as recommended by manufacturer for intended application.

00406.16 **Cradles, Spacers, and Isolators for Inserted Domestic Water Pipe** - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, pipe shall be supported by casing spacers at no more than 10 feet between spacers or otherwise shown on the plans. Each spacer shall be 12 inches wide and manufactured of minimum 14 gauge Type 304 stainless steel. All nuts and bolts shall be corrosion resistant and compatible with the respective band. Each spacer shall have a minimum of 4 runners manufactured of a high molecular weight polymer plastic. The runner supports shall be of adequate height to position the carrier pipe in center of casing with a minimum top clearance of 1/2 inch. All casing spacers for use with larger than 36 inch diameter carrier pipe shall be factory designed taking in consideration the weight of the carrier pipe filled with water. All calculations and drawings shall be submitted for approval.

00406.17 **Casing End Seals** - Casing end seals shall be used to completely close both ends of the casing. These end seals shall be pull on (seamless) or wrap around with stainless steel straps for securing to the carrier pipe and the casing. End seals shall be constructed of specially compounded synthetic rubber a minimum thickness of 1/8 inch.

00406.18 **Cathodic Protection** - Where cathodic protection is used on the carrier pipe, an above ground test box constructed specifically for this purpose will be provided. Install casing vent pipe if shown on the plans. Test box will have test wires attached to casing wall and carrier pipe as shown on the cathodic protection details or as directed.

### Equipment

00406.20 **Excavating Equipment for Unmanned Boring and Jacking** - The boring head for such operations shall be designed to secure anchor to the leading section of the pipe string to prevent any wobble or any deviation in alignment during the boring operation. The boring head shall also be removable, and capable of excavating a small distance outside the outer diameter of the casing. In addition, the boring head shall be steerable to the extent necessary to conform to line and grade requirements herein.
00406.21 Excavating Equipment for Manned Tunneling and Boring and Jacking - Excavating equipment for such boring and jacking and for tunneling shall be steerable with full-face control capability. All machinery and moving parts such as shove jacks, breasting plates, breasting jacks, cutting equipment, excavating equipment, and the like, shall be new or refurbished to like new condition. All air and hydraulic lines and connections shall be new or like new, and shall be capable of withstanding maximum service pressures. All electrical wiring and insulation shall be new or like new and of explosion proof type electric Class 1, Group D, Division 1 of National Electrical Code. All electrical motors, accessories, and installations and electrical equipment inside the excavated volume shall conform to Class I, Division 2 requirements of Subpart K, OSHA Standards 29 CFR 1926, current revision.

00406.22 Jacking Equipment - Mount main jacks in a jacking reaction frame located in the jacking shaft or pit. Main jacks shall advance pipe or casing by pushing a successive string of connected conduit sections toward a receiving shaft or pit. Determine necessary jacking force in advance and design complete jacking system before submitting for review. The main thrust jacking system shall develop a uniform distribution of jacking forces on the end of the casing or direct-jacked pipe by the use of appropriate thruster rings and cushioning material. Use intermediate jacking stations at the Contractor's discretion as approved.

00406.23 Pipe Lubrication Equipment - If lubrication is needed to keep jacking forces within the thrust capacity of jacks, use pumping equipment and accessories that are suitable for the intended purpose: to inject lubricant through injection nipples. The lubricant shall be of a composition and consistency to reduce skin friction between the initial support conduit and the excavated surface during jacking operations.

00406.24 Line and Grade Monitoring - Use a laser and target system, water levels, surveys or other approved methods to continuously monitor line and grade during manned boring or tunneling operations. For unmanned boring, check line and grade daily, every 40 feet or at intervals proposed in accepted submittal. Calibrate monitoring equipment before the beginning of each operation and check again at the beginning of each shift during the operation. Maintain monitoring equipment and keep it in good working condition at all times. Mount laser or other continuous monitoring equipment independently of any jacking frame, backup plate, or reaction bulkhead in such a manner as to keep it completely stable during operations.

00406.25 Grouting Equipment - Use positive displacement pumping equipment equipped with a colloidal mixer of a type normally used to grout backfill space behind tunnel liner, jacked casing, or direct-jacked pipe, as applicable. Monitor grouting pressure at all times during grouting and limit pressure so as to have no detrimental effects on the liner or conduit. Calibrate all gauges and other equipment prior to their use on the project.
Labor

00406.30 General - Supervisors shall have a minimum of 5 years experience in tunneling or boring and jacking operations.

Construction

00406.41 Required Submittals - Submit a complete construction plan showing details of the proposed methods of construction and the sequence of operations to be performed. Submit the plan at least 30 calendar days prior to materials and equipment purchase, or prior to mobilization if the equipment is already owned. A Professional Engineer registered in the State of Oregon shall stamp all structural or geotechnical designs. These submittal requirements are not intended to limit submittals, but to provide the minimum of details that must be included for each size and location of each contracted boring and jacking operation.

(a) Boring and Jacking Submittals - Submit details of the following for approval before beginning the boring and jacking operation:

(1) General - Show subsurface excavation and face control at point of excavation, muck removal and disposal, pipe installation methods, details of jacking system including intermediate jacking systems, if used, and shaft or pit location, construction, shoring and bracing designs, including dewatering schemes whenever necessary.

(2) Boring and Jacking Contractor - Submit names and contact information of Contractor or subcontractor actually performing the Work along with qualifications for performing the Work including references and experience on similar past projects.

(3) Sequence of Work and Construction - Submit drawings and written description identifying details of the proposed sequence of work and construction operations to be performed as required by the method of excavation. The drawings and descriptions shall be sufficiently detailed to demonstrate whether the proposed materials and procedures will meet the requirements of the Contract Documents. Show site constraints and staging. Include proposed contingency plans for any critical or particularly dangerous phases of boring and jacking operation.

(4) Boring Equipment - Submit detailed drawings of boring equipment including dimensional data and proposed overcut, excavation method, head or shield operation and steering, arrangement of components and face control method. Provide technical specifications of the boring equipment and trailing equipment including performance capabilities (include any modifications) and experience record with proposed equipment. Describe method of steering, if any, and methods of minimizing over excavation and loss of ground, especially when excavating cobbles and boulders.
(5) **Jacking System** - Submit jacking system drawings and details showing jack set up, backstop for jack thrust, bearing block, or other means of furnishing reaction for the jacking frame, intermediate jacking stations, if used, and thrust and other performance capabilities of all jacking system components. Show details of method by which jacking thrust is transferred to the conduit being jacked and methods of protecting conduit from damage due to thrust. Provide description of any cushioning material to be used and show detail of placement between successive sections. Furnish data on maximum available thrust of the system.

(6) **Jacked Pipe** - Submit anticipated jacking loads and design calculations for direct-jacked pipe or casing per the design criteria set forth in the Contract Documents. The design calculations shall take into account maximum ground and hydrostatic loads, jacking thrust, slurry and grout pressures, external loads such as construction equipment, stockpiles, railroads, highway traffic, and any other anticipated loads. Show and describe all anticipated loads. Provide structural details of the pipe or casing proposed to be jacked, particularly reinforcing and cushioning at the joints. Show details of joining casing sections by welding or other joining methods.

(7) **Shafts** - Submit plans showing shaft or pit locations, layout, dimensions, surface construction, excavation equipment, excavated material disposal, and their locations and layout with respect to the shafts or pits. Submit scale drawings, details, and design calculations for shaft shoring and bracing stamped by a professional structural or geotechnical Engineer licensed to practice in the State of Oregon.

(8) **Maintaining Line and Grade** - Submit details and description of proposed guidance equipment, method of line and grade control, and proposed frequency of line and grade checking. In case of deviation, include proposed method of bringing actual boring and jacking alignment and elevation back onto specified line and grade.

(9) **Backfill Space Lubrication** - Submit proposed method of furnishing backfill space lubrication, if any. Include anticipated lubricant, lubricant injection rates and volumes, injection equipment, pumping procedures and capacities, methods of introducing lubricant into backfill space, proposed water-based non-toxic lubricant mix and other pertinent system components.

(10) **Muck Removal** - Submit details of muck removal system and disposal plan including equipment to be used. Provide details for handling and disposal of any contaminated media anticipated or encountered. Indicate sites for cleanup of trucks and other vehicles to prevent dirt nuisance or contamination of adjacent property.

(11) **Grouting Annular Space and Backfill Space Fill** - Submit details of annular and backfill space grouting methods to be used including equipment and placement, sequence of operations, schedule, pumping procedures, sand or grout mix, plug and insertion points, and method of
monitoring and controlling fill pressure for each of the required filling operations.

(12) Support Systems - Submit layout and details of all support equipment including ventilation system, lighting layout, and electrical system and emergency backup systems. Show air quality monitoring systems, procedures, frequencies, redundancies, and record keeping to be used.

(13) Tees and Wyes - If tees or wyes are to be constructed, submit drawing and details of typical pipe fitting connection and installation.

(14) Modification of Existing Facilities - Submit a design for any part of the existing sewer system that must be changed or new structures that may be required because of the particular method or procedure used by the Contractor (Manholes, headwalls, vaults, etc.).

(15) Inserted Pipe - If a carrier pipe or other conduit is to be placed in a previously bored and jacked casing, submit placement method, equipment, backfill material, and details of bracing to prevent pipe shifting and flotation.

(16) Dewatering Equipment - When groundwater is known to exist or is expected to be encountered, submit a dewatering plan showing location, size, and layout of pumps, wells, piping, appurtenant equipment, and points of discharge and disposal to be used to keep excavations free of water. Conform to dewatering requirements set forth elsewhere in these Specifications.

(17) Utility Protection Plan - Submit, for approval, a utility protection plan before starting work. The plan will be created from the same scale and details as the construction drawings. The following items must be included in the plan:

- Location of all utilities impacted by construction by type, size and status of use.
- Methods employed by the Contractor to locate each and every utility.
- List of utility owners and 24-hour emergency contact numbers
- Methods planned by the Contractor to support utilities while in full operation.
- Hours of planned shutdown of utilities if required.
- Special support details approved by the owner/operator of all high pressure gas lines
- Correspondence confirmation from all utilities that proposed plan meets their approval
• If impacted utility requires support during construction, the support system must be designed and stamped by a registered engineer licensed in the State of Oregon.
• Other conditions may apply depending on field conditions.

(b) Tunneling Submittals - Submit details of the following for review before beginning the tunnel construction:

(1) General - Submit a complete construction plan showing details of the proposed methods of construction and the sequence of operations to be performed. Submit at least 30 calendar days prior to materials and equipment purchase, or prior to mobilization if the equipment is already owned. A professional engineer registered in the State of Oregon shall stamp all structural or geotechnical designs. These submittal requirements are not intended to limit submittals, but to provide the minimum of details that must be included for each size and location of each contracted boring and jacking operation.

(2) Tunneling Contractor - Submit names and contact information of Contractor or subcontractor actually performing the Work along with qualifications for performing the Work including references.

(3) Sequence of Work and Construction - Submit drawings and written description identifying details of the proposed sequence of work and construction operations to be performed as required by the method of excavation. The drawings and descriptions shall be sufficiently detailed to demonstrate whether the proposed materials and procedures will meet the requirements of the Contract Documents. Show site constraints and staging. Include proposed contingency plans for any critical or particularly dangerous phases of tunneling.

(4) Tunneling Equipment - Submit drawings of tunneling equipment and dimensional data including proposed overcut, excavation method, head or shield operation and steering, arrangement of components and face control method. Provide technical specifications of tunneling equipment and trailing equipment including performance capabilities (include any modifications) and experience record with proposed equipment. Describe methods of minimizing over excavation and loss of ground, especially when excavating cobbles and boulders.

(5) Primary Liner System - Submit scale drawings, details, and dimensional data for primary liner and components thereof. Show sequence of installation, bracing to prevent shifting or rotation, and laydown areas for required materials. Drawings, details, and design calculations for primary liner system shall be stamped by a professional engineer licensed to practice in the State of Oregon.
(6) **Shafts** - Submit plans showing shaft or pit locations, layout, dimensions, surface construction, excavation equipment, excavated material disposal, and their locations and layout with respect to the shafts or pits. Submit scale drawings, details, and design calculations for shaft shoring and bracing stamped by a professional structural or geotechnical engineer licensed to practice in the State of Oregon.

(7) **Maintaining Line and Grade** - Submit details and description of proposed guidance equipment, method of line and grade control, and frequency of line and grade checking. Include method of bringing tunnel back onto specified line and grade in case of deviation.

(8) **Muck Removal** - Submit details of muck removal system and disposal plan including equipment to be used. Provide details for handling and disposal of any contaminated media anticipated or encountered. Indicate sites for cleanup of trucks and other vehicles to prevent dirt nuisance or contamination of adjacent property.

(9) **Grouting Annular Space and Backfill Space** - Submit details of backfill and annular space grouting methods to be used including equipment and placement, pumping procedures, grout mix, plug and insertion points, and method of monitoring and controlling grout pressure for each of the required grouting operations.

(10) **Support Systems** - Submit layout and details of all support equipment including ventilation system, lighting layout, and electrical system and emergency backup systems. Show air quality monitoring systems, procedures, frequencies, redundancies, and record keeping to be used.

(11) **Tees and Wyes** - If tees or wyes are to be constructed, submit drawing and details of typical pipe fitting connection and installation.

(12) **Modification of Existing Facilities** - Submit a design for any part of the existing sewer or water system that must be changed or new structures that may be required because of the particular method or procedure used by the Contractor (Manholes, headwalls, vaults, etc.). Submit drawings, details, and design calculations for shaft shoring and bracing stamped by a registered professional engineer licensed to practice in the state of Oregon.

(13) **Inserted Pipe** - If a pipe or other conduit is to be placed in a previously tunneled casing, submit details of bracing to prevent pipe shifting and flotation, backfill material, placement method and equipment.

(14) **Dewatering Equipment** - When groundwater is known to exist or is expected to be encountered, submit a dewatering plan showing location, size, and layout of pumps, wells, piping, appurtenant equipment, and points of discharge and disposal to be used to keep excavations free of water. Conform to dewatering requirements set forth elsewhere in these Specifications.
(15) **Settlement Monitoring** - Submit details of the settlement-monitoring plan intended to be used. The minimum number of settlement measuring points shall be at least at quarter stations along the centerline of the boring and jacking alignment. Settlement points at either side of the centerline points shall also be installed as needed.

00406.42 **Alternate of Boring and Jacking or Tunneling** - Boring and jacking or tunneling may be allowed in lieu of each other or in lieu of specified open trench installation; however approval must first be obtained. Unless specified, the Engineer retains sole discretion to reject the substitute method without rejecting other methods. Approval will in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the requirements set forth herein.

00406.43 **Excavation** - Excavation for work under this Section is unclassified and includes whatever materials are encountered to the depths shown on the Plans or as required. Estimate the kind and extent of the various materials that will be encountered in the excavation based on experience with nearby work, surface investigation, any subsurface investigation that may have been performed, and any applicable geotechnical data that may be available.

(a) **Establishing Line and Grade** - The Engineer will provide the survey control points indicated on the Plans or other survey points as may be agreed. Check these survey control points in the field before commencing excavation and report any errors or discrepancies. When all survey control points are found to be correct, use them to establish and maintain all reference lines and grades for the construction of the pipe or conduit. Install all direct-jacked pipe, casing, tunnel liner, or inserted pipe to true line and grade. Should any deviation from true line and grade occur, modify the installation operation to correct the deviation at no additional cost to the City. Unless otherwise shown or specified, the Contractor will be permitted a deviation from the specified line and grade equal to 1/2 inch for line and 1/4 inch for grade per 100 feet of centerline length.

(b) **Jacking Procedure**:

1. **Cradle** - Construct a concrete cradle in the jacking shaft true to line and grade and conforming to the outside radius of the pipe. The cradle shall be of such dimensions as to uniformly support the pipe under the lower 60° sector measured on the outside of the pipe. The curved surface shall be formed or accurately screeded to the proper dimensions. It shall be reinforced with not less than 0.3 % of longitudinal steel and not less than 0.5% of transverse steel with respect to the cross-sectional area of the cradle. The transverse steel shall be bent equal to the radius of the outside of the pipe plus 2 inches and shall extend to within 1 inch of every surface of the cradle.

2. **Concrete Base Slab** - In lieu of the concrete cradle specified above, and subject to the approval of details by the Engineer, set steel rails in a concrete base slab parallel to the longitudinal axis of the pipe and to true line and grade for jacking pipe support.
(3) **Gasket Integrity** - Verify that pipe gaskets are in place and that the joints are watertight. After each section of pipe has been set into position in the jacking shaft and assembled with previously installed pipe, test pipe joint as specified. Remove and reinstall any pipe with a defective joint.

(4) **Pipe End Protection** - For either concrete or steel pipe, properly protect the driving ends of pipe being jacked against spalling and other damage. Similarly protect intermediate joints by installing sufficient bearing shims to properly distribute the jacking stresses. Remove any section of pipe showing signs of failure and replace it with a new section of pipe or with a cast-in-place section adequate to carry the loads imposed upon it at no additional cost to the City.

(c) **Excavation Limits** - Carry out all excavation entirely within the boring or tunneling equipment. No excavation in advance thereof will be permitted. Make every effort to avoid any loss of earth outside the equipment.

(d) **Working Conditions** - At all times, maintain clean working conditions inside the boring and jacking or tunneling operation and associated shafts. Remove all muck, debris, material spills, unusable supports and other material not required for the operation as excavation progresses. Do not allow such material to accumulate within the tunnel, casing, conduit, pipe, or shafts.

(e) **Excavation Records and Control** - Maintain a log of soil excavated versus face advance during the tunneling or jacking operation. The log shall be sufficiently accurate and up-to-date to quickly alert the operator of the face controlling equipment of over excavation and creation of voids. Make the log available to the Engineer at all times and submit a copy at the end of each shift. If at any time more soil is removed than calculated based on the forward progress, stop excavation and increase the rate of advance for the operation. When jacking pressures require it, resume excavation at the minimum necessary to maintain the minimum rate of advance necessary to prevent the casing or tunneling equipment from “freezing” in place. Determine the cause of overbreaks and correct it before continuing. Immediately report all such cases of overbreaks to the Engineer.

(f) **Settlement Monitoring** - Take initial settlement readings before shafts or pits are excavated, and record all readings as a base line for comparison to subsequent readings. Take readings at the same time each day of tunneling operations. Submit a copy of all readings at the end of each day. Any settlement in excess of 0.25 inch shall be corrected by the contractor to the satisfaction of the City at the Contractor’s expense.

(g) **Settlement** - Execute all work of excavating, lining, boring, jacking, grouting, and constructing the conduit so that settlement is minimized. The completed direct-jacked pipe, casing, or tunnel liner shall have full bearing against earth with no voids or pockets left in any portion of the work. Promptly fill the backfill space between the tunnel liner, direct-jacked pipe, or casing and the excavated surface with specified backfill material, as approved. Provide full breasting of excavation face when operations stop for more than 2 hours or sooner as site conditions dictate.
(h) **Protection of Adjacent Property** - Before beginning construction at any location, adequately protect existing structures, utilities, trees, shrubs and other objects in accordance with General Requirements provisions regarding protection and restoration of property. Assume all costs for repair of, or compensation for, damage to adjacent facilities due to negligence or lack of adequate protection. Tunnel or install direct-jacked pipe or casing under railroad embankments, highways or streets so as to minimize the interference with the operation of the railroad, highway, or streets.

(i) **Cleanup** - Provide surface drainage as required during construction to protect the Work and to avoid nuisance to adjoining property. Conduct operations in such a manner that trucks and other vehicles and equipment do not create a dirt nuisance in adjacent and nearby streets. Conform to erosion control requirements set forth elsewhere in these Specifications.

(j) **Continuity of Jacking Operations** - Once commenced, perform boring and jacking operations **on each project workday** without interruption until the direct-jacked pipe or casing has been jacked between the specified limits. This requirement may be modified if the Contractor submits for prior approval methods and details that will preclude the “freezing” or seizure of the casing and ensure that the excavation face is stable at all times.

(k) **Voids and Loss of Ground** - Should loss of ground occur during tunneling or boring and jacking operations, backfill all voids promptly. Fill all remaining voids before completion of operations. Such filling or backfilling shall be with grout unless otherwise approved. Surface settlement or excessive muck volume will be conclusive evidence that voids exist.

(l) **Lubrication** - Maintain an envelope of pipe lubrication around the exterior of the pipe during the boring and jacking operation to reduce the exterior conduit wall friction and to reduce the possibility of the pipe “freezing” or seizure in place. Utilize lubrication immediately upon start of jacking and maintain use continuously until jacking is completed. Calculate backfill space volume and measure grout injected to ensure adequate lubrication is being utilized. Provide copies of calculation of backfill space volume and amount of injected pipe lubrication to the Engineer on a shift-by-shift basis.

00406.44 **Jacking Steel Casing** - Join sections of steel casing by welding the joints with a continuous circumferential weld or by other approved means. Provide joints that are capable of resisting the boring and jacking forces without failure. Provide casing of such strength as to withstand the boring and jacking loads and of such diameter to allow filling the backfill space with the specified material. Unless otherwise specified, the size and wall thickness of the casing to accommodate the final pipe shall be at the Contractor’s option.
00406.45 Installing Steel Liner Plates - Install bolt-together steel liner plates when specified or otherwise selected for use. Install plates progressively as excavation proceeds. Do not excavate more than 24 inches past the end of the last-placed liner plate. Install an additional full section of the liner before resuming excavation. In sandy and running ground environment, inject grout at pressures not exceeding overburden pressure to fill voids behind the liner as excavation proceeds. At a minimum, place grout at the end of each shift as close to the heading as possible using grout stops as necessary. Start grouting in the lower holes moving upward as the annular space is filled. Whenever necessary, install additional threaded nipples filling each hole or where grout interconnection with adjacent holes occurs.

00406.46 Pressure Grouting After Jacking or Tunneling:

(a) Procedure - In all cases, pressure grout backfill space and voids outside casing or primary liner after it is in position through bored holes or injection nipples provided. Start grouting at one end through a side hole and pump grout until grout appears in the grout hole at the crown. Then start grouting through the opposite side hole until grout appears at the hole in the crown. Next grout through the hole at the crown until grout appears in the next set of holes along the pipe. Plug the holes at the starting point and move to the next set of holes and repeat grouting sequence until full length of jacked pipe has been grouted. Once commenced, grouting shall be completed without stopping.

(b) Documentation - During grouting operations, maintain complete records at all times. Record grout mixes, grout pressures, amount of grout takes, injection rates, weather conditions and temperature including start and stop times and interval before restarting operations. Submit all requested data daily.

00406.47 Inserting Pipe - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, provide cradles under the barrel of each pipe unless otherwise specified or approved. Join the pipe and slide into the pipe or casing. The pipe barrel shall bear continuously on casing spacers. Conform to applicable pipe installation requirements of Section 00445, including hydrostatic or air testing and tolerances for line and grade.

00406.48 Backfilling Pipe - Completely fill the annular space between the inserted pipe and the primary tunnel liner or jacked casing with approved backfill material in such a manner as to prevent pipe shifting or flotation. Pour or pump the fill from the two ends and from intermediate points as necessary. Complete grouting in a continuous operation without stopping. Perform sand filling using a gunite machine or other approved equipment. Installed pipe must conform to pipe deflection testing requirements set forth in Section 00445.
Measurement

00406.80 Measurement:

(a) Installation - Completed and acceptable pipe installed by tunneling or boring and jacking will be measured either on a lump sum basis or linear foot basis, as shown on the Bid. Linear foot measurement will be from end to end along the centerline of the final tunnel liner or direct-jacked or inserted pipe or conduit between portals or will be the length shown on the Plans, whichever is less.

(b) Contractor Convenience - Tunneling or boring and jacking extensions beyond the limits shown will be considered to be for the Contractor's convenience unless ordered in writing. If approved, measurement of such extensions will be made as if the open trench method of construction had been used.

00406.81 Tunneling, Boring and Jacking in Lieu of Open Trench - Where tunneling or boring and jacking is approved in lieu of open trench construction, measurement will be made as though the open trench method had been used. Such measurement will include all the pay items that would have been applicable if the open trench construction method had been used. No additional measurement will be made for any pay item that would not have been applicable.

00406.82 Separate Item Basis - If the Special Provisions or Contract Schedule of items indicate a unit basis of payment, measurement of quantities will be made on the length basis from end to end along the centerline, or from center to center of manholes, inlets, other structures, or portals as applicable.

Payment

00406.90 Payment - Payment will include full compensation for all excavation, shafts, portals, jacking pits, pipe, conduits, pipe bedding, tunnel stabilization, backfill, lubricant, grouting pipe, casing and all appurtenances as approved, complete in place, except for tees and wyes.

(a) Optional Use of Casing - Where casing is used at the option of the Contractor in lieu of direct-jacked pipe, the casing and the backfill between the pipe and the casing will be included in the pay item for boring and jacking as applicable, and no separate payment will be made therefore.

(b) Casing or Tunnel Liner - There will be no separate payment for casing or tunnel liner used to install pipe or for backfill between inserted pipe and the casing or liner. If tunneling, boring and jacking, or open trench excavation is used at the Contractor’s option in lieu of another specified method, payment will be made as originally bid.

00406.91 Lump Sum Basis - The accepted quantities of tunneling or boring and jacking work done on a lump sum basis will be paid as follows:
### 00406.92 Separate Unit Basis

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Tunneling</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Boring and Jacking</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Item (a) applies to all excavation, shafts, portals, jacking pits, pipe, conduits, pipe bedding, tunnel stabilization, backfill, lubricant, grouting pipe, casing and all approved appurtenances.

Item (b) applies to all excavation, shafts, portals, pipe, conduits, pipe bedding, backfill, lubricant, grouting pipe casing, and all approved appurtenances.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, materials and incidentals necessary to complete the work as specified.

### 00406.93 Incidental Basis

- When neither the Special Provisions or Contract Schedule of Items indicate separate payment for tees and wyes under this section, the work is considered incidental and no separate payment will be made.

(a) **Installation** - Completed and acceptable pipe installed by tunneling or boring and jacking will be paid either on a lump sum basis or linear foot basis, as shown in the Contract Schedule of Items. Linear foot measurement will be from end to end along the centerline of the final tunnel liner or direct-jacked or inserted pipe or conduit between portals or will be the length shown on the Plans, whichever is less.
(b) **Contractor Convenience** - Tunneling or boring and jacking extensions beyond the limits shown will be considered to be for the Contractor’s convenience unless ordered in writing. If approved, payment of such extensions will be made as if the open trench method of construction had been used.
Section 00412 - Pipe Bursting

Description

00412.00 Scope - This work consists of furnishing and installing HDPE pipe in gravity sewer pipe by the pipe bursting method.

Materials

00412.10 Pipe - Furnish high molecular weight, high-density polyethylene pipe and fittings that are made from virgin grade material, to the diameter as specified, and to tolerances meeting ASTM F714. The minimum ratio of orthogonal diameters prior to installation shall be 0.95.

(a) Markings - Pipe materials shall be legibly marked by the pipe manufacturer with the following information:

- Name and trademark of manufacturer
- Nominal pipe size
- Dimension ratio
- The letters PE followed by the polyethylene grade per ASTM D1248, followed by the Hydrostatic Design Basis in hundreds of psi
- Manufacturing Standard Reference
- A production code from which the date and place of manufacture can be determined

Pipe material shall be listed by the Plastic Pipe Institute (PPI) with a designation of PE 3608 or 4710 and have a minimum cell classification of 345464C as described in ASTM D3350. Pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material pipe. Pipe (excluding black colored pipe) stored outside shall not be recycled. Pipe and fittings shall be made in conformance with ASTM F714 and ASTM D3261 as modified for the specified material. The material shall have a long-term hydrostatic strength (LTHS) of 1,600 psi when tested and analyzed in accordance with ASTM D2837. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects and be uniform in density and other physical properties. Any pipe not meeting these criteria will be rejected.

(b) Pipe Color - Pipe shall be:

- Black or gray only.
- Homogeneous throughout.
(c) Dimension Ratio (DR) - Pipe shall conform to the following:

- Nominal Size: 8 to 18 inches
- Minimum Strength DR: 17

00412.11 Service Connections - New lateral service connections to the sewer main shall be accomplished either by Inserta-Tee®, electrofusion saddle type fittings, or approved equal. The service connection shall be specifically designed for connection to the HDPE sewer main being installed.

00412.12 Contractor Submittals:

(a) Shop Drawings - Provide the following:

- Submit catalog cuts, specifications, dimensioned drawings, installation details and sketches, and other pertinent information for the HDPE pipe installation work.
- Verify with the pipe manufacturer all connection details.
- Submit detail drawings and a written description of the construction procedure and sequence including locations for initiating bypass and receiving bypass of the sewage flow for host sewer and sewer laterals, install new house sewer and service laterals, and disconnection and reconnection of the sewer service lateral connections.
- Submit method of bursting, including listed equipment by size, make, model and manufacturer.

(b) Certification - Furnish a certified affidavit of compliance for all HDPE pipe and fittings furnished confirming that the materials supplied fully conform to the requirements specified herein.

(c) Diversion of flow - Submit a complete plan for a diversion of flow in accordance with Section 00490.

(d) Fusion Weld - Perform trial fusion welds in the field and submit samples to the Engineer for review prior to installation of the pipe. All full penetration welds shall provide a homogeneous material across the entire cross section of the weld. The fusion machine employed for the trial welds shall be the same machine that will be utilized for the complete project installation work.

00412.15 Quality Assurance - Quality assurance of the pipe and fittings shall include certified laboratory data confirming that said tests have been performed on a sample of the pipe provided this contract, or on pipe from the production run. Tests must show that satisfactory results were obtained prior to any installation of said pipe.
Labor

00412.30 Qualifications - The pipe bursting contractor shall be a licensed installer of the selected pipe bursting system. The contractor must be satisfactorily trained by the pipe bursting system manufacturer and certified in writing as such.

Pipe bursting insertion equipment shall be operated only by technicians who have a minimum of 3 years experience in the installation of the polyethylene pipe, using pipe bursting technology as specified herein. The technician's experience and references shall be documented in the HDPE pipe submittal.

Polyethylene pipe joining shall be performed by personnel trained in the use of butt-fusion equipment by the specific manufacturer of fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by a qualified and certified representative of the equipment and pipe manufacturer.

Fusion joining and other procedures necessary for correct assembly of the polyethylene pipe shall be done only by personnel trained in those skills to the satisfaction of the Engineer and the pipe supplier.

00412.31 Certified Operators - Fusion equipment shall be operated only by technicians who have been certified by the pipe manufacturer or supplier and who have a minimum of 2 years experience of fusion welding 8 inches or larger diameter pipelines. The technician's experience and verifiable references shall be documented in the HDPE pipe submittal.

Construction

00412.40 General - Identify and locate all sewer service connections according to Section 00401. An original copy of the post-television inspection video tape shall be provided to the Engineer for final approval.

00412.41 Preparation - All work shall be performed as specified herein and supervised by personnel experienced in the installation of pipe using the pipe bursting system.

Receiving/insertion pits shall be located to suit the pipe bursting operation without impacting the surrounding area of facilities. Restore at contractor's expense those pit areas where new manholes are not being installed. This includes providing a new manhole if an existing manhole is removed or damaged.

Identify and inform the Engineer of all pipe types and material encountered during the preparation phase. Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Engineer. Upon completion of the insertion and installation of the new pipe, expedite the reconnection of lateral service connections so as to minimize any inconvenience to the customers.
Excavate, expose, and isolate all sewer service connections prior to the start of any pipe bursting operation and pipe insertion. Determine if any tee connections are live and in mortar, concrete, or reinforced concrete.

If existing manholes are used as pits, remove all inverts and benches and channels to permit access for installation equipment as appropriate. When installing through an existing manhole, enlarge the input and output pipe as appropriate to accommodate the maximum OD size of the bursting device.

00412.42 Handling and Storage - Exercise special care during the unloading, handling, and storage of all polyethylene pipes to ensure that the pipe is not cut, gouged, scored, or otherwise damaged. Remove any pipe segment that has cuts in the pipe wall exceeding 10% of the wall thickness. Store pipe in a manner such that it is not deformed axially or circumferentially. After the unloading of pipe material at the project site and before installation, inspect all pipes to verify their condition with the Engineer. Submit a pipe condition inspection report for review and approval prior to installation.

Polyethylene pipe without an ultraviolet inhibitor shall be protected against the outside elements.

00412.43 Diversion of Flow - Furnish, install, maintain and operate a bypass pumping system as needed in accordance with the diversion of flow specifications outlined in Section 00490.

00412.45 Sags In Line - The Engineer will identify any sag in the existing sewer greater than 1/2 inch and show on the plans. Take necessary means to eliminate these sags by the system of pipe replacement, digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Engineer. Elimination of these existing sags shall be considered incidental to the pipe bursting bid item and no separate payment will be made.

Any sag found in a new pipe installed by pipe bursting that did not exist before installation of the new pipe shall be eliminated to the satisfaction of the Engineer at no additional cost to the City.

00412.46 Point Repairs - Repair the pipe where point repairs are identified on the Drawings. If not shown, point repairs will constitute extra work when approved by the Engineer. The work shall include verifying the location of the point repair, locating all interfering utilities, temporary flow bypassing, traffic control; excavation, haul off of all material, shoring, dewatering, pipe repairs or replacement, connections to existing pipe, backfilling, and surface restoration.
Pipe Joining -

Sections of polyethylene pipe shall be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer’s recommendations. Fusion equipment used in the joining procedure shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure. Electrofusion may be used for field closures as necessary when appropriate fusion equipment can be utilized in a trench type environment.

A fire-retardant bag or suitable enclosure shall be used with the heater plate to facilitate control of the heating process and to protect the heater plate surfaces from dirt and other debris when not in use. The heater plate surfaces shall be cleaned regularly as needed to prevent accumulation of fusion welding residues or other substances that may result in faulty pipe joining.

Butt fusion shall conform to ASTM D2657 and pipe manufacturer’s criteria for the type of joining. Joint strength shall be equal to that of the adjacent pipe. All fusion of pipe shall be in accordance with Section 00445.

After achieving the proper melt pattern, the pipe ends shall be brought together in a firm, rapid motion applying sufficient pressure to form a pipe bead (1/8 inch to 3/16 inch in height) around and inside the entire circumference of the pipe.

The inside and outside of pipe ends shall be cleaned with a cotton or non-synthetic cloth to remove dirt, water, grease, and other foreign materials. The pipe ends shall be cut square and carefully aligned just prior to heating.

Make all connections to concrete manholes, structures and pipelines using slip-on sanded adaptors. Rejoin ends of the pipeline in accordance with the manufacturer’s recommendation. Render the inside surface of the pipe free of cuts, gouges, or scratches. Remove fusion beads on the inside of butt welds with an inside rotary cutter or other approved method. Unless otherwise directed or approved, bead removal shall restore the inside diameter to that of the rest of the pipe. Use only tools and methods recommended by pipe manufacturer when cutting or machining the pipe.

Pipe Installation - Excavate, expose, and isolate all sewer service connections prior to the start of any pipe bursting operation and pipe insertion. If the existing service connections are encased in mortar, concrete, or reinforced concrete, remove the encasement.

Install the pipe by utilizing a constant tension system with a static, hydraulic or pneumatic bursting device that breaks away the existing pipe. The void created by the bursting device shall be sufficient in size to accommodate the HDPE pipe, which shall be installed immediately after the void has been formed. Provide adequately designed pipe bursting equipment to accomplish the replacement of the existing pipe under all adverse conditions.

All noise related to construction activities shall comply with 00290.30(d).
At no time shall the bursting device or the installation process put any undue stress on the existing surface. Manhole benches and channels shall be reconstructed after the new pipe is in-place.

Secure the pipe to concrete structures or manholes after the pipe has been installed along the length of sewer replaced. Use a sanded coupler adapter, as supplied by the pipe manufacturer around the pipe exterior, and grouted into the structure wall to create a watertight seal. The new pipe shall extend 12 inches inside of the manhole opening. The structure or manhole connections shall be made a minimum of 12 hours after pipe insertion.

00412.49 Low Pressure Air Testing - Low pressure air testing shall comply with 00445.72.

00412.50 Service Connections - Successfully test the installed pipe prior to reconnecting sewer services. Sewer service connections shall be connected to the new pipe and installed in a hole that shall be drilled the full inside diameter of the outlet or as recommended by the connection manufacturer.

Finishing and Cleanup

00412.70 Flushing - Prior to final acceptance and final inspection of the pipe by the Engineer, flush and clean all parts of the system by removing all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the pipe.

00412.71 Final Video Inspection - Provide Post-Construction Video Inspection according to Section 00401.

Measurement

00412.80 Measurement - The quantity of the pipe replaced by pipe bursting will be measured on a linear foot basis, for each pipe size, from center to center of manholes or other structures, as applicable.

Service connections will be measured on a unit basis, per each, by actual count, regardless of size. There will be no measurement of excavation and backfill or the required testing.

Payment

00412.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item Unit of Measurement
(a) HDPE Pipe-burst Installation. ___ Inch. .................. Foot
(b) Service Connections .......................... Each

Item (a) the nominal size of the new HDPE pipe will be inserted in the blank.

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Item (b) includes all required work to excavate for, backfill, and install service connections.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Resurfacing work will be paid for according to Section 00495.

No separate or additional payment will be made for surface restoration for pits, CCTV inspection (pre and post) pipe cleaning (pre and post), sag elimination, point repairs, leak testing, and acceptance testing.
Section 00415 – Vegetated Stormwater Facilities

Description

00415.00 Scope - This work consists of constructing stormwater planters, swales or curb extensions to the lines and grades shown or established. The work includes furnishing and constructing connections to other drainage structures or systems, and installation and maintenance of the entire facility, as necessary, for a complete installation.

00415.01 Definitions:

Stormwater Curb Extension - A stormwater facility that protrudes into the roadway. The facility is often used to retrofit existing developed roadway by removing a portion of the existing pavement and roadbed. Then a curb is constructed closer to the roadway centerline in order to install a landscaped depression that collects, filters, infiltrates, and conveys stormwater. A stormwater curb extension may also be constructed with new roadway development. Existing sidewalks, plantings strips and curbs may or may not be modified. Plantings are surrounded by vertical curbs or walls on all sides.

Stormwater Planter - A stormwater facility with a relatively flat landscaped reservoir used to collect, filter, infiltrate and convey stormwater. Plantings are surrounded by vertical curbs or walls on all sides.

Stormwater Swale - A stormwater facility with a landscaped depression used to collect, filter, infiltrate, and convey stormwater. Plantings are located on gradually sloping areas between the roadway curbing and sidewalk.

Materials

00415.10 Materials - Furnish materials meeting the following requirements:

- Coir Filter Fabric...............................................00280.10(v)
- Commercial Grade Concrete ....................................00440
- Controlled Low Strength Material (CLSM)....................00442
- Geomembrane Liner..................................................00350
- Mulches ................................................................ 01040.20
- Open Graded Aggregates ................................02690.20(g)
- Perforated Corrugated Polyethylene Pipe ............ 02410.60
- Plantings....................................................................01040
- Topsoil, Stormwater Facility..............................01040.14(d)

00415.11 Plastic Sheeting - Use minimum 30 mil thick polyvinyl chloride or HDPE sheeting.

00415.12 Ballast Aggregates - Furnish ballast aggregates of 4" - 2" as shown. Use clean, hard, durable aggregates, reasonably well graded from the maximum to minimum size.

00415.13 Ballast Aggregates Acceptance - The material will be accepted by visual inspection by the Engineer.
00415.40 **General** - Construct the planters or swales as shown or as directed. A facility table, including finish elevations and dimensions, will be provided by the Engineer.

The length of open excavation in advance of concrete or soil placement operations shall be kept to a minimum, and in no case shall it exceed two blocks at one time unless otherwise approved. If the unfinished excavation or restoration exceeds approved limits, the associated construction operation shall be suspended and not resumed until authorized.

00415.41 **Earthwork** - Excavate according to Section 00330 and to the depths, widths, and cross-sections shown, specified, or directed. Facility bottoms, temporary construction benches, and final soil surfaces shall be without ruts or other surface imperfections capable of channeling water flows.

00415.42 **Existing and Proposed Utility Services** - When encountered during construction, utility lines must be relocated by the utility owner. Coordinate this work with the Engineer and each facility per 00150.55(c).

Wherever existing utility service trenches are encountered adjacent to a facility during excavation and construction, provide a watertight seal along the utility trench wall whenever granular material is present in the exposed portion of the trench. The seal shall be by means of a native soil, imported clay or bentonite plug as approved. Taking care not to over-excavate, carefully remove the granular material at least 6 inches into the rock trench wall and firmly pack the resulting space with native soil, imported clay, or bentonite as directed.

00415.43 **Plastic Sheeting of Geomembrane Liner** - Install as shown or directed.

00415.44 **Retaining Walls, Concrete Curbs, Walks and Other Concrete Structures** - Install as shown or directed. Remove all concrete overspill and debris from facility prior to aggregate or topsoil placement.

00415.45 **Material Placement** - After construction of the concrete elements, install materials as shown or directed.

00415.46 **Facility Erosion Control** - Temporary erosion control measures are required until permanent stabilization methods are functional. Install as shown or directed, and in accordance with Section 00280.

00415.47 **Finish Grading** - Grade slopes in a uniform manner as shown or directed. Bring grading conflicts to the Engineer prior to proceeding with the work. Round any abrupt changes in the surfaces and feather grades gradually to meet existing contours. Minor adjustments to the grading and contouring shown are anticipated to meet site conditions. Hand grading and final refinement of the finish grade shall be as directed. The Engineer will have final approval of all grading and contouring.
Protection of the Facility - During all phases of construction, the facility must be protected from foot or equipment traffic that is unrelated to the construction of the facility. Under no circumstances should materials and equipment be stored in the facility. If an excavated area is to be left open overnight, secure the area to ensure public safety by installing temporary fencing and traffic control measures as directed.

Facilities shall be kept clean and shall not be used as erosion or sediment control structures during construction.

Facility Maintenance and Establishment

Maintenance and Establishment Period - During the 2 year warranty period, the facilities are to be inspected and cleaned at least every 6 months, as sediment or debris accumulation necessitates. In this same period, refresh or restore topsoil and plantings in accordance with good horticultural practices under prevailing conditions. At the end of the warranty period, and prior to final inspection and acceptance by the City, perform a final clean-out of the facility.

Measurement

Measurement - The quantities of facilities constructed under this Section will be measured on the area basis, in place:

Area Basis - Measurement will be on the ground surface by the square foot. The limits of measurement will be the back of curb, edge of sidewalk, or other asphalt or concrete structure surrounding the facility. If a facility does not have an edge on a side, the limit of measurement will be the top of slope of the facility.

Payment

Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Stormwater Curb Extensions</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Stormwater Planters</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Stormwater Swales</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate pay items, no separate or additional payment will be made for earthwork.
Pipe outside of the defined facility area will be paid for according to Section 00445.

Inlets will be paid for according to Section 00470.

Connection to existing structures will be paid for according to Section 00490.

Retaining walls will be paid for according to Section 00596.

Pavement and base aggregate will be paid for according to Sections 00640 and 00744.

Concrete curbs, walks and other miscellaneous concrete structures will be paid for according to Section 00759.
Section 00430 - Subsurface Drains

Description

00430.00 Scope - This work consists of constructing subsurface drains to the lines and grades shown or established using drain pipe, special filter material or granular drain material, and drainage geotextile.

00430.01 Definitions - The terms used in designating drain pipe or when referring to them on the plans are as follows:

Aluminum - The base metal for aluminum sheets.

Concrete, Steel, Aluminum, Polyethylene, Polyvinyl Chloride - The basic material of the pipe.

Drain Pipe - Perforated pipe of specified material.

Metal - Aluminum and steel.

Steel - The base metal for galvanized or aluminum coated sheets.

Subsurface Drain - Drainage system beneath the base, usually with a perforated drain pipe, to collect and drain groundwater.

00430.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its limitations will be shown on the plans or on a "Pipe Data" sheet of the plans.

The limiting factors and requirements shown on the plans or on the Pipe Data sheet are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution meets the approval of the Engineer and is made at no additional cost to the City.

00430.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00430.10 Materials - Furnish materials meeting the following requirements:
Furnish wire mesh that is commercial quality 1/4 inch galvanized metal screening.

**00430.11 Granular Drain Backfill Material** - Furnish granular drain backfill material of 1 1/2" - 3/4", 1 1/4" - 3/4", or 3/4" - 1/2" crushed or uncrushed rock or gravel meeting the requirements of 02690.20(d) and the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1 1/2&quot; - 3/4&quot;</th>
<th>1 1/4&quot; - 3/4&quot;</th>
<th>3/4&quot; - 1/2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>95 - 100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1 1/4&quot;</td>
<td>90 - 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>90 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 15</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td></td>
<td></td>
<td>0 - 3</td>
</tr>
</tbody>
</table>

**Construction**

**00430.40 General** - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, according to Section 00405 and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install a Type W-1 delineator at each outlet protection block as shown.

**00430.41 Foundations in Unyielding Material** - Excavate rock, hardpan or other unyielding materials a minimum of 3 inches below established grade of the pipe exterior to place special filter material or drain backfill material.

**00430.42 Laying Pipe** - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

**00430.43 Joining Pipe** - Fasten pipes together with appropriate coupling fittings or bands as specified for the type of pipe used. Close upstream end of pipe with plugs suitable to prevent entry of soil materials.
00430.44 **Contact Surfaces, Aluminum to Concrete** - Coat aluminum pipe and aluminum coated steel pipe that contact portland cement concrete with asphalt mastic according to Section 00445.

00430.45 **Inspection** - The installation will be inspected after the pipe is laid and joined and before backfilling. Remove and reinstall or replace any pipe found to be out of alignment, unduly settled or damaged.

00430.46 **Backfilling:**

(a) **Special Filter Material** - After the pipe is installed and inspected, place up to 12 inches of uncompacted special filter material above the top of the pipe. Above this, place approved backfill material or special filter material, as directed, and compact according to Section 00405.

(b) **Granular Drain Backfill Material** - Drainage geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

**Measurement**

00430.80 **Measurement** - The quantities of subsurface drain pipes of the various kinds, types and sizes will be measured, with no deduction for fittings and special sections, along the pipe flow line from end to end of pipe.

The quantities of subsurface drain outlets will be measured on the unit basis.

**Payment**

00430.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Inch Drain Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Subsurface Drain Outlets</td>
<td>Each</td>
</tr>
</tbody>
</table>

In item (a), the nominal diameter of pipe will be inserted in the blank.

Item (b) includes furnishing and installing pipe, constructing outlet protection blocks, connecting pipe to inlets, and excavating and disposing of excess materials.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Delineators will be paid for according to 00840.90.

Trench resurfacing will be paid for according to 00495.90.
No separate or additional payment will be made for:

- trench excavation
- trench backfill
- special filter material
- drainage geotextile
- granular drain backfill
- fittings
- special pipe sections
Section 00440 - Commercial Grade Concrete

Description

00440.00 Scope - This work consists of furnishing, placing and finishing commercial grade concrete (CGC).

Materials

00440.10 Materials - Furnish materials meeting the following requirements:

| 02020 Water | 02040 Admixtures | 02080 Grout | 02050 Curing Materials | 02070 Bonding Agents | 02010 Cement | 02030 Modifiers | 02060 Aggregates |

00440.11 Proportioning - Furnish in writing to the Engineer, the proportions by weight of the following materials before using CGC:

- air entraining admixtures
- cement
- each size of aggregate
- fly ash
- GGBF slag
- other admixtures
- water

00440.12 Properties of CGC - Furnish a workable mixture of CGC that is uniform in composition and consistency, and has the following characteristics:

- Entrained Air - 4.0% to 7.0%
- Slump - 5 inches or less
- Compressive Strength - Minimum 3,000 psi at 28 days
- Temperature - Minimum 50 °F to maximum 90 °F

00440.13 Field-Mixed Concrete - CGC may be field mixed for work items listed in 00440.14(a).

00440.14 Acceptance Sampling and Testing:

(a) General - Acceptance sampling and testing will be based on samples obtained at the site of placement from the discharge of the delivery vehicle. All sampling and testing shall be performed by a QCT.
CGC mixture may be accepted visually for the following items of work:

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Conduit Backfill</td>
<td>00960</td>
</tr>
<tr>
<td>Fence Post Footings</td>
<td>01050</td>
</tr>
<tr>
<td>Guardrail Anchors</td>
<td>00810</td>
</tr>
<tr>
<td>Irrigation System Thrust Blocks</td>
<td>01120</td>
</tr>
<tr>
<td>Mailbox Support Footings</td>
<td>01070</td>
</tr>
<tr>
<td>Outlet Protection Blocks</td>
<td>00430</td>
</tr>
<tr>
<td>Square Tube Sign Support Footings</td>
<td>00930</td>
</tr>
</tbody>
</table>

(b) **Delivery Tickets** - Send a delivery ticket with each load recording the source, day, time of batch, size of load and quantity of individual constituents in the load. A delivery ticket will not be required for field-mixed concrete.

(c) **Plastic CGC** - Acceptance of plastic CGC will be based on tests performed by the QCT according to the MFTP and 00440.12.

(d) **Hardened CGC** - Acceptance of the hardened CGC will be according to 00440.12. Cast one set of cylinders per 20 cubic yards, with a maximum of one set per day.

00440.15 **Quality Control** - Provide quality control according to Section 00165.

00440.16 **Pre-Approved Mix Designs** - Contact the Project Manager for a list of pre-approved CGC Mixes.

### Labor

00440.30 **Quality Control Personnel** - Provide certified technicians in the following fields:

- CSTT
- QCT

### Construction

00440.40 **General:**

(a) **Mixing** - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mixture.

(b) **Placing** - Place CGC according to the appropriate Sections in which CGC is required and the following:

- Place using the best common practices to avoid segregation.
- Vibrate and spade to achieve a dense homogeneous concrete, free of voids and rock pockets.
- Place within 90 minutes after batching and mixing.
(c) **Forms** - Provide forms for CGC according to the appropriate Sections in which CGC is required and best common practices. Place to the lines and grades shown or directed.

(d) **Weather** - Do not place CGC when the air temperature is below 35 °F without approval.

Protect from freezing if the air temperature is expected to drop below 35 °F during the first 5 calendar days after CGC placement.

(e) **Curing** - Cure CGC by covering with burlap, canvas, sand or other acceptable material, and keep moist for a minimum of 7 calendar days.

Curing compounds may be used except on concrete surfaces or reinforcement that will come in contact with adjacent concrete pours. Use compounds according to the following:

<table>
<thead>
<tr>
<th>Section</th>
<th>Item</th>
<th>Type 1 or 1-D Clear</th>
<th>Type 2 White-Pigmented</th>
</tr>
</thead>
<tbody>
<tr>
<td>00480</td>
<td>drainage curbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00599</td>
<td>slope paving curbs, and berm paving</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>00759</td>
<td>walks, sidewalk ramps, driveways, surfacings, curbs, and islands</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Use Type 2 except when the Engineer requires Type 1 or 1-D

Apply curing compounds at a rate of not be less than 1 gallon per 150 square feet.

00440.41 **General Surface Finish** - Give concrete surfaces a general surface finish, according to 00540.53(a), in addition to the finish specified for a particular item of work.

00440.42 **Replacement or Price Reduction** - Remove concrete represented by cylinders that fail to meet the minimum strength requirement and replace at no additional cost to the City. If the Engineer determines that the low-strength concrete is suitable for the purpose intended, the Contractor may accept a price reduction established by the Engineer instead of removal and replacement.

**Measurement**

00440.80 **Measurement** - No measurement of quantities will be made for CGC.

City of Portland 2010
00440.90 Payment

00440.90 Payment - No separate or additional payment will be made for CGC. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00442 - Controlled Low Strength Materials

Description

00442.00 Scope - This work consists of furnishing and placing Controlled Low-Strength Materials (CLSM).

00442.01 Definition:

Controlled Low-Strength Material - A highly flowable lean concrete mix; a mixture of fly ash, cement, fine aggregates, water and admixtures, if necessary.

Materials

00442.10 Materials - Furnish materials meeting the following requirements and as modified in the Special Provisions:

- Admixtures ................................................................. 02040
- Fly Ash ................................................................. 02030.10
- Portland Cement .................................................. 02010.10

00442.11 Fine Aggregates - Furnish fine aggregates that are commercial quality concrete sand.

00442.12 Proportioning of CLSM Mixture - Furnish the following, to the Engineer, prior to using any CLSM on the Project:

- Written certification of proposed CLSM materials proportions and compressive strength.
- 28-day cylinder reports from a trial CLSM batch based on above certification. Include evidence that compressive strength requirements for specific applications are met.

00442.13 Compressive Strength - CLSM shall attain a 28-day compressive strength of 100 psi - 200 psi.

00442.14 Acceptance - Acceptance will be based on the Engineer's review and approval of written certification and trial batch cylinder reports as required by 00442.12.

Measurement

00442.80 Measurement - No measurement of quantities of CLSM will be made for CLSM.

Payment

00442.90 Payment - No separate or additional payment will be made for CLSM. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00445 - Sanitary, Storm and Culvert Pipe

Description

00445.00 Scope - This work consists of constructing and or/reconstructing culverts, gravity and pressure sewers, service laterals, underdrains, inlet leads, stubouts, and associated joints, fittings, and other accessories.

Install pipes in the kinds, sizes and lengths and at the locations shown on the plans or as directed to the lines and grades established. The work includes furnishing and constructing joints and connections to other drainage structures or systems, as necessary, for complete installations.

00445.01 Definitions - The following terms have the meanings presented below when used in this Section:

Concrete, Ductile Iron, PVC, and HDPE - The basic material of the pipe

Concrete Block - Encasements, thrust blocks, anchor blocks, plugs and cutoff diaphragms

Culvert Pipe - Typically, a concrete, ductile iron, PVC, or HDPE pipe passing under a roadway

DR (Dimension Ratio) - The pipe average outside diameter divided by its minimum wall thickness

Flexible Pipe - Pipes constructed of ductile iron, PVC, steel and HDPE. For the purposes of these specifications, all potable water pipes are considered to be flexible pipes.

HDPE - High Density Polyethylene

Joint - The place where the ends of sections or modified sections of pipe contact one another

Metal Pipe - Ductile Iron

Pavement - Pavement as defined in Section 00110, as well as driveways, curbs, gutters, walks, dikes, walls and other similar asphalt or portland cement concrete structures

Pipe - All pipe, regardless of kind, size, shape or use

Plain Concrete - Non-reinforced concrete

PVC - Polyvinyl Chloride

Rigid Pipe - Pipes, other than potable water pipes, constructed of concrete and clay
Sanitary and Storm Sewer Pipe - Typically, concrete, PVC, solid wall HDPE or ductile iron pipe.

SDR (Standard Dimensional Ratio) - Same as DR

Section - The individual pieces in which the furnished pipe is manufactured.

Materials

00445.10 General - Furnish appropriate manufacturer or fabricator certification, based on the manufacturer's quality control tests, that the materials used in the production of the pipe meet these Specifications. Materials and strength shall be as specified for the particular kind of pipe and fittings required.

Use flexible elastomeric gasket joints on all pipes and fittings unless joining pipe by butt fusion. Furnish caps or plugs with each fitting, outlet or stub as required, with the same type gasket or joint as the pipe.

Each pipe shall be clearly marked to identify its class and date of manufacture.

Use the same material for all pipe and fittings for both the sewer mainline and any service laterals located between two consecutive manholes, unless otherwise approved. Use 6 inch pipe for residential service laterals when not otherwise specified.

Provide tee or wye fittings in the sewer main for service laterals and catch basins or inlet connections. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

Cap or plug all fittings that are terminal ends or for future use and provide with gaskets of the same material as used in the pipe joint. Fit with an approved mechanical stopper, or install an integrally cast knockout plug. The cap or plug shall be capable of withstanding test pressures without leaking and, when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.
Materials - Furnish materials meeting the following requirements:

- Corrugated or Spiral Rib Aluminum Alloy Pipe: 02420.40
- Corrugated or Spiral Rib Steel Pipe and Pipe Arches: 02420.10
- Commercial Grade Concrete in blocks: 00440
- Ductile Iron Pipe: 02420.11
- Electronic Location and Visual Identification of Sewers: 00446
- Metal Reinforcement in Blocks: 02510.10
- Nonreinforced Concrete Pipe: 02410.10
- Polyvinyl Chloride (PVC) Pipe: 02410.70
- Protective Coatings: 02420.20
- Reinforced Concrete Pipe: 02410.10
- Rubber Gaskets: 02440.40
- Solid Wall High Density Polyethylene (HDPE) pipe: 02410.60

(a) Pipe Anchors - Use pipe anchors conforming to the details as shown.

(b) Cleanouts - Use materials conforming to the details as shown.

(c) Electronic Location and Visual Identification of Sewers - Use materials in accordance to Section 00446.

(d) Fittings for Concrete Pipe - Where fittings are fabricated by inserting a stub into a hole cut in concrete pipe, grout with a non-shrink grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

(e) Fittings for HDPE Pipe - HDPE fittings shall be molded or fabricated. Manufacture all HDPE fittings from the same cell class of material as the mainline pipe. Fittings shall be manufactured in accordance with ASTM D 3261-97. Butt fusion outlets shall be manufactured to the same outside diameter or externally reinforced wall thickness, tolerances and the internal pressure service equivalent as the mating pipe.

1. **Fittings for Gravity HDPE Pipe** - For gravity HDPE pipe, fittings shall have a DR of the same or greater strength than the pipe.

2. **Fittings for Pressure HDPE Pipe** - All HDPE fittings used in pressure pipeline applications shall be pressure rated the same as or greater than the pressure rating of the pipe. Mitered HDPE fittings used in pressure applications shall be manufactured using the butt fusion process from pipe of the same size and a minimum of one Standard Dimension Ratio heavier than the main pipe.

Use Type 316 stainless steel stiffeners where plain ends of pipe are used in conjunction with mechanical fittings that rely on compressing the outside pipe diameter. Also use stainless steel stiffeners whenever mechanical restraints provide restraint to a HDPE pipe system.
(f) Flanges for HDPE Pipe - Where approved, use flanged connections to mechanically connect HDPE pipe to HDPE pipe and fittings. Use HDPE pipe flanges with Type 316 stainless steel backing rings. All nuts, washers and bolts for flanges shall be Type 316 stainless steel. Connection hardware shall develop the full strength of the flanged joint. Suitable gaskets are required when joining to non-polyethylene materials.

(g) Flexible Couplings for HDPE Pipe - Use flexible couplings for joining HDPE pipe to HDPE pipe and fittings. Flexible couplings shall be specifically designed for the application, and shall have a pressure rating equal to or greater than the main pipe.

(h) HDPE Laterals - Tee and wye fittings to connect service laterals shall be either molded butt fusion HDPE fittings or molded saddle fusion HDPE fittings. In situations where laterals exceed the sizes available in molded fittings, fabricated HDPE fittings will be allowed only with approval.

(i) Joints for HDPE Pipe - HDPE pipe and fittings shall be joined by the butt fusion process set forth in ASTM D 3261-97 and ASTM D 2657-97. The butt fusion procedure shall also conform to the manufacturer’s specific recommendations. The tensile strength at yield of the butt fusion joints shall be not less than that of the pipe.

(j) Service Lateral 2 Inch x 4 Inch Markers - Use materials conforming to Section 00446.

(k) Flexible Closure Collar Couplings - Do not use flexible closure collar couplings unless specified or approved. Couplings shall incorporate full length and full diameter shear bands. All metal parts shall be stainless steel. Couplings shall be of the type produced by “Fernco” or “Mission” or approved equal.

Labor

00445.30 General - Perform all pipe fusion using a competent operator that has been trained, as certified by the supplier or manufacturer of the pipe.

(a) Welder Qualifications for Fusing HDPE Pipe - The operator shall have a minimum of 2 years experience in fusing those sizes of pipe shown. A representative of the supplier shall field review and approve the procedure used for the first 4 fusion joints.

(b) Training Sessions - Provide training sessions on the proper procedures for testing, assembly and installation of HDPE pipe and associated hardware. Address polyethylene fusion machine operation instructions in detail. General construction personnel with the responsibility of assembly, fabrication, handling, installation, and testing of pipe shall attend training. Quality control personnel and polyethylene fusion machine operators shall also attend training sessions. Submit a list of those authorized to perform polyethylene fusion before any installation or work on HDPE pipe.
Make all training sessions available to the Engineer at no additional cost to the City. Schedule training sessions at a date and time agreeable to both parties.

**Construction**

00445.40 **General** - Construct culvert, sanitary sewer, and storm sewer, pipe according to the following:

(a) **Trench Work** - Excavate trench, prepare bedding, pipe zone material and trench backfill, and dispose of excavated material according to Section 00405.

(b) **Line and Grade** - The Engineer will establish centerline and grade control prior to the start of construction.

Do not deviate from the specified line and grade more than 1/2 inch for line and 1/4 inch for grade, provided such variation does not result in a level or reverse sloping invert. Measure for grade at the pipe invert.

Establish line and grade with an approved pipe laser, or other approved method, by transferring the cut information from the offset stakes starting with 0+00 at a downstream manhole or structure, then, at intervals of 0+10, 0+25, and 0+50 and continuing at 50 foot intervals, maximum, thereafter.

All other methods of establishing line and grade for pipe shall transfer the cut information from the offset stakes at maximum intervals of 25 feet. Submit all other alternate methods, other than lasers, for approval before beginning work.

Lay sewer service lateral pipe in a straight line and at a uniform grade between the tee or wye and the end stake established by the Engineer. Where minimum slopes are used, lay the pipe by means of a builder’s level of good quality and not less than 24 inches in length. Minimum slope shall be 1/4 inch per foot unless otherwise approved but in no case less than 1/8 inch per foot.

(c) **Pipe Distribution and Handling** - Unload pipe only by approved means.

Inspect the pipe and fittings prior to lowering into the trench to ensure no cracked, broken or otherwise defective materials are used. Clean the ends of the pipe thoroughly, remove foreign matter and dirt from the inside of the pipe, and keep the pipe clean during laying and joining.

Do not distribute more than one day’s supply of material in advance of pipe laying unless otherwise approved. Do not unload pipe of any size by dropping to the ground. Do not drop or dump pipe into trenches. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipe from the jobsite.
(d) Concrete Closure Collars - Use concrete closure collars only when approved, and only to make connections between dissimilar pipe or where standard rubber gasketed joints or transition couplings are not available. Place the collars using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, first prepare the PVC surface for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, apply an approved commercial concrete bonding agent to the sand surface prior to placement of the concrete.

(e) Installation of Sanitary Sewer Service Tees and Wyes - Install tees, wyes and service lateral fittings as shown or as staked in the field. Provide a compacted aggregate base of pipe bedding material under all tees, wyes and lateral fittings extending to the springline of the fittings.

Provide ends of all service laterals and fittings with an approved watertight plug, or cap suitably braced to prevent blow off during hydrostatic or air tests. The plug or cap shall be removable and provide a socket suitable for making a flexible joint lateral connection or extension.

The maximum deflection permissible with any one fitting, except a service lateral tee, shall not exceed 45°; accomplish the deflection with standard bends.

Connect a service lateral to a manhole or structure only when approved. Make the connection so a standard pipe joint is located not more than 18 inches from the manhole or structure.

(f) Pipe Anchors - Construct metal or concrete pipe anchors as specified or as shown.

00445.41 Installing Pipe Under Railroad - Prior to beginning any under-track work, submit plans of construction, and details of the methods and equipment proposed to be used, to the Engineer for submittal to the Railroad. Do not begin under-track work until Railroad approval is obtained.

Within the limits indicated on the plans, do not install the pipe under the railroad tracks by the open trench method. Within these limits install the pipe by tunneling, jacking, boring or similar methods, approved by the Railroad, as the Contractor elects, according to Section 00406. Install the pipe to the lines and grades established and backfill completely all voids around the installation with specified material, to the satisfaction of the Railroad.

00445.43 Placing and Joining Pipe:

(a) General - Begin pipe laying at the downstream end of the pipe line and proceed upgrade with spigot or tongue ends pointing in the direction of flow. Assemble joints in accordance with the recommendations of the manufacturer for the type of joint used. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.
Take care to properly align the pipe before joints are forced entirely home. All pipe joints shall be in the “home” position, where the least gap (if any) exists when the pipe components that are fitted together as tightly as the approved joint design permits. After installation, prevent movement from any cause including uplift or floating.

Prevent excavated or other foreign material from getting into the pipe. Plug or close off pipes that are stubbed off for future connection. When cutting or machining of the pipe is necessary, use only the tools and methods recommended by the pipe manufacturer. All field joints shall:

- Provide equal or greater strength than the adjoining pipe.
- Fit close and tight.
- Provide a smooth and uniform interior surface.
- Secure and hold adjoining sections to each other.
- Fasten securely to adjoining structures and special sections.

(b) Concrete Pipe:

(1) Elliptical Reinforced Pipe - Lay elliptical reinforced pipe so that the top or bottom marks are not more than 5° from vertical.

(2) Flexible Joints at Structures - Provide 36 inch or smaller sewer pipes entering or leaving manholes or other structures with flexible joints within 18 inches of the exterior wall. Pipes larger than 36 inch shall have a flexible joint within a distance from the exterior wall equal to 1/2 the inside pipe diameter. If the flexible joint exceeds the specified distance from the exterior wall, Class A bedding, in Section 00405, may be used as a substitute. Do not substitute Class A bedding without first receiving the City's approval. Class A bedding, shall extend from the structure to the back of the pipe bell. Also provide a #4 rebar mat with 3 longitudinal bars minimum, cross-tied on 12 inch centers beneath the pipe and extended into the structure wall or base or as directed.

(3) Joint Gap - Repair all joint gaps that exceed the normal “home” position gap by more than 1/4 inch. In cases where a joint gap exists but does not exceed the normal “home” position gap by more than 1/4 inch, the Engineer may require repair of the joint if, in the Engineer's judgment, these gaps detract significantly from the integrity of the joint based on soil conditions and the intended use of the pipe.

(4) Multiple Excessive Joint Gaps - When three or more joint gaps exceed the allowable joint gap or when three or more corrections of defective work occur within any manhole-to-manhole section, properly relay all pipe between first and last defect to reduce the total defects to two per manhole-to-manhole section. Complete this work at no additional cost to the City. Work required in repairing or re-laying is included as part of Contractor’s construction work limits.
(5) Excessive Joint Gap - Should a joint gap in the completed line exceed the allowable joint gap determined in accordance with the MSPCP and these Specifications or should visible leakage exist at the joint, construct a reinforced concrete closure collar around the joint or re-lay the pipe as approved at no additional cost to the City. Repaired joints will be subject to joint testing requirements.

(c) PVC Pipe - Install PVC pipe and fittings in conformance with the manufacturer's recommendations.

Cut the pipe in a neat manner, at right angles to the axis of the pipe, and dress the cut end.

(1) Connections to Manholes - Make connections to manholes with an approved manhole adapter grouted into the manhole wall or cast-in-place with the manhole base. If the joint at the coupling meets the requirement of a flexible joint as determined by the Engineer, no additional flexible joint within 18 inches of the manhole wall will be required.

(2) Service Lateral Connections to Mainline - Connect service laterals to mainline PVC sewer pipe with full line tees and standard wyes and eighth bends.

(3) Perforated PVC Pipe - Install perforated PVC pipe according to Section 00430.

(d) HDPE Pipe - Install solid wall HDPE pipe and fittings in conformance with the manufacturer's recommendations.

Assemble and join solid wall HDPE pipe at the site using the thermal butt-fusion method or approved coupler to provide a leak proof joint. Threaded or solvent-cement joints are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Use personnel certified as fusion technicians by the manufacturer of the pipe or fusing equipment to accomplish the fusing.

Join HDPE pipe by the thermal butt fusion method prescribed in ASTM D 2657-97 and ASTM D 3261-97, and also in accordance with the procedures established by the pipe manufacturer, including fusion pressure, temperatures and cycle times when specified. Pay particular attention to use of proper interface pressures and heater plate temperatures. The tensile strength at yield of the butt-fused joints shall not to be less than that of the pipe.

Only personnel possessing appropriate qualifications and certifications shall join pipe. If necessary, clear, grade and surface joining sites to provide enough space for pipe storage and fusion equipment. Render the site free of rocks, stumps and debris that could cut, scar, or gouge the pipe. Provide a shelter over the joining operation during adverse weather conditions. Prevent water from coming into contact with the fusion heater plate. Perform all joining above ground unless otherwise approved.
Assemble lengths of pipe into suitable installation lengths. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Prior to attempting fusion on polyethylene pipe, qualified joining personnel shall obtain and use correct fusion temperature, interface pressure, and cycle time information for the particular HDPE material being joined. The selected fusion equipment shall conform to pipe manufacturer equipment recommendations.

Fused joints on gravity pipelines do not require electronic data recording, unless directed. Fused joints on pressure pipelines shall be monitored and documented with an electronic data recording system. Use the data recording system to monitor the following information:

(1) Data Recording System Record Data

- Date and Time
- Joint Number
- Job Number
- Employee Number
- Machine ID
- Machine Model
- Piston Area
- Pipe Material
- Pipe Size

Interface Pressures

- Heat
- Soak
- Fuse
- Cool

Recommended Gauge Pressure

- Heat
- Soak
- Fuse
- Cool

Recorded Data

- Drag Pressure
- Data logger Probe Temperature
- External Probe Temperature
The data recording system shall be McElroy Datalogger or approved equal. At the start of each shift, provide the Engineer with copies of the fusion graphs for the previous shift’s fusions. Cut out and remove any joints determined to be outside the acceptable parameters a minimum of 12 inches from the joint and rejoin using the thermal butt fusion process.

Install fittings, couplings and fuse joints to make a complete HDPE pipe system. During shipping, delivering, and installing, handle and store the pipe, fittings, and accessories according to manufacturer’s recommendations and in such a manner as to ensure a sound, undamaged condition upon incorporation into the Work. Provide adequate storage for all site-delivered materials and fusion equipment. Protect and maintain all such material and equipment.

Follow manufacturer’s recommendations when hauling, unloading, and stringing pipe. Take all necessary precautions to prevent damage to the pipe. Do not push or pull pipe and fittings over sharp projections. Do not drop pipe or allow other objects to be dropped on it.

Inspect the pipe for defects before installation. Remove any pipe from the site that shows kinks, buckles, cuts, gouges, or any other damage that may affect the performance of the pipe and replace it with new identical pipe. Remove all sections of pipe with cuts, gouges, or scratches on the outside surface of the pipe that exceed 10% of the wall thickness of the pipe. Whether found before or after installation, replace defective material with sound identical material without additional cost to the City.

Lower pipe and accessories into the trench by means of derrick, ropes, belt slings, or other suitable hoisting equipment. Unless otherwise directed, complete all joints before placing butt-fused polyethylene pipe in the trench. Do not under any circumstances drop or dump any pipeline materials into the trench. Before backfilling, render the full length of each section of pipe resting solidly upon pipe bedding material. Pipe that has the bedding grade disturbed after placement shall be taken up and reinstalled.

Do not perform pipe fusion in water or when trench conditions are unsuitable for the Work. Join all butt-fused joints above ground and not in the trench unless otherwise approved. If so approved, water shall be kept out of the trench until joining is completed.

When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter pipe or fittings. Pipe ends left for future connections shall be plugged or capped.

Polyethylene pipe shall be brought to within 5 °F of ambient earth temperature prior to cutting to length for placement of fittings. All HDPE pipe shall be at the temperature of the surrounding soil at the time it is backfilled and completed.

Make all connections to concrete manholes, structures and pipelines using slip-on sanded adaptors. Rejoin ends of the pipeline in accordance with
the manufacturer's recommendation. Render the inside surface of the pipe free of cuts, gouges, or scratches. Remove fusion beads on the inside of butt welds with an inside rotary cutter or other approved method. Unless otherwise directed or approved, bead removal shall restore the inside diameter of the rest of the pipe. Use only tools and methods recommended by pipe manufacturer when cutting or machining the pipe.

(2) Bolt Up Procedure for Flanged HDPE - Submit manufacturer's bolt up procedure.

(e) Field-Fabricated Fittings:

(1) Fittings - Field fabricate tee or wye fittings for required connection when shown or approved. Field-fabricated connections shall be free of visible leakage. Make all field-fabricated tee or wye fittings equal to or better than approved manufacturer supplied tee or wye fittings and provide a flexible joint at the point of connection to the tee or wye. Do not allow the tee or wye to protrude past the inside wall surface of the sewer main. Finish the inside wall surface to provide a smooth, uniform area for uninhibited flow.

(2) Connection to Sewer Main - Fabricate fittings by inserting a pipe stub into a hole cut in the sewer main and grout with a non-shrink grout. Coat surfaces to receive grout with an epoxy-bonding agent before grouting. Submit fabrication details of fittings for approval before fabrication. The Engineer may require steel reinforcement at no additional cost to the City. If approved, use a pre-manufactured pipe connector in lieu of tees for field-fabricated connections on sewer reconstruction projects.

(f) Inspection - After the pipe is laid and joined, and before any backfilling over it, the installation will be inspected. Re-lay or replace any pipe found to be out of alignment, unduly settled, to have excessive joint gap, or to be damaged.

(g) Service Lateral 2 Inch x 4 Inch Markers - Install 2 inch x 4 inch markers at the end of each new service lateral not connected to a building sewer as shown or as directed by the Engineer and according to Section 00446.

(h) Disconnection and Reconnection of Existing Service Laterals - Disconnect existing service laterals from the existing sewer and reconnect to new sewer as shown or directed. Locate all existing service laterals and utilities before beginning work.

(i) Deep Connection Risers - Construct Deep Connection Risers as shown or directed, and conforming to the Standard Drawings.

(j) Culverts - Remove and replace culverts in conformance with all applicable requirements of this section and Section 00405 Trench Excavation, Bedding and Backfill.

00445.45 Backfilling - After the pipe is installed and inspected, backfill pipe zone and trench according to Section 00405.
00445.46 **Concrete Blocks** - When called for by the plans or directed, construct concrete blocks, with commercial grade concrete according to Section 00440.

00445.48 **Electronic Location and Visual Identification of Sewers** - Install facilities for electronic location and visual identification of sewers as shown or directed, according to Section 00446.

**Finishing, Clean Up and Testing**

00445.70 **General** - After laying and joining pipe for sanitary sewers, storm sewers and culverts, and backfilling trenches, test the installations for water tightness, including inlet and outlet connections, to the Engineer's satisfaction. Perform video inspection, deflection, and hydrostatic testing and low-pressure air testing as required.

00445.71 **Requirements Prior to Tests:**

(a) **General** - All sanitary, storm and culvert gravity systems, siphon and irrigation systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible infiltration of water. Test manholes as specified in Section 00470.

On pipe 42 inches in diameter and larger, individual joints may be tested by an approved joint testing device. All details of the testing procedure shall meet the approval of the Engineer.

Hydrostatically test all pressure sewers and fittings in accordance with Section 01140 unless otherwise specified.

Make all arrangements for furnishing clean, potable water from an approved source for testing purposes. Perform the tests and provide personnel, hoses, tank trucks, plugs and other necessary equipment to complete the tests at no additional cost to the City. The method, equipment and personnel are subject to approval. A permit from the PWB or other water district is required if a hydrant is used.

(b) **Plugging Tees, Wyes, Stubs and Service Connections** - Plug all wyes, tees, stubs and service connections with gasketed caps or plugs securely fastened or blocked to withstand test pressures.

(c) **Testing Equipment** - Furnish all necessary testing equipment and perform the tests in a manner that provides observable and accurate measurements of either air or water leakage under the specified conditions. Calibrate and certify gauges at the direction of the Engineer. Provide the certification with the gauge.
00445.72

(d) Cleaning - Before final testing, final manhole-to-manhole inspection and Acceptance of Work flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

During the final manhole-to-manhole inspection, if any foreign matter is still present in the system, flush and clean the sections and portions as required. Do not allow debris to flow into downstream system. Keep all connecting piping clean and free of debris that is generated from construction activities.

00445.72 Pipe Testing:

(a) General - Perform the tests in a manner satisfactory to the Engineer. Provide testing equipment that gives observable and accurate measurements of either air or water leakage under the specified test conditions. Calibrate the gauges for air testing with a standardized test gauge furnished by the Engineer. The Engineer will observe the calibration. Notify the Engineer before each field air test.

Test a section of constructed sewer for Acceptance only after completing all service laterals, manholes, backfilling and compaction between the stations to be tested. Unless otherwise approved, do not allow testing of completed sections of sewer between manholes to lag more than one completed section behind the work in progress. The Engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the Acceptance of Work for those completed sections of sewer and allow connections before the whole system is completed.

(1) Safety Precautions - Only qualified personnel will be permitted to conduct the test. All plugs used to close the system for the testing shall be capable of resisting the expected internal pressures. Securely brace plugs, if necessary.

(2) Ground Water - The presence of ground water can affect the results of the test. Determine the average height of groundwater over the lines immediately before starting the test, using an approved method.

(3) Infiltration - Infiltration of ground water in any amount is unacceptable. Correct such failures occurring within the warranty period in an approved manner at no additional cost to the City.

(4) Coatings - Do not internally or externally coat a sewer with any type of substance in an attempt to improve its performance when performing an air or hydrostatic test.

(b) Hydrostatic Testing - Sewer pipe and joints shall sustain a maximum allowable loss by leakage of 0.04 gallons per hour per inch diameter per 100 feet when field-tested by either infiltration or exfiltration methods, regardless of pipe material used.
Testing of HDPE sewers shall conform to pressure or hydrostatic acceptance testing set forth elsewhere in these specifications.

For test purposes, the hydrostatic head shall exceed the maximum estimated ground water level in the section being tested by at least 72 inches and in no case shall it be less than 72 inches above the sewer crown of the highest section in the test section, including service laterals. In all cases, determine the height of the water table at the time of the test by exploratory holes or other approved method. The Engineer will make the final decision regarding the test height for the water in the sewer section to be tested. The length of sewer tested by exfiltration will be limited so that the pressure on the invert of the lower end of the section will not exceed 16 feet of water column. Make an allowance of 0.05 gallons per hour per foot diameter per foot of head above the manhole invert for each manhole included in a test section. If the test produces more than the allowable leakage, test manholes and sewer lines separately.

The Engineer will account for all service lateral footage included in the test section and subject to the specified minimum hydrostatic head in computing allowable leakage rate.

The sewer test section may be filled 24 hours before the time of exfiltration testing to permit normal water absorption into the pipe wall to take place.

Use air testing when the elevation of any sewer test section between manholes cannot meet the above criteria.

(c) Air Testing - At any time, the Engineer may require a calibration check of the test instrumentation. All air used shall pass through a single control panel.

All temporary plugs used to close the sewer for the air test shall be securely braced and capable of resisting the applied internal pressure. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before removing the plugs. The testing equipment shall include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and shall allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. If possible, inject the air at the upper plug. Use only qualified personnel to conduct the test.

The pressure gauge used in air testing shall have minimum divisions of 0.1 psi and an accuracy of 0.1 psi. All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

(1) The Contractor may wet the lines prior to testing. Clean the sewer to be tested; remove all debris. Plug all sewer outlets with suitable temporary test plugs. Brace each plug securely.

(2) Determine the average height of the groundwater over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.
Add air slowly to the section of system being tested until the internal air pressure is raised to 4 psi greater than the average back pressure due to groundwater.

After the test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

After the temperature stabilization period, disconnect the air supply.

Record the time in seconds that is required for the internal air pressure to drop from 3.5 to 2.5 psi greater than the average back pressure due to groundwater.

The tested section will be acceptable if the time recorded in (6) above is not less than the time in seconds \( T \) computed by the formula:

\[
T = \frac{K}{C}
\]

Where:

\[
K = \text{the sum of the computations } \left( 0.011 d^2L \right) \text{ for each size of pipe and its length in the section}
\]

\[
C = \text{the sum of the computations } \left( 0.0003882 dL \right) \text{ for each size of pipe and its length in the section, except that the minimum value for } C \text{ shall be } 1
\]

\[
d = \text{inside diameter of the pipe in inches}
\]

\[
L = \text{length of pipe in feet}
\]

If the sewer fails to meet these requirements, determine the reason for leakage and repair or replace all defective materials or workmanship, all at no additional cost to the City.

(d) Individual Joint Testing:

The following requirements are for air testing of 42 inch or larger sewers:

General - The Contractor may test each individual joint for leakage using a pneumatic joint testing apparatus. The method, equipment and personnel used in individual joint testing shall be as approved. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.1 psi and have an accuracy of 0.1 psi. All air used shall pass through a single control panel.

Submit necessary joint and joint tester data necessary for computing the combined annular test volume.

Perform testing of individual sewer joints as sewer pipe laying progresses. Conduct a joint test immediately after constructing and backfilling each mainline sewer pipe section.
At the sole discretion of the Engineer upon the satisfactory installation and testing of the first ten successive pipe joints of each sewer size, the Contractor may elect to test joints at no greater than one work day intervals instead of making tests after laying each pipe section.

(2) Method - All air testing shall be by the Time Pressure Drop Method. Clean the sewer and remove all debris before beginning the air test. The sewer may be wet if desired. The test procedure is as follows:

a. Determine the average height of the groundwater over the line. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

b. Add air slowly to the section being tested until the internal air pressure is raised to 4 psi greater then the average back pressure due to ground water.

(3) Acceptance - The allowable minimum time for a drop in pressure from 3.5 to 2.5 psi greater than the average back pressure of any ground water shall be the time per unit volume “T” in seconds, from the following table, multiplied by the combined annular volume of the joint and joint tester “V_y” in cubic inches. (Minimum Time = T * V_y)

<table>
<thead>
<tr>
<th>Pipe Inside Diameter (Inches)</th>
<th>Time per Unit Volume (Sec. per Cu. In.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>0.0109</td>
</tr>
<tr>
<td>42</td>
<td>0.0093</td>
</tr>
<tr>
<td>48</td>
<td>0.0082</td>
</tr>
<tr>
<td>54</td>
<td>0.0073</td>
</tr>
<tr>
<td>60</td>
<td>0.0065</td>
</tr>
<tr>
<td>66</td>
<td>0.0059</td>
</tr>
<tr>
<td>72</td>
<td>0.0054</td>
</tr>
<tr>
<td>78</td>
<td>0.0050</td>
</tr>
<tr>
<td>84</td>
<td>0.0047</td>
</tr>
</tbody>
</table>

(4) Repairs - If a joint does not meet the test time established herein, construct a reinforced concrete closure collar around the joint or reassemble the joint as approved at no additional cost to the City.

00445.73 Deflection Testing - In addition to the hydrostatic or air test, perform a deflection test on all sewers and culverts constructed of PVC, HDPE or other flexible pipe material. The test shall be completed not less than 30 days nor more than 60 days after the trench backfill and compaction have been completed, unless otherwise approved. Conduct the test by pulling an approved solid pointed mandrel through the completed sewer. The diameter of the mandrel shall be 95% of the inside pipe diameter unless otherwise specified. Conduct testing on a manhole-to-manhole basis. Before testing, completely flush the sewer with water, clean, and remove all debris.
00445.75 Repairs:

(a) General - Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified tests and inspections on those sections at no expense to the City.

(b) Correcting Pipe Defects - Repair or replace, in an approved manner, any section of sewer not meeting the air or hydrostatic test requirements, deflection test requirements, joint testing, which has visible leakage, or is noted as deficient in video inspection. Internal pipe repairs are not acceptable. Resealing of pipe is not an approved repair method.

(c) Visible Infiltration of Groundwater - Following a successful hydrostatic or air test, visible infiltration of groundwater in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections, at no expense to the City.

Measurement

00445.80 Measurement - Trench excavation, bedding, pipe zone material, trench backfill and acceptance testing for pipes will be measured according to Section 00405.

00445.81 Pipes and Appurtenances - The quantities of pipe of the various kinds, types and sizes, complete and in place, will be determined by the length and depth of installation as follows:

(a) Pipes - Measurement of all installed conduit, pipes, sanitary and storm sewers, including culverts, pressure sewer and pipe stubouts from manholes, will be made on a linear foot basis for the various classes, types and sizes of pipe in the Proposal. For pipe on a grade less than 15%, except service laterals, measure the pipe length horizontally from center-to-center of manholes or to the end of the pipe, whichever is applicable. For pipe on a grade of 15% or more, measure the pipe length on the slope distance from center-to-center of manholes or to the end of the pipe, whichever is applicable. No deductions will be made for fittings or for structures.

Service laterals will be measured on the linear foot basis for the type and size of pipe installed as shown in the Proposal. Length will be measured as total length of pipe installed, commencing at the point of connection to a tee, wye, manhole or pipe as applicable and terminating at the end of the pipe, including all fittings, measured along the pipe centerline.

Disconnecting and reconnecting an existing service lateral will be measured on the same basis as for service lateral pipe, and the footage required to complete an installation will be included in the total footage for service lateral pipe as shown in the Proposal.

Inlet lead pipes will be measured on the linear foot basis for the type and size of pipe installed as shown in the Proposal. Length will be measured along the pipe centerline in place from face of structure to face of structure of manholes,
inlets, or to the end(s) of pipe, whichever is applicable, and rounded to the nearest foot.

(b) **Tee and Wye Fittings** - Tee and wye fittings will be measured on the unit basis per each by actual count of units in place. No deduction will be made from measurement of pipe for the length of the fitting. Pipe plugs, stoppers and other fittings required to accomplish the work will be Incidental to this item.

(c) **Metal Pipe Anchors** - There will be no separate measurement for metal pipe anchors.

(d) **Concrete Pipe Anchors** - Concrete pipe anchors will be measured on the unit basis, per each, by actual count of units in place.

(e) **Concrete Closure Collars** - Concrete closure collars will be measured on the unit basis, per each.

(f) **Cleanouts** - Terminal cleanouts and service lateral cleanouts will be measured on the unit basis, per each, by actual count of units in place.

(g) **Deep Connection Risers** - Deep connection risers will be measured on the unit basis, per each.

(h) **Field Fabricated Connections** - Field fabricated connections will be measured on the unit basis, per each, by actual count of units in place.

(i) **Concrete in Blocks** - The quantities of concrete used in blocks will be measured in place on the volume basis as shown.

(j) **Reinforcement** - The quantities of reinforcement used in blocks will be incidental to concrete blocks and no measurement will be made.

(k) **Service Lateral 2 Inch x 4 Inch Markers** - Service lateral 2 inch x 4 inch markers will be measured according to Section 00446.

00445.82 **Acceptance Testing** - No measurement will be made of required air, hydrostatic and deflection acceptance testing.

00445.83 **Installation Under Pavement** - Pipe installed under pavement will be measured according to 00445.81. Trench resurfacing will be measured according to Section 00495.

00445.84 **Installation Under Railroad** - There will be no measurement of materials (except for pipe) for the lump sum pay item "Pipe Under Railroad". Pipe installed under railroads will be measured according to 00445.81.

00445.85 **Special Sections** - In addition to measurement of inlet lead pipe in 00445.81(a), a pay quantity allowance of 2 feet of the larger diameter pipe will be made for each special factory-fabricated section of pipe incorporated into the work as elbows, bends or reducers.
Payment

00445.90 General - The Contract unit price for each pay item reflects plan requirements or the Contractor’s choice from the applicable options listed on the Pipe Data Sheets (if shown).

00445.91 Payment - The accepted quantities of pipe and related work items performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) _____ inch Pipe, ____ x ____ inch, Bedding Type ________</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Pipe Tees or Wyes, ____ x ____ inch</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Concrete Pipe Anchors</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Concrete Closure Collars</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Terminal Cleanout</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Service Lateral Cleanout</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Deep Connection Risers</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Field Fabricated Connections</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Concrete in Blocks</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

In item (a), the nominal pipe diameter will be inserted in the first blank. The type and design standard of pipe will be inserted in the second blank. The appropriate pipe zone bedding type will be inserted in the third blank.

Items (b) through (h) include pipe plugs, stoppers and other fittings required to accomplish the work.

For item (b) the tee or wye will be a compatible pipe type and class as indicated in 00445.91(a) or as specified. The nominal size will be inserted in the first blank and the lateral size inserted in the second blank.

Payment for a service lateral connection to a new manhole will made under item (b) for a tee of the same inside diameter as the service lateral.

Payment will be payment in full for furnishing and placing all materials, and for furnish all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for service lateral 2 inch x 4 inch markers will be according to Section 00446.

There will be no separate payment for metal pipe anchors. Payment will be included in payment for the appropriate pipe pay item.

The accepted quantities of reinforcement will be paid for on the weight or lump sum basis according to 00530.90. If there is no item provided in the Contract Schedule of Items for “Reinforcement in Blocks” the cost will be considered incidental with payment for reinforcement included in the item “Concrete in Blocks”.

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Payment for pipes will include bedding, pipe and pipe zone material, compaction, joint materials, joining, fittings, and pipe acceptance testing.

Payment for trench excavation and trench backfill will be as specified in Section 00405.

Payment for facilities for electronic location and visual identification of sewers will be as specified in Section 00446.

Payment for connections to existing manholes will be as specified in Section 00490.

Payment for perforated pipe will be according to Section 00430.

00445.95 Acceptance Testing - All work and material involved in testing of sanitary sewers, storm sewers, and culverts as specified will be considered Incidental and included in payment made for the applicable pipe pay item.

00445.96 Installation Under Pavement - There will be no separate payment for the additional work involved in placing pipe under pavement. Payment for trench resurfacing will be according to Section 00495.

00445.97 Installation Under Railroads - Payment for the additional work involved in placing pipe under existing railroad tracks as specified within the limits indicated on the plans, will be made at the Contract lump sum amount for the pay item "Installing ______ inch Pipe Under Railroad". The nominal diameter of pipe will be inserted.

Payment will be payment in full for furnishing all equipment, labor, and Incidentally necessary to complete the installation as specified. Payment for the pipe will be made according to 00445.91. Payment for resurfacing will be according to Section 00495.

00445.98 Incidental Basis - When neither the Special Provisions nor Contract Schedule of Items indicates separate payment for work under this Section, perform the work as Incidental work for which no separate payment will be made.
Section 00446 - Electronic Location and Visual Identification of Sewers

Description

00446.00 Scope - This work consists of providing facilities or systems for electronic location and visual identification of sewers (ELVIS) including restoration of pre-existing ELVIS facilities or systems disturbed by construction or restoration work.

Materials

00446.10 Electronic Locating Materials - Furnish materials meeting the following requirements:

(a) Marker Balls - Use Omni Marker Model 162, or approved equal. Marker balls shall:

- Be green in color, maximum 4.5 inches in diameter, and made with exterior material of HDPE
- Be locatable with standard electronic marker locating devices at a depth up to 5 feet
- Produce a spherical RF field regardless of orientation
- Contain no floating or movable parts, and no batteries or active components

(b) Tracer Wire - Use Copperhead Reinforced Tracer wire manufactured by Copperhead Industries, LLC or approved equal. Tracer wire shall be direct burial #12 AWG solid, annealed copper-clad carbon steel high strength tracer wire, 380 pounds average tensile breaking load, with 30 mil high molecular weight high density green polyethylene jacket complying with ASTM D 1248, 30 volt rating.

(c) Underground Detectable Marking Tape - Use Terra Tape® Sentry Line® Detectable Underground warning tape manufactured by Reef Industries, Inc. or approved equal. Marking tape shall consist of material impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Marking tape shall be reinforced in a tri-layer laminate consisting of coated woven scrim, a solid foil core, and a clear encapsulating film. The marking tape shall be made of a solid foil core encased between a HDPE scrim coated with 100% virgin polyolefin pigmented resins and a clear protective film that allows full view of the foil to ensure continuity. The solid core must provide detectability utilizing either the inductive or conductive modes using a pipe and cable locator. The ink used to print the material must be permanent and not subject to removal by normal handling or upon burial.

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The width of the tape shall be 6 inches. The tape for mains shall be blue and imprinted continuously over its entire length in permanent black ink with the words "Caution - Water" for force mains. The tape for sewer force mains shall be green and imprinted continuously over its entire length in permanent black ink the words "Caution - Sewer Line."

(d) **Ground Wire** - Use #12 AWG bare solid copper wire.

(e) **Tracer Wire Connectors** - Use the following direct-bury connectors as shown:

- **Direct-bury lug connectors** – Use DRYCONN® DIRECT BURY LUG connectors by King Innovations, or approved equal.
- **Direct-bury twist connectors** - Use 3M DBY Direct Bury Splice Kit 09053 connectors or approved equal.

Connectors shall be waterproof, corrosion proof and suitable for #12 AWG solid core wire be pre-filled with silicone and suitable for use with low voltage tracer lines of less than 50 volts. Lug connectors shall have a waterproof plastic housing that encases the silicone pre-filled lug terminals. Twist connectors shall have a waterproof epoxy-filled packaging that encases the silicone pre-filled twist connectors.

(f) **Locator Station** - Use FlangeFink® locator stations manufactured by Cott Manufacturing or approved equal. Locator station shall be Lexan® polycarbonate, green in color, with terminals suitable for #12 AWG leads. Use single (2 lead) locator stations with 2 terminals, 1 for ground wire and 1 for tracer wire, when only 1 tracer wire is terminated in manhole. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.

00446.11 **Visual Identification Materials** - Use materials conforming to the following requirements:

(a) **Tracer Wire Locate Boxes** – Use Carson Industries L Series model 708 with green locking type cover marked “Sewer Locate Wire”, or approved equal. Tracer wire locate boxes shall be made from polyolefin, with a green cover marked "Sewer Locate Wire”. Cover shall be locking type with a nominal 6 inch opening.

(b) **Cleanouts** - Use materials conforming to the Standard Drawings and Section 00445.

(c) **Manholes and Inlets** – Use materials conforming to the Standard Drawings and Section 00470.

(d) **Service Lateral Plastic or Copper Markers** – Use markers of the type that requires installation to be recessed below grade. Either plastic or copper markers may be used. In new concrete, use “new construction” markers; in existing concrete use “retrofit” markers and use adhesive recommended by the manufacturer. Use the following materials as shown:
(1) Plastic Pavement Markers - Use A-TAG pavement markers by Rhino Marking and Protective Systems or approved equal. Plastic markers shall be UV stabilized and fade resistant, be of a material meeting or exceeding a tensile strength of 3,500 psi, and meet test requirements as outlined in ASTM G53, Standard Practice for Light and Water Exposure of Nonmetallic Material. Markers shall be green in color, with the words, “WARNING, SEWER PIPELINE, Call Before You Dig”, molded to the top of marker.

(2) Copper Pavement Markers – Use Berntsen Concrete Marker Item # BP2 or approved equal. Copper markers shall be made from copper material chosen by manufacturer, and shall have the words “Sewer Lateral” stamped on the top.

(e) Service Lateral 2 Inch x 4 Inch Markers - Use new, pressure-treated 2 inch x 4 inch lumber, utility grade or better, conforming to Sections 02130 and 02190.

Construction

00446.40 General - Install ELVIS facilities as shown or directed according to the following requirements for all new and reconstructed sewers:

00446.41 Electronic Locating Facility Installation:

(a) Marker Balls - Install marker balls according to manufacturer’s recommendations and as shown or directed and according to the following requirements:

- Install marker balls directly above the pipe alignment at a depth no less than 3 feet and no more than 4.5 feet below final surface grade.
- Install marker balls during trench backfill operations by placing the marker ball in compacted backfill. Cover marker ball with a minimum of 6 inches of backfill and compact backfill before continuing trench backfill operations.
- Install marker balls with trenchless pipe installations by core-drilling hole of a minimal diameter needed to allow clearance for placement of marker ball. Backfill with approved trench backfill, pavement base and pavement, as applicable.
- Install marker balls directly above connection points, termination points and all fitting locations, and at a minimum spacing of 50 feet on sewers with a straight horizontal alignment except on mainline sewers between two visible manholes.
- Install marker balls at a minimum spacing of 25 feet directly above sewer mains or pressure lines installed on a radius.
- Install marker balls on new or reconstructed sewer service laterals, directly above the centerline of the end of the lateral at the curb line or as directed.

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• Install marker balls directly above every alignment change along pressure lines, sewer mains and service laterals.
• Install marker balls directly above manholes for manholes with buried covers.

(b) Tracer Wire and Terminal Appurtenances - Restore pre-existing tracer wire systems disturbed by adjacent work as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:

1. Locator Stations - Install locator stations as shown within manholes. Mount locator station to manhole wall within 18 inches of manhole rim with 2 stainless steel expansion anchors. Drill a minimum 3/8 inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station, and attach to one of the lugs in the locator station. When multiple tracer wires are terminated in manhole install a multi-lead locator station. Extend a ground wire from the locator station through a minimum 3/8 inch diameter hole in the manhole wall. Install ground wire approximately 3 feet deep, and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction. Seal all holes drilled in manhole walls with silicone sealant.

2. Storm Inlet Tracer Wire Termination - Terminate tracer wire inside inlet and directly over storm outlet pipe by placing tracer wire as follows: Drill a minimum 3/8 inch diameter hole through inlet wall to pass tracer wire through to inside inlet wall. Seal hole with silicon sealer or material approved. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed.

3. Service Lateral Tracer Wire Termination - Terminate tracer wire at ends of service laterals as shown or directed, as follows:
   a. Termination in Tracer Wire Locate Boxes - Extend the tracer wire in one continuous piece up vertically from the pipe trench and into the bottom of the locate box. Leave 18 inches of coiled tracer wire inside locate box.
   b. Termination at 2 Inch x 4 Inch Markers - Extend tracer wire in one continuous piece directly up service lateral 2 inch x 4 inch markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2 inch x 4 inch marker.

(c) Underground Detectable Marking Tape – Bury all underground detectable warning tape for both water and sewer force mains 24 inches below
finished grade directly over center of pipeline unless otherwise shown or as directed.

**00446.42 Visual Identification Facilities** - Provide facilities for visual identification of sewers as shown or directed and as follows:

(a) **Manholes, Terminal Cleanouts and Storm Inlets** - Install manholes or storm inlets at ends of sewers as shown and according to Section 00470. Install terminal cleanouts at ends of sewers as shown and according to Section 00445.

(b) **Lateral Cleanouts** - Install lateral cleanouts as shown or directed and according to Section 00445. Install lateral cleanouts as close to property line as practical at approved locations.

(c) **Tracer Wire Locate Boxes** - Restore pre-existing tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed.

(d) **Service Lateral Plastic or Copper Markers** - Install plastic or copper markers in the concrete curb directly over the centerline of all new and reconstructed service laterals, as shown or directed. Either plastic or copper markers may be used. If there is not suitable concrete curb for marker placement, then install a lateral cleanout as shown or directed according to Section 00445.

(e) **Service Lateral 2 Inch x 4 Inch Markers** – Place a 2 inch x 4 inch marker at the end of each new service lateral not connected to a building sewer. Omit markers only as approved. Block the capped or plugged service lateral end with a wood block against undisturbed earth and install the marker. Extend the marker from the blocked service lateral invert to at least 12 inches above the existing or proposed finish ground surface. Install marker in one piece. No splicing will be accepted.

Paint the exposed portion of the marker after its installation with quality quick drying enamel white paint for a storm only sewer and green paint for a sanitary or combined sewer. After the paint has dried, use black, quick drying enamel and neatly indicate the distance from the ground surface to the top of the service lateral in feet and inches.

Do not disturb the position and location of the marker during the backfilling operation. If the marker is broken, moved out of location, or vertical alignment is changed during the backfilling operation, reopen the trench and replace the marker.

### Finishing and Testing

**00446.70 General** - Test all installed marker balls and tracer wire and appurtenances with locating equipment before acceptance. Replace all marker balls and tracer wire that cannot be located with the testing equipment and retest until all defects are corrected. Document the GPS coordinates for each marker ball.

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Measurement

00446.80  **Measurement** - No measurement of quantities will be made for electronic location and visual identification of sewers.

Payment

00446.90  **Payment** - No separate or additional payment will be made for electronic location and visual identification of sewers. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00470 - Manholes, Catch Basins and Inlets

00470.00 Scope - This work consists of constructing manholes, catch basins, inlets, sumps, sump and sedimentation manholes, inside drop manhole assemblies, siphon boxes, slope protectors and other similar structures. Construct the structures of commercial grade concrete, or other material, with necessary frames, covers, gratings, and other fittings and hardware.

References to manholes, sumps, sedimentation manholes, inlets, siphon boxes, slope protectors and inside drop manhole assemblies refer to standard structures of specific design and use, and are identified on the plans. The term "concrete" refers to commercial grade concrete.

00470.01 Cast-in-Place and Precast Construction - Concrete manholes and sumps shall be cast-in-place or precast, as shown or specified. Concrete inlets and siphon boxes may be either cast-in-place or precast. Precast concrete inlets shall not be used in the roadway.

Materials

00470.10 Materials - Furnish materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Aggregate Base</th>
<th>00640.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Grade Concrete</td>
<td>00440</td>
</tr>
<tr>
<td>Concrete Drain Tile</td>
<td>02410.40</td>
</tr>
<tr>
<td>Corrugated Metal Pipe</td>
<td>02420.10, 02420.40</td>
</tr>
<tr>
<td>Couplings</td>
<td>02410.60</td>
</tr>
<tr>
<td>Geotextile</td>
<td>02320</td>
</tr>
<tr>
<td>Grout</td>
<td>02080</td>
</tr>
<tr>
<td>High Density Polyethylene (HDPE) Pipe</td>
<td>02410.60</td>
</tr>
<tr>
<td>Joint Material</td>
<td>02440.40, 02440.50, 02440.60</td>
</tr>
<tr>
<td>Metal frames, Grates, Covers, and Ladders</td>
<td>02450.30</td>
</tr>
<tr>
<td>Nonreinforced Concrete Pipe</td>
<td>02410.10</td>
</tr>
<tr>
<td>Polyethylene Pipe</td>
<td>02410.60</td>
</tr>
<tr>
<td>Polyvinyl Chloride (PVC) Pipe, Schedule 40</td>
<td>02410.70</td>
</tr>
<tr>
<td>Polyvinyl Chloride pipe (PVC), ASTM 3034</td>
<td>02410.70</td>
</tr>
<tr>
<td>Precast Concrete Manholes, Catch Basins and Inlets</td>
<td>02450.10, 02450.20</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>02510.10, 02510.40</td>
</tr>
</tbody>
</table>

00470.11 Precast Concrete Manholes and Bases - Furnish cones with the same wall thickness and reinforcement as riser sections.

All precast manholes sections, sedimentation manholes, bases, sumps and cone sections manufactured for City work must conform to the requirements of the current Manufacturing Standards for Precast Concrete Products (MSPCP) Manual published by the City's Materials Testing Laboratory. Furnish only rubber-gasket sections as specified or conforming to the Standard Plans and ASTM C478. Use only preformed rubber gaskets or mastic sealer for jointing material. Tongue and groove manhole sections must be approved and accepted before use on any project.

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Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material to be supplied to the Project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C497.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

<table>
<thead>
<tr>
<th>48 inch</th>
<th>72 inch</th>
<th>96 inch</th>
<th>120 inch</th>
<th>144 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 inch</td>
<td>84 inch</td>
<td>108 inch</td>
<td>132 inch</td>
<td></td>
</tr>
</tbody>
</table>

Heights of sections shall be multiples of 6 inches, except heights of manhole sections 72 inches through 144 inches in diameter shall be as required to fit site conditions.

(a) Precast Concrete Bases - Precast base sections may be used provided all details of construction are approved before shipment.

(b) Manhole Grade Rings - Use manhole grade rings on all manholes. Grade ring extensions are to be limited to a minimum height of 3 inches and a maximum height of 12 inches.

(c) Manhole Steps, Polypropylene Covering, and Polyethylene Netting Encasement for Sumps - Use only material that conforms to the requirements as shown in the Contract Drawings and Details.

(d) Time of Installation - Unless shown or specified otherwise, install steel reinforced polypropylene steps in all concrete manhole cones and sections before delivery to the job site.

(e) Certification of Steps - Manhole steps that are not on the City’s list of approved manhole steps will require testing of the steps and observation of the step installation process prior to delivery. Obtain a current list of approved manhole steps from the City’s Materials Testing Laboratory.

(f) Precast Inlets and Catch Basins - Precast units may be used in lieu of cast-in-place units when approved. Submit details of proposed units for approval. Concrete risers for extensions shall be a maximum of 6 inches in height and of the same quality as the main section. Risers shall only be used where approved.

00470.12 Cap Screws - Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to the requirements of ASTM A 453/A 453M.

00470.13 Inside Drop Manhole Connectors - Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

Provide and furnish inside drop manhole assemblies per the Contract drawings and details shown and specified.
00470.14  **Pipe and Fittings** - Furnish pipe and fittings as specified and conforming to the applicable portions of Section 00445.

00470.15  **Pipe Stubouts** - Pipe stubouts shall be the same type and strength classification as approved for use in the lateral, main or trunk sewer construction. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Furnish watertight plugs with each stubout and adequately brace against hydrostatic or air test pressures.

00470.16  **Drain Rock Backfill** - Drain rock placed between the sump and the edge of the excavation shall be 4" - 2" aggregate with a maximum of 10% fractured faces. Drain rock shall be free from organics, frozen earth, or other deleterious material. The Engineer may inspect all potential stockpile sites prior to delivery of material.

00470.17  **Aggregate Cover** - Where sump drain rock would otherwise be in contact with the connecting pipe, provide a cover of at least 6 inches of 1" - 0 or 3/4" - 0 clean, aggregate continuously around the pipe. Use a geotextile fabric, as specified, conforming to Section 02320 as the medium between the aggregate cover and drain rock.

00470.18  **Base Drain Backfill** - Use aggregate base or selected granular backfill material that is free from silts or other fines.

00470.19  **Manhole, Inlet and Catch Basin Frames, Covers and Grates:**

(a)  **Manholes** - Manhole castings shall be true to size, weight and tolerances shown. The bearing seat shall not rock when checked by the test jig. Supply all test gauges. Do not subcontract any of the work other than testing procedure, patterns, machining and cartage. The casting shall not be made by the open mold method and be free of porosity, shrink cavities, cold shuts or cracks, or any defects that would impair serviceability.

Do not repair defects by welding or by the use of “Smooth-on” or other cosmetic material. All castings shall be shot or sandblasted. Do not apply paint or other coating. Each casting shall have distinctly cast upon it the initials of the manufacturer and the year of the cast. These characters shall be minimum 1 1/4 inches in height and 1/8 inch in relief. Cast the heat number into each casting. Provide all labor and equipment for handling all castings during testing and inspection. Refer to Section 00165 for test methods and references.

(b)  **Frames and Grates** - Fabricate frames and grates for inlets and catch basins from steel conforming to ASTM A7, A36 or A373 in accordance with the Standard Plans. Weld all connections. When assembled, frames and gratings shall rock no more than 1/16 of an inch. When checked by a test jig, the bearing seat of either component shall have no more than 1/16 of an inch rock.

(c)  **Catch Basins** - Use metal sump catch basins from the CPL. An approved equal catch basin shall comply with Portland’s plumbing code.
00470.20 Access Doors - Use access door from the CPL or constructed from steel or aluminum with a non-slip surface conforming to the requirements of 02484.35(a).

Construction

00470.40 General:

(a) Excavation, Backfill and Foundation Stabilization - Excavate and backfill according to Section 00405. When specified, or as directed, remove unsuitable material that will not support the manhole or other structure, excavate below grade and backfill with foundation stabilization material according to Section 00405.

(b) Pipe Connections - Place connecting pipe at the alignment and grades as shown. If not shown, inlet piping shall enter manholes at a depth of 8 feet below finish grade or 14 inches less than the depth of the manhole whichever is less. Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall. Ensure that pipe connections to the structure are completely watertight.

Grout concrete pipe connections to manholes so they are watertight, using non-shrink grout conforming to 02440.50. When grouted into the manhole section, the pipe section shall not extend more than 18 inches outside the manhole. If an approved flexible connection for concrete pipe is provided at the manhole, full or partial pipe sections may be stubbed into the manhole as required. When using flexible pipe, use approved sanded manhole adapters where pipe enters the manhole or inlet.

Connect pipe to sanitary manholes using an approved adapter specifically manufactured for the intended service. Do not use field-fabricated waterstops or improvised adapters. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming to 02440.50. Connections to all manholes, sedimentation manholes, sumps, and inlets shall have a flexible joint located within 18 inches of the structure wall.

00470.41 Precast Concrete Manholes - Precast manhole components may be used to construct standard, sump, sedimentation and drop manholes.

(a) Bases - If bases are cast-in-place, consolidate the concrete by mechanical vibration. Screed off the concrete so that the first manhole section to be placed has a level, uniform bearing surface for the full circumference.

If bases are precast, carefully place the base section on the prepared bedding so it is fully and uniformly supported at true grade and alignment.

Construct the invert to match that of the sewer pipe. Where the size of the sewer pipe is changed at the manhole, construct the invert to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, break out the top to the springline of the pipe for the full width of the manhole, and completely
cover the exposed edge of the pipe with mortar. During construction divert existing flows of water or sewage away from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until initial set has been achieved. All finished surfaces shall conform to drawings as shown.

(b) Precast Manhole Sections - Thoroughly wet all lift holes, completely fill with nonshrink grout, and smooth and point both inside and out to ensure water tightness.

Use preformed plastic or rubber gaskets on all joints between manhole sections. Non-shrink grout is allowed on joints, and grade rings above the cone.

Set manhole covers to the finish grade of ground or street surface using manhole grade rings on all manholes. The total height of manhole grade rings between the manhole cone and manhole cover frame shall be a maximum of 12 inches. In roadways and other areas intended for traffic, a minimum of one manhole grade ring is required between the cone and manhole cover frame.

When grout is used do the following:

- Clean and wet the surfaces to be joined with water.
- Do not allow free water to come in contact with grout joints within 24 hours after the mortared joints are finished.
- Protect the completed joints against rapid drying.

(c) Grates, Frames, Covers and Fittings - Set metal frames for manholes on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. The Type 1 grate for Type "D" inlets shall be cut in half parallel to the bars. Clean bearing surfaces and provide uniform contact. Secure all fastenings. Construct all mortared, sanitary sewer manhole necks and all riser ring joints made with non-shrink grout using an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

(1) Manhole Frame and Covers - Set frame in a bed of mortar with the mortar carried over the flange of the frame. Set frame so the top of the cover is flush with surface of adjoining pavement or ground surface unless otherwise shown or approved.

(2) Watertight Installation - Where a manhole cover is to be permanently buried, install a watertight manhole frame and cover only where shown or as approved. Place 2 layers of 65 pound per square smooth surfaced roll roofing or approved material over all buried covers before backfilling.

(3) Watertight Application - Install tamperproof or watertight manhole frames and covers where shown or as approved.
(d) **Manhole Step and Ladder Installation Requirements** - Fasten steps and ladders to the manhole walls according to the manufacturer’s recommendations as shown and to all applicable safety standards, as approved. All steps within a manhole shall be of the same design, type and size. Mixing of unmatched steps within the same manhole is not acceptable. Align steps vertically. Loose steps will be cause for rejection of that manhole cone or section.

(e) **Manhole Grade Rings** - Install grade rings as shown to the approved height. Lay grade rings in mortar with sides plumb and tops level. Seal joints with mortar as specified for manhole sections. Grade rings shall be watertight.

(f) **Inside Drop Manhole Assemblies** - Construct inside drop manhole assemblies at each location shown.

00470.42  **Precast Concrete Catch Basins and Inlets** - Install precast catch basins and inlets to the specified line and grade.

00470.43  **Cast-in-Place Concrete Construction:**

(a) **General** - Construct cast-in-place catch basins and inlets, according to Section 00440. Finish all inside surfaces smooth and free of depressions or protrusions. Form exterior surfaces with steel, plywood or other approved materials. Form other surfaces with matched boards, plywood, or other approved material. Do not cast directly against trench walls, rock, or earth unless approved. Inlet depth shall be a minimum of 30 inches and a maximum of 48 inches from finish grade unless otherwise shown or approved. Do not load cast-in-place bases until approved or tests indicate the concrete can support the required load.

(b) **Cast-in-Place Catch Basins and Inlets** - Construct forms for both the inside and outside walls of cast-in-place catch basins. Forms shall be tight and well braced, with chamfered corners. Remove all water and debris prior to placing concrete. Provide and position sanded collars to be cast in proper alignment when PVC or HDPE inlet leads are used.

Consolidate the concrete immediately after placement with an approved vibrator. Limit vibration time to that necessary to produce satisfactory consolidation without causing segregation. Screed the top surface and trowel exposed surfaces to a smooth finish, free from marks or irregularities. Radius exposed edges with a steel edging tool. After forms are removed, patch any defects in the concrete with an approved mortar mix.

Immediately after removal of forms and final finishing, cure according to 00440.40(e).

(c) **Finishing/Connection for Catch Basins and Inlets** - Construct inlets in accordance with the Plans. Float finish the inside face and floor. Only use the same pipe material for the inlet lead from the inlet to a connection with another sewer or a downstream structure.
(d) **Placing Precast Inlets** - When precast inlets are approved, set an inlet to grade at the locations shown or as approved.

(e) **Adjusting Inlet and Catch Basin Height Extensions** - When approved, construct height extensions as shown. Lay risers in mortar with sides plumb and tops to the proposed finish grade. Seal joints with mortar and trowel the interior and exterior surfaces smooth. Prevent mortar from drying out and cure by applying an approved curing compound or other approved method. All finished work shall be watertight.

(f) **Installation of Inlet and Catch Basin Frame and Grate** - Set frame and grate at the elevation shown. Frame shall be cast integral with the structure. All bearing surfaces shall be clean and provide uniform contact. Embed anchor bolts and other fastenings firmly in concrete or secure as approved.

00470.44  **Precast Sumps**:

(a) **General** - Construct precast sumps to a depth of 30 feet in conformance with the Plans. Construct precast sumps before constructing sedimentation manholes. Make all sump pipe connections as specified or approved.

(b) **Connections** - Make all sump pipe connections to the sump wall as shown. Grout all pipes into a sump wall to provide a watertight seal around pipes. Each connecting pipe shall have a flexible joint within 18 inches of the sump wall.

(c) **Depth** - Construct a sump to its full depth unless unstable or caving soil strata is encountered during construction. The Engineer will determine the need for sumps of lesser depth than shown. Do not construct a sump less than 20 feet deep.

(d) **Sump Backfill** - Use a tremie or other approved method to backfill the drain rock around the sump to prevent material from striking the netting during the backfill operation. Avoid damage to or displacement of the structure.

00470.45  **Sump and Manhole Locations**:

(a) **General** - The Engineer will establish and adjust sump and sedimentation manhole locations to minimize conflicts.

(b) **Spacing** - When constructing 2 or more sumps in an area, construct the sumps approximately 25 feet apart, or as approved. The spacing may be greater than 25 feet in order to avoid overhead wires, underground utilities or other obstacles to construction. Before beginning construction, the Engineer will determine the proper spacing at a site.

(c) **Abandoned Sump Manhole Installation** - When a sump manhole cannot be constructed to its specified minimum depth the Engineer will direct the Contractor to stop work and abandon the site. Place and compact native or imported granular material and restore the site to its preconstruction condition.
00470.46  Sedimentation Manholes:

(a) General - Construct a precast sedimentation manhole in conformance with
the Plans.

(b) Typical Location - Unless otherwise specified or noted on the Plans,
construct the sedimentation manhole 25 feet upstream from the first sump.
Obtain approval before changing the location of a sedimentation manhole to
avoid overhead wires, underground utilities or other obstacles.

(c) Connections - Connect all sedimentation manhole piping to the manhole
wall as shown. Grout pipe into manhole wall to provide watertight seal.

(d) Inspection - To allow for inspection by the Engineer, pump all
accumulated water from a sedimentation manhole.

00470.47  Concrete Inlet Base Drains - Provide concrete inlets with base
drains leading from abutting aggregate base or selected granular backfill
material.

Use concrete pipe, concrete drain tile, HDPE or PVC plastic pipe for basin
drains. Place and compact backfill without damaging pipe or inlet.

00470.48  Access Door for Manholes - Install an access door in the
sidewalk for manholes that straddle the curb face as shown or directed.

Maintenance, Clean up and Testing

00470.70  Cleaning - Upon completion, clean each structure of
accumulated silt, debris or foreign matter of any kind and maintain clean until
final acceptance of the work.

00470.71  Sump Testing - To ensure the optimum sump and storm sewer
pipe performance, determine the in-place capacity of the sump downstream
from the sedimentation manhole for each sump system. The sump system will
be noted in the Special Provisions. Testing shall take place after a sump has
been constructed, in conformance with the following requirements:

(a) Filling Sump - Fill sump with water at an initial rate of 300 gpm and record
the water elevation below the sump rim after 5 minutes. Maintain initial flow
rate and continue taking recordings of the water elevation at 5 minute intervals.
When the water elevation stabilizes, increase the flow rate by 300 gpm, record
the water elevation at the new flow rate as described in the initial process.
Continue the sump test by increasing the flow rate at increments of 300 gpm
until the sump has reached its maximum capacity.

Provide the Engineer with all recorded test data. The test may be completed
using flow from one fire hydrant. However, a second fire hydrant may be
necessary to complete the sump test.
Upon completion of each sump test, compare tested sump capacity flow rate to the minimum flow rate noted in the projects special provisions. Contact the Engineer immediately if tested flow rate is less than the minimum flow rate determined by the Engineer.

Provide water flow from fire hydrants to any sump being tested using 8 inch (nominal) diameter pipe.

Deliver clean water to the sump or sedimentation manhole for testing. The introduction of silts, sediments or gravel to sumps and sedimentation manholes shall not be permitted.

(b) Permit Requirements - Obtain a permit for use of fire hydrants from the permit center of the PWB prior to making any connections to a fire hydrant. The following procedures will apply in making application for issuance of a permit:

- Present 2 approved 8 inch slow opening and closing gate valves and spanner wrench for inspection and tagging, if not renting the City sump capacity tester. Rental of the City sump capacity tester includes 2 approved 8 inch gate valves, spanner wrench and 850 feet of aluminum pipe.
- Know the locations of hydrants to be used with respect to street intersections.
- Be prepared to make a monetary deposit upon issuance of the permit. Call the Permit Center ahead of the time to ascertain the minimum deposit required for use of the hydrant(s) and charges for use of the hydrant(s).

(c) Engineer Notification - Notify the Engineer of the estimated time of commencement of sump tests at least 2 hours prior to such commencement. The Engineer will be present during all sump capacity tests.

Based upon the results of the sump capacity test, the number or depth, of subsequently installed sumps may be modified.

The City has one sump capacity tester available on a “first come - first served” basis. The tester and pipe trailers may be rented per day for a maximum of 2 days per written application.

The Contractor is not required to use the City’s sump capacity tester. However, if the tester provided by the Contractor is other than the City’s, it must be approved prior to conducting sump capacity tests. Submit written details of the proposed sump capacity tester including flow measuring instrument, 8 inch piping and 8 inch gate valve specifications. The Engineer will approve or reject this submittal within 2 weeks after receipt of said submittal.

Perform sump capacity tests to determine the capacity of the sump to ascertain that the designed sump is adequate. The Engineer will determine the final number of sumps to be tested.
00470.72 Casting Certification and Test Samples:

(a) General - Certify as to the tensile strength properties and the Brinell Hardness. The Engineer reserves the right to require a tensile test bar, as per ASTM A48, for each 20 castings or heat (lot) when less than 20 castings are made from one heat (lot).

(b) Testing - Testing shall be performed at the option of the Engineer in accordance with one or both of the following methods:

(1) Tensile Specimens - Method A shall consist of testing tensile specimens in accordance with ASTM A48. Notify the Engineer at least 24 hours in advance of casting the units and bars so as to schedule time to witness the melt to permit identification of both bars and castings. Provide machined test specimens conforming to the dimensions specified for Specimen B of ASTM A48. Machining of the test specimens shall be at no additional cost to the City.

(2) Proof Load Test - Method B shall consist of a Proof-Load Test. The cover, while resting in its frame, shall sustain a 40,000 pound load applied through a 1 inch thick by 9 inch ASTM A36 steel plate on a 1/4 inch rubber pad centered on the manhole cover.

(3) Proof Load Rate - Using a calibrated testing machine, apply the specified load and hold for a period of 1 minute. Upon removal of the load, examine the test specimen for cracks and permanent deformation. Any cracks or permanent deformation will be cause for rejection.

(4) Cost Responsibility - The Engineer will perform all testing of the castings. Passing tests will be a City cost. Failed tests shall be at the Contractor’s cost.

(5) Test Procedure - Test specimens will be selected by the Engineer and tested as follows:

a. Proof-Load test 2 assembled test specimens for each 20 castings or heat when less than 20 castings.

b. If the tested specimens of a designated lot pass the test, all of the units of that lot are considered to comply with the load requirements.

b. If either of the tested specimens of a designated lot fails to pass the test, then test 5 additional specimens from the same lot selected by the Engineer.

d. If the 5 additional specimens pass the load requirements of the test, then the total number of that lot to be furnished will be considered as complying with the requirements except that any of the previous test specimens that failed to meet the load test requirements will be rejected.
If any of the 5 additional specimens fail to meet the load test requirements, then the entire lot will be rejected except for the test specimens that passed the test. All specimens that pass this test will be returned. The City will not be responsible for those that fail the test.

**Sewer Manhole Acceptance Testing** - Field test all sanitary sewer manholes for acceptance by either hydrostatic or vacuum testing after completion of backfilling, compaction and surface restoration, including paving. If the manhole fails the test, make necessary repairs by an approved method, and retest the manhole. Repair and retest the manhole until a satisfactory test is obtained.

(a) **Hydrostatic Testing** - Perform hydrostatic testing according to ASTM C 497/C 497M. Plug all inlets and outlets and fill the manhole with water. Fill each manhole to the rim at the start of the test. Leakage in each manhole shall not exceed 0.3 gallons per hour per foot of head above the invert. Determine leakage by refilling to the rim using a calibrated container. Manholes may be filled 24 hours prior to the time of testing to permit normal absorption into the manhole walls.

(b) **Vacuum Testing** - Perform vacuum testing according to ASTM C 1244/C 1244M. Plug and brace all pipes entering the manhole. Place the test head in or on top of the manhole ring. Draw a vacuum of 10 inches of mercury on the manhole, close the valve on the vacuum line of the test head, and shut off the vacuum pump. Measure the time for the vacuum to drop to 9 inches of mercury. The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in the following table:
<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>30 or less</th>
<th>33</th>
<th>36</th>
<th>42</th>
<th>48</th>
<th>54</th>
<th>60</th>
<th>66</th>
<th>72</th>
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<tr>
<td>Depth * (feet)</td>
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<td>8 or less</td>
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<td>74</td>
<td>87</td>
<td>98</td>
<td>108</td>
<td>121</td>
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</tbody>
</table>

* Depth is measured from the top of the manhole to the lowest invert.
** Test times for manhole depths between those shown in this table may be calculated by interpolation.

**Measurement**

00470.80 **Measurement** - The quantities of manholes, sump manholes, sedimentation manholes, sumps, inlets, catch basins, siphon boxes, slope protectors, sump capacity testing, manhole inside drop assembly, and other structures will be measured on a unit basis.

The quantities of special concrete structures will be made on a lump sum basis.

00470.81 **Manholes and Inside Drop Assembly over 8 Feet Deep** - Measurement for a manhole over 8 feet deep will be from 8 feet below the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest 0.1 of a foot.

00470.82 **Sump Manhole Greater or Less than 30 Feet Deep** - Measurement for each constructed sump greater or less than 30 feet deep, will be for each vertical foot of sump greater or less than 30 feet to the nearest 0.1 of a foot.

00470.83 **Abandoned Sump Manhole Installation** - Measurement for each partially completed sump manhole directed to be abandoned will be measured on a unit basis.
Payment

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Concrete Manholes, _____ inch, 0-8 Ft Depth</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Concrete Manholes, _____ inch, Deeper than 8 Ft</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Concrete Manholes, __________________</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Concrete Sumps</td>
<td>Each</td>
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<tr>
<td>(e) Concrete Inlets, Type ____________________</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Concrete Siphon Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Concrete Diversion Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Concrete Irrigation Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Concrete Junction Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(j) Concrete Monument Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(k) Manhole Slope Protectors</td>
<td>Each</td>
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<tr>
<td>(l) Catch Basins, __________________________</td>
<td>Each</td>
</tr>
<tr>
<td>(m) Inside Drop Assembly, _____ inch</td>
<td>Each</td>
</tr>
<tr>
<td>(n) Sump Manhole, 30 Ft Depth</td>
<td>Each</td>
</tr>
<tr>
<td>(o) Sump Capacity Test</td>
<td>Each</td>
</tr>
<tr>
<td>(p) Watertight Manhole Frame and Cover</td>
<td>Each</td>
</tr>
<tr>
<td>(q) Abandon Sump Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>(r) Access Doors</td>
<td>Each</td>
</tr>
</tbody>
</table>

In items (a), (b), and (m) the diameter of the manhole or assembly will be inserted in the blank, with a separate pay item provided for each size.

In items (c), (e) and (l) the type of structure will be inserted in the blank, with a separate pay item provided for each type.

Item (d) is for sump inlet as shown.

Under item (n), an adjustment, plus or minus, will be made if the sump manhole is not built to a depth of 30 feet. The adjustment will be calculated by dividing the sump manhole bid price by 30 feet to determine the adjustment cost per foot.

Item (o) includes any stand-by time required for the sump capacity test and evaluation.

Item (p) will be the additional cost above providing a standard manhole frame and cover.

Item (q) includes restoration of pavement base on pavement.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Manhole pipe stubouts will be paid for according to Section 00445.

No separate or additional payment will be made for:

- earthwork not covered as trench or ditch excavation
- pipe connections
- rock backfill
- aggregate base backfill
- drain tile
- acceptance testing
Section 00480 - Drainage Curbs

Description

00480.00 Scope - This work consists of constructing mechanically extruded curbs using either commercial grade concrete (CGC) or asphalt concrete material.

Construct the curbs at the locations and to the lines, grades and dimensions shown on the plans or as directed.

Materials

00480.10 Materials - Furnish materials meeting the following requirements:

| Commercial Grade Concrete............................................00440 |
| Emulsified Asphalt............................................................02710 |
| Epoxy Bonding Agent..................................................02070.10 |
| Preformed Expansion Joint Filler.................................02440.10 |

00480.11 Asphalt Concrete - Furnish dense graded, Level 2, 1/2 inch asphalt concrete mixture meeting the requirements of Section 00744. The mixture may be varied when conditions require it, if approved. The mixture will be visually accepted.

Construction

00480.40 Preparation of Base - Clean pavements upon which drainage curbs are to be constructed so that they are free of dirt, dust, oil, grease or other extraneous matter.

00480.41 Bonding Material Application:

(a) CGC Curbs - Bond CGC curbs to underlying pavements with an epoxy bonding agent from the CPL or conforming to 00480.10. Apply according to the manufacturer's recommendations and at a rate that provides a thorough coating to the surface with all voids and depressions filled. Place the new curb on the epoxy bonding agent within 15 minutes after spreading, or before it loses its tackiness, whichever is sooner.

(b) Asphalt Concrete Curbs - Bond asphalt concrete curbs to underlying pavement with either:

- An epoxy bonding agent meeting the requirements of 00480.10 or from the CPL, applied in the manner specified in 00480.41(a), or
- An emulsified asphalt of the type designated by the Engineer and conforming to 00480.10. Apply emulsified asphalt at a rate of 0.05 to 0.10 gallons per square yard of curb. Place the new curb on the emulsified asphalt after the asphalt separates from the water breaks, but before it loses its tackiness.
00480.42 Commercial Grade Concrete Curbs:

(a) Placing and Finishing - Feed concrete into the extruding machine at a uniform rate and operate the machine under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete. Perform finishing work as required to present a smooth, dense surface.

Remove and replace honeycombed sections. Repair of honeycombed or other defective sections by plastering will not be permitted.

(b) Transverse Expansion Joints - Space expansion joints as shown. The width of the joint and thickness of the filler shall not be less than 1/2 inch. Construct each expansion joint at right angles to the curb alignment, normal to the surface of the curb and provide complete separation of new concrete.

Firmly support the adjacent portions of the curb with close fitting shields if expansion joints are sawed before the concrete has hardened.

Mortar the joint filler in place if sawing is performed after the concrete has hardened.

(c) Transverse Contraction Joints - Space contraction joints as shown. Form the joints by grooving, by inserting and removing plates or other devices, by inserting and leaving in place preformed expansion joint fillers or by other approved means.

Make joints no wider than 1/4 inch, and deep enough so that at least 1/3 of the cross-sectional area of the curb is severed. Tool the edges of joints. Clean unfilled grooves and fill with joint filler flush with the surface of the concrete.

(d) Curing - Begin curing curbs immediately after completing machine or hand finishing of the fresh concrete, according to 00440.40(e).

00480.43 Asphalt Concrete Curbs - Construct asphalt concrete curbs by the mechanical extrusion method. Produce a well compacted mass of asphalt concrete with a uniform texture finish.

00480.44 Line and Grade - Place a 12 foot straightedge on the top or face of curb. The curb surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade changes or curves.

Measurement

00480.80 Measurement - The quantities of drainage curbs will be measured on the length basis, for each continuous run measured along the line and grade of the curb.
Payment

Payment - The accepted quantities of drainage curbs performed under this Section will be paid for at the Contract unit price, per foot, for the item "Drainage Curbs".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work as specified.
Section 00490 – Work on Existing Sewers and Structures

Description

00490.00 Scope - This work consists of joining new work to existing facilities, repairing or abandoning sewer lines and structures, adjusting existing manholes, inlets, boxes and other similar structures. Remove and dispose of pipe, manholes and catch basins that are scheduled for removal according to Section 00310.

00490.01 Definitions:

Adjust - To raise, lower or reconstruct structures to a new top elevation flush with the surrounding surface.

Box - Valve box, meter box, monument box or other similar structure with a removable cover.

Bypass Pumping - The process of pumping sanitary sewer or storm flows around a manhole or pipeline during the construction or rehabilitation of those facilities.

Inlet - Structure designed to receive surface water through a grate or orifice and to discharge water through pipes.

Manhole - Manhole, sump or similar structure designed to permit entry of sewer lines and working space for maintenance.

Manhole Neck - The upper portion of a manhole, having vertical walls and a uniform diameter or dimension just sufficient to receive and support the metal frame.

Materials

00490.10 Materials - Furnish materials of either existing materials in a condition suitable for reuse and meeting current design, or new materials that meet the following requirements:

- Commercial grade concrete.................................00440
- Joint materials............... 02440.40, 02440.50, 02440.60
- Metal frames, covers, grates and ladders .............02450.30
- Pipe materials .................................................00445.11
- Precast concrete sections.................... 02450.10, 02450.20
- Reinforcement.................................................02510.10

00490.11 High Early Strength Concrete - Furnish high early strength concrete meeting the requirements of commercial grade concrete, except it shall contain a minimum of 705 pounds per cubic yard of Type III or Type IIIA cement or an approved Type C or Type E admixture with a minimum of 592 pounds per cubic yard of Type I or Type II cement.
00490.12  Temporary Plating - Temporary plating shall conform to Section 00275.

**Construction**

00490.40  General:

(a) **Preparation** - Excavate and backfill according to Section 00405. Remove and dispose of old concrete and other materials according to Section 00310.

Obtain approval before reusing salvaged metal frames, covers, grates and fittings on structures to be adjusted.

When concrete is placed around frames, paint the portion of the frame that contacts the concrete with hot asphalt before the concrete is poured.

Provide high early strength concrete when shown on the plans, or when traffic is required to traverse the structure due to staging requirements. The Engineer will determine the length of curing time.

Construction of new manholes shall conform to Section 00470.

(b) **Diversion of Flow:**

(1) If sewer or storm drain diversion is necessary to do the contract work, submit a “Sewer Diversion Plan” to the Engineer prior to the start of construction. The Sewer Diversion Plan shall describe the Contractor’s proposed method of managing and conveying all flows during all phases of construction. The plan shall contain, at a minimum, a plan view of the diversion facilities on a site map, and the individual components including but not limited to: pump types, size and placement; diversion pipe size, type, and placement above and below ground, power supplies, method of damming the flow, and redundancy.

(2) The Engineer will provide the Contractor with the anticipated sewer flow rates to prepare the Sewer Diversion Plan and to size the diversion pump(s), pipe(s), and related appurtenances. Refer to the Project Special Provisions for the specific information needed to prepare a Sewer Diversion Plan.

Flow within the City sewer system can fluctuate greatly with weather conditions. The Contractor is required to have ability to divert the expected annual average maximum flow corresponding to the time when work will occur whenever flow diversion is needed to complete the project.
After the Engineer has reviewed and approved the Sewer Diversion Plan, no change is allowed. Change to any aspect of the approved Diversion Plan, including different diversion facilities or discharge location(s), shall require resubmittal and approval by the Engineer.

(3) No sewer diversion operation may proceed unless the Contractor has, at the work site, the following items:

   a. Dry granular lime, or a 10% bleach solution, of sufficient quantities as determined by the Engineer, to be spread on any sewage release (defined as sewage being backed up or discharged to any unintended place or causing a threat to public health or safety) as a disinfectant. Disinfectants may not be directly applied to any surface waters, streams, creeks, or other natural or manmade surface water conveyance facilities when water is present.

   b. Equipment to secure the area of sewerage release and isolate the public from accessing the release site. As a minimum, include barricades and caution tape.

   c. Equipment and materials on hand to stop the release and repair the failed item.

   d. Equipment and materials to clean and disinfect the site, rake up solid debris, and to dispose of material properly.

(4) When necessary, divert the flow by use of pumps to the next downstream manhole. Provide adequate pumps and piping to divert flow to downstream sewer lines. All diversion flow piping shall be buried, with leak-proof pump hoses, unless approved.

(5) Maintain diversion of flow during working hours and return flow to gravity during non-working hours unless otherwise approved. Be responsible for continuity of flow and uninterrupted sewer service to each facility connected to the sewer during the execution of the work. All pipe connections shall be water tight.

(6) If pumped diversion of flow is allowed, incorporate redundant pumps and power supplies. Have personnel on site to monitor pumped flow diversion system continuously. Personnel monitoring the pumped diversion must also be capable of starting backup system in an automatic mode capable of handling diversion flows. Back up power sources and pumps shall have the same capacity as the primary pumping equipment.

(7) Use generators that meet or exceed requirements imposed by local noise ordinances, and place generators so as to minimize disturbances to residential areas. When working outside the hours defined in Subsection 00290.30(d), secure a noise variance, if required, at no additional cost to the City. Comply with the more restrictive noise control requirements established for non-working hours. Contact the Office of Neighborhood Involvement, Noise Control Office.
(8) Be responsible for all fines, cleanup, repair, property damage costs and other claim costs resulting from sewage release, including sewage entrance into buildings.

(9) Have sufficient equipment and materials at the work site to immediately cease, contain and clean up any sewage release that occurs during diversion operations. Leaking pipes and pumps shall be replaced or repaired. Immediately clean up sewage releases.

(10) Immediately notify the following agencies of any sewage release:

   a. Bureau of Environmental Services Spill Response.
   b. Bureau of Maintenance (BOM)
   c. Oregon Emergency Response System (OERS, if the spill is directly into any water body of the State).

(11) Provide these agencies and the Engineer with the following information:

   a. Release site.
   b. Date and time release started and stopped if known.
   c. Release flow rate and estimate of volume.
   d. Receiving stream or watercourse.
   e. Action taken to stop release.
   f. Cause of release.
   g. Clean-up actions

00490.41 Manholes over Existing Sewers:

(a) General - Construct manholes in accordance to Section 00470. Test all sanitary sewer manholes according to Section 00470.

Provide all rigid pipe entering or leaving a manhole with a flexible joint within 18 inches of the manhole structure. Flexible pipe may be exempt from this requirement when using an approved manhole adapter to make the connection to the manhole.

Prevent material or debris from entering the line. When required, provide all diversion facilities and perform all work necessary to maintain flow in existing lines. Obtain the Engineer's approval prior to diverting flows.

(b) Diversion of Flow - Before beginning work on any existing operating sewer submit a Sewer Diversion Plan in conformance with these Specifications to the Engineer. Obtain approval before beginning work. Approval will not relieve the Contractor of responsibility for maintaining adequate flow capacity at all times and adequately protecting new and existing work.
(c) Extent of Work - Construct manholes over existing operating sewers at locations shown on the Plans. Perform necessary excavation and construct new manholes in conformance with applicable requirements of Section 00470.

(d) Damaged Connections - Connect any existing or new sewers to the manhole. Replace any sewer damaged by construction operations entering or leaving a manhole at no additional cost to the City.

(e) Interior Finishing - After constructing the manhole, carefully break out the existing pipe within the manhole, cover the broken edges with mortar and trowel smooth as approved.

(f) Precautions To Be Taken - Prevent broken material or debris from entering the sewer. At all times, maintain flow through the existing sewer. After placing new concrete or mortar, protect the area for a period of 7 days.

(g) Connection to Existing Manholes - Carefully, break out existing manhole base and walls as approved. Grout in new sewer to provide watertight seal, and, when applicable, rework the existing base to provide smooth flow channels into and through existing manhole as specified.

(h) Manhole Connections - Construct openings in the existing manhole base or barrel as required. Construct connections that are watertight and that will provide a smooth flow into and through the manhole. All sanitary sewer pipe connections, including those at invert level as well as penetrations for drop connectors, conduits and carry-throughs, shall conform to the requirements of Section 00470.

(i) Removal of Existing Pipes, Manholes & Sewer Appurtenances - Remove from the site and dispose of existing pipelines, manholes and sewer appurtenances which lie in the line of and are to be replaced by the new construction.

00490.42 Service Line Connections to Existing Sanitary Sewers and Facilities:

(a) General - Make connections of service lines to existing sewers watertight. Make connections, where possible, to existing tees or wyes that have been previously installed and plugged. Remove the plug and make the connection according to Section 00445. Make transition couplings between dissimilar pipe materials using approved commercial adapters. Where tees or wyes for connection are absent or unusable, connect service lines with approved commercial taps. Install taps by coring without protrusion into, or damage to, the existing sewer. Support the sewer and replace bedding material, as necessary, to prevent settlement of the sewer grade.

(b) Penetrations in Manholes - Core-drill all openings to connect pipe up to 10 inches in diameter. Provide a minimum of 1 foot of clearance in all directions between the edge of the opening and the edge of any other adjacent opening or pipe and 6 inches of clearance from any manhole joint. Openings for pipe larger than 10 inches require Engineer's approval.
00490.43 Abandoning Pipe in Place - Drain abandoned pipes and plug watertight. Plug abandoned pipes with gasketed mechanical plugs or grout seals, as directed. Where abandoned pipes connect to sewer manholes, install the plugs or seals from the inside of the manhole and reshape the channel to conform to the Standard Drawings.

Fill abandoned pipes greater than 12 inches diameter with sand, controlled low-strength material meeting the requirements of Section 00442, or other approved material.

00490.44 Filling Abandoned Pipes, Manholes and Catch Basins:

(a) General - Fill all existing manholes and structures shown to be abandoned with pea gravel or with granular material meeting the requirements of Section 02630.

Compact pea gravel until there is no reaction or yielding observed under the compactor. Compact the granular material to 90% of maximum density according to AASHTO T 99.

Remove all structures to a minimum of 2 feet below subgrade. Remove manhole or inlet frame and cover and plug all abandoned pipes with permanent plugs. Cover in-place pea gravel with 2 mats of non-woven filter fabric, extended at least 1 foot beyond the outside walls of manhole, sump, or basin. The landscaped or unimproved roadway sections shall be backfilled with approved materials meeting the requirements of 00330.13. The last one foot of backfill shall use materials as shown.

(b) Sumps - Remove sediment, contaminated soil, and water and properly dispose of these materials according to Section 00291. Remove top cone and first solid concrete section to a depth of approximately 8-10 feet below ground. Fill sump with CLSM meeting the requirements of Section 00442. Backfill void with approved materials meeting the requirements of 00405.14. Place geotextile meeting the requirements of 02320 on top the CLSM that extends beyond the outside of the sump and surrounding backfill.

(c) Permanent Plugs - Provide permanent plugs where sumps, manholes, inlets, pipes and other sewer appurtenances are removed or abandoned. Also provide plugs where shown. The minimum length of concrete plug shall be 8 inches. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage. Clean the interior surfaces of all pipes to be cut off or abandoned, as approved. For pipes greater than 12 inches in diameter, fill with CLSM or as specified. Construct a concrete plug in each end of all pipes 18 inches or less in diameter. For 21 inch and larger pipe, the plug may be constructed of common brick or concrete block. Cover the exposed face of block or brick plug with mortar.
00490.45 Salvaging Manhole Frames, Covers and Grates - Remove manhole frames, covers and grates scheduled for salvage and store in an approved location. Frames, grates and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the work if of suitable size and condition. Replace, at no additional cost to the City, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.

Clean salvaged components to be reused of foreign material by methods that will not harm the components.

(a) Existing Manhole Frames and Covers - Manhole frames and covers removed by the Contractor are the property of the City. Notify the Engineer a minimum of 1 day before removal to arrange for pick up of the removed frames and covers, if not reused.

00490.46 Adjusting Manholes and Structures:

(a) General - Bring manholes, inlets, catch basins and other structures to the specified finished grade by methods of construction as required in Sections 00445 and 00470.

Excavation necessary for bringing a structure to grade shall center about the structure and minimize the area of disturbance, as approved. At the completion of the structure adjustment, backfill the void around the structure with crushed aggregate and thoroughly compact it before installing the finished surface.

(b) Metal Steps and Ladders - If existing manholes or similar structures have metal steps or metal ladders, provide new steps or new ladder extensions in the adjusted structure, in kind. Construct according to the Standard Drawings.

(c) Concrete and Masonry Manholes - Manholes may be raised or lowered as specified below or as shown.

(1) Minor adjustments of manholes are those that require adding or removing precast grade rings or metal rings as approved.

(2) Major adjustments of manholes are those that infringe into the cone or flat top section. Remove the cone or flat top, add or remove sections, and replace the cone or flat top. Use risers to attain desired grade. When approved, adjustment of an existing manhole to a lower grade shall comply with the following:

   a. Do not reduce the manhole cone height to a point such that the inside diameter exceeds 25 3/4 inches
   
   b. Do not allow the manhole form casting to rest on a manhole step.
   
   c. Construct a 12 inch wide, concrete collar around the frame casting from 1 1/2 inches below the top of the cone to 1 1/2 inches below the top of manhole frame casting.

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d. If the cone is cracked during reduction, restack the manhole with shorter manhole sections and a new cone.

Precast sections removed in the adjusting work may be reused in other adjusting work or in new construction provided they are in good condition and otherwise conform to the Specifications. Precast items that are not used in the work shall be disposed of according to 00290.20.

(d) Reconstruct Manhole Base - Conform to applicable requirements of Section 00470. Exercise caution in chipping out an existing concrete base to prevent cracking of manhole walls. Prevent any material from entering the sewer. Pour new base to a minimum of 6 inches below the lower projection of the pipe, being either the bell or barrel. Construct new channels to the elevations shown on the Plans. Conform to details for channel construction as shown. Repair any cracks that occur because of work operations with new grout to form a watertight seal, as approved.

(e) Replace Manhole Steps - Remove non-conforming or defective steps as follows:

Obtain approved manhole steps from the CPL or current list of City’s Materials Testing Laboratory. Assure that no material created or dislodged during removal of existing or installation of new steps enters the manhole or sewer. Replace all manhole steps identified for replacement. If manhole rehabilitation is required, perform all work prior to beginning installation of steps. All steps within a manhole shall be of the same design, type and size. Mixing of unmatched steps within the same manhole is not acceptable. Align steps vertically. Spacing between steps must be as shown. Install new steps according to manufacturer’s instructions or as approved.

00490.47 Adjusting Catch Basins and Inlets:

(a) Cast-in-Place Concrete Catch Basins and Inlets:

- After existing frames and grates or covers have been removed, chip away the exposed top surface to expose firm concrete. Provide at least 1 inch clearance below the frame to be placed.
- Clean the new surface by brushing and moistening with water at the time of placing new concrete.
- Provide the necessary forms to maintain existing structure dimensions in the new work.
- Place new concrete according to Section 00440 to the required grades. The frame may either be preset in the form or placed in the fresh concrete to the required grades.
- Finish the concrete top surfaces as required to match the grades required.
- Grout existing and new inside surfaces, as required, to attain a uniform surface transition.
(b) Precast Concrete Catch Basins and Inlets - The entire precast structure may be reset to a new grade when the nature of the structure and conditions permit.

Precast concrete sections may be added or removed as required to obtain proper grade.

Precast structures may be raised by using precast sections provided that:

- The material conforms to the general requirements of the existing structure
- Sections are set and joined to each other and to existing sections
- Uniform bearing of bearing surfaces is assured
- Positive safeguards are made against displacement when in service.

(c) Catch Basin Connections - Adjust as follows:

- Place connecting pipe at the required line and grade.
- Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.
- Connect to the structure with a watertight joint.

Conform to applicable requirements of Section 00470. Carefully, break into existing inlet or catch basin and grout in a watertight seal between the new pipe and the inlet or catch basin wall. Plaster mortar smooth inside pipe opening. Alignment, pipe slope, and other construction details shall be as approved. Plug all abandoned pipes with permanent plugs. Slope bottom of inlet to drain to new pipe. Plaster mortar smooth all interior walls of inlet or catch basin.

(d) Bicycle Protection for Existing Inlet Grates - Modify any existing inlet grate that does not have bicycle protection straps as shown or directed.

00490.48 Adjusting Boxes, Cleanout Lids and Similar Structures - Raise or lower boxes, lids and similar structures by one of the following methods:

- Resetting the entire structure on a firm foundation.
- Adding extensions of like material below the original structure if raising the structure to a point where it would not enclose or protect its contents.
- Placing precast box extensions, or cast-in-place concrete.
- Complete replacement of the structure with a new structure of adequate design approved by the Engineer.

00490.49 Finish Grade - Center a 12 foot straightedge, as far as practical, over the center of the cover of manholes and boxes. The final grade of the pavement surface and adjusted manholes and boxes shall not vary more than 1/8 inch from the finish grade and cross section at any point along the straightedge.
00490.50 **Correction of Defects** - Perform all corrective work, including any re-inspection, necessary and provide documentation of the corrective work.

**Measurement**

00490.80 **Measurement** - The quantities of adjusted and reconstructed manholes, connection to existing manholes, filling abandoned manholes, sumps, inlets, boxes, catch basins, adjust structures to grade, reconstruct manhole base, connect pipe to existing inlets and catch basins, bicycle protection for existing grates, permanent plugs larger that 12 inches and other similar structures will be measured on the unit basis.

The quantities of manholes over existing sewers, connections to existing structures, and filling abandoned structures will be measured on the unit basis.

00490.81 **Lump Sum Basis** - Under this method, no measurement of quantities will be made.

00490.82 **Volume Basis** - Under this method, measurement on the volume basis will be within the neat line of the structure as shown.

**Payment**

00490.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Minor Adjustment of Manholes</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Major Adjustment of Manholes</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Adjusting Inlets</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Adjusting Boxes</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Adjusting Catch Basins</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Manholes over Existing Sewers</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Connection to Existing Structures</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Filling Abandoned Structures</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Existing Pipe Connection to New Manhole</td>
<td>Each</td>
</tr>
<tr>
<td>(j) Reconstruct Manhole Base</td>
<td>Each</td>
</tr>
<tr>
<td>(k) Permanent Plugs</td>
<td>Each</td>
</tr>
<tr>
<td>(l) Bicycle Protection for Existing Grates</td>
<td>Each</td>
</tr>
<tr>
<td>(m) Replace Manhole Steps</td>
<td>Each</td>
</tr>
<tr>
<td>(n) CLSM for abandoned structures</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

Item (a) applies to manholes adjusted by adding or removing precast or metal grade rings.
Item (b) applies to manholes adjusted by:

- removing and reconstructing part or all of the cone or flat top
- removing and replacing the entire cone or flat top
- adding precast risers below the cone of precast manholes

Item (f) applies to manholes that are installed over existing sewers.

Item (h) applies to filling abandon pipes, manholes, sumps, inlets, boxes and other similar structures and includes all material and labor required to complete the work as specified.

Under item (f), any existing pipe that needs to be replaced in order to connect to a new manhole will be paid under Section 00445.

Item (k) applies to plugs larger than 12 inches.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- earthwork
- backfill
- protective coatings
- replacement of sump backfill
- base drains
- aggregate bases
- pavements
- connections
- structure abandonment
- removing and disposing of existing structures and pipe
- permanent plugs 12 inches or smaller

00490.91 Lump Sum Basis - The accept quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Diversion of Flow".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Section 00491 - Sump System Remediation

Description

00491.00 Scope - This work consists of remediating a stormwater sump system damaged by the Work.

00491.01 Definitions:

Sump System Site - An area, shown on the Plans, that includes one or two sump manholes with drain rock, one sedimentation manhole and the pipe that connects these structures excluding any inlet structure and any pipe(s) between the sedimentation manhole and any inlet.

Material

00491.10 Drain Rock Backfill - Furnish clean gravel that is free of organics and is free draining. Unless otherwise directed. Use either:

- Pea Gravel as defined in 00110.20.
- 4” - 2” Aggregate with a maximum of 10% fractured faces.

Provide material that matches the character of the existing drain rock backfill. Obtain approval of material before material delivery and use.

Construction

00491.40 Sump System Preservation - When constructing sewer facilities adjacent to a sump system site, implement measures to avoid damage to any site facilities. Do not remove or abandon any sump manhole, unless identified in the Plans.

00491.41 Sump System Site Remediation - Remediate unavoidable damage by implementing any of the following measures:

- Remove sump drain rock that conflicts with the Work without disturbing the sump manhole. Replace the drain rock between the sump and the edge of excavation with new material. Prior to placing drain rock, protect the exposed native soil with Geotextile fabric, or other approved method. Do not disturb the exposed soil during backfill placement, or allow it to fall into the voids of the newly placed drain rock.

- Select geotextile fabric for separation purposes from Section 02320 or from the CPL and install between the drain rock and the pipe zone and trench backfill material, as shown.

- Remove and replace the sedimentation manhole according to Section 00470.
• If Work damages any portion of the pipe between the site structures remove the entire length between the structures and replace with pipe of the same material and size but not less than 10 inches in diameter according to Section 00445.

• Remove and replace any base aggregate and pavement damaged when remediating a sump system site according to Section 00495.

Obtain approval of any proposed work to these facilities.

<table>
<thead>
<tr>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>00491.80 Measurement - The quantities of sump system site remediation will be measured on the unit basis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>00491.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the item &quot;Sump System Site Remediation&quot;.</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Removing and replacing a sedimentation manhole will be paid according to Section 00470.

Removing and replacing damaged pipe between structures will be paid according to Section 00445.

Removing and replacing site pavement and aggregate base will be paid according to Section 00495.
Section 00495 - Trench Resurfacing

Description

00495.00 Scope - This work consists of resurfacing pipe trenches, including replacement of pavement, temporary surfacing, curbs, sidewalks, rock surfacing, topsoil, landscaping and other features removed or damaged during pipe trenching operations.

Materials

00495.10 Materials - Provide trench resurfacing materials that match existing material removed from pipe trenches, or meeting the following:

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>00640</td>
</tr>
<tr>
<td>Concrete Paving</td>
<td>00756</td>
</tr>
<tr>
<td>Concrete Sidewalks, Curbs and Driveway</td>
<td>00759</td>
</tr>
<tr>
<td>Control Low Strength Materials (CLSM)</td>
<td>00442</td>
</tr>
<tr>
<td>Emulsified Asphalt Concrete (EAC)</td>
<td>00736</td>
</tr>
<tr>
<td>Emulsified Asphalt Prime Coat/lining</td>
<td>00705</td>
</tr>
<tr>
<td>Emulsified Asphalt Surfacing</td>
<td>00710</td>
</tr>
<tr>
<td>Emulsified Asphalt Tack Coat/lining</td>
<td>00730</td>
</tr>
<tr>
<td>Minor Hot Mixed Asphalt Concrete (MHMAC)</td>
<td>00744</td>
</tr>
<tr>
<td>Rock Surfacing</td>
<td>00640</td>
</tr>
<tr>
<td>Topsoil, Planting and Seeding</td>
<td>01040</td>
</tr>
</tbody>
</table>

Furnish sand used for edge sealing that is clean sand with no visible sign of silts or organic materials.

00495.11 Temporary Surfacing Material - Use MHMAC or products on the CPL.

00495.12 Temporary Plating - Temporary plating shall conform to Section 00275.

Construction

00495.40 General - The following construction requirements are for resurfacing trenches in various locations as shown. Refer to Section 00405 for trench surface removal requirements.

(a) Minor Hot Mixed Asphalt Concrete (MHMAC) Paving - Place MHMAC paving according to Section 00744.

(b) Emulsified Asphalt Concrete (EAC) Paving - When temporary surfacing is required prior to placing permanent surfacing, place EAC paving a minimum of 2 inches thick. The temporary paving shall be smooth with surface variations not greater than 1/2 inch from the existing surfacing. Where the temporary patch adjoins existing surfaces the joint shall not be greater than 1/4 inch high. Maintain the temporary surfacing until the permanent surfacing is placed. MHMAC mix may be used if approved.
(c) **Emulsified Asphalt Prime Coat** - Construct emulsified asphalt prime coat according to Section 00705.

(d) **Emulsified Asphalt Surfacing** - Construct emulsified asphalt surfacing treatment according to Section 00710.

(e) **Edge Sealing Tack Coat Application** - Seal all adjoining asphalt concrete pavement surfaces with an edge sealing tack coat. Place sufficient tack coat to seal the adjoining surfaces. After the tack coat has been placed, spread clean sand over the tack coat. Reapply additional tack coat and sand to cover any edges that are not completely sealed in the first application.

(f) **Aggregate Base** - Place aggregate base according to Section 00640.

(g) **Concrete Sidewalk, Curb and Driveway** - Construct concrete sidewalk, curbs and driveways according to Section 00759.

(h) **Concrete Paving** - Construct concrete paving according to Section 00756.

(i) **Rock Surfacing** - Construct rock surfacing according to Section 00640.

(j) **Topsoil** - Place topsoil according to Sections 00405 and 01040.

(k) **Landscaping** - Place landscaping according to the requirements of Section 01040.

(l) **Controlled Low Strength Material (CLSM)** - Place CLSM according to Section 00442. After the CLSM is placed and until the trench is paved, provide steel plates, or other approved covering, over the trench to allow access for vehicles, bicycles and pedestrians. Protect CLSM surface from vehicle loads for 3 days before placing MHMAC.

00495.41 **Temporary Surfacing** - Construct temporary surfacing with a minimum of 2 inches of MHMAC material or as shown.

**Measurement**

00495.80 **Measurement** - The quantities of trench resurfacing will be measured on the area basis. The length will be measured horizontally along the centerline of the installed pipe from edge to edge of the surface replaced. The width will be the trench width detailed in Section 00405 plus 12 inches as shown below. The width will be measured from edge to edge of the top of the trench.

For temporary trench resurfacing, the width will be the trench width detailed in Section 00405.
00495.90

(a) Sewer Pipe:

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Width of Trench Resurfacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 10 inches</td>
<td>42 inches</td>
</tr>
<tr>
<td>12 to 21 inches</td>
<td>OD plus 30 inches</td>
</tr>
<tr>
<td>24 to 36 inches</td>
<td>OD plus 34 inches</td>
</tr>
<tr>
<td>42 to 54 inches</td>
<td>OD plus 54 inches</td>
</tr>
<tr>
<td>60 inches and larger</td>
<td>OD plus 58 inches</td>
</tr>
</tbody>
</table>

(b) Water Pipe:

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Width of Trench Resurfacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 16 inches</td>
<td>OD plus 30 inches</td>
</tr>
<tr>
<td>24 inches and larger</td>
<td>OD plus 36 inches</td>
</tr>
</tbody>
</table>

When the pipe is installed under pavement by tunneling, boring, or jacking methods, the work will be measured for payment according to 00406.80.

Payment

00495.90 Payment - The accepted quantities of trench resurfacing will be paid at the Contract unit price, per square yard, for the following items.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Trench Resurfacing</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(b) Temporary Trench Resurfacing</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(c) Trench Resurfacing w/o Base, ____</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

Item (b) includes the cost to remove and dispose of the temporary surfacing when no longer needed.

Item (c) is only for the replacement of the trench surfacing material. In the first blank, indicate the resurfacing material. In the second blank, the thickness of resurfacing material. Payment for aggregate base will be paid for according to Section 00640.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for replacement of disturbed landscape items.

When the pipe is installed under pavement by tunneling, jacking, or boring methods, the work will be paid for according to 00406.90.
When the Contract Schedule of Items does not indicate payment for trench resurfacing or other work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.
PART 00500 - BRIDGES

Section 00501 - Bridge Removal

Description

00501.00 Scope - This work consists of removing and disposing of existing bridges or portions of existing bridges as shown or specified.

Construction

00501.40 Removal and Disposal - Perform removal and disposal work according to Section 00290 and Section 00310.

Measurement

00501.80 Measurement - No measurement of quantities will be made for bridge removal work performed under this Section.

Payment

00501.90 Payment - The accepted quantities of bridge removal work will be paid for at the Contract lump sum amount for the item "Bridge Removal Work".

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00503 - Bridge Deck Cold Plane Pavement Removal

Description

00503.00 Scope - This work consists of removing existing pavement from bridge deck surfaces.

Equipment

00503.20 Equipment for Grinding on Bridge Decks - To remove pavement from bridge decks, use power-operated diamond grinders, micro-milling equipment, or hydroblast machines capable of uniformly removing the existing surface to the depths required.

(a) Diamond Grinders - Diamond grinders shall be power-driven self-propelled units with cutting heads made up of diamond cutting blades.

(b) Micro-milling - Micro-milling equipment shall consist of the following:

(1) Cold Plane or Rotomill Grinders - Cold plane or rotomill grinding machines using carbide cutting tools in a rotary drum. Provide equipment with a tooth spacing of not more than 1/4 inch, capable of leaving a smooth, uniform pattern of striations. Limit machines to a gross operational weight of no more than 35 tons and a forward speed to 2.5 feet per minute. Operate at a drum speed of at least 120 RPM.

(2) Shot-Blasters - Mono-directional or bi-directional electric-powered shot blast machines with single or multiple blast wheels.

Machines shall cover at least 2.5 feet per pass, and shall conform to EPA air pollution requirements by containing dust and steel abrasive media. If the equipment is not equipped for simultaneous bi-directional blasting, make separate passes in opposite directions to ensure equal cleaning on all sides of the exposed aggregate. Limit forward speed to 2.5 feet per minute.

(c) Hydroblasting - Hydroblasting equipment shall be capable of removing concrete at a rate and volume acceptable to the Engineer without leaving a striated surface. Remove the entire original deck surface to a minimum depth of 0.125 inch. Demonstrate the removal rate and accuracy of the equipment to the Engineer prior to commencing work.

Construction

00503.40 Pavement Removal on Bridges - Remove pavement from bridges according to the following:
(a) General:

- Before removing the wearing surfaces, do the following:
  - Determine the actual depth of pavement to be removed.
  - Block all deck drains and all catch basins. Do not allow any grinding, chipping, sweeping, flushing, or shot blasting material to enter them.
  - Remove material that is within 12 inches of all joints in a manner acceptable to the Engineer. Do not damage any joints.
  - Remove AC, laitance, and residual film by approved hand methods in areas that cannot be reached by grinding machines.
  - Hydroblast all deck surfaces before placing high performance concrete.
  - Repair all damage to abutting concrete surfaces or other surfaces that are damaged by the Contractor's operations at no additional cost to the City.

(b) AC Surfacing - Do not grind into the existing concrete bridge deck.

(c) PCC Surfacing - If diamond, cold plane, or rotomill grinders are used, clean the entire surface with a shot blaster after completion of the diamond grinding operation. Provide a final surface that is free of cement paste and sand and has a minimum 0.125 inch depth of exposed large aggregate.

(d) Scheduling - Schedule the work so the full width and length of travel lane pavement can be removed during the same shift. Remove the shoulder area within 24 hours after removing the travel lane pavement.

If the depth of the existing pavement to be removed is over 2 inches, then within the same day construct a wedge of asphalt concrete, at a slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at joints, deck drains, catch basins, and other structures. Maintain wedges as long as the area remains under traffic or until pavement is replaced. Remove and dispose of wedges before placing new surfacings.

00503.41 Surface Tolerance - Test with a 12 foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any 2 ridge contact points, shall not exceed 1/4 inch.

00503.42 Disposal of Materials - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of the material according to 00290.20 unless special sites are specified in the Special Provisions.

00503.43 Maintenance Under Traffic - If the cold planed pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the roadway.
Measurement

00503.80 Measurement - The quantities of bridge deck cold plane pavement removal will be measured on the area basis. The area will be determined by measuring the width and length of the bridge deck surface, measured to the nearest 0.1 foot, and calculated to the nearest square yard.

When the depth of pavement to be removed is variable, the depth is an estimate and will be considered approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00503.90 Payment - The accepted quantities of bridge deck cold plane pavement removal will be paid for at the Contract unit price, per square yard, for the item "Bridge Deck Cold Plane Pavement Removal, _______ Deep".

The depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for removing asphalt concrete surfacing from bridge decks for the preparation of waterproofing membrane or for constructing, maintaining, and removing temporary wedges.
Section 00510 - Structure Excavation and Backfill

Description

00510.00 Scope - This work consists of excavating, backfilling and disposing of materials in connection with the construction of bridges, grade separation structures, rigid frame structures, and other major structures. Other major structures under this Section are retaining walls, reinforced concrete box culverts, headwalls, structural plate structures, and pipe culverts, sewers, siphons and irrigation pipes greater than 72 inches in diameter.

This work does not include any earthwork covered under any sections of Parts 00300 or 00400, or any earthwork that may be specifically included and provided for as incidental work for particular items or parts of the work. The construction, measurement, and payment of embankment at bridge ends and engineered fills will be according to Section 00330.

00510.01 Lines, Grades, and Cross Sections - Perform the work to the lines, grades and cross sections shown or as established.

00510.03 Cofferdam Plans, Calculations, and Construction Inspection - Submit stamped cofferdam plans and design calculations according to 00150.35 except as modified by this subsection.

Design cofferdams according to the ODOT Bridge Design and Drafting Manual.

Submit a Cofferdam Design Summary and complete a Cofferdam Design Checklist prepared by the cofferdam design engineer, to accompany the plans and calculations. Include the following in the summary:

- A list of cofferdam members with their capacities and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit 5 sets (9 sets if railroad approval is required) of the plans, and 3 copies (5 copies if railroad approval is required) of the calculations, summary, and checklist.

The Engineer will provide a list of construction concerns at least 2 days prior to the cofferdam design engineer’s inspection. Upon completion of the cofferdam construction and immediately after dewatering, the cofferdam design engineer of record, accompanied by the Engineer, shall inspect the cofferdam. Do not continue construction until:

- The cofferdam design engineer furnishes the Engineer a written statement that the cofferdam conforms to the design and will serve the intended purpose, and
- The Engineer agrees in writing that all construction concerns have been addressed and the cofferdam will serve the intended purpose.
Shoring Plans, Calculations, and Construction Inspection -
Submit stamped shoring plans and design calculations according to 00150.35 except as modified by this subsection.

Design shoring according to the ODOT Bridge Design and Drafting Manual.

Submit a Shoring Design Summary and complete a Shoring Design Checklist prepared by the shoring design engineer, to accompany the plans and calculations. Include the following in the summary:

- A list of shoring members with their capacities and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit 5 sets (9 sets if railroad approval is required) of the plans, and 3 copies (5 copies if railroad approval is required) of the calculations, summary, and checklist.

The Engineer will provide a list of construction concerns at least 2 days prior to the shoring design engineer's inspection. Upon completion of the shoring construction, the shoring design engineer of record, accompanied by the Engineer, shall field inspect the shoring. Do not continue construction until:

- The shoring design engineer furnishes the Engineer a written statement that the shoring conforms to the design and will serve the intended purpose and;
- The Engineer agrees in writing that all construction concerns have been addressed and the shoring will serve the intended purpose.

Materials

Selected General Backfill - Furnish soil selected from roadbed, ditch, trench, or structure excavations meeting the requirements of 00330.13.

Selected Granular Backfill - Furnish granular material selected from roadbed, ditch, trench or structure excavations meeting the requirements of 00330.14.

Granular Wall Backfill - Furnish granular wall backfill meeting the requirements of 02630.11.

Granular Structure Backfill - Furnish granular structure backfill meeting the requirements of 02630.10.

Quality Control - Provide quality control according to Section 00165.
Labor

00510.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CDT

Construction

00510.40 Clearing, Grubbing, and Removal Work - In the absence of pay items under Section 00310 and Section 00320, the provisions of those sections apply when applicable. Perform such work as incidental work for which no separate payment will be made.

Clearing, grubbing, and removal limits shall be at least 10 feet outside of the entire structure, including the ends of the structure but within the right-of-way.

00510.41 Structure Excavation - Structure excavation includes:

- Removal of all material necessary for the construction of foundations and substructures as shown or specified.
- Placement of all backfill except granular wall backfill and granular structure backfill.
- Disposal of excavated material not required or suitable for backfill according to 00330.41(a)(5).
- Correction, according to recognized practice, of conditions detrimental to the work, including removal of excess water.

Shore, brace, or use cofferdams to protect excavations unless open excavation would not be detrimental to adjacent structures, roadways, or waterways.

If the plans show concrete in footings placed against undisturbed material, make excavation for footings as nearly as possible to neat lines of the footings. Where such material will not stand vertically after excavation and the excavation does not exceed 1 foot outside the footing dimensions, fill all space between the footing and remaining undisturbed material to the top of the footing with footing concrete or granular structure backfill material, as directed. Compact the granular structure backfill to 97% of maximum density, according to 00330.43.

Concrete placed against steel sheet piles in cofferdams or cribs will be considered placed against undisturbed material, whether or not the steel sheets are later removed.

Where practical, excavate rock materials using pavement breakers, rippers, backhoes, other excavation equipment or non-explosive means that preclude breakage of rock materials below and outside of the structure excavation limits. If blasting is required, perform such work in a manner that avoids disturbing rock outside the structure excavation limits. Use controlled blasting techniques.
00510.42 Structure Excavation and Backfill Below Elevations Shown -
Excavate soft, unstable or unsuitable material below footings or bases of structures, including bedding, if any, to elevations as directed.

Perform one of the following as directed:

- Increase the length of columns or walls until the bottom of the footing is at the new established elevation.
- Increase the thickness of footings until the bottom of the footing is at the new established elevation
- Backfill the subexcavated area to the plan elevation according to 00510.46(a).

00510.43 Preservation of Channel - Do not excavate outside of caissons, cribs, cofferdams, sheet piling or sheeting, or disturb the natural streambed unless specified or allowed. Where such excavation is allowed, comply with Section 00405. Do not sidecast any excavated material into the stream.

When allowed, the necessary excavation for placement of riprap outside the perimeter of the footing may be made without the use of cofferdams or cribs, and disposed of according to 00330.41(a)(4).

00510.44 Cofferdams and Cribs - Design and construct cofferdams and cribs when shown, specified or determined by the Contractor to be necessary for performing the work in the dry inside them as follows:

- Prepare and submit plans, calculations, summary and checklist for cofferdams or crib designs according to 00510.03.
- Provide interior dimensions for cofferdams and cribs to give sufficient clearance for the inspection of forms.
- When weighted cribs are used to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, provide an appropriate special anchor system such as dowels or keys to transfer the entire weight of the crib into the foundation seal.
- Do not leave cofferdam or crib timber or bracing extending into the substructure concrete.
- Place and cure seal concrete according to 00540.48(e).
• Vent or port, at low water level, any cofferdam that is to remain in place.
• Unless otherwise directed, remove cofferdams or cribs, including all sheeting and bracing, after the completion of the substructure. Do not disturb or damage the finished concrete.

00510.45 Pumping - No pumping of water from the interior of any foundation enclosure will be allowed during the placing of concrete or for a period of at least 24 hours thereafter unless an effective means of eliminating moving water through fresh concrete is employed. Water may then be pumped, if approved.

Do not pump to dewater a sealed cofferdam until the seal concrete meets the requirements of 00540.48(e).

00510.46 Preparation of Foundations - Do not place concrete on prepared foundations without prior approval. Construct foundations as follows:

(a) Backfilled Foundations - Construct the top surface of the foundation fill at least 3 feet beyond the area to serve as a foundation unless otherwise shown or directed. Use selected granular backfill or granular structure backfill as directed. Place in 6 inch layers and compact to not less than 95% of maximum density according to 00330.43.

(b) Undisturbed Soil Foundations - Do not disturb the sides or bottoms of foundation excavations. Place concrete against undisturbed soil when shown. Concrete may be used as backfill, subject to 00540.45(a). If soil is disturbed, compact all disturbed material to 95% of maximum density according to 00330.43.

(c) Formed Foundations on Soil - Do not disturb the bottoms of foundation excavations. If soil is disturbed, compact all disturbed material to 95% of maximum density according to 00330.43.

(d) Rock Foundations - Before placing concrete:

• Clean all rock surfaces and remove loose material
• Clean seams and fractures according to 00510.41, and seal with grout
• Level, step or roughen the rock surface as shown or as directed

Construct formwork, if allowed or required, and place concrete as soon as practical following the removal of material, to the specified elevation.

00510.47 Embankment Construction at Bridge Ends - Construct embankments at bridge ends according to 00330.42(c)(7) and, when shown, engineered fills according to 00330.42(c)(8).
00510.48 Backfill:

(a) General - Prepare for, place and compact backfill according to 00330.42 and 00330.43, if it becomes a part of a roadway embankment or is to support a roadway, bridge approach end panel, rock slope protection or slope paving, and is not covered by 00510.41, 00510.42, 00510.46, or 00510.47.

Do not place backfill that will cause unbalanced loading on the concrete until the concrete has been in place 7 calendar days and test cylinders show the concrete strength to be 100% of design strength according to 00540.17(c).

Do not place backfill against any other concrete until the concrete has been in place three calendar days, and test cylinders show the concrete strength to be 40% of design strength according to 00540.17(c).

Place backfill and riprap in a manner that will not damage the concrete footings, drain pipes, and other permanent work. Do not jet or puddle the backfill unless approved in writing. Prevent large lateral or wedging compaction forces from occurring directly against the concrete.

Dispose of excess materials according to 00330.41(a)(4).

(b) Bridge Abutments and Retaining Walls - Backfill at abutments and retaining walls with granular wall backfill to the upper pay limits shown or as directed, and as follows:

- Do not place backfill until superstructure elements are set, pinned and tensioned.
- Place backfill required at the front face of retaining walls before backfilling behind the wall.
- For single span bridges with abutments, keep the backfill heights within 2 feet of each other.
- Place granular wall backfill at all weep holes.

(c) Pier and Column Footings - Backfill piers and columns as follows:

- Use either selected general backfill, selected granular backfill, riprap or other materials as shown or directed.
- Deposit backfill around piers and columns on all sides to approximately the same elevation at the same time.
- Place backfill up to the original ground surface, the upper limits of pay excavation, or as shown or directed.

(d) Reinforced Concrete Box Culverts, Structural Plate Structures and Pipe Culverts Over 72 Inches in Diameter - Provide bedding, if required, according to 00405.12. Use backfill materials conforming to 00510.12 or 00510.13 unless otherwise specified. Place and compact as shown and according to 00405.46. Place backfill up to the surrounding ground surface, to the top of trench, or the upper backfill pay limits shown or as directed.

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Measurement

00510.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Shoring, Cribbing and Cofferdams - No measurement of quantities will be made for shoring, cribbing, and cofferdams.

(b) Structure Excavation - Structure excavation will be measured according to the following:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of structure excavation will be listed in the Special Provisions.

(2) Volume - Under this method, structure excavation will be measured on the volume basis in original position (position before excavating).

Quantities will be limited to the neat lines shown, or if not shown, will be limited to the following:

a. Lower Limit - The lower limit will be the elevations shown for the bottoms of structure footings or bases, including bedding, if any.

b. Upper Limits - The upper limit will be determined as follows:

1. Within Embankments - The planes of the new embankment at the elevation specified or established.

2. Within Roadbed or Channel Change Excavations - The planes of the bottoms and side slopes of the excavations.

3. All Other Cases - The ground surface immediately before starting the excavation.

c. Horizontal Limits - The horizontal limits will be the vertical planes parallel to and 1 foot outside the neat lines of the footings or bases of all structures, except for structural plate structures and pipe culverts over 72 inches in diameter, which will be as shown.

When the Engineer approves or directs, structure excavations less than the specified horizontal limits, the measured limits will be the actual excavation made.

(c) Structure Excavation Below Elevations Showed - Structure excavation below elevations shown will be measured according to the following:

(1) Lump Sum - When structure excavation is lump sum basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made as follows:
• **0 to 3 Feet Below Elevations** - For excavation 0 to 3 feet below elevations shown, measurement will be determined according to 00190.10(f) and based on a theoretical unit price of the lump sum structure excavation item.

• **More than 3 Feet Below Elevations** - For excavation more than 3 feet below elevations shown, measurement will be determined according to Section 00196.

(2) **Volume** - When structure excavation is volume basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made on the volume basis.

Quantity limits will be from the bottom limit described in 00510.80(b-2-a) to the new lower limits of the excavation for the footing or base of the structure, including bedding, if any, established by the Engineer. The horizontal limits will be vertical extensions of the quantity limits established according to 00510.80(b)(2)(c).

(d) **Granular Wall/Structure Backfill** - Granular wall backfill and granular structure backfill will be measured on the volume basis, of material used in backfilling as determined by cross section measurement of the materials in place. The quantities will be limited to the quantities placed according to the plans and specifications or as directed. When backfilling excavated areas, the quantities will be limited to the pay limits of the excavation for the part of excavated areas backfilled with the specified granular backfill material.

**Payment**

00510.90 **Payment** - The accepted quantities of work performed under this Section will be paid for as follows:

(a) **Shoring, Cribbing and Cofferdams** - Shoring, cribbing, and cofferdams will be paid for at the Contract lump sum amount for the item “Shoring, Cribbing and Cofferdams”.

No separate or additional payment will be made for maintaining and removing all materials.

No separate or additional payment will be made for clearing and grubbing, preparing foundations, pumping, and cleaning up.

If the Engineer orders excavations that extend below the elevation shown, the Contractor will be compensated to extend shoring, cribbing, and cofferdams as follows:

<table>
<thead>
<tr>
<th>Footing Elevation Changes</th>
<th>Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 3 feet below</td>
<td>No extra payment</td>
</tr>
<tr>
<td>More than 3 feet below</td>
<td>Section 00196</td>
</tr>
</tbody>
</table>

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When the Contract Schedule of Items does not indicate payment for shoring, cribbing and cofferdams, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

(b) **Structure Excavation** - Structure excavation will be paid for at the Contract lump sum amount or the Contract unit price, per cubic yard, for the item "Structure Excavation".

Except for granular wall backfill, no separate or additional payment will be made for backfilling and compacting to the elevation specified.

(c) **Structure Excavation Below Elevations Shown** - Structure excavation below elevations shown will be paid for as follows:

1. **Lump Sum** - For excavation 0 to 3 feet below elevations shown, payment will be determined and made according to 00190.10(f). For excavation more than 3 feet below elevations shown, payment will be determined and made according to Section 00196.

2. **Volume** - For excavation 0 to 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation".

For excavation more than 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation Below Elevations Shown". If the Contract Schedule of Items does not indicate payment for this work, payment will be determined according to Section 00196.

(d) **Granular Wall/Structure Backfill** - Granular wall backfill and granular structure backfill will be paid for at the Contract unit price, per cubic yard, for the item "Granular Wall Backfill" or "Granular Structure Backfill", as applicable.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- removing material forced up between foundation piles during driving or of material used in backfilling around piles, should subsidence occur during driving
- bedding
- excavations made below the elevations established for the bottoms of the footings or bases, including bedding, if any, or for any other unauthorized excavations. Backfill, seal, or otherwise repair these unauthorized excavations with concrete or other material acceptable to the Engineer according to 00510.46 at no additional cost to the City.
- water removed from excavations and water used in compaction or other items of work.
Section 00512 - Drilled Shafts

Description

00512.00 Scope - This work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts, according to these Specifications and the plans.

00512.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ soil, rock, or a casing.

Permanent Casing - Casing designed as part of the drilled shaft and intended to remain in place after concrete placement is completed.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00512.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

The Foundation Data shown in the plans is a compilation of pertinent information including, but not limited to, the Soils and Geological Exploration Logs.

Materials

00512.10 General - Furnish materials meeting the following requirements:

(a) Reinforcement - Use reinforcement complying with Sections 00530 and 02510.

(b) Concrete - Use Class 4000 structural concrete according to Section 02001, except as modified in this Section.

00512.12 Concrete Mix Design - Design the drilled shaft concrete mix for minimum segregation. Use a pre-approved mix design that meets the slump requirements of Section 02001.

Mix a trial batch and take test cylinders for one 7-day and two 28-day test breaks prior to placing concrete in the completed shaft excavations.
Water may be added at the Project Site only if allowed by the mix design and if approved. Accurately measure water added at the site by water meters, buckets or other approved devices and limit it to 1.0 gallon per cubic yard. Retarding or water-reducing agents may be used to maintain specified slump ranges and to facilitate temporary casing extraction. To allow for adequate concrete workability throughout the duration of concrete placement and prior to temporary casing extraction, provide a concrete mix having a slump loss characteristic such that a minimum slump of 4 inches is maintained for the entire duration of the pour. Admixtures may be used if tested and certified in the mix design and if approved.

00512.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A 252 or ASTM A 36. Furnish permanent casing meeting the requirements of ASTM A 36 with the application of supplemental requirement S5. Test each heat of steel at 40 °F with a minimum absorbed energy requirement of 15 foot pounds. Do not use previously used casing for permanent casing. Use casing of sufficient strength to resist handling, transportation and installation stresses and the external stresses of the subsurface materials. Ensure that the casing is clean and watertight prior to placement in the drilled shaft excavation. Use casing with an outside diameter not less than the specified drilled shaft diameter.

00512.14 Drilling Slurry - Furnish drilling slurry meeting one of the following requirements:

(a) Mineral Slurry - Use mineral slurry conforming to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Mud Density</td>
<td>64 - 75 lb./cu. ft.</td>
</tr>
<tr>
<td></td>
<td>API * 13B-1, Section 1</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td>Marsh Funnel and Cup</td>
<td>26 - 50 sec./qt.</td>
</tr>
<tr>
<td></td>
<td>API * 13B-1, Section 2.2</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>Glass Electrode, pH Meter,</td>
<td>8 - 11</td>
</tr>
<tr>
<td></td>
<td>or pH Paper</td>
<td></td>
</tr>
<tr>
<td>Sand Content</td>
<td>Sand</td>
<td>4.0 % max.</td>
</tr>
<tr>
<td></td>
<td>API * 13B-1, Section 5</td>
<td></td>
</tr>
</tbody>
</table>

Maintain slurry temperature at 40 °F or more during testing.

* American Petroleum Institute

(b) Synthetic Slurries - Select synthetic slurries from the CPL. Use synthetic slurries according to the manufacturer’s recommendations and the Contractor’s quality control plan. The sand content of synthetic slurry shall be less than 2.0% (API 13B-1, Section 5) prior to final cleaning and immediately prior to concrete placement.
(c) **Water Slurry** - Water may be used as slurry when casing is used for the entire length of the drilled shaft. Use of water slurry without full-length casing will only be allowed with the Engineer’s approval. Use water slurry conforming to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Requirement (Maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Mud Weight Density</td>
<td>70 lb./cu.ft.</td>
</tr>
<tr>
<td></td>
<td>API 13B-1, Section 1</td>
<td></td>
</tr>
<tr>
<td>Sand Content</td>
<td>Sand</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>API 13B-1, Section 5</td>
<td></td>
</tr>
</tbody>
</table>

Do not use blended slurries.

**00512.15 Crosshole Sonic Log (CSL) Access Tubes** - Furnish steel crosshole sonic log (CSL) access tubes meeting the following requirements:

- Steel access tubes shall be at least 1 1/2 inch inside diameter Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S.
- Use access tubes having a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of the source and receiver probes used for the testing. Ensure that access tubes are watertight, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Fit the access tubes with watertight caps on the top and bottom.
- Access tube acceptance will be based on manufacturer’s certification that the furnished material meets the requirements of this Specification.

**00512.18 Grout** - Furnish portland cement grout meeting the requirements of Section 02080.

**00512.19 Quality Control** - Maintain and be responsible for quality control of the drilled shaft work throughout the construction operation. The Engineer will inspect all drilling operations and verify the suitability of all drilled shaft construction procedures. Provide lights, mirrors, weighted tape, weighted probe, personnel, and all assistance required for the Engineer to perform inspection during drilled shaft construction.
**00512.30 Personnel Qualifications** - Perform the drilled shaft construction work using a company and personnel experienced in drilled shaft construction work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the companies experience relevant to the Project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth and any special construction techniques required. Also provide the experience qualifications of the company performing the CSL testing. Before the preconstruction conference, provide the following information to verify the firm’s experience and the qualifications of personnel scheduled to perform the drilled shaft construction and CSL testing:

- Submit a project reference list of at least 3 separate foundation projects, successfully completed in the last 5 years, with drilled shafts of diameters and depths equal to or larger than those shown in the plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner’s contact person’s name and current phone number for each project listed.
- On-site supervisors shall have at least 2 years experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and scope to those shown in the plans and in similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.
- Drill operators shall have at least one year experience in the construction of drilled shaft foundations.
- Perform CSL testing using an independent testing organization retained by the Contractor and approved by the City. Furnish personnel experienced in operating the CSL testing equipment. Submit the CSL testing firm qualifications according to 00512.40(a). The CSL testing firm shall have successfully performed CSL testing on a minimum of 5 projects during the last 3 years. CSL testing personnel shall be trained in the operation of the CSL equipment and have at least one year of experience in operating CSL testing equipment on a minimum of 10 shafts.

The Engineer will respond within 21 calendar days after receipt of the submittal. Do not begin work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors, drill operators, or CSL testing personnel to the Engineer, who will have 7 calendar days to respond to each request. Additional costs resulting from the suspension of work due to the changing of personnel is the Contractor’s responsibility, and no adjustment in Contract Time resulting from the suspension of work will be allowed.
Construction

00512.40 Submittals - Provide the following submittals to the City for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 calendar days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.
- A review of equipment suitability based on the Contractor’s understanding of the site subsurface conditions. Include a project history of the drilling equipment that demonstrates the successful use of the equipment for drilled shafts of equal or greater size in similar subsurface conditions.
- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include details of the methods and materials used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the casing and surrounding soil, if permanent casing is specified. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft (if applicable).
- Details of the proposed method(s) for ensuring drilled shaft stability during excavation and concrete placement.
- Details for the use of drilling slurry including mix design, slurry head requirements, mixing methods, maintaining, and disposing of the slurry (if applicable). Include a discussion of the suitability of the proposed drilling slurry in relation to the anticipated subsurface conditions.
- A plan for quality control of all drilling slurries, if their use is proposed. In the quality control plan, include property requirements, required tests and test methods to ensure the slurry performs as intended. Submit to the Engineer the name and current phone number of synthetic slurry manufacturer’s representatives who will provide technical assistance during construction. Provide the name(s) of the Contractor’s personnel assigned to the Project and trained by the synthetic slurry manufacturer in the proper use of synthetics slurries.
- Unstamped reinforcing steel shop drawings and details of reinforcement placement, including bracing, splicing, centering, and lifting methods and the method for supporting the reinforcement on the bottom of the shaft excavation according to 00150.35. Include details on the type, number, and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction. Include details for attaching the CSL test access tubes to the reinforcing cage (if applicable).
- Evidence that the proposed materials and concrete mix design conform to all applicable Specifications.
Details of concrete placement, including proposed operational procedures for pumping and tremie methods. Include details for grout placement in the crosshole sonic logging test access tubes after testing is completed (if applicable).

Detailed procedures for permanent casing installation and temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and equipment for casing installation and removal.

CSL testing company performing the CSL testing work, including documentation demonstrating that the company, and company personnel, meets the required qualifications.

Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.

Methods for protecting existing structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 calendar days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 calendar days for approval of modifications. Do not begin drilled shaft construction work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the City. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or material of the drilled shafts shown on the plans that are proposed in the repair plan will require stamped calculations and working drawings according to 00150.35.

(c) Drilled Shaft Inspection Reports - Provide the Engineer with a completed Drilled Shaft Inspection Report for each drilled shaft, detailing the actual location, alignment, elevations, dimensions, and quantities of the shafts.

Submit the report within 21 calendar days after the completion and acceptance of each shaft. A "Drilled Shaft Inspection Report" form is available from the Engineer.

(d) Concrete Placement Logs and Volume Curves - Measure and record all concrete placed into drilled shafts using standard ODOT forms designated for this purpose or other forms approved by the Engineer. Provide the Engineer with a completed Drilled Shaft Concrete Placement Log and Concrete Volume Curve Form for each drilled shaft within 24 hours after completion of shaft concrete placement.
00512.41 Drill Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least 7 calendar days before beginning any shaft construction work at the site to discuss construction procedures, schedules, staging, personnel, equipment to be used, and other elements of the approved shaft installation plan as specified in 00512.40. If synthetic slurry is used to construct the shafts, the frequency of scheduled site visits to the project site by the synthetic slurry manufacturer's representative will be discussed. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the casing, mixing and installing slurry (as applicable), placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the synthetic slurry shall also attend.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, hold an additional meeting before any additional shaft construction operations are performed.

00512.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown and within the specified tolerances listed below. Determine the drilled shaft dimensions and alignment with approved methods. The following construction tolerances apply to drilled shafts unless otherwise stated:

- **Horizontal Position (At the Plan Elevation of the Top of Shaft):**
  - **Shaft Diameter Less Than or Equal to 6 Feet** - 3 inch horizontal tolerance from the location shown.
  - **Shaft Diameter Greater Than 6 Feet** - 6 inch horizontal tolerance from the location shown.

- **Top Elevation of Shaft Concrete:**
  - **Top Elevation Above Water** - Minus 3 inches to plus 1 inch from the plan top of shaft elevation.
  - **Top Elevation Under Water** - Minus 3 inches to plus 6 inches from the plan top of shaft elevation.

- **Vertical Alignment in Soil** - May not vary from the plan alignment by more than 1.5% of the shaft length.

- **Vertical Alignment in Rock** - May not vary from the plan alignment by more than 2% of the shaft length.

- **Top of Steel Reinforcement** - Plus or minus 6 inches from the plan top of steel reinforcement elevation.
Frequently check the plumbness, alignment, and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary to complete corrections for out-of-tolerance drilled shafts will be at the Contractor’s expense, and no extension of the Project completion date will be granted. Materials and work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for as Extra Work.

00512.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls and bottoms for the full depth of the excavation, using approved materials, equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer’s approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer’s satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation:

- Is stabilized at the bottom, sides and surface to prevent soil caving or swelling or a reduction of soil strength, and
- Is covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.
(b) Protection of Existing Structures - Control shaft construction operations to prevent damage to existing structures and utilities. Preventive measures include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation and monitoring and controlling the vibrations from construction activities such as the driving and vibrating of casing or sheeting, drilling of the shaft, or from blasting, if blasting is allowed. Repair all damage caused to existing structures, utilities or other facilities, resulting from drilled shaft construction activities, at no additional cost to the City.

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

Where the acceleration coefficient used for seismic design of the structure is less than or equal to 0.10, temporary telescoping casing may be used for the drilled shafts, subject to the following conditions:

- Submit the request to use temporary telescoping casing to the Engineer for approval. Specify the diameters and lengths of the temporary telescoping casing and the shafts where use is requested.
- The minimum diameter of the shaft shall be as shown on the plans.
- Backfill all voids between the temporary telescoping casing and the plan shaft dimensions with a material that approximates the geotechnical properties of the subsurface soils, or with concrete as approved.
- Use temporary telescoping casing material conforming to 00512.13.

(d) Unexpected Drilled Shaft Obstructions - Remove any natural or manmade object encountered that was not revealed by the City’s site investigation, and that would cause a significant decrease in the rate of advancement if removed using the techniques and equipment used successfully to excavate the shaft. The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and the classification of any unexpected obstructions. Removal of unexpected obstructions from the shaft excavation will be paid as Extra Work.

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid as Extra Work.

(f) Drilling Slurry Installation - If synthetic drilling slurry is selected, provide a manufacturer’s representative to provide technical assistance at the site prior to use of the slurry, who shall remain at the site during construction and completion of a minimum of one drilled shaft to adjust the slurry mix for the specific site subsurface conditions. After the manufacturer’s representative is no longer at the site, provide the approved personnel trained in the use of the synthetic slurry for the remainder of the shaft slurry operations to supervise the proper slurry mix design and quality control procedures.
All in-hole drilling slurry shall meet the required slurry specifications during excavation and prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

Unless otherwise approved, maintain the level of slurry in the excavation at not less than 5 feet above the groundwater level for mineral slurries or 10 feet above the groundwater level for synthetic or water slurries. Maintain the slurry level a sufficient distance above all unstable zones to prevent bottom heave, caving or sloughing.

Maintain the required slurry properties and levels at all times during shaft construction, including work stoppages, unless other approved stabilization methods are applied.

Feed slurry continuously into the shaft excavation as drilling progresses so that a stable excavation is maintained. Use a self-priming pump to reclaim the slurry. Keep a standby pump available during the drilling operation.

**Drilling Slurry Inspection and Testing** - Mix and thoroughly hydrate all drilling slurries in an appropriate storage facility. Collect sample sets from the storage facility and perform tests to ensure the slurry conforms to the specified material properties before introduction into the drilled shaft excavation. A sample set shall be composed of samples taken at mid-depth and within 24 inches of the bottom of the storage facility.

Sample and test all slurry in the presence of the Engineer, unless otherwise directed. The sample sets of slurry within the excavation shall consist of samples taken at mid-depth of the excavation and within 24 inches of the bottom of the excavation. Collect and test sample sets during the drilling operation as necessary to ensure the specified properties of the slurry are maintained. Clean, recirculate, de-sand, or replace the slurry as necessary to maintain the specified slurry properties. Final cleaning of the excavation and placement of concrete will not be allowed until the test results indicate the slurry properties are as specified.

Perform a minimum of 2 sets of slurry tests per 8 hour work shift, the first test being done at the beginning of the shift. Field conditions may require more frequent testing to ensure acceptable slurry properties.

Make copies of all slurry test results available to the Engineer on request.

**Clean Out** - Use appropriate means, such as a cleanout bucket, pump or air lift, to clean the bottom of the drilled shaft excavations. No more than 2 inches of loose or disturbed material will be allowed at the bottom of the excavation for end-bearing drilled shafts. No more than 6 inches of loose or disturbed material will be allowed at the bottom of the excavation for side friction drilled shafts. Assume end-bearing shafts unless otherwise shown or specified. Shaft cleanliness will be determined by the Engineer.
Notify the Engineer of completion of each drilled shaft excavation to permit inspection before proceeding with construction. Measure final shaft depths with a suitable weighted tape or other approved method after final cleaning to determine that the shaft bottom meets the requirements in the Contract. Do not proceed with shaft construction until the bottom cleanliness requirements have been met and the bottom (shaft tip) elevation is approved.

00512.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel extending from 6 inches above the bottom of the shaft excavation to the elevation shown. The reinforcing cage may be supported on the bottom of the shaft excavation if approved. Support the reinforcing cage to prevent distortion or settlement during concrete placement. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement unless otherwise approved.

(c) Splicing - Splice all drilled shaft reinforcement using approved mechanical splicer's unless otherwise shown or approved.

(d) Concrete Cover - Maintain the required concrete cover shown on the plans by placing concentric spacer bars or other approved devices around the reinforcing cage. Provide details of the proposed centering method on the shop drawings submitted according to 00512.40.

00512.46 Crosshole Sonic Log Test Access Tubes - Furnish and install access tubes for CSL testing as shown. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible in each drilled shaft and in the pattern shown. Extend the access tubes from the bottom of the reinforcement cage to at least 24 inches above the top of the shaft. Joints required to achieve full-length access tubes shall be watertight. Do not damage the access tubes during reinforcement cage installation and concrete placement. Fill the tubes with potable water, according to 02020.10(b), as soon as possible, but no more than one hour after concrete placement and reinstall the top watertight caps. Check water level and top off as needed.

Replace all access tubes that the test probe cannot pass through to the full depth of the shaft at no additional cost to the City. Replace all damaged access tubes with 1.5 inch to 2.0 inch diameter holes cored through the concrete for the entire length of the shaft. Unless otherwise directed, locate replacement core holes approximately 6 inches inside the reinforcement. Do not damage the shaft reinforcement during coring operations.
Fill the access tubes with grout only after all CSL testing has been completed and the shaft has been accepted.

**00512.47 Concrete** - Furnish and place concrete according to the following:

(a) **Concrete Placement** - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Prior to concrete placement, ensure the shaft clean-out requirements are met according to 00512.43(h) and the properties of the slurry (if used) conform to specifications. Shaft concrete may be placed without mechanical vibration in those areas of the drilled shaft that are not formed or are below the ground line or the water surface.

Place concrete continuously until concrete at the top of the shaft is free of water, soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation. Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement occurs because of a delay in concrete delivery or other factors, reduce the placement rate to maintain a flow of fresh concrete into the shaft excavation.

Unless otherwise approved by mix design, allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter of at least 8 inches. For placement by concrete pump, use hose with inside diameter of at least 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) **Dry Shaft Concrete Placement** - Concrete may be placed by free-fall if all of the following conditions are met:

- no more than 3 inches of water is present in the bottom of the excavation at the beginning of the pour.
- groundwater seepage into the excavation is at a rate of no more than 12 inches per hour.
- shaft diameter is greater than or equal to 3 feet.

Under free-fall placement, deposit concrete through the center of the reinforcement cage by a method which prevents segregation of aggregates and splashing of concrete on the reinforcement cage. Place concrete so that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars or steel cage bracing.
(c) **Wet Shaft Concrete Placement** - If the drilled shaft excavation does not meet the requirements for dry concrete placement, stabilize water inflow and place the concrete under water or slurry with a tremie pipe or pump hose according to 00540.48(e). Place concrete continuously from the bottom of the shaft to the top-of-shaft elevation shown. Use a plug in the tremie pipe or pump hose to force water or slurry ahead of the advancing flow of fresh concrete. Dispose of all displaced water, slurry, or waste concrete according to 00290.20. When groundwater, the drilling water or slurry in the shaft excavation is to be removed by pumping during concrete placement, have a standby pump available.

Place concrete in a continuous operation so that the concrete always flows upward within the shaft. Withdraw the delivery hose or pipe slowly as the elevation of the fresh concrete rises in the shaft. Keep the discharge end of the pipe or hose at least 5 feet below the surface of the concrete after the concrete has reached a depth of 5 feet. Maintain sufficient concrete inside the hose or pipe to prevent drilling fluid from entering. During concrete placement, provide and maintain markings on the tremie pipe or pump hose, or a sounding device or other appropriate method to determine the relative elevations of the fresh concrete surface and the bottom end of the pipe or hose. Raise the bottom end of the pipe or hose only when the pipe or hose has a sufficient head of fresh concrete to prevent the formation of a void at the bottom.

(d) **Concrete Curing and Cleaning** - Allow the exposed top of concrete to cure a minimum 7 calendar days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel, and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the plans. Remove all loose material and poor quality concrete at the top of the shaft down to sound concrete prior to performing any required CSL testing.

(e) **Casing Removal** - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of at least 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00512.42. Casing that cannot be extracted during, or immediately after, the concrete placement operation may be cause for rejection of the shaft.
Remove the tops of permanent casing to the top of the drilled shaft or the finished groundline, whichever is lower, unless otherwise shown or directed. Remove the tops of permanent casing for shafts constructed in a permanent body of water to the low water elevation, unless otherwise shown or directed.

00512.48  Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the results of CSL, or other, integrity testing (if conducted), field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts. For shafts that are integrity tested, the Engineer will determine final acceptance of each tested shaft, based on the integrity test results and inspection reports and will provide a response to the Contractor within 5 calendar days after receiving the CSL test report.

(a) Crosshole Sonic Log Testing - Provide crosshole sonic log testing equipment and perform crosshole sonic log testing and analysis on the first drilled shaft completed at each structure and subsequent shafts as specified or designated for testing by the Engineer. Provide CSL testing equipment conforming to the requirements of ASTM D 6760 and approved by the Engineer. Provide all necessary access and other support to the CSL testing firm necessary to do the CSL testing work.

Unless otherwise directed, perform one CSL test on each shaft designated for testing. A single CSL test consists of all ultrasonic profile combinations in a given shaft. Test completed drilled shaft foundations using Ultrasonic Crosshole Testing methods (Crosshole Sonic Log (CSL) Testing) according to ASTM D 6760. Inform the Engineer of scheduled CSL testing at least 3 calendar days prior to the testing. Perform all CSL testing using the Contractor's CSL technician in the presence of the Engineer.

Allow at least 3 calendar days of curing time before testing unless otherwise approved. Additional curing time beyond 3 calendar days may be required if the shaft concrete contains admixtures such as set retarding admixture or water reducing admixture. Additional CSL testing required due to the CSL testing being conducted on concrete that has not cured sufficiently is at no additional cost to the City. Additional curing time required due to concrete admixtures will not be grounds for additional compensation or time extensions.

(b) Contractor's CSL Test Reports - Provide a brief summary report of the data, with interpretation of the test results, to the Engineer at the completion of each test. Provide copies (either hardcopies or electronic files) of the raw test data as requested. Mark the test data files to identify, as a minimum, the structure, bent and shaft number, the date of CSL testing, depths of testing and any other pertinent information.
Submit 3 copies of a final CSL Test Report for each shaft tested according to ASTM D 6760. Provide electronic file copies of the raw CSL data measurements (compatible with the Cross Hole Ultrasonic Monitor (CHUM) program), if requested. The report shall summarize the CSL testing performed, data analysis, and interpretation of CSL data with special attention made to the identification and location of any anomalies or possible defects. Provide interpretation of the CSL test data in terms of overall shaft integrity and acceptance. Submit all reports to the Engineer within 5 calendar days of the performance of the tests.

(c) Additional Testing and Investigation - Conduct additional testing or investigation necessary to identify the location, extent and condition of possible shaft defects if requested by the Engineer. Additional testing and investigation may include, but is not limited to, additional CSL testing, excavation work or core drilling.

If requested by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. The number, location and depths of the core holes will be determined by the Engineer. Submit the method and equipment used to drill and remove cores from the shaft to the Engineer for review and approval prior to drilling. Use a coring method that provides complete core recovery and minimizes abrasion and erosion of the core. If a defect is confirmed, as determined by the Engineer, all investigation costs associated with identifying the defect will be at no additional cost to the City and no extension of the Project completion date will be granted, regardless of whether the identified defect is repaired or not.

If no defect is identified in the investigation work, and the CSL tubes were satisfactorily installed according to ASTM D 6760 and accepted, the City will pay for all coring and excavation costs associated with the additional investigation and grant an appropriate time extension, if required, according to Section 00190 and Section 00195. If it is determined by the Engineer that the CSL tubes were not installed properly thus invalidating the CSL test results, all coring, excavation, and other investigation and evaluation costs will be at no additional cost to the City and no extension of the Project completion date will be granted.

Fill all core holes with grout only after the evaluation process is completed and the shaft is accepted and approved.

(d) Drilled Shaft Repair - Repair all defects and rejected shafts according to 00512.40(b). Perform additional CSL testing, or other investigation required, as directed by the Engineer, to confirm the quality of the completed shaft repair work at no additional cost to the City with no time extension granted.

For temporary casing not extracted from the shaft excavation, submit a repair plan or a structural evaluation to the Engineer for approval according to 00512.40. If caving occurs during concrete placement submit a repair plan to the Engineer for approval.
00512.49 Scheduling and Restrictions - Unless otherwise approved, do not proceed with construction of subsequent shafts until the CSL testing has been completed on the first drilled shaft and the results have been approved and accepted, in writing by the Engineer. Approval to proceed with the construction of subsequent shafts, before receiving approval of the first shaft will be based on the Engineer's observations of the Contractor's workmanship during construction of the first shaft and the Engineer's review and assessment of the following:

- The Contractor's conformance with the approved shaft installation plan.
- The Contractor's daily reports and inspector's daily logs of excavation, rebar, and concrete placement.
- The concrete placement logs and volume curves.

Written notification will be provided to the Contractor on whether or not to proceed with subsequent shaft construction within 24 hours after completion of the first shaft. If the Engineer determines the first shaft to be of questionable quality, discontinue all shaft construction until the CSL test results of the first shaft are received and reviewed and the shaft accepted, in writing, by the Engineer.

Denial of permission to proceed with subsequent shaft construction will not be cause for contract time extension.

Do not proceed with the third drilled shaft until the final CSL test results from the first drilled shaft has been received and reviewed and the shaft accepted, in writing, by the Engineer.

After the first drilled shaft on the Project has been accepted, make no significant changes in construction methods, equipment, or materials used to construct subsequent shafts, unless otherwise approved.

Measurement

00512.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Furnish Drilling Equipment - No measurement of quantities will be made for furnishing drilling equipment.

(b) Permanent Casing - Permanent shaft casing will be measured on the length basis.

(c) Drilled Shaft Excavation - Drilled shaft excavation will be measured on the length basis by the vertical excavated length from the bottom of the shaft to the ground surface or to the mudline if under water. If the top of the shaft is located below the original ground surface, measurement will be made to the top of the shaft as shown or directed. If directed to excavate drilled shafts below the elevations shown, the drilled shaft excavation will be measured from the revised bottom of shaft.
(d) **Drilled Shaft Concrete** - No measurement of quantities will be made for drilled shaft concrete. Estimated quantities of concrete will be listed in the Special Provisions.

(e) **Drilled Shaft Reinforcement** - No measurement of quantities will be made for drilled shaft reinforcement. Estimated quantities of reinforcement will be listed in the Special Provisions.

(f) **Crosshole Sonic Log Equipment Mobilization** - CSL testing equipment and operating personnel mobilization will be measured on the unit basis for each time the Contractor mobilizes equipment and personnel to the Project for CSL testing as required by the Engineer.

(g) **Crosshole Sonic Log Test Access Tubes** - CSL access tubes will be measured on the length basis of the number of tubes installed in the shafts.

Grout used to fill the access tubes after the completion of CSL testing will not be measured.

(h) **Crosshole Sonic Log Tests** - CSL tests will be measured on the unit basis for each CSL test completed, reported, and accepted. No separate measurement will be made for CSL tests performed at the Contractor’s option.

**Payment**

00512.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
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</thead>
<tbody>
<tr>
<td>(a) Furnish Drilling Equipment</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Permanent Shaft Casings</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Drilled Shaft Excavation, ____ Diameter</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) Drilled Shaft Concrete</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(e) Drilled Shaft Reinforcement</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) CSL Equipment Mobilization</td>
<td>Each</td>
</tr>
<tr>
<td>(g) CSL Test Access Tubes</td>
<td>Foot</td>
</tr>
<tr>
<td>(h) CSL Tests</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (a) includes furnishing and moving the drilling equipment to the Project, setting up the equipment at the various locations on the Project and removing the equipment from the Project.
Partial payments for item (a) will be made as follows:

- When drilling equipment is on the job, assembled and ready to excavate the shafts ....................................................60%
- When all shafts have been excavated and shaft concrete has been placed and accepted ................................................40%

In item (c), the diameter of the shaft will be inserted in the blank. Item (c) includes excavating the shafts and disposing of the excavated material and for furnishing, placing, splicing, and removing temporary shaft casing and forms.

Item (e) includes all reinforcement within the drilled shaft plus the reinforcement shown which is to be embedded in the shaft and extends above the top of the drilled shaft including the continuous vertical and spiral reinforcement extending from the bottom of the shaft to the elevation shown. No separate or additional payment will be made for bracing, mechanical splices, centering devices, and support for the bottom of the reinforcement cage.

Item (f) includes each time the Contractor mobilizes all testing equipment and personnel onto the Project as required for CSL testing. Once CSL equipment and personnel are mobilized onto the Project, no separate or additional payment will be made for equipment mobilization required to access test shafts at different locations within the Project limits.

Item (g) includes filling the tubes with grout after completion of CSL testing.

Item (h) includes all testing, interpretation, analysis, electronic data, and final report for each tested and accepted shaft.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

If the Contractor chooses to use a larger shaft diameter casing than the shaft diameter shown, no additional payment will be made for the larger casing, or for the additional excavation, concrete, and reinforcement.
Section 00520 - Driven Piles

Description

00520.00 Scope - This work consists of furnishing and driving piles of the type and dimensions shown or specified, including cutting off or building up piles when required.

Materials

00520.10 General - Furnish materials meeting the following requirements:

- Preservative Treatment of Timber ......................................... `02190
- Prestressed Concrete Piles ................................................02520.20
- Reinforced Pile Tip .............................................................02520.10
- Steel Piles ...........................................................................02520.10
- Steel Reinforcement for Concrete ...........................................00530
- Timber Piles ........................................................................02120.20
- Timber Pile Straps ..............................................................02120.30

00520.11 Engineer's Estimated Length List - Furnish steel piles of sufficient length to attain the penetration and bearing resistance specified, and to extend into the cap or footing as shown. The Contractor may, at no additional cost to the City, drive test piles, make borings, and perform other investigations the Contractor considers necessary. The "Engineer's Estimated Length" of steel piles will be listed in the Special Provisions.

00520.12 Pile Order List - Furnish prestressed concrete and timber piles according to the pile order list in the Special Provisions, which will list the type, number, and length of piles. The pile order length includes an allowance for variation. The Contractor may increase the order lengths as necessary to suit pile driving operations at no additional cost to the City.

00520.13 Test Piles - Furnish test piles according to the test pile length list in the Special Provisions. When test piles are required, the production pile lengths shown or specified in the Special Provisions are estimated lengths only. The actual lengths to be furnished for production piles will be determined by the Engineer after the test piles have been driven. This applies for all pile types.

00520.14 Unused Piles - Acceptable full length piles furnished according to the estimated length list, order list, or revised pile order list, but not incorporated in the work, will be handled according to one of the following:

- Mark and identify piles for the Contractor's own use.
- Return piles to the supplier with the City paying transportation and restocking charges.
- The City will purchase from the Contractor piles that are stockpiled at a location on the Project selected by the Engineer according to 00195.80.
Equipment

00520.20 Equipment for Driving Piles - Provide pile driving equipment meeting the following requirements:

(a) Impact Pile Hammers - Provide a striking part of the hammer not less than 1/3 the weight of the helmet and pile being driven, but never less than 2,750 pounds.

(1) Air-Steam Hammers - Provide power plant and equipment for air-steam hammers with sufficient capacity under working conditions to maintain the volume and pressure at the hammer specified by the manufacturer and with accurate pressure gauges easily accessible to the Engineer.

(2) Open-End Diesel Hammers - Provide open-end (single-acting) diesel hammers equipped with a device which allows the Engineer to visually determine hammer stroke at all times during pile driving operations. Provide the Engineer with the hammer manufacturer's chart equating stroke and blows per minute.

(3) Closed-End Diesel Hammers - Provide closed-end (double-acting) diesel hammers equipped with a bounce chamber pressure gauge, mounted near ground level so the Engineer can easily read it. Before driving, provide the Engineer a chart calibrated within 6 months before first use on the Project to actual hammer performance, equating bounce chamber pressure to either equivalent energy or stroke.

(4) Gravity Hammers - Provide gravity hammers that have a ram weighing between 2,000 pounds and 5,000 pounds and a drop height of not more than 10 feet. The weight of gravity hammers shall not be less than the combined weight of helmet and pile.

(5) Hydraulic Hammers - Provide either single or double acting hydraulic hammers equipped with monitoring systems to measure impact velocity and determine equivalent energy and stroke. Locate monitoring systems for easy access by the Engineer.

(b) Vibratory Hammers - Control installation of production piles with vibratory hammers according to the power consumption, rate of penetration, specified tip elevation, or other acceptable means which assure the pile resistance equals or exceeds the required nominal pile bearing resistance. After driving piles with a vibratory hammer, verify pile resistance (see 00520.42) by driving them with an impact hammer of suitable energy. Do not use vibratory hammers to drive test piles or when preboring or jetting.

(c) Driving Components:

(1) Pile Cushion - Protect the heads of prestressed concrete piles with a pile cushion made of wood or other approved material.

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The pile cushion shall be:

- Equal to or greater in cross-sectional contact area than the pile head
- In full contact with the pile head
- No less than 4 inches thick, before driving begins, if made of plywood

Provide a pile cushion for each pile. 1/2 the original thickness or begins to burn.

(2) Helmet - Equip piles driven with impact hammers with an adequate metal helmet. The helmet shall:

- Fit around the pile top
- Be axially aligned with the hammer and pile
- Distribute the hammer energy to the total cross section of the pile head
- Be guided by leads

(3) Hammer Cushion - Equip impact pile driving equipment with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to ensure uniform driving performance. Provide hammer cushions of durable manufactured materials according to the hammer manufacturer's guidelines. Do not use wood, wire rope, or asbestos hammer cushions.

Place a striker plate, as recommended by the hammer manufacturer, on the hammer cushion to ensure uniform compression of the cushion material.

Inspect the hammer cushion in the presence of the Engineer at the beginning of pile driving at each structure or after each 100 hours of use during pile driving, whichever is less. Replace the hammer cushion when its thickness becomes less than 75% of its original thickness.

(4) Followers - Use a follower between the pile hammer and the pile to transmit energy when the pile head is below the reach of the hammer, if allowed by the Special Provisions or approved in writing. If a follower is allowed, drive the first pile in each bent, and every tenth pile driven after that, full length without a follower. Before additional piles are installed, verify that the first two piles installed with followers in each substructure unit meet the position and alignment criteria of 00520.41(f).
(5) Leads - Support piles in line and position while driving. Construct pile hammer leads to give the hammer freedom of movement while maintaining alignment of the hammer and the pile to ensure concentric impact for each blow. Leads shall be fixed unless the Engineer approves the use of swinging leads. Fit swinging leads, when used, with a pile gate at the bottom of the leads. To maintain alignment of batter piles, use horizontally braced swinging leads, adequately embedded in the ground, or rigidly attached to prevent movement during pile driving.

(d) Approval of Pile-Driving Equipment:

(1) General - Before beginning test pile or production pile driving, obtain approval in writing of pile driving equipment.

To obtain approval, complete and submit the City's "Pile and Driving Equipment Data" form at least 14 calendar days before pile driving begins. This form is available from the Engineer. Within 14 calendar days of receiving the form, the Engineer will notify the Contractor of approval or rejection of the pile-driving equipment.

During pile-driving operations, no changes to the approved equipment will be allowed without the Engineer's written permission. Submit a request for change on a "Pile and Driving Equipment Data" form. The Engineer will give notification of approval or rejection within 7 calendar days of receiving the form. Time required for resubmission and review of a Contractor's equipment change request is not a basis for a Contract Time extension request unless the Engineer does not respond in 7 calendar days.

(2) Standard Evaluation Method - The standard method of evaluating driving equipment requires that the field-measured hammer energy be within the range of energy levels given in Table 00520-1 corresponding to the nominal pile bearing resistance shown.

<table>
<thead>
<tr>
<th>Nominal Pile Bearing Resistance (kips)</th>
<th>Minimum Field Energy (foot-pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 180</td>
<td>6,500</td>
</tr>
<tr>
<td>&gt; 180 and ≤ 280</td>
<td>11,000</td>
</tr>
<tr>
<td>&gt; 280 and ≤ 420</td>
<td>20,000</td>
</tr>
<tr>
<td>&gt; 420 and ≤ 600</td>
<td>35,000</td>
</tr>
<tr>
<td>over 600</td>
<td>Wave Equation required</td>
</tr>
</tbody>
</table>

1 Using FHWA Gates equation (see 00520.42(b)), except all driving criteria for double acting and differential hammers both air, steam and diesel will be by the wave equation analysis.
If during the pile-driving operation, the Engineer determines the hammer is not operating properly and is unable to drive the piles to the required resistance, do not use the hammer until repaired to the Engineer's satisfaction.

The required number of hammer blows indicated by the FHWA Gates equation at the nominal pile bearing resistance shall be at a rate between 3 and 15 blows per inch.

(3) Wave Equation Method - Select a suitable hammer for driving piles and perform wave equation analyses. Use the 1987 or newer version of the Wave Equation Analysis Program (WEAP). Conduct the wave equation analyses using personnel qualified by training and experience to perform this type of work.

Submit the WEAP analysis concurrent with the Pile and Driving Equipment Data Form. The Engineer will approve or reject the pile driving equipment submittal after a review of the wave equation analysis conducted by the Contractor.

Provide pile hammers meeting the following requirements based on wave equation analysis:

- The energy of the submitted hammer shall produce a wave equation predicted blow count between 3 and 15 blows per inch for the nominal resistances, pile lengths and other conditions specified.
- The pile stresses indicated by the wave equation at the nominal resistance shall not be greater than the stress at the point of impending damage to the pile as follows:
  - **Steel Piles** - Tensile and compressive stresses in the pile of 90% of the pile material’s yield strength for the grade of steel specified at any time during the pile installation.
  - **Prestressed Concrete Piles**:
    - A tensile stress of \(0.95 \sqrt{f'c}\) + effective prestress
    - A compressive stress of \(0.85 f'c\) - effective prestress
    Where: \(f'c\) = concrete compressive strength (ksi)
  - **Timber Piles** - A compressive driving stress of three times the allowable static design stress.

Hammers not meeting these requirements will be rejected. Replace rejected hammers with suitable hammers.

Use input values for the wave equation analyses provided in the Special Provisions and according to the following:

Use the following settings and default values as input to the wave equation analysis program:
Output option (IOUT) zero (normal option).
- RN is the nominal pile bearing resistance.
- Smith damping.
- Do not use residual stress option.
- Default hammer efficiency values. Do not adjustment the hammer’s efficiency outside of the wave equation program recommended (default) values without prior concurrence of both the pile hammer manufacturer and the Engineer.
- % skin is the percent skin friction.

A Pile Driving Analyzer (PDA) test may be required prior to approval of non-default wave equation input values.

At a minimum, provide the following information and documentation:
- A written summary of how the proposed hammer and associated equipment meets the specifications regarding blow count criteria and allowable pile stresses.
- Electronic and paper copies of the wave equation input and output files. Output files shall be in the standard WEAP output format.
- WEAP analysis demonstrating that for the required nominal bearing resistances and conditions provided, the hammer will produce pile stresses less than those described above for the range of hammer strokes expected in the field.
- The "Pile and Driving Equipment Data" form.
- WEAP hammer input files for hammers not in the wave equation default hammer files.

For City reviewing and approving of the wave equation analysis submittals, the following will be taken into consideration:
- The pile length for use in the WEAP analysis will be the total pile length at the end of driving, including all pile length above the ground surface. This length may be longer than the Engineers Estimated length depending on the site conditions, equipment used, pile hammer access limitations and other factors.
- The properties and thicknesses of the hammer and pile cushion materials.
- Various hammer types such as direct-drive diesel, standard diesel, air/steam or hydraulic hammers have major effects on predicted stresses and blow counts.
- Changes in pile type or size will affect the blow count rate and pile stresses.
- Battered piles may effect hammer energy transfer and blow counts.

Failure to address these issues may be cause for rejection of the proposed pile hammer.
The size of the pile hammer selected according to the above specification may have significant impacts on the size and capacity of associated equipment including the leads and crane. This equipment, in turn, may have significant impacts on the size and capacity of work bridges, shoring required for existing structures or other aspects and elements of construction.

Failure of a previously approved hammer to operate properly during construction will be cause for rejection.

**Construction**

00520.40 Preparation for Driving:

(a) **Excavation** - Unless otherwise provided or authorized, do not drive piles until after excavation is complete. Remove to the correct elevation any material forced up by pile driving before concrete for the foundation is placed, at no additional cost to the City.

(b) **Embankments** - Unless otherwise provided or authorized, do not drive piles until the roadway embankment at bridge ends is in place according to 00330.42. Drive piles completely through roadway embankments to the required penetration and bearing in the underlying material.

00520.41 Driving:

(a) **General** - Drive piles as specified with approved pile driving equipment to the required penetration depth and to the required nominal pile bearing resistance as shown or specified.

(b) **Installation Sequence** - Unless otherwise shown or specified, install individual piles in pile groups starting from the center of the group and proceeding outward in either direction, or as approved.

(c) **Minimum Penetration** - Unless otherwise specified or approved, drive piles at least 12 feet below the footing or pile cap, 12 feet below the groundline at trestle pile locations, and completely through embankments at bridge ends. When shown or specified drive piles to a greater minimum penetration. If the required penetration cannot be attained with a hammer complying with 00520.20(d), provide a larger hammer, prebore or jet holes, or use other approved methods as necessary to attain the required penetration.

(d) **Preboring** - Use augering, wet-rotary drilling or other methods of preboring only when specified or with written approval. When allowed, prebore holes at pile locations and to the depths shown or directed. Make prebored holes smaller than the diameter or diagonal of the pile cross section, but sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as cobbles, boulders or rock layers are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. The use of a reinforced section (spud) to loosen the subsurface material at pile locations will not be allowed unless otherwise approved.
Perform preboring in a manner that will not impair the bearing or lateral capacity of the piles already in place or the safety of existing adjacent structures. When it is determined that preboring has disturbed the load bearing resistances of previously installed piles, restore those piles that have been disturbed to conditions meeting the requirements of this Specification by redriving or by other acceptable methods. The Contractor shall be responsible for the costs of any necessary remedial measures unless the preboring method was specifically included in the Contract Documents and properly executed by the Contractor.

1) **End-Bearing Piles** - For end-bearing pile as classified by the Engineer, preboring may be carried to the surface of the end-bearing foundation material. Following that, drive pile with an approved impact pile hammer to the specified blow count.

2) **Other Piles** - For other piles, extend preboring to the minimum pile penetration depth and then drive pile with an approved impact pile hammer to the specified blow count.

After completion of driving, fill any void space remaining around the pile with sand or other approved material.

3) **Jetting** - Jetting may only be used when allowed in the Contract Documents or if approved in writing. When jetting is not required in the Contract Documents, but approved at the Contractor's request, determine and submit for review the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The Contractor shall be responsible for all damage caused by unapproved or improper jetting operations, unless the jetting method was specifically included in the Contract Documents and properly executed by the Contractor. Control, treat if necessary, and dispose of all jet water in a satisfactory manner. Drive all jetted pile with an approved impact hammer.

4) **Location and Alignment Tolerance** - Place the tops of piles at plan cutoff elevation and horizontally within 6 inches of plan locations. No pile shall be nearer than 4 inches from any edge of the cap. Any increase in cap size to meet this edge distance requirement will be at no additional cost to the City.

Install piles so the axial alignment of the top 10 feet of the pile is within 5 inches of the specified alignment. For piles that cannot be inspected after installation, make an alignment check before installing the last 5 feet of pile. The Engineer may require that driving be stopped to check the pile alignment. Pulling laterally on piles to correct misalignment or splicing a properly aligned section onto a misaligned section will not be allowed.

If the specified location or alignment tolerances are exceeded, the effect of the pile misalignment on the substructure design will be investigated. If the Engineer determines corrective measures are necessary, implement suitable measures and pay all costs and delays associated with the corrective action.
(g) **Heaved Piles** - Make elevation readings on piles during pile driving operations to check on pile heave. Take elevation readings after each pile has been driven and again after piles within a radius of 15 feet have been driven. Redrive to the required penetration and resistance all piles that have risen more than 1/2 inch, at no additional cost to the City. Continue readings until the Engineer determines that such checking is no longer required. If pipe piles which have been filled with concrete subsequently heave, redrive them to original position, after the concrete has attained specified strength, with an approved hammer-pile cushion system.

(h) **Test Piles** - When specified, furnish and drive test piles at the locations and to the lengths directed. All test piles shall be of the kind and size specified for the permanent foundation piles unless otherwise directed. Drive all test piles with approved pile driving equipment. The specified length of test piles will be greater than the estimated length of production piles to provide for variation in soil conditions. Drive test piles using driving equipment identical to that which the Contractor proposes to use on the production piling. Excavate to the elevation of the bottom of the footing before driving test piles. (see Section 00510)

Drive test piles to or below the required minimum tip elevation and to a hammer blow count established by the Engineer. Allow test piles which do not attain the hammer blow count specified at the minimum tip elevation shown to "set up" for 24 hours, or less if directed, before being redriven. (see 00520.42(d)) If the tops of test piles reach plan grade without attaining the required pile bearing resistance, splice them and drive until the required bearing resistance is attained.

Remove test piles that are not to be incorporated in the completed structure to at least 2 feet below the surface of the ground and backfill the remaining hole with acceptable material.

Do not order piling to be used in the permanent structure until test pile data has been reviewed and the production pile order lengths are determined. The Engineer will provide the Engineer's estimated length list or pile order list within 7 calendar days after completion of all test pile driving specified in the Contract.

00520.42 **Nominal Pile Bearing Resistance:**

(a) **General** - Drive piles with approved pile driving equipment to the lengths necessary to attain the required penetration and nominal pile bearing resistance. Adequate pile penetration will be considered reached when the piles are driven to or below the minimum penetration depth and the specified equation resistance value is achieved. If piles do not achieve the specified resistance when driven to order length or estimated length, splice and drive them to penetrations established by the Engineer. The pile blow count shall be at a rate of between 3 and 15 blows per inch at the required nominal pile bearing resistance. The required number of hammer blows per inch at final penetration shall be maintained for 3 consecutive inches unless "refusal" driving is first obtained. "Refusal" driving is defined as 20 blows per 1 inch or as determined by the Engineer.
If water jets are used with the driving, the bearing value shall be determined by the specified equation from the results of driving after the jetting has been completed according to 00520.42(e).

(b) FHWA Gates Equation - Unless otherwise specified, the Engineer will determine nominal pile bearing resistance of the driven pile by the FHWA Gates equation:

\[ R_n = 1.75 \left( \sqrt[10]{E} \right) \log_{10}(10N) - 100 \]

where:

- \( R_n \) = Nominal Pile Bearing Resistance (kips)
- \( E \) = \( W \times H \) (Hammer energy (foot-pounds) at the ram stroke observed in the field)
- \( W \) = Weight (pounds) of striking parts of hammer
- \( H \) = Height of fall (feet) of the ram measured during pile driving in the field
- \( \log_{10}(10N) \) = Logarithm to the base 10 of the quantity 10 multiplied by \( N \)
- \( N \) = Number of hammer blows per inch at final penetration to be sustained for 3 consecutive inches

\[ N = 10^{\left( \frac{R_n + 100}{1.75 \sqrt[10]{E}} - 1 \right)} \]

or \( N = 10 \) to the power in brackets

The FHWA Gates equation is applicable only if:

- The hammer is in good condition and operating in a satisfactory manner.
- The hammer has a free fall.
- A follower is not used.
- The head of the pile is not broomed or crushed.

If the Engineer determines that the hammer being used may not be attaining the specified bearing resistance when the above equation is applied, the Engineer may order the Contractor, at no additional cost to the City, to verify the bearing resistance values obtained by the use of a different hammer.

(c) Wave Equation Analysis - If specified, the Engineer will determine nominal pile bearing resistance based on wave equation analysis.

(d) Set Period and Redriving - If piles do not attain the required nominal bearing resistance when driven to the specified length, and if allowed or required, allow the piles to stand for a "set period" without driving. The "set period" shall be a minimum of 24 hours unless otherwise approved by the Engineer. After the set period, perform check driving on either 2 piles in each
bent or on 1 pile in every 10 piles, whichever is more. The Engineer will
designate the piles on which check driving is to be performed. Do not use a
cold hammer for redriving. Warm up the hammer before redriving begins by
applying at least 20 blows to another pile. Redriving shall consist of driving the
pile to the required bearing resistance with a maximum of 15 blows. If the
specified hammer blow count is not attained on redriving, the Engineer may
direct the Contractor to drive all of the remaining pile length and repeat the set
period and redriving procedure. Splice those piles driven to plan grade that do
not attain the hammer blow count required, and drive until the required bearing
resistance is attained. If the required bearing resistance is attained for each pile
that is redriven, then the remaining piles in that bent will be considered
satisfactory when driven to at least the same penetration and resistance as the
redriven piles.

(e) Jetted Piles - The nominal pile bearing resistance of jetted piles will be
based on impact driving blow count after jetting has been completed. Jet pipes
may be removed when the pile tip is at the required minimum pile tip elevation
and before the pile is driven to the required bearing resistance. For piles that
are jetted at the Contractor's request and do not attain the required nominal
bearing resistance at the ordered length, splice, as required, and drive with a
specified impact pile hammer until the required nominal bearing resistance is
achieved according to appropriate criteria in 00520.42. Regardless of City
approval, the Contractor shall pay all costs of splicing and driving piles beyond
the order length if jetting is requested by the Contractor.

(f) Followers - The required nominal pile bearing resistance of piles driven
with followers will only be considered acceptable when the follower-driven piles
attain the same tip elevation as piles driven without followers. (see
00520.20(c)(4))

(g) Vibratory Hammers - The nominal bearing resistance of piles driven with
vibratory hammers will be based on impact driving blow count after the
vibratory equipment has been removed. When vibratory installation of the piles
is approved by the Engineer and the vibrated piles do not attain the required
nominal bearing resistance at the specified length, splice them as required, at
no additional cost to the City, and drive with a specified impact pile hammer
until the required nominal bearing resistance is achieved, according to
00520.42.

(h) Load Tests:

(1) Static Load Test - Perform static load tests on foundation or test piles
when specified or required. Conduct static load tests according to ASTM D
1143 using the quick load test method to plunging failure or the capacity of
the loading system. Use testing equipment and measuring systems
capable of applying 150% of the nominal pile bearing resistance or 1,000
tons, whichever is less.

(2) Dynamic Load Tests - Take dynamic load test measurements during
the driving of piles designated as dynamic load test piles as specified.
Perform dynamic testing according to ASTM D 4945.
Drive the pile to such depth that the dynamic load test equipment indicates that the nominal pile bearing resistance shown has been achieved, unless otherwise directed. Monitor the stresses in the piles during driving with the dynamic test equipment to ensure the values do not exceed the values in 00520.20(d-3). If necessary, reduce the driving energy by using additional cushions or reduce the energy output of the hammer to stay below the values in 00520.20(d-3). If non-axial driving is indicated by dynamic test equipment measurements, immediately realign the driving system.

00520.43 Steel Piles:

(a) General - Unless otherwise specified, furnish standard steel piles in the longest practical lengths.

(b) Storage and Handling - Store and handle steel piles in ways that protect them from damage. Bent or kinked piles will be rejected.

(c) End Treatment - Cut pile ends square.

(d) Reinforced Pile Tips - Install pile points, shoes, or other tip reinforcement according to the manufacturer's recommendations and Section 02520.

(e) Driving - During driving, protect the pile head with a fitted metal helmet.

(f) Splices - Where splices are unavoidable, submit for approval their number, location and details.

   (1) Welded Splices - Make welded splices using a full penetration butt weld, as shown. Comply with the welding procedures of AWS D1.1.

   (2) Mechanical Splices - Mechanical splices may be used if the splice transfers the full pile strength in compression, tension, and bending, according to unstamped working drawings submitted according to 00150.35 and approved by the Engineer.

(g) Welding - Weld pile splices, pile tips, pile anchors, and other welded attachments to steel piles according to AWS D1.1.

   (1) Splices - Splice joints for round piles shall conform to Joint B-U4a or C-U4a-GF (Single-Bevel Groove Weld) in D1.1 Figure 3.4. Weld back-up rings with a full penetration groove weld.

Splice joints for H-piles shall conform to Joint B-U3b or B-U3-GF (Double V-Groove Weld) in D1.1 Figure 3.4 for both the web and flange sections. Joint B-U4a or C-U4a-GF may be substituted on the flange weld. Provide access holes at the ends of the web according to D1.1 Section 5.17.
(2) **Submittals** - Prior to welding, submit the following for approval:

- A Welding Procedure Specification (WPS) for all pile welds, conforming to the limitations of D1.1 Table 4.5. Both ASTM A 36 and ASTM A 252 Grade 1 and 2 may be treated as prequalified base metals under Group 1. ASTM A 252 Grade 3 will not be considered a prequalified base metal unless the steel has a Carbon Equivalent (CE) of 0.30% or less. Develop a Procedure Qualification Record (PQR) for all welding using Grade 3 steel or present proof that the chemistry of the steel meets the CE requirements.

- Qualification documents for each welder. Use welders qualified according to D1.1 Section 4 for the position, process and pile diameter used on the job.

Do not begin welding without approval.

Following completion of all welding, submit the following:

- An inspection report stating that the welding under the Contract was performed according to D1.1. The report shall include a review of the WPS, a review of welder qualifications and a report on visual inspection of the welds on the job site. The inspection shall be signed by a Certified Welding Inspector (CWI) holding QC1 certification as defined in D1.1 Section 6.

- If the plans or Specifications call for additional inspection other than visual, include reports in the submittal.

(3) **Additional Testing** - The Engineer may request additional nondestructive testing (NDT), such as radiography or ultrasonic testing of any or all welds. If the additional testing identifies defects warranting rejection, perform repair and additional inspection at no additional cost to the City. If the additional NDT does not identify defects warranting rejection, the City will pay the cost of the additional testing. Radiographic and ultrasonic defect indications will be evaluated according to the statically loaded criteria of D1.1.

(h) **Cutoff Lengths** - Cut off the tops of all permanent piles square and smooth at the elevation shown or as directed. All cut-off pile becomes the property of the Contractor. Dispose of according to 00290.20. With approval, undamaged cutoffs may be used as pile extensions or welded together to form full length piles. Steel pile cutoffs welded together, whether pile extensions or full length piles, shall not vary from a straight line more than 0.25 inch in 20 feet measured along any edge of the pile.

All acceptable cutoffs and unused pile lengths remaining at completion of pile driving will be marked for identification by the Engineer as acceptable for use on other or future City projects if requested by the Contractor.
(i) **Capping** - If required by the plans, cap steel piles with a steel plate of the size and shape shown. Connect this cap to the pile according to the details shown.

**00520.44 Prestressed Concrete Piles:**

(a) **General** - Furnish full-length prestressed concrete piles according to the Special Provisions and Section 00550.

(b) **Lifting, Storing, and Transporting** - Lift, store and transport prestressed concrete piles according to 00550.49.

(c) **Strength Before Driving** - Do not drive precast, prestressed concrete piles until the conditions of 00550.12(d) are met, and the Engineer gives consent to proceed.

(d) **Extensions or "Build-ups"** - If additional driving is required beyond the order length, splice on pile extensions or build-ups as specified and directed. Prestressed concrete pile cutoffs may be used as extensions if additional driving is not required. Do not use pile cutoffs as extensions exceeding 5 feet in length unless approved.

   (1) **Epoxy-Dowel Method** - Make splices of prestressed concrete piles to prestressed concrete piles and poured-in-place extensions or build-ups with the epoxy-dowel method, as shown or approved.

   (2) **Mechanical Splices** - Mechanical splices may be used subject to limitations of 00520.43(f).

(e) **Cutoffs** - Cut off permanent prestressed concrete piles at the elevations shown or directed. All cut-off lengths become the property of the Contractor. Dispose of according to 00290.20. Take care to prevent spalling of the concrete below the footing or pile cap. Repair damage to the piles at no additional cost to the City.

(f) **Finishing** - Finish all exposed prestressed concrete pile surfaces to 1 foot below ground surface according to 00550.47.

**00520.45 Timber Piles:**

(a) **General** - Furnish full length treated timber piles according to the Special Provisions and 02120.20. Cut the heads of piles back square to untreated wood before driving. Provide a length of pile above the elevation of cutoff sufficient to permit the complete removal of all pile damaged by driving. Splicing of timber piles will not be allowed.
(b) **Storage and Handling** - Store and handle piles to avoid damage. Avoid breaking the surface of treated piles. Do not use cant hooks, dogs or pike poles on portions of the piles remaining in the completed work. Give cuts or breaks in the surface of treated piles three brush coats of pentachlorophenol, hot creosote oil or other preservative from the CPL. Pour pentachlorophenol, hot creosote oil or preservative from the CPL into all bolt holes. If the treatment is damaged so the integrity of the pile is in jeopardy, the pile will be rejected. Furnish a replacement pile at no additional cost to the City.

(c) **Strapping** - Strap timber piles with at least 3 straps as follows:

- One approximately 18 inches from the butt
- One approximately 24 inches from the butt
- One approximately 12 inches from the tip

Use straps manufactured according to 02120.30. Wrap the strap around the pile once and fasten with a clip so crimped that the joint will have a tensile strength of at least 4,100 pounds. Install the straps after pressure treating the pile.

(d) **Reinforced Pile Tips** - Provide metal tips and fasten securely to the pile when shown or specified. Carefully shape the pile tip to secure an even, uniform bearing on the pile tip reinforcement.

(e) **Cutoffs** - Saw timber piling to a plane parallel to the bottom of the structure at the elevation shown or as directed. All cut-off materials become the property of the Contractor. Dispose of according to 00290.20.

(f) **Capping** - Cover timber pile heads not encased in concrete with alternate layers of hot asphalt and loosely woven fabric, using 4 applications of asphalt and 3 layers of fabric. Make the cover at least 6 inches more in dimension than the diameter of the pile head. Neatly fold down over the pile and secure by binding with not less than 7 complete turns of commercial corrosion resistant wire (13.5 gauge minimum diameter) held in place by large headed commercial corrosion resistant nails or staples. Hot-dipped galvanized or stainless steel straps and clips conforming to 02120.30 may be used instead of commercial corrosion resistant wire. Neatly trim the edges of the fabric projecting below the binding.

**00520.46 Damaged or Defective Piles** - In addition to other specified requirements:

- Approval of a pile hammer shall not relieve the Contractor of responsibility for piles damaged from misalignment of the leads, failure of capblock or cushion materials, failure of splices, malfunctioning of the pile hammer or other improper construction methods.
- Piles damaged during installation will be considered unsatisfactory unless the nominal bearing resistance is proved by load tests performed by the Contractor. If such tests indicate inadequate resistance, take corrective measures, such as the use of damaged piles at reduced resistance, installation of additional piles, strengthening of damaged piles, or replacement of damaged piles.

- A concrete pile will be considered defective if a visible crack appears around the entire periphery of the pile, or any other crack or defect is observed which is determined to affect the strength or performance of the pile.

- Do not place footing concrete until all piles within a footing are inspected by the Engineer.

**Measurement**

00520.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Furnish Equipment for Driving Piles - No measurement of quantities will be made for furnishing equipment for driving piles.

(b) Furnish Piles - The quantities of furnishing steel, prestressed concrete, timber, and test piles will be measured on the length basis, to the nearest foot, as follows:

(1) Steel Piles - Steel piles will be the length of each pile remaining in the completed work, from the pile tip to the cutoff plane.

(2) Prestressed Concrete and Timber Piles - Prestressed concrete and timber piles will be the sum of the lengths of piles of the types and lengths ordered, furnished according to these Specifications, and stockpiled in good condition at the work site.

(3) Test Piles - Test piles, including test piles remaining in the completed work, will be measured according to (b-1) and (b-2) above as applicable.

No allowance will be made for that length of pieces furnished by the Contractor to replace piles previously accepted by the Engineer, but that are subsequently damaged before completion of the Project.

(c) Drive Piles - The quantities of driving steel, prestressed concrete, timber, and test piles will be measured on the unit basis. Driving test piles includes test piles remaining in the completed work.

Preboring will be measured on the length basis, to the nearest foot.

Jetting will be measured on the unit basis, for each pile driven with the aid of jetting.
(d) Load Tests - Load tests to be will be measured on the unit basis, for the number of specified load tests completed and accepted. Load tests made at the option of the Contractor will not be measured.

(e) Reinforced Pile Tips - The quantities of reinforced pile tips will be measured on the unit basis.

(f) Pile Splices - Pile splices will be determined as follows:

1. Steel Piles - Splices incorporated in the finished structure that were made to increase the length of the pile 5 feet or more for estimated pile lengths of 60 feet or less and 10 feet or more for estimated pile lengths of over 60 feet beyond the estimated pile length will be measured on the unit basis. Only one splice will be measured per pile.

No measurement will be made for splices to steel piles within the estimated lengths listed in 00520.11 of the Special Provisions.

2. Prestressed Concrete Piles - No measurement of quantities will be made for prestress concrete pile splices shown or specified Additional splices required to complete the work will be done as Extra Work according to Section 00196.

Payment

00520.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Furnish Pile Driving Equipment</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Furnish ____ Piles</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Furnish ____ Test Piles</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) Drive ____ Piles</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Drive Test Piles</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Preboring Piles</td>
<td>Foot</td>
</tr>
<tr>
<td>(g) Jetting Piles</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Pile Load Test (static)</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Pile Load Test (dynamic)</td>
<td>Each</td>
</tr>
<tr>
<td>(j) Reinforced Pile Tips</td>
<td>Each</td>
</tr>
<tr>
<td>(k) ______ Steel Pile Splices</td>
<td>Each</td>
</tr>
</tbody>
</table>

Partial payments for Item (a) will be made as follows:

- When equipment for driving piles is furnished and is satisfactorily driving piles ............................................. 75%
- When driving piles is complete and equipment has been removed from site ...................................................... 25%
Item (a) includes:

- furnishing all materials, equipment, and labor necessary for transporting, erecting, maintaining, replacing any ordered equipment, dismantling and removing the entire pile driving equipment
- resubmittal of wave equation analysis data if original data is rejected
- replacing previously approved hammers if hammer operates improperly
- all considerations when selecting the pile hammer size

The cost of all materials and labor, including the manipulation of the pile driving equipment in connection with driving piles will be included in the unit price each for driven piles. Furnishing equipment for driving sheet piling is not included in this work.

In items (b),(c), (d) and (k) the type and size of pile will be inserted in the blank.

Item (d) includes cutting off piles, treating and capping pile heads, attaching anchor brackets, lugs or other attachments, and finishing concrete piles.

Items (d) and (e) include all expenses involved in driving piles which have not attained the required bearing resistance and are required to stand for a "set period".

Item (j) includes attaching the tips to the piles.

Item (k) includes steel pile splices required to increase pile length beyond the estimated length listed in 00520.11 of the Special Provisions. No payment will be made for splices to steel piles that are within the estimated lengths listed in 00520.11 of the Special Provisions.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for work needed to drive piles to minimum tip elevation as shown or specified.

No separate or additional payment will be made for welding inspection performed according to 00520.43(g)(2).

No separate or additional payment will be made for preboring and jetting of piles if not included in the Contract Schedule of Items but requested by the Contractor.

Preboring and jetting, if not included in the Contract Schedule of Items, larger hammers, and construction of concrete pile extensions, build-ups, and splices ordered by the Engineer, as a result of differing site conditions (see 00140.40) will be made on an Extra Work basis according to Section 00196.
Section 00530 - Steel Reinforcement for Concrete

Description

00530.00 Scope - This work consists of furnishing and placing steel reinforcement of the grade, type and size shown or specified.

Materials

00530.10 General - Furnish materials meeting the following requirements:

- Deformed Bar Reinforcement ............................................. 02510.10
- Epoxy Coated Reinforcement ............................................. 02510.11
- Galvanized Coating .......................................................... 02510.30
- Mechanical Splices .............................................................. 02510.20
- Welded Wire Fabric .............................................................. 02510.40
- Wire Reinforcement .............................................................. 02510.60

00530.11 Order Lists and Bending Diagrams - Before ordering material, submit all order lists according to 00150.37 and unstamped bending diagrams according to 00150.35 for approval. Do not order material until such lists and bending diagrams have been approved. The review of order lists and bending diagrams by the Engineer will in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Revise lists and diagrams as required to make them comply with the design drawings at no additional cost to the City.

Order lists and bending diagrams for reinforcement affected by stressing system in prestressing beams or post-tensioning systems such as anchorage design and duct placement will not be reviewed before the stressing system is reviewed.

00530.12 Fabrication - Cold bend reinforcement bars to the shapes shown. Make bends, tag, mark and ship reinforcement bars according to the current edition of the CRSI "Manual of Standard Practice".

00530.13 Miscellaneous Metal - Minor metal parts such as drains, bolts, concrete anchors, spacer blocks, expansion and bearing devices, access hole covers and frames, anchor bolts, inserts and similar miscellaneous metal, unless otherwise provided, will be classified as reinforcement.

Pipe attached to or used in conjunction with bridge deck drains or catch basins will be classified as reinforcement.

00530.14 Concrete Inserts - Furnish hot-dip galvanized expanded coil concrete inserts with closed-back ferrule threaded to receive UNC threaded bolts or rods of the size shown. Provide concrete inserts with the following minimum lengths and capacities:
<table>
<thead>
<tr>
<th>Bolt or Rod Diameter (Inches)</th>
<th>Minimum Insert Length (Inches)</th>
<th>Minimum Safe Working Load In Shear or Tension (Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>4 1/2</td>
<td>4,000</td>
</tr>
<tr>
<td>1</td>
<td>5 1/2</td>
<td>6,000</td>
</tr>
<tr>
<td>1 1/4</td>
<td>7 1/2</td>
<td>10,000</td>
</tr>
<tr>
<td>1 1/2</td>
<td>9 1/2</td>
<td>16,000</td>
</tr>
</tbody>
</table>

**Labor**

**00530.30 Mechanical Splice Installers** - Provide qualified mechanical splice installers to construct mechanical splices. To qualify an installer, provide the Engineer with three completed mechanical splice samples of each type and size to be installed on the Project for each mechanical splice installer, at no additional cost to the City. Prepare the splice samples as follows:

- Make splice samples in the presence of the Engineer using the same materials, equipment, and procedures that will be used on the Project.
- Construct each splice sample according to the manufacturer's recommendations.
- Construct each splice sample with 2 equal lengths of straight reinforcing bar so the total length of the assembled splice sample is at least 48 inches.
- Mark each splice sample with the heat treatment lot number.

Provide.splice samples that meet the requirements of 02510.20. Do not begin mechanical splice installation until the Engineer confirms, in writing, the qualification of each mechanical splice installer. The Engineer may suspend mechanical splice installation if the Contractor substitutes unapproved personnel during construction.

**Construction**

**00530.40 Protection of Material** - Store reinforcement above the surface of the ground on dunnage. Protect reinforcement from damage at all times. Ensure reinforcement is free of dirt, detrimental rust or scale, paint, oil and other foreign substances when placed in the work.

In addition to the requirements above, store epoxy coated bars with supports close enough to prevent sagging in the bundles. Provide protective padding when bundles are stacked or when supported on metal. Store bars as close as practical to where they will be placed in the structure. Cover bars with an opaque material during storage to protect them from exposure to sunlight and saline mist. Move bars to or from storage according to 02510.11(c) to minimize damage to the coating. Do not allow the total exposure time from bar delivery to concrete placement, while in storage or in place, to exceed 2 months.
00530.41 Placing and Fastening - Place all reinforcement within the tolerances recommended in the CRSI "Manual of Standard Practice" unless otherwise specified. Hold reinforcement firmly during the placing and setting of concrete.

(a) Fabric - If fabric reinforcement is shipped in rolls, straighten it into flat sheets before placing.

(b) Ties and Supports - Keep reinforcement properly positioned during placement of concrete according to the following:

- Tie bars in top mats of footings and deck slabs at all intersections. Where bar spacing is less than 6 inches, tie alternate intersections.
- Tie all other bars at all intersections except where spacing is less than 1 foot in each direction; in that case tie alternate intersections.
- When precast concrete blocks are used, provide blocks that have cast-in wire ties. Provide tie wires meeting the requirements of 02510.60.
- For bridge decks, support the top mat of reinforcing steel from the bottom mat with reinforcing bar supports according to Chapter 3 of the CRSI "Manual of Standard Practice" (SBU, BBU or CHCU) at 24 inch maximum centers.
- Where at least one of the bars to be tied or supported is epoxy coated, provide tie wires that are either plastic coated or epoxy coated. Where precast concrete blocks with cast-in wire ties are used to support bridge deck reinforcement, the wire ties need not be coated.

(c) Clearances:

- Provide the same surface clearance for ties and splices that is shown or specified for the reinforcement.
- Maintain distance from the forms with stays, precast concrete blocks, ties, hangers, or other approved supports.
- Separate layers of bars with precast concrete blocks or by other suitable devices.
- Use precast concrete blocks with approved shape and dimensions and with the same or greater compressive strength as the concrete to be placed.
- Do not use pebbles, pieces of broken stone or brick, metal pipe or wooden blocks as bar supports or to separate layers of bars.
- Use stainless steel metal chairs conforming to the requirements of ASTM A 493, Type 430 or plastic chairs from the CPL when the legs of the chair will be on an exposed surface.
- Turn up the legs of metal chairs a minimum of 1/8 inch.
- Remove all precast member lifting devices prior to placing concrete deck reinforcement.
- Ensure bridge deck clearances meet the requirements of 00540.48(g).
(d) Approval - After placing reinforcement in any member have it inspected and approved before placing concrete. Concrete placed in violation of this provision may be rejected and removal required.

00530.42 Splicing:

(a) General - Furnish full length reinforcing bars the specific length shown or the calculated length for those designated "full length".

If specific locations are designated for splices, make splices only at those locations, or use full-length bars.

In the absence of other directions, including bars designated "continuous," furnish reinforcing bars to provide the minimum practical number of bars.

Where splicing is allowed, unless shown otherwise:

- Splice No. 11 bars and smaller by lapping, or with an approved mechanical splice.
- Splice No. 14 bars and larger with an approved mechanical butt splice.

(b) Lapped Splices - In lapped splices, place the bars in contact and fasten together according to 00530.41 with at least 3 ties per splice.

Where coated reinforcement is spliced to uncoated reinforcement, provide the required splice lap for the coated reinforcement unless shown otherwise.

(c) Mechanical Splices:

(1) General - Construct mechanical splices according to 02510.20 and the manufacturer’s recommended procedures. Use devices that join bars end-to-end if a butt splice is specified; otherwise bars may be lapped or joined end-to-end. All requirements for mechanical splices apply to mechanical butt splices.

Ensure mechanical butt-spliced reinforcing bars do not deviate from the layout line by more than 1/4 inch over a 3 foot length of bar.

When approved, dowels may be replaced by reinforcing bars with threaded sleeve mechanical splice couplers embedded in the portion of concrete placed first and threaded reinforcing bars inserted in the couplers after forms are removed. Construct assemblies that develop 135% of the specified minimum yield strength of the dowels shown or specified. Construct reinforcing bars that have effective splice or development lengths equal to the replaced dowels.
(2) **Sampling and Testing:**

a. **General** - Furnish labor, material and equipment for fabricating sample mechanical splices at no additional cost to the City. All sample splices will be tested by the City at no cost to the Contractor.

b. **Samples** - Provide all samples meeting the requirements of 02510.20 and this subsection.

c. **Testing** - Construct test splices in the presence of the Engineer. Construct test splices with 2 equal lengths of straight reinforcing bar so that the total length of the assembled sample is not less than 148 inches. Mark each splice sleeve with the heat treatment lot number.

d. **Jobsite Quality Control** - During the installation of mechanical splices:

- Submit one quality control sample for each 100 splices performed up to 500 splices then submit one sample for each 500 splices. This sequence of testing will be required for each heat treatment lot used.
- Make non-threaded mechanical splice quality control samples at the jobsite in a manner similar to that used for the production splices.
- Fabricate threaded sleeve mechanical splice quality control samples on a random basis during the cutting of threads on the reinforcing bars and deliver to the Engineer at the jobsite with the material they represent.
- Complete the splice according to the manufacturer's recommendations.
- Quality control samples will be tested according to this Section. If any sample fails to meet the test criteria, the lot which it represents will be rejected until the cause of failure has been determined. Materials from a rejected lot may be accepted if they are shown to be free of the condition which caused the failure.

(3) **Installation** - Install splices in the presence of the Engineer. Splices made without the Engineer present will be rejected.

Do not place stirrups and other reinforcing bars between a mechanical splice sleeve and the surface of the concrete where it would impair the specified clearance. Instead, place additional reinforcement as necessary at no additional cost to the City.

Coat mechanical splices of epoxy coated reinforcing bars after installation, according to AASHTO M 284 for patching damaged epoxy coatings.

Where precoating is required, precoat splices with an approved coating.
Following installation on projects within 25 aerial miles of the Pacific Ocean, coat exposed areas of bare steel with heat shrink tubing from section 2510.11 of the CPL. On all other projects, coat exposed areas of bare steel with heat shrink tubing or epoxy patching material from section 2510.11 of the CPL. Apply coating according to AASHTO M 284.

(d) **Welded Splices** - Perform welded splices of steel reinforcing according to AWS D1.4. Submit welder certification, Welding Procedure Specifications and Procedure Qualification Records to the Engineer for approval.

00530.43 **Splicing Welded Wire Fabric** - Overlap sheets of welded wire fabric as shown or provide edge and end laps not less than one mesh in width. Securely fasten sheets at the ends and edges according to 00530.41.

00530.44 **Substitutions** - Substitute different size bars only if approved.

00530.45 **Inspection and Repair of Epoxy Coated Rebar** - Inspect coated bars before placement for damage to coating. Patch all visual defects in the coating with a prequalified patching material according to AASHTO M 284 before installation. Clean areas to be patched to remove all surface contaminants and damaged coating. Promptly treat cleaned areas according to the resin manufacturer's recommendations and before detrimental oxidation occurs. Where rust is present, remove it by blast cleaning or power tool cleaning methods immediately before applying the patching material. Clean and roughen the metal before applying patching material. Feather the patching material 2 inches to 3 inches, or as recommended by the manufacturer, into undamaged coated areas. Apply patching material to a thickness greater than 8 mils.

Clean visual damage found after placement as specified above. Coating damage exceeding 2% of the surface area in any lineal foot section of a bar may be cause for rejection of that bar.

00530.46 **Marine Environment** - On projects within 3 aerial miles of the Pacific Ocean, clean bars with a high pressure washer (1,500 pounds per square inch minimum pressure, with a fan pattern, 4.5 gallons per minute capacity) just prior to placing concrete.

**Measurement**

00530.80 **Measurement** - The quantities of reinforcement will be measured by one of the following methods:

(a) **Lump Sum** - Under this method, no measurement will be made. Estimated quantities of reinforcement will be listed in the Special Provisions. The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed estimated quantities.

(b) **Weight** - Under this method, reinforcement will be measured on the weight basis, of reinforcement incorporated into the concrete based on the total computed weight for the sizes and lengths of bars as shown or authorized.
The following assumed densities will be used as a basis for computing the theoretical weight of miscellaneous metal:

- Steel - 490 pounds/cubic foot
- Copper - 555 pounds/cubic foot
- Cast Iron - 450 pounds/cubic foot

The weight of mesh will be computed from the theoretical weight of plain wire. If the weight per square foot is shown, that weight will be used.

For the purpose of computing weight of reinforcement, weights published in the CRSI "Manual of Standard Practice" will be used.

The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed quantities.

If bars are substituted at the Contractor's request, and as a result, more steel is used than specified, only the amount specified will be included in the pay quantities. When laps are made for splices for the convenience of the Contractor, the extra reinforcement will not be included in the pay quantities.

**Payment**

- **00530.90 Payment** - The accepted quantities of reinforcement will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Reinforcement</td>
<td>Lump Sum or Pound</td>
</tr>
<tr>
<td>(b) Coated Reinforcement</td>
<td>Lump Sum or Pound</td>
</tr>
</tbody>
</table>

Item (a) includes fabricating and placing uncoated reinforcement as specified.

Item (b) includes placing epoxy coated reinforcement as specified.

Payment for reinforcement will be made when the reinforcement is incorporated into the concrete.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified,

No separate or additional payment will be made for clips, wire, separators, wire chairs, and other material used in fastening the reinforcement in place.
**Section 00535 - Resin Bonded Anchor Systems**

**Description**

**00535.00 Scope** - This work consists of drilling and preparing holes in hardened concrete and providing and installing anchor bolts or reinforcement using a resin bonded anchor system as shown.

**Materials**

**00535.10 Materials** - Furnish anchor bolts meeting the requirements of 02560.30 and reinforcing steel meeting the requirements of Section 02510 as shown. High-strength anchor bolts meeting the requirements of ASTM A 193, Grade B7 may be substituted in place of these specified in 02560.30(b).

Furnish a polyester, vinyl ester, or epoxy resin bonding system from the CPL that will sustain not less than the pullout forces shown. See Table 00535-1 when pullout forces are not shown. Provide the resin in proper proportions to be mixed easily.

<table>
<thead>
<tr>
<th>TABLE 00535-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Pullout Force</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>Anchor Bolts</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Dia. (incg)</td>
</tr>
<tr>
<td>1/2</td>
</tr>
<tr>
<td>5/8</td>
</tr>
<tr>
<td>3/4</td>
</tr>
<tr>
<td>7/8</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Unless shown otherwise, do not install anchors larger than 1 inch in diameter using a resin-bonded anchor system.

Unless shown otherwise, select a resin from the CPL as follows:

- For Grade 36 and Grade 55 anchors, use either low strength or high strength resin.
- For Grade 105 anchors and Grade 60 rebar, use high strength resin only.
Provide the Engineer with:

- Certification, according to 00165.35, that the anchor system meets all requirements for the Project.
- Mill test certificates verifying the strengths of material used in the manufacture of the anchors.
- Proposed embedment depths for approval, if not shown.

Unless shown otherwise, galvanize all anchors which have any portion of the anchor exposed.

Galvanize according to AASHTO M 232 (ASTM A 153) or AASHTO M 298 (ASTM B 695), Class 50. When within 25 aerial miles of the Pacific Ocean, galvanize according to AASHTO M 232 (ASTM A 153) only. Unless otherwise shown, anchors that become completely encased in concrete will not require galvanizing.

Provide thread lengths as shown. If thread lengths are not shown and the anchor is not rebar, provide threads on the resin-bonded end of the anchor for at least 80% of the embedment depth shown.

**Construction**

**00535.40 Construction** - Install the anchor system according to the manufacturer’s recommendations and to the embedment depths shown. Use epoxy resins only when the ambient air temperature is within the temperature range recommended by the manufacturer. Unless stated otherwise in the manufacturer’s instructions, use a drill bit diameter 1/8 inch larger than the nominal anchor diameter for AASHTO M 314 anchors and 5/64 inch larger than the out-to-out diameter for rebar. Unless shown otherwise, drill holes for anchor bolts as follows:

When the center of the hole is more than 6 inches from a concrete edge, use either a 9 pound air hammer weight, or a carbide bit rotary hammer with 2 cutting edges on the diameter.

When the center of the hole is 6 inches or less from a concrete edge, use either a diamond bit core drill or a carbide bit rotary hammer with 4 cutting edges on the diameter.

Clean holes with a non-metallic brush, compressed air, and water. Remove excess water from the hole. The cleaned hole may be damp, but be free of concrete dust, foreign matter, and standing water.

When nuts are applied to anchor bolts, tighten to one quarter turn past snug-tight unless shown otherwise.
**Measurement**

00535.80  **Measurement** - No measurement of quantities will be made for resin bonded anchor systems.

**Payment**

00535.90  **Payment** - No separate or additional payment will be made for resin bonded anchor systems. This work is included in payment made for the applicable items in which the anchor system fastens.
Section 00540 - Structural Concrete

Description

00540.00 Scope - This work consists of furnishing, placing, and finishing portland cement concrete, throughout this Specification referred to as structural concrete or concrete, for bridges and other structures according to these Specifications and in close conformity to the lines, grades and dimensions shown or established.

00540.01 Abbreviations and Definitions:

ASTV - Actual Strength Test Value - See 02001.02 for definition.

Falsework - Structural system to support the vertical and horizontal loads from forms, reinforcing steel, plastic concrete, structural steel, loads from placement operations and other related loads.

Forms - Structural system to contain the horizontal pressures exerted by plastic concrete.

HPC - High Performance Concrete - See 02001.02 for definition.

Post-Tensioned - Tensioning of prestressing steel after concrete has reached specified strength.

Surrounding Temperature - The air temperature measured in the shade. When placement and curing of concrete is enclosed, it is the lowest temperature within the enclosure.

Tolerance:

- The permitted variation from a given dimension or quantity, or
- The range of variation permitted in maintaining a specified dimension, or
- A permitted variation from location or alignment.

00540.02 Deck Pre-Placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel who are to be involved in the concrete work at a mutually agreed time approximately 3 weeks in advance of placing concrete for bridge decks. Ensure the Engineer, concrete supplier, and any other subcontractor is represented. Present and discuss all phases of the concrete deck placement work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer and the entire concrete placement crew at the job site 1/2 hour before the first placement begins to discuss placement duties and procedures.
Materials

00540.10 General - Furnish materials meeting the following requirements:

Concrete ................................................................................................................. 02001
Concrete Coating ................................................................................................. 02210.30
Curing Materials ................................................................................................... 02050
Epoxy and Non-Epoxy Bonding Agents ................................................................. 02070
Epoxy and Non-Epoxy Grouts ................................................................................. 02080
Epoxy Cement ......................................................................................................... 02060
Poured Joint Fillers ................................................................................................. 02440.30
Preformed Expansion Joint Filler ............................................................................. 02440.10

00540.11 Classes of Concrete - Furnish concrete meeting the requirements of Section 02001 and the requirements of Table 02001-1 for the classes of concrete to be used in various structures and concrete paving mixtures. The plans or Special Provisions will show the class of concrete required for the component parts of the structure. Use the specified class of concrete, or a higher class. Where the class is not specified, use Class 3300.

00540.14 Concrete Mix Tolerances and Limits - Furnish a workable concrete mixture, uniform in composition and consistency and meeting the properties and limits requirements of 02001.20.

00540.15 Form Materials - Furnish wood, plywood, metal, or other suitable form material. For round concrete columns, provide either metal or other approved form material that produces a smooth and true surface free from fins, joints and other irregularities. Where plywood is used, provide a minimum nominal thickness of 5/8 inch.

00540.16 Quality Control - Provide quality control according to Section 00165 and the following:

- Sample and test according to the MFTP.
- For all structural concrete, provide personnel according to 00540.30 to sample and test the mix for temperature, air content, slump, water-cementitious ratio, density and yield, from the first load of each placement, whenever there is a visible change in the slump of the concrete, and when a set of cylinders is obtained.
- If the results of any test are outside of the specification limits, stop placement of the load. Correct the load or, if the load cannot be corrected, do not incorporate it into the work. Test subsequent loads before any further concrete placement. Correct subsequent loads if any of the tests are still outside the specification limits. Return to the specified test frequency when the test results from two consecutive loads are shown to meet the specification limits.

00540.17 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

537 City of Portland 2010
(a) **Aggregate** - Acceptance will be based on the Contractor’s quality control testing, if verified, according to Section 00165. Blend aggregates only as allowed in 02001.20.

(1) **Aggregate Gradation** - A stockpile contains specification aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level indicated in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) **Non-specification Aggregate Gradation** - Stockpiled aggregates that contain non-specification aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(b) **Plastic Concrete** - Acceptance of plastic concrete will be based on tests performed by the Contractor’s QCT, according to the tolerances and limits of 02001.20.

(c) **Hardened Concrete** - Cast and cure test specimens according to AASHTO T 23 in 6 inch x 12 inch or 4 inch x 8 inch, single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) **General** - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test cylinders at the City certified laboratory.

(2) **Actual Strength Test Value (28-Day)** - The ASTV is the average compressive strength of the 3 cylinders tested. If the compressive strength of a single test specimen varies by more than 10% from the average of the other 2 specimens, that compressive strength value will be discarded. The average compressive strength test of the 2 remaining specimens will be the ASTV.

(3) **Acceptance** - Hardened concrete with an ASTV meeting or exceeding the specified design strength, \( f'c \) will be accepted for strength. If the ASTV is less than \( f'c \) but at least 85% of \( f'c \), the Engineer may review the results to determine if the concrete represented by the cylinders is suitable for the intended purpose. Remove concrete that has an ASTV less than 85% of \( f'c \) unless otherwise authorized, in writing, by the Engineer. If the concrete is removed, the cost of removal, replacement and all related work is the Contractor's responsibility. If the Engineer determines that the concrete is suitable for the intended purpose, the concrete may be allowed to remain in place, subject to a price adjustment according to 00150.25.
If an ASTV falls below $f'c$, the Contractor may submit a written plan within 3 days of the test for review by the Engineer. Provide a plan outlining a proposed alternate method of evaluating compressive strength. Provide evidence that a reasonable $f'cr$ (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. If the Engineer determines that the compressive strength test results are suspect from definable external factors, the Engineer may allow an alternate method of acceptance.

**Equipment**

00540.22 **Concrete Conveying Equipment** - Use clean, non-aluminum conveying equipment capable of supplying concrete to the point of placement without segregation.

(a) **Concrete Pumping Equipment** - Provide a discharge line for the pump made of steel or rubber pipe and having the following minimum size:

<table>
<thead>
<tr>
<th>Nominal Maximum Size of Concrete Aggregate</th>
<th>Minimum Pipe Size, Inside Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>4 inches</td>
</tr>
<tr>
<td>1 1/2 inches</td>
<td>5 inches</td>
</tr>
</tbody>
</table>

(b) **Chutes** - Use steel or steel-lined chutes. Where steep slopes are required, equip the chutes with baffles or provide short lengths that reverse the direction of movement.

(c) **Pipes or Trunks** - Other than tremie seal pipe, provide rubber or steel pipes, and plastic trunks.

(d) **Tremie Seal Pipe** - Provide a tremie seal pipe that:

- Is rigid pipe with minimum diameter of 10 inches and sufficient length to reach from the bottom of the excavation to above the waterline, with an attached receptacle or hopper for receiving concrete.
- If jointed, is the flange-and-gasket type and waterproof.
- Has means to close the discharge end.
- Is supported to permit free movement of the discharge end throughout the seal.
- Is equipped with a device to permit rapid lowering when necessary to retard or stop the flow of concrete.

00540.23 **Vibrators** - Provide vibrators that:

- Are an internal type unless other methods are approved by the Engineer.
- Are capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.
00540.24
- Are in working condition to meet manufacturer’s rating.
- Are fitted with a manufactured rubber head to minimize damage to epoxy coated reinforcement.

00540.24 Deck Finishing Machine - Provide a deck finishing machine that is:
- Capable of finishing the entire roadway surface or the specified stage construction width.
- Self-propelled with positive control in both forward and reverse directions.
- Capable of raising rolls or screed to clear the screeded surface with positive control to the specified grade.
- Equipped with augers.
- Equipped with rollers or vibrating screeds.

(a) Deck Finishing Machine Support System - Furnish calculations and detailed drawings of the proposed deck finishing machine support system according to 00540.41.

(b) Other Deck Finishing Equipment - In narrow bridge widenings where a deck finishing machine is not practical, a mechanical vibrating screed may be used.

00540.25 Straightedge - Furnish a 12 foot metal straightedge for checking bridge deck roadway and sidewalk surface tolerances.

00540.26 Concrete Saws - Provide power-driven concrete saws for sawing joints and as required for surface texture.

00540.28 Power Washers - Provide power washers that produce a minimum 2,500 psi pressure at the nozzle, with a fan pattern, and a minimum 4.5 gallons per minute capacity. For bridge decks, provide at least one power washer for each side of the deck section to be placed. When using power washers to produce a fog spray for curing, match the flow rates and pressures of the power washers with the fogging nozzles to produce an average droplet size of 3 mils, according to the nozzle manufacturer’s recommendation.

00540.29 Work Bridges - Provide at least 2 transverse work bridges when placing concrete on a bridge deck. Use the transverse work bridges to facilitate placement of the cure.

Labor

00540.30 Quality Control Personnel - In addition to the certified technicians required in 02001.50 provide and designate an individual to be present at the placement site at all times during concrete placements for projects with more than 100 cubic yards of structural concrete and for all high performance concrete, and who is authorized and responsible for acceptance and rejection of materials.
Construction

00540.40  Tolerances - The following tolerances apply to cast-in-place structures:

(a) Foundation Footings:

(1) Lateral Alignment:

- Actual (as cast) location of the center of gravity: 0.02 times width of footing in the direction of misplacement, but not more than 2 inches
- Supporting masonry: 1/2 inch

(2) Level or Vertical Alignment:

- Top of footing supporting masonry: 1/2 inch
- Top of other footings: minus 2 inches to plus 1/2 inch

(3) Cross-Sectional Dimensions:

a. Horizontal dimension of formed members: minus 1/2 inch to plus 2 inches
b. Horizontal dimension of unformed members cast against soil:
   - Less than and equal to 2 feet: minus 1/2 inch to plus 3 inches
   - Over 2 foot and less than and equal to 6 feet: minus 1 1/2 inch to plus 6 inches
   - Over 6 feet: minus 1/2 inch to plus 12 inches

c. Vertical dimension (thickness): 0 to plus 6 inches

(4) Relative Alignment - Footing side and top surfaces may slope with respect to the specified plane at a rate not to exceed 1 inch in 10 feet.

(b) All Other Structural Members:

(1) Vertical Alignment:

- Exposed surfaces: ± 3/4 inch
- Concealed surfaces: ± 1 1/2 inches
- Construction joints: 0 to minus 3 inches

(2) Lateral Alignment - Centerline alignment: 1 inch

(3) Level Alignment:

a. Profile grade: ± 1 inch
b. Top of other concrete surfaces and horizontal grooves:
   - Exposed: ± 3/4 inch
   - Concealed: ± 1 1/2 inches

c. On ramps, sidewalks and intersections, in any direction, the gap below a 12 foot unlevelled straightedge resting on high spots shall not exceed 1/4 inch.

d. On bridge decks, in any direction the gap below a 12 foot unlevelled straightedge does not vary from the testing edge by more than 1/8 inch.

(4) Cross-Sectional Dimensions:
   - Bridge slabs and decks vertical dimension (thickness): minus 1/8 inch to plus 1/4 inch
   - Members such as columns, beams, piers, walls and others (slab thickness only): minus 1/4 inch to plus 1/2 inch
   - Openings through members: 1/2 inch

(5) Relative Alignment:
   a. Location of openings through members: 1/2 inch
   b. Formed surfaces may slope with respect to the specified plane at a rate not to exceed the following amounts in 10 feet:
      - Watertight joints: 1/8 inch
      - Other exposed surfaces: 1/2 inch
      - Concealed surfaces: 1 inch
   c. Unformed exposed surfaces, other than pavements and sidewalks, may slope with respect to the specified plane at a rate not to exceed the following amounts:
      - In 10 feet: 1/4 inch
      - In 20 feet: 3/8 inch

00540.41 Design of Falsework for Vertical Pressures:

(a) Submittal of Working Drawings and Calculations - Submit stamped falsework plans and design calculations according to 00150.35, except as modified below.
Ensure the falsework designer prepares a Falsework Design Summary and completes a Falsework Design Checklist to accompany the plans and calculations. Include in the summary a list of each falsework member with its:

- Assumed dead and live loads
- Allowable and design stresses
- Allowable and calculated deflections
- Design references and derivations for design formulas
- Documentation for computer generated calculations

The Falsework Design Checklist is included in the Special Provisions.

Submit 5 sets (9 sets if railroad approval is required) of the plans and 3 copies (5 copies if railroad approval is required) of the calculations, summary, and checklist.

Design falsework according to the current edition of "AASHTO Guide Design Specifications for Bridge Temporary Works" except where in conflict with these Specifications.

(b) **General Design Loads** - Design and construct falsework to support the total applied loads and provide enough redundancy in the design to prevent a failure of the entire system.

Ensure design loads used are the maximum loadings. Ensure deflections used on manufactured devices and assemblies do not exceed the manufacturer’s recommendations. Furnish catalog data that lists the manufacturer's recommendations.

(c) **Falsework Foundation:**

(1) **On Soils** - Consider anticipated construction and soil conditions in determining the soil's support capacity, including draining water away from the supports. For falsework supported on soils, show the following in the calculations:

- Assumptions and methods used to determine the soil's capacity to support the footing loads.
- Anticipated falsework footing settlement based on the allowable soil bearing values.

(2) **On Piles** - For falsework supported on piles, show on the working drawings the pile type, size and spacing. Accompany these drawings with calculations which show the assumptions and methods used to design the piles and the bearing values to which the piles need to be driven to support the calculated loads.

(d) **Requirements at Highway and Railroad Traffic Openings** - For falsework adjacent to or spanning a highway or railroad traffic opening, do the following:
Design the posts using a minimum elastic section modulus, about each axis, of:
- 12.2 cubic inches for structural steel
- 244 cubic inches for timber

Increase the vertical post load 150%. If the load on the falsework will be increased by load transfer due to prestressing, increase the vertical post load by the additional load due to prestressing or by 150%, whichever is greater.

Provide mechanical connections for posts to supporting footing with capacity to resist a minimum lateral force of 2,000 pounds applied in any direction at the base of the post.

Provide mechanical connections between top of posts and the cap or stringer capable of resisting a lateral force of 1,000 pounds from any direction.

Tie down all beams or stringers spanning traffic so that each will resist a 500 pound force from any direction.

Use 5/8 inch diameter or larger bolts at connections for timber bracing.

Show temporary erection/removal bracing on the falsework plans.

(e) Additional Requirements at Railroad Traffic Openings - For falsework bents within 20 feet of the track centerline:

- Design bracing so that the bent will resist the required horizontal load or 500 pounds, whichever is greater.
- Provide solid sheathing of 5/8 inch thick plywood between 3 feet and 16 feet above the top of the rail, properly blocked at the edges.
- On falsework plans, show:
  - Collision posts if they are required
  - Soffit and deck overhang forming details

00540.42 Falsework Construction - Construct falsework according to the current edition of "AASHTO Construction Handbook for Bridge Temporary Works", except where in conflict with these Specifications. Assure that falsework is constructed according to the falsework design and on soils equal to or exceeding design assumptions. Within 2 days of notice of the falsework design engineer's pending inspection, the Engineer will provide a list of construction concerns. Do not place concrete until the falsework design engineer of record, accompanied by the Engineer, field inspects that portion of the falsework proposed for use. Do not place concrete until all construction concerns have been addressed, the falsework design engineer furnishes the Engineer a written statement that the falsework conforms to the design and will serve the intended use, and the Engineer agrees in writing that the falsework will serve the intended use.

Set falsework to give the finished structure the camber shown or specified.
Install telltales on falsework at locations as directed and use jacks, hardwood wedges or other methods approved, to take up settlement in the formwork.

When used, provide sand jacks consisting of a metal piston and metal frame filled with compacted, clean, dry sand. Ensure the annular space between the top bearing plate or piston and the frame does not exceed 1/4 inch.

Use temporary concrete barriers according to 00225.12(c) to protect falsework from damage from adjacent traffic. Make provisions to prevent damage by debris in streams.

Upon completion of the structure, remove all falsework to at least 24 inches below ground line or streambed.

Limit the height of timber blocking and wedging to 24 inches, or to less than 1 1/2 times the least horizontal dimension of the blocking or wedges, whichever is smaller. Limit post, shim pack and wedging assemblies supporting beams to 6 faying (interface or contact) surfaces. Ensure adjacent beam support assemblies do not have a difference of more than 2 faying surfaces. Ensure timber blocks loaded perpendicular to the grain are free of splits.

For post-tensioned structures, do not remove falsework until post-tensioning is complete.

00540.43 Joints - Construct joints in concrete bridges according to details shown or directed.

(a) Construction Joints - Make construction joints between concrete placements only where shown or specified unless otherwise approved.

Do not form construction joints in concrete exposed to salt water between levels of extreme low and high water. Where concrete may be exposed to the action of alkaline water or soil, place concrete continuous until completion of the section, or until the concrete is at least 18 inches above the ground or high water level.

Unless otherwise shown, provide construction joints with a roughened surface. Do not smooth or trowel aggregate into the cement paste. Provide a minimum deviation from a plane surface or 1/4 inch and a maximum deviation from a plane surface equal to the maximum size of aggregate in the specified class of concrete.

Within 24 hours after placing concrete, clean the joint surface by removing loosened particles of aggregate, damaged concrete, unconsolidated concrete and surface laitance with a high pressure washer conforming to 00540.28 to the extent that clean aggregate (free of cement film) on 50% of the surface is exposed. Clean the joint surface again immediately prior to the concrete placement to remove any subsequent deposits of dirt, debris or other foreign materials. Saturate the joint surface with potable water immediately before resuming concrete placement. Remove standing water in depressions or hollows of the joint surface.
(b) **Open Joints** - Locate open joints as shown. Construct the form so the form support system may be released as soon as the concrete takes its initial set. Do not chip or break the corners of the concrete when removing forms. Do not extend reinforcing bars across an open joint unless shown.

(c) **Joints with Fillers** - Construct joints with preformed expansion joint fillers or poured fillers as shown and according to the manufacturer's recommendations for the filler used.

(d) **Bridge Deck Expansion Joints** - Construct expansion joints for bridge decks as shown and according to Section 00585.

00540.44 **Foundations** - Place concrete foundations for structures on suitable soil or rock bearing surfaces, concrete seals or piles as shown. Excavate and backfill according to Section 00510.

00540.45 **Construction of Forms** - Construct forms that:

- Are mortar-tight and sufficiently rigid to conform to and maintain the specified dimensions and tolerances.
- Provide a 3/4 inch chamfer on all exposed concrete edges unless otherwise noted.
- Provide a smooth concrete surface unless otherwise specified.
- Are constructed so portions may be removed without disturbing forms that are to remain.
- Are treated with a release agent that is not detrimental to the concrete.
- Are cleaned of dirt, sawdust, excess water and other foreign material before placing concrete in the forms.
- Are saturated with water immediately before placing concrete and kept damp during placement.
- Are retightened before depositing new concrete on or against concrete which has hardened.

On structures 25 aerial miles from the Pacific Ocean, construct metal ties or anchorages within the forms so they can be removed to a depth of 2 inches from accessible surfaces. On all other structures, construct metal ties or anchorages within the forms so they can be removed to a depth of at least 1 inch from accessible surfaces.

Install embedded conduit 2 inches clear of the nearest face of concrete.

Secure in place expanded polystyrene forms and spacers between adjacent concrete placements to prevent floating or displacement during concrete placement. Carefully cut joints in expanded polystyrene and fill with a suitable filler or mastic to prevent intrusion of concrete mortar. After the concrete has hardened, completely remove expanded polystyrene unless otherwise stated.

Permanent stay-in-place bridge deck forms are not allowed unless shown otherwise.
(a) **Footings** - When footings are not founded in firm rock, concrete may be placed without forms if the excavation does not exceed the tolerances of 00540.40(a)(3)(b).

Do not form portions of footings founded in firm rock. Place concrete against undisturbed rock, filling the overbreak to the top of rock or top of footing.

(b) **Accessible Box Girder Cells** - Falsework and deck forms for accessible box girder cells may be supported by girder stems or bottom slab provided the bottom slab is fully supported and designed to take additional loading from deck forms and falsework, deck concrete, and concrete placement forces.

(c) **Inaccessible Box Girder Cells** - Falsework and deck forms for inaccessible box girder cells may be left in place provided:

- Falsework and deck forms left in place are not supported off the bottom slab. Falsework and deck forms supported by girder stems are allowed.
- 1/2 inch preformed expansion joint filler are placed between the end of deck forms and transverse beams and at 25 foot spacing in the deck forms.
- Box girder cells are cleared of materials and forms except as necessary to support the deck slab before the deck forming is complete.

(d) **Form Maintenance** - Set forms and maintain them true to designated line and grade until the concrete hardens. When forms appear to be unsatisfactory, either before or during the placing of concrete, the Engineer may order the work stopped until the defects have been corrected. Leave forms in place for periods specified in 00540.52.

00540.47 **Delivering Concrete** - Schedule delivery of concrete to ensure continuous delivery during placement. For all placements except seal and deck placements, ensure the interval between the end of one load and the start of the next load does not exceed 20 minutes. See 00540.48 for seal and deck placements.

If the requirements of the previous paragraph are not met, the Engineer will determine whether the concrete has taken its initial set and may order a bulkhead installed or removal of concrete in the affected placement.

00540.48 **Handling and Placing Concrete:**

(a) **General** - Do not place concrete under water or in flowing water unless specifically authorized. Place concrete:

- In the sequence shown or as approved.
- In its final position in the forms within 1 1/2 hours after the addition of the cement to the aggregate. A retarder may be used or required. Use a retarder from the CPL and furnish at no additional cost to the City.
As close as possible to its final position and consolidated to:
- Avoid segregation of the materials and displacement of the reinforcement
- Produce a dense, homogeneous concrete, free of voids and rock pockets
- Through pumps, chutes or trunks conforming to 00540.22, when placement requires dropping concrete more than 5 feet. Place the bottom of pump hose, chutes, pipes or trunks as close to final placement position as practical.
- In layers not more than 18 inches thick, except for seal concrete placement, and unless shown otherwise. Place and consolidate each layer before the preceding layer has taken initial set to avoid surfaces of separation between the layers.

Do not place concrete prior to complete approval of:
- The excavation and the bearing material in a foundation
- Installed piling
- The falsework and forms
- Placed reinforcing steel

After initial set of the concrete, do not disturb the forms or place loads on the ends of reinforcing bars projecting from the concrete placement until allowed by 00540.52.

(b) Pumping Concrete - Pump concrete with pumping equipment conforming to 00540.22. Pump a cement-water slurry through the lines before starting the mix through the pump. Operate the pump in a manner that produces a continuous stream of concrete without air pockets or segregation. When a placement nears completion, if concrete remaining in the pipeline is to be used, remove it in a manner that will not cause contamination of the concrete already in place.

There will be no extra payment for additional cement or additives required to ensure a mix is pumpable.

(c) Vibrating Concrete - Except for seal concrete, thoroughly consolidate fresh concrete according to the following:
- Vibrate concrete internally using mechanical vibrating equipment.
- Provide an extra vibrator for emergency use.
- Re-vibration of concrete may be required as directed.

Apply vibration at the point of freshly deposited concrete. Apply vertically at points uniformly spaced not farther apart than 1 1/2 the radius over which the vibration is visibly effective. Penetrate into previously placed plastic layers.
Do not use vibrators to make concrete flow or to move concrete from one point to another in the forms. Do not apply directly on or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration.

Supplement vibration by spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners or other locations impossible to reach with vibrators.

Continue vibration until the concrete is thoroughly consolidated. Discontinue vibration if segregation occurs or localized areas of grout form.

(d) Concrete Exposed to Salt Water, Alkaline Water, or Soil - For concrete exposed to salt water, see 00540.43(a) for location of construction joints, and 00540.53 for surface finish requirements.

Do not allow alkaline water or soil to contact the concrete during placement or for a period of at least 72 hours after placement. See 00540.43(a) for location of construction joints.

(e) Seal Concrete - Deposit seal concrete in still water near its final position, by means of a tremie seal pipe meeting the requirements of 00540.22(d) or a concrete pump with a rigidly held discharge line to prevent unwanted vertical movement. Place seal concrete continuously from start to finish, at a rate of at least 50 cubic yards per hour, keeping the surface of the concrete nearly horizontal at all times. Place each increase in height before the preceding concrete has taken its initial set.

Do not use vibrators.

At the start of the work and on any withdrawal of the pipe, close the discharge end to prevent water entering the pipe. During the progress of the work, keep the pipe full of concrete to the bottom of the hopper. When concrete is dumped into the hopper, start the flow of concrete by slightly raising the discharge end, always keeping it in the deposited concrete. Control the elevation of water inside the cofferdam to prevent any flow through the seal.

Dewatering may proceed when the concrete seal has achieved a compressive strength of 2,200 psi. Remove high spots, laitance and other unsatisfactory material from the exposed surface.

(f) Walls, Abutments, Bents, Piers, Columns, Beams, Girders, and Slabs - Place concrete following the sequences shown and the delay period specified in 00540.52.

Delay placement for the superstructure until the column forms have been stripped sufficiently to determine the character of the column concrete. Ensure superstructure loads are not carried by the bents or piers until the concrete has been in place and has attained the strength specified in 00540.52.
Stop placement for the bottom slab of box girder structures at the bottom of beam stems or bottom of stem fillets. Before placing concrete in the stems, wait for a period not less than that specified in 00540.52.

Stop placement for T-beams and box girder stems at the bottom of the deck fillet. Before placing deck concrete, wait for a period not less than that specified in 00540.52.

(g) Bridge Decks - Use deck finishing machines conforming to 00540.24 and set to run parallel to the skew of the bent lines. Place screed rails outside the finishing area. Extend screed rails beyond both ends of the scheduled placement length for a distance that allows the finishing machine to reach all of the concrete.

For bridges with continuous spans, ensure reinforcing steel is in place and tied in any adjacent span in the continuous bridge segment before placing concrete.

Before placing concrete, operate the finishing machine the length of the proposed placement, and check the deck thickness and clearance from the screed to the reinforcing steel in the presence of the Engineer, by an approved method. The permissible variation from the clearance indicated will be plus or minus 1/4 inch. Make necessary corrections before beginning the placement.

Furnish transverse work bridges according to 00540.29. Extend the screed rails beyond the start end to allow placement of all transverse work bridges on the screed rails before placement of concrete begins.

Do not place bridge deck concrete until the Engineer is satisfied that the Contractor:

- Meets the requirements of 00540.41, 00540.45 through 00540.49, and 00540.52.
- Has the finishing machine and transverse work bridges placed and ready on the screed rails.
- Is able to deliver concrete for decks so deck placement progresses at a rate of not less than 20 feet per hour.
- Proceeds up grade from the lowest deck elevation, unless otherwise shown.
- Is able to produce and place concrete at a rate sufficient to complete proposed placement and finishing operations within the specified time.
- Illuminates the work area during hours of darkness.
- Has experienced concrete finishers and necessary finishing tools and equipment at the work site.
- Provides wind breaks, fog spray, or other approved methods when the concrete surface is exposed to conditions which may cause premature drying during placement operations.
If delays occur lasting longer than 30 minutes, the Engineer may order construction of a bulkhead. If a bulkhead is constructed, do not begin further placement in that span or the adjacent falsework span, if any, for at least 24 hours. Construct bulkheads only where shown or when directed by the Engineer.

**00540.49 Weather Conditions for Concreting:**

(a) **All Concrete Placement:**

(1) **Hot Weather** - Maintain the concrete temperature during hot weather as specified. When concrete temperatures approach 80 °F, take appropriate action to lower concrete temperature.

Do not place concrete on or in forms if surface temperature of forms or reinforcing steel is 90 °F or above.

(2) **Cold Weather:**

a. **General** - Do not place concrete if the air temperature is, or is forecast to be, below 40 °F the day of placement or is forecast to be below 40 °F on any of the next 7 calendar days after placement, unless a specified enclosure and heat are used or insulated forms are approved and used.

Keep the foundation, form surfaces and reinforcing steel free of frost and ice.

Ensure the temperature of the concrete is not less than 60 °F when placed in the forms. If air temperature is below 40 °F, heat mixing water to a temperature of at least 70 °F, but not more than 150 °F, or heat the aggregates with either steam or dry heat. Ensure the temperature of concrete produced with heated aggregate, heated water, or both does not exceed 80 °F before placing.

b. **Enclosures** - If enclosures are used, do the following:

- Furnish and use a 24-hour high-low or continuous temperature recording thermometer to record air temperature within the enclosure.
- Supply heat and curing moisture.
- Maintain the air temperature in the enclosure between 60 °F and 80 °F for a period of 7 days after placing concrete.
c. Insulated Forms - When approved by the Engineer, insulated forms, capable of maintaining the surface of the concrete at not less than 50 °F for a period of 7 days, may be used instead of enclosures and heating. If forms are insulated, protect exposed horizontal surfaces with a similar layer of insulating material securely fastened in place. If the insulated forms do not maintain the proper temperature at the concrete surface, use auxiliary protection, and provide additional heat and thermometer, as described in (b) above.

(b) Bridge Deck Placement - Place concrete for bridge decks:

- Only if not raining and the combination of air temperature, relative humidity, concrete temperature and wind velocity produces an evaporation rate of less than 0.10 pounds per square foot of surface area per hour, according to Figure 00540-1, or
- Within an enclosure, according to 00540.49(a)(2)(b).
FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE

To estimate evaporation rate:
1. Enter the chart at the appropriate air temperature. Move vertically to the relative humidity.
2. Move right to the concrete temperature.
3. Move down to the wind velocity.
4. Move horizontally to read the approximate evaporation rate.
5. The dashed line is an example. (75 °F air temperature, 50% relative humidity, 80 °F concrete temperature, 10 mph wind velocity = approximately 0.15 lb sq ft hr rate of evaporation.)

1 Based on ACI 305 R, “Hot Weathering Concreting”
00540.50  Bridge Deck Roadway and Sidewalk Finish:

(a) General - After the bridge deck roadway and sidewalk concrete is placed and consolidated, strike it off to lines, grades and cross sections shown.

(b) Deck Roadway Finish - After the deck roadway concrete has been screeded with a finishing machine conforming to 00540.24, float, if necessary, to produce a uniform surface, according to 00540.55. If the work does not conform to the prescribed limits, stop the operation until revised methods, changes in equipment, or correction of procedures are approved for trial. Also stop the revised operation if it does not produce a specified surface.

(c) Deck Roadway Texturing - After correcting any non-specification surface tolerance according to 00540.55, texture the deck roadway surface with a saw that cuts grooves into the bridge deck as follows:

- Cut grooves 1/8 inch wide and 1/8 inch to 3/16 inches deep.
- Unequally space grooves from 3/4 inch to 1 1/2 inches apart with a minimum of 12 grooves for every foot of deck surface. Measure groove spacing parallel to the roadway centerline.
- Orient the grooves perpendicular to the roadway centerline and full width of the roadway except leave smooth strips 16 inches wide along each curb face. Do not overlap grooves.
- Continuously remove saw slurry and laitance from the sawing operation while cutting grooves.
- Cut grooves after the bridge deck has been checked for non-specification surface tolerances as required by 00540.55 and after the water cure is complete.
- Cut grooves no sooner than 14 days after the deck is cast. Cut grooves before opening the roadway to traffic. For structures constructed in stages, the roadway may be opened to traffic before cutting grooves provided the time period from opening to actual construction of grooves is between June 1 and October 1.

(d) Deck Sidewalk Finish - After the deck sidewalk surface has been struck off with a strike board, float it with a wooden or cork float. Use an edging tool on edges and at expansion joints. Remove edging tool marks prior to final finishing. Apply a light broom texture to the surface.

00540.51  Curing Concrete:

(a) General Requirements - Cure cast-in-place concrete with water. Begin curing as soon after placement as possible without damaging the freshly placed concrete. Continue curing for 7 days after placement.

Keep surfaces not covered by waterproof forms damp by applying water with a fog nozzle until the surface has set sufficiently to allow sprinkling with water or covering with wet burlap or an approved wet or dry material.

Do not interrupt curing for more than one hour during the curing period.
If temperature falls below 35 °F during the 7 day cure period, the Engineer may require enclosures or insulated forms according to 00540.49(a)(2).

(b) Curing Concrete Bridge Decks - In addition to requirements of 00540.49, cure cast-in-place concrete bridge deck surfaces by doing the following:

- Provide wind breaks or other approved methods when exposed to conditions which may cause premature drying during placement operations. Premature drying is defined as an evaporation rate equal to or greater than 0.20 pounds per square foot per hour, as determined from Figure 00540-1, or as the loss of surface sheen when the evaporation rate at the surface exceeds the bleed rate.

- Provide high pressure washers, according to 00540.28, fitted with fog nozzles during all deck placements to prevent and control premature drying. Apply fog spray upwind of the concrete placement during finishing. The purpose of fogging is to maintain a layer of high humidity above the concrete surface in order to minimize water loss in the mix after placement and before application of cure. Do not allow larger water droplets that drip from nozzles to fall onto the freshly finished plastic concrete.

- Cover the concrete with a single layer of clean initial covering immediately after finishing. Apply initial covering no later than 20 minutes after final pass of the finishing machine and no greater than 20 feet from the back of the finishing machine. Provide an initial covering with a minimum length sufficient to cover the bridge deck from side to side of the concrete placement. Use one of the following:
  - Saturated wet burlap having a minimum dry weight of 10 ounces per yard for material 40 inches wide. Presoak the burlap by immersing it completely in water for 72 hours prior to the deck placement and presoak new burlap with a wetting agent. Overlap the edges at least 6 inches.
  - Non-woven, needle punched polypropylene fabric curing blanket from the CPL. Thoroughly wet fabric within 15 minutes of fabric placement. Overlap the edges at least 12 inches.

- Provide soaker hoses for additional soaking of the initial covering. Place over the full width of the concrete placement, at a maximum of 10 foot intervals. Do not allow initial wetting of burlap or fabric to dry before soaker hoses are in place and operational. Operate soaker hoses continuously to keep the initial covering saturated.

- Place a layer of 4 mil polyethylene film over the initial covering and soaker hoses. Provide clear or white polyethylene film if the air temperature is forecasted to be above 65 °F within 24 hours of the concrete placement, and black at other times, as determined by the Engineer. Overlap the edges of polyethylene film by 12 inches. Keep the film in place by taping and weighting the edges where they overlap or are vulnerable to movement by wind. Once a particular type of film has been placed, do not change it during the curing period.

- Maintain a continuous water cure of the concrete surface for 14 days.
(c) **Additional Cure Time** - If, during the cure time, the surrounding temperature falls below 45 °F, extend the cure for the number of hours the temperature is below 45 °F.

**00540.52 Removal of Forms and Falsework, and Subsequent Loading** - Do not remove forms and falsework or place subsequent loads without approval.

In determining when to remove forms and falsework, and when to place subsequent loads, the Engineer will consider the Contractor's proposed schedule, the location and character of the structure, the weather, and other conditions influencing the setting of the concrete. If appropriate, these operations will be controlled by compressive strength tests of cylinders cast by the Contractor and witnessed by the Engineer. Test the cylinders at a recognized testing laboratory at no additional cost to the City. Cure cylinders under conditions which are equivalent to the most unfavorable field conditions for the portions of the concrete which the cylinders represent.

Forms and falsework may be removed and subsequent loads may be placed when both conditions of Table 00540-1 are met.

<table>
<thead>
<tr>
<th>Table 00540-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part 1:</strong></td>
</tr>
<tr>
<td>Form and Falsework Removal for:</td>
</tr>
<tr>
<td>Side form for footings, walls, abutments, caps, traffic and pedestrian barriers, and any other side forms not supporting the concrete weight</td>
</tr>
<tr>
<td>Columns</td>
</tr>
<tr>
<td>Cantilevered bridge deck sidewalks</td>
</tr>
<tr>
<td>Bridge decks supported on steel beams or precast, prestressed concrete members; top slabs of concrete box culverts</td>
</tr>
<tr>
<td>Crossbeams, caps, box girders, T-beam girders, and flat slab superstructures</td>
</tr>
<tr>
<td>Arches</td>
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<tr>
<td><strong>Part 2:</strong></td>
</tr>
<tr>
<td>Subsequent Loading 3 of:</td>
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<table>
<thead>
<tr>
<th>Item</th>
<th>Days</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings for signal, luminaire and sign supports</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>Footings&lt;sup&gt;4&lt;/sup&gt;</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>Walls, wall-type abutments, columns, vertical girder stems, and box culvert stems over 4 feet in height&lt;sup&gt;4&lt;/sup&gt;</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>Bottom slabs of box girders</td>
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<td>5</td>
</tr>
<tr>
<td>Members and falsework designed integrally to carry the additional loads</td>
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<td>7</td>
</tr>
<tr>
<td>Pile caps, bents, and other members designed as moment-carrying members</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>All other members</td>
<td>100</td>
<td>7</td>
</tr>
</tbody>
</table>

1. From the time of the last placement in the forms or falsework supports and excluding days when the surrounding temperature is below 40 °F for a total of 4 hours or more.
2. Where continuous spans are involved, the time for all spans will be determined by the last concrete placed affecting any span.
3. Except loads from forms and reinforcing steel of further concrete placements.
4. Mass type or other type members where subsequent loading will not induce flexural bending and flexural stresses.

Early removal of forms does not eliminate the curing requirement of 00540.51.

Remove forms and falsework:

- With methods not likely to deface, damage, or cause overstressing of the concrete.
- In a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.
- From the interior of structural steel box girders.
- From accessible concrete box girder cells before any loading, post-tensioning or removal of the supporting falsework.
- From all decks after subsequent loading is authorized, except those necessary to support the deck slab in inaccessible cells.

Dispose of forms and falsework according to 00290.20(c).
00540.53 **Surface Finish Other Than Bridge Decks** - Provide concrete surfaces with a general surface finish unless otherwise shown or specified. See 00540.50 for bridge deck and sidewalk surface finishing. Leave concrete surfaces unfinished as they come from the forms when exposed to salt water between the levels of extreme low and high water, except for needed repairs.

If a Class 1 or Class 2 surface finish is required, it will not include the interior sides of girders and the underside of decks between girders. Finish Class 1 and Class 2 surfaces to a point 1 foot below finished ground line.

(a) **General Surface Finish** - Give all concrete surfaces a general surface finish prior to the higher class finish specified for a particular item of work. A general surface finish consists of the following:

(1) **On All Surfaces:**

- Remove form bolts and metal to a depth of 1 inch, 2 inches on structures within 25 aerial miles of the Pacific Ocean.
- Remove rock pockets and unsound concrete.
- Fill holes and depressions at least 1/2 inch in depth or diameter with an approved patching material.

(2) **On All Exposed Surfaces:**

- Correct bulges, fins, depressions, stains, discolorations and other imperfections.
- Slope formed surfaces with respect to the specified plane at a rate not to exceed the following amounts in 10 feet, if required:
  - Watertight joints: 1/8 inch
  - Other exposed surfaces: 1 1/2 inch
  - Concealed surfaces: 1 inch
- Slope unformed, exposed surfaces, other than pavements and sidewalks, with respect to the specified plane at a rate not to exceed the following, if required:
  - In 10 feet: 1/4 inch
  - In 20 feet: 3/8 inch

The Engineer will determine the extent of the required repairs.

(b) **Class 1 Surface Finish (Ground and Coated)** - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Apply coating according to (d) below.
(c) **Class 2 Surface Finish (Ground, Floated and Coated or Uncoated)** - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Float the surface with a rubber or sponge float, using a paste of fine mortar sand, cement, water, and bonding agent to fill air holes or voids and to bring the surface to a uniform texture. Keep the retextured surface damp a minimum of 12 hours or until the paste has set, whichever is longer. If dusting occurs after the retextured surface sets and is rubbed, refinish the surface.

After the paste has set for a minimum of 24 hours, apply coating according to (d) below.

(d) **Concrete Coating** - Apply either a concrete paint or a concrete stain or sealer as shown or specified. Where a Class 1 or Class 2 surface finish is shown, apply a concrete paint unless specified or shown otherwise.

1. **Concrete Paint** - Thoroughly saturate the surface with water and coat it, while damp, with a coating material conforming to 02210.30(c). Apply a minimum of 2 coats of coating material. Apply coating according to the manufacturer’s instructions. The second coat may be applied any time after the previous coat, when touched lightly, does not adhere to the finger. Additional coats may be required to provide uniformity in coverage and color. Mortar sand may be added to the coating material to help achieve a uniform surface.

2. **Penetrating Concrete Stain or Sealer** - Select a penetrating concrete stain or sealer from the CPL. Apply stain or sealer to a dry concrete surface and according to the manufacturer’s instructions. Ensure the concrete has cured sufficiently. Apply a minimum of 2 coats of stain or sealer. Additional coats may be required to provide uniformity in coverage and color.

00540.54 **Crack Inspection and Deck Sealing** - Immediately after the cure period, the Engineer will inspect the deck surface for cracks.

After correcting non-specification surface tolerance according to 00540.55 and after texturing the deck surface according to 00540.50(c), seal all visible cracks with a methacrylate sealer or epoxy sealer as directed by the Engineer. In areas where the cracks are numerous, the entire area may be flooded with a methacrylate or an epoxy sealer. Cover the sealer with a dry, washed sand, prior to the sealer setting. Use only CPL listed methacrylate or epoxy products approved for deck sealing applications.

Perform deck sealing work at no additional cost to the City. Complete all deck sealing work before opening to traffic, unless otherwise directed by the Engineer. If the bridge is opened to traffic at the Contractor’s request prior to completion of deck sealing, perform all additional traffic control to complete deck sealing at no additional cost to the City.
00540.55 Final Acceptance of Bridge Deck Surface - Ensure the finished bridge deck roadway surface meets the tolerance specified in 00540.40(b)(3)(d) at every point. Furnish a 12 foot straightedge and use it under the Engineer's direction.

Correct non-specification surface tolerances by complete removal and replacement or with a diamond grinder. If the surface is ground, take care not to unnecessarily sacrifice concrete cover over the reinforcing bars. Restore transverse texture to specification tolerance. Perform correction work, including required traffic control, at no additional cost to the City.

Measurement

00540.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Concrete - Concrete will be measured by one of the following methods:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of concrete will be listed in the Special Provisions.

Concrete quantities listed for cast-in-place deck is based on the nominal deck thickness shown.

Concrete quantities for prestressed, precast members, piling, bridge rail, slope paving, tremie seals and other similar items will not be included in the listed quantities.

(2) Volume - Under this method, concrete will be measured on the volume basis within the neat lines of the structure as shown.

No deductions will be made for the volume of pile heads, metal reinforcement, scoring, chamfer strips or structural steel embedded in the concrete.

(b) Sawcut Texturing - The quantities of surface texturing will be measured on the area basis. The area will be determined by surface measurement of the width of bridge deck or end panel from curb face to curb face minus 16 inches on each side, and the full length of the bridge deck or end panel. The area will be calculated to the nearest square yard, for each bridge.

Payment

00540.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Foundation Concrete, Class ______</td>
<td>Lump Sum or Cubic Yard</td>
</tr>
<tr>
<td>(b) Deck Concrete, Class ______</td>
<td>Lump Sum or Cubic Yard</td>
</tr>
<tr>
<td>(c) General Structural Concrete, Class ______</td>
<td>Lump Sum or Cubic Yard</td>
</tr>
<tr>
<td>(d) Sawcut Texturing</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

In items (a), (b), and (c), the class of concrete will be inserted in the blank.

Item (a) includes footings, pile caps, and all other elements so designated.

Item (b) includes bridge decks and all other elements so designated.

Item (c) includes columns, crossbeams, diaphragms, wingwalls, backwalls, abutments, and all elements that are not designated as either (a) or (b) above.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Reinforcing steel, metal expansion joints, or other metal incorporated in the work will be paid for according to the appropriate Section in which the work is performed.

No separate or additional payment will be made for:

- surface finish, fogging, curing, joint filler, admixtures and other similar items, and for all other items required to complete the concrete work
- portland cement and fly ash used in excess of the minimum specified
- extra concrete required to fill footings cast directly against rock or soil or where forms are omitted
- additional concrete placed in deck buildups on top of beams to achieve the desired deck elevations
Section 00545 - Reinforced Concrete Bridge End Panels

Description

00545.00 Scope - This work consists of constructing reinforced portland cement concrete bridge end panels at the locations shown or as directed, and in close conformity to the lines, grades and dimensions shown or established.

Materials

00545.10 Materials - Furnish materials meeting the requirements of Section 00530 and Section 02001, modified as follows:

- Furnish Class HPC4000 concrete for end panels, unless shown otherwise.
- When pipe under end panels are shown, provide one of following types:
  - Class V reinforced concrete pipe meeting the requirements of 02410.20
  - Schedule 80 polyvinyl chloride (PVC) pipe meeting the requirements of ASTM D 1785
  - Type PSM polyvinyl chloride (PVC) sewer pipe meeting the requirements of ASTM D 3034 SDR 26
  - Grade A or B galvanized steel pipe, STD weight class minimum, meeting the requirements of ASTM A 53, hot-dip galvanized according to AASHTO M 111 (ASTM A 123)
  - For pipe under end panels, provide pipe bedding, pipe zone material, and backfill meeting the requirements of 00405.12, 00405.13, and 00405.14.
  - Provide granular structure backfill meeting the requirements of 00510.13.

00545.15 Quality Control - Provide quality control according to Section 00165.

Labor

00545.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CDT
- CSTT
Construction

00545.40  General - Perform work according to Section 00530 and Section 00540 except as modified by this Section.

00545.41  Earthwork - Remove pavement and subgrade according to Section 00310 and Section 00330.

00545.42  Surface Finish - For end panels with an asphalt concrete wearing surface, a finishing machine and roadway texturing are not required. For end panels without an asphalt concrete wearing surface, texture the end panel roadway surface by sawcutting according to 00540.50(c). Perform sawcutting on end panels no sooner than 14 days after the end panels are cast.

00545.43  Curing - Cure concrete according to 00540.51(a).

00545.44  Expansion Joints - Construct expansion joints as shown, according to Section 00585, and as follows:

- Install armored corners for strip seal joints in preformed blockouts a minimum of 14 days after the bridge deck and end panels are cast. Set the joint opening as shown. Support the armored corners securely in position before placing concrete in the joint blockout.
- Place compression joint seals or poured sealant joint seals a minimum of 14 days after the bridge deck and end panels are cast.
- Place asphaltic plug joints a minimum of 14 days after the end panels are cast and after final paving is complete.

Sawcut the AC wearing course at the roadway end of end panels when detailed on the plans, as soon as practical but within 48 hours after paving. Use a sawcut width of 5/8 inch, plus or minus 1/8 inch, and 1/4 inch less than the thickness of the wearing course, to a maximum depth of 1 1/2 inch. Flush the sawcut thoroughly with a high-pressure water stream immediately after the cut has been made. Before the cut dries out, blow it free of water and debris with compressed air. Fill the joint with a traffic loop sealant from the CPL.

00545.45  Pipes under End Panels - Install pipes under end panels for future utilities as shown and according to Section 00445.

00545.46  AC Paving - Compact AC abutting end panels according to 00745.62(b).

00545.47  Bridge Rails - Construct bridge rails on end panels as shown and according to Section 00587.
00545.80 Measurement

**00545.80 Measurement** - The quantities of reinforced concrete bridge end panels will be measured on the area basis. The area will be determined by surface measurement of the width and length of each separately constructed end panel. The area will be calculated to the nearest square yard, for each bridge.

Surface texturing by sawcutting will be measured according to 00540.80.

Expansion joints at panel ends will be measured according to 00585.80.

Bridge rails on end panels will be measured according to 00587.80.

00545.90 Payment

**00545.90 Payment** - The accepted quantities of reinforced concrete bridge end panels will be paid for at the Contract unit price, per square yard, for the item "Reinforced Concrete Bridge End Panels".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals to complete the work as specified.

Surface texturing by saw cutting will be paid for according to 00540.90.

Expansion joints at panel ends will be paid for according to 00585.90.

Bridge rails on end panels will be paid for according to 00587.90.

No separate or additional payment will be made for:

- sawcutting and filling the joint in the wearing surface at the roadway end
- furnishing and placing pipe under the end panels for future utilities
- extra thickness of panels as shown at the panel ends
- required stage construction, including splices
Section 00550 - Precast Prestressed Concrete Members

Description

00550.00 Scope - This work consists of the manufacture, storage, transportation and installation of precast prestressed concrete girders, box girders, slabs or other concrete members. Precast prestressed concrete members in this Specification will be referred to as members.

00550.02 Design - Essential elements of design and section dimensions for members are as shown. Submit unstamped working drawings, stressing calculations, and detensioning sequence for all members for approval according to 00150.35.

00550.03 Alternate Designs - City design specifications will be furnished by the City upon request. The Contractor may propose another type of prestressing system or different member dimensions provided the following requirements are met:

- Before manufacturing the members, submit stamped design calculations, working drawings, and specifications for all modified members according to 00150.35.
- With the calculations, show that the member meets all applicable service and strength limit states used for the City design.
- Do not increase member dimensions by more than 1 inch, except that bulb width and overall depth may be increased up to 2 inches from the dimensions shown. Where overall depth is increased, verify that the required minimum vertical roadway clearance has been maintained.
- Do not incorporate alternate materials or members into the work until the proposal has been accepted by the Engineer.
- Make any structural changes required to accommodate an approved alternate prestressing system or section at no additional cost to the City.

00550.04 Member Tolerances:

(a) General - Fabricate members to the dimensional tolerances in the PCI "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products" and as specified below. Acceptance or rejection of members outside these tolerances will depend on how the structure's strength, rideability and appearance are affected.

(b) Twist - Provide members with a relative twist of member bearing surfaces between member ends of less than or equal to 1/16 inch per foot of bearing width measured at right angles to the centerline of the member.
Fabricator Certification and Qualification - Certification under the PCI Plant Certification Program is required for all plants producing precast prestressed concrete bridge members. Certification in Bridge Group B3 or Bridge Group B4 is mandatory for the fabrication of prestressed straight strand bridge members. Certification in Bridge Group B4 is mandatory for the fabrication of prestressed draped strand bridge members.

Materials

Materials - Furnish materials meeting the following requirements:

- Backer Rod ............................................................... 02440.14
- Concrete Coating ...................................................... 02210.30
- Concrete ........................................................................ 02001
- Deformed Bar Reinforcement ..................................... 02510.10
- Epoxy and Non-Epoxy Grouts ....................................... 02080
- Epoxy Coating .......................................................... 02510.11
- Keyway Grout ........................................................... 02080.30
- Poured Joint Filler ..................................................... 02440.30
- Prestressing Reinforcement ......................................... 02515
- Tie Rods .................................................................. 02560.30

Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance of aggregate will be based on the Contractor's quality control testing, if verified, according to Section 00165.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the QCT, according to Section 02001.

(c) Hardened Concrete:

(1) General - Acceptance of hardened concrete will be based on analysis of compressive strength test results of cylinders cast and cured by the Contractor and tested according to AASHTO T 22 by a CSTT at an ODOT certified laboratory and verified according to Section 00165.

(2) Sampling and Testing - Obtain a sample from a delivery vehicle, selected at random, during placement in each bed. Test the sample for temperature, slump, density and air content and cast at least 3 cylinders for testing at 28 days. Cure the cylinders in a manner similar to the members they represent. Alternately, the cylinders may be cured in a curing chamber correlated in temperature with the concrete in the beds. Leave the cylinders in the bed with the member or in the curing chamber until the member is stripped. After the member is stripped, place the acceptance cylinders in storage in a moist condition according to AASHTO T 23.
(3) **Acceptance** - Concrete members with an ASTV meeting or exceeding the specified design strength, \(f'c\), will be acceptable for strength. If the compressive strength of a single test specimen varies by more than 10% from the average of the other specimens, that compressive strength value will be discarded. The average compressive strength test of the remaining specimens will be the ASTV.

If the ASTV is less than \(f'c\) but at least 85% of \(f'c\), the Engineer may review the results to determine if the member is suitable for the intended purpose. If suitable, the concrete represented by an ASTV less than \(f'c\) may be accepted subject to a price adjustment according to 00150.25.

Concrete that has an ASTV less than 85% of \(f'c\) will not be accepted. All costs of removal, replacement, and all related work is the Contractor’s responsibility.

**Equipment**

**00550.20 Prestressing Equipment** - Provide hydraulic jacks equipped with calibrated pressure gauges. Calibrate the jack and gauge combination and furnish a graph or table showing the calibration to the Engineer.

If other types of jacks are used, furnish calibrated proving rings or other devices that accurately indicate the jacking forces.

Recalibrate the jack and gauge combination annually or at any time the results are in question.

**00550.25 Vibrators** - Provide either internal or external vibrators in working condition meeting the manufacturer’s rating.

When epoxy coated reinforcement is used, use internal vibrators fitted with a manufactured rubber head to minimize damage to the epoxy coating.

**Construction**

**00550.40 Forming** - Provide forms that are mortar-tight and sufficiently rigid to conform to the specified dimensions without appreciable distortion, warping or opening of joints.

Before placing concrete in the forms, remove all dirt, sawdust, excess water and other foreign material.

Tighten forms before depositing new concrete on or against hardened concrete.

**00550.41 Placing Reinforcement** - Place reinforcement according to the plans, Section 00530, and these Specifications.
00550.42  Pretensioning:

- Do not proceed with stressing prior to receiving the Engineer's approval of stressing calculations submitted according to 00550.02.
- Provide a person, skilled in the use of the system of prestressing to be used, to supervise the work and assist the Engineer.
- Hold the prestressing strands accurately in position and stress by jacks meeting the requirements of 00550.20.
- Determine the force induced in the strands by measurement of elongation and, independently, by direct measurement of force using a pressure gauge dynamometer and load cell. If the difference in force determination for the 2 methods exceeds 5%, determine the cause and correct it.
- Measure strand elongation on the first and last strands stressed, and on at least 10% of the other strands in the bed.
- Record the jacking forces and the elongations produced.
- In single straight strand tensioning, and in a completely open bed with no headers or other possible sources of friction, loads indicated by the gauging system may be used.

00550.43  Placing Concrete:

(a) General - Place concrete so that the finished members are uniform and monolithic, free from cold joints.

Do not deposit concrete in the forms until the Engineer has inspected and approved the placement of reinforcement, conduit, anchorages and prestressing steel.

In preparation for placing concrete, prepare forms according to 00550.40. Remove struts, stays and braces serving temporarily to hold the forms in correct shape and alignment before the placing of concrete when the concrete placing has reached an elevation rendering them unnecessary. Remove these temporary members entirely from the forms and do not bury them in the concrete.

Place concrete close to its final position, without segregation of materials or displacement of the reinforcement.

(b) Consolidation - Consolidate concrete, during and immediately after placing, by mechanical vibration as follows:

- Operate vibrators at frequencies that produce consolidated placements.
- Do not use vibration for shifting concrete to the extent of causing segregation.
Vibrate at points uniformly spaced and not further than twice the radius over which vibration is visibly effective.
Continue vibration until the concrete is thoroughly consolidated, but not until segregation occurs or localized areas of grout form.

**00550.44 Hot or Cold Weather** - Produce and place concrete within the temperature range specified in 02001.20(d). When the air temperature is, or is expected to be, below 40 °F or above 100 °F, observe the following precautions:

- Do not place concrete on forms, reinforcing steel or appurtenances when the temperature of these facilities is below 40 °F. Provide heat to maintain their temperature at 40 °F minimum.
- Do not place concrete when the form temperature is 100 °F or more.

**00550.45 Curing** - Cure members with low-pressure steam or radiant heat inside a suitable enclosure to contain the steam or heat, and minimize moisture and heat loss.

(a) **Curing Temperature** - Measure cure temperature by one of the two following methods:

1. **Measuring Enclosure Temperature**:
   - Equip the enclosure with 24-hour recording thermometers at each end of each casting bed. Record the temperature for each thermometer on a single chart for each 24-hour period.
   - Do not allow the curing temperature within the enclosure to exceed 160 °F. During the initial application of live steam or radiant heat, do not allow the temperature within the enclosure to increase at a rate exceeding 40 °F per hour.

2. **Measuring Concrete Temperature**:
   - Embed a thermocouple 6 inches to 8 inches from the top or bottom of the member on its centerline and near its midpoint.
   - Record the concrete temperature with a calibrated recorder that provides a continuous record of time and temperature throughout the curing cycle.
   - Do not allow the concrete temperature to exceed 190 °F. During the initial application of steam or radiant heat, do not allow the concrete temperature to increase at a rate exceeding 80 °F per hour.
(b) **Curing with Low-Pressure Steam:**

- Make the initial application of steam after initial set of concrete as determined by AASHTO T 197 (ASTM C 403).
- Provide a steam supply line to the enclosure equipped with a motor-operated modulating steam control valve operated by a temperature-sensing element located in the enclosure.
- Provide steam at 100% relative humidity.
- Do not apply steam directly on the concrete, form surfaces or test cylinders.
- Distribute the steam within the enclosure through suitable ports located on each side of the units within the enclosure at not more than 30 foot centers to keep the units being cured completely and uniformly surrounded with steam.

(c) **Curing with Radiant Heat** - Radiant heat may be applied to beds by means of pipes circulating steam, hot oil or hot water, by electric blankets or heating elements adjacent to forms, or by circulating warm air under and around forms. Do not allow pipes, blankets or heating elements to be in contact with concrete, form surfaces, or test cylinders.

**00550.46 Release of Prestress** - Transfer bond stress to the concrete, or release end anchors, only when the concrete has attained the minimum compressive strength shown or specified for such transfer of load. Cut or release the elements according to the sequence shown on the reviewed working drawings so lateral eccentricity of prestress will be a minimum.

Determine the compressive strength of the concrete to establish time for detensioning by testing standard cylinders cast and cured identically with the member. Cast and test cylinders used to determine release time according to AASHTO T 22 and AASHTO T 23.

**00550.47 Surface Finish** - Apply the specified finish to each surface as shown or specified.

Where no finish is shown or specified, provide a Class 1 surface finish to all exposed concrete surfaces, except on the tops of members, unless shown otherwise. For concrete surfaces that are not exposed, provide a general surface finish except on the tops of members. For surfaces receiving a Class 1 surface finish (ground and coated), finish the surfaces when the member is in its final position and finish to a point 1 foot below the finished ground line.

Provide a roadway finish on the tops of members. After the concrete has been struck to grade and cross section, float it to produce a uniform surface. After the concrete has hardened sufficiently, texture it with a 1/8 inch wide steel-tined tool that will mark the finished concrete to a depth of 1/8 inch to 3/16 inch. Space the markings 3/4 inch on centers. Do not overlap the texturing. Produce the texture transverse to the roadway centerline and full member width.
(a) General Surface Finish - Apply a general surface finish as a final finish or preparatory to a higher class finish.

<table>
<thead>
<tr>
<th>Remove strands in members, except members with ends to be embedded in concrete, to a depth of 1 inch from the face of the concrete and point up the resulting holes flush with the end of the member with an epoxy grout from the CPL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove all metal form bolts, snap ties and any other metal to a depth of 1 inch below the finished concrete surface. Repair air pockets over 1/2 inch in depth, all form tie removals, rock pockets and unsound concrete, and fill resulting holes or depressions with concrete or a patching material from the CPL. On exposed surfaces, correct all bulges, fins, depressions, repairs, stains or discolorations to produce a smooth surface with uniform texture, lines, and appearance.</td>
</tr>
</tbody>
</table>

The Engineer will determine the extent of required repairs.

(b) Class 1 Surface Finish (Ground and Coated) - After completion of the general surface finish:

- Grind the surface with a power grinder or other equal method to remove all laitance and surface film.
- Thoroughly saturate the surface with water and coat while damp with a coating material conforming to 02210.30(c).
- Apply a minimum of 2 coats of coating material. The second coat may be applied at any time after the previous coat does not adhere to the finger. Apply additional coats as required to provide uniformity in coverage and color.
- Mortar sand may be added to the coating material to achieve a uniform surface.

00550.48 Exposed Reinforcement - After a member is removed from the casting bed, clean any projecting reinforcement of dirt, oil, grease, rust and corrosives and protect it from damage until concrete is cast around it.

00550.49 Lifting, Storing, Transporting, Erecting, and Bracing - Be responsible for the safety of precast members during all stages of construction. Include lifting and storage details on the working drawings for all precast members. Lifting, storage, transporting, erecting, and bracing details will not be reviewed by the Engineer. Lifting, storage, transporting, erecting and bracing of members is the sole responsibility of the Contractor subject to the following requirements:

(a) Lifting:

- Lift members so as to prevent damage.
- Lift members at the support points specified by the manufacturer.
• Lift members in a manner that does not cause damaging bending or torsional forces.
• Members will be rejected if not handled correctly as specified.

(b) Storing - Store members with support points that are level transversely.

c) Transporting - Transport members from the casting yard not less than 7 calendar days after casting, not less than 7 days after all concrete patching and repairing is complete and after 28-day compressive strengths have been achieved.

• Temporary prestress strands may be added to precast concrete members for the purpose of controlling concrete stresses during transportation. Detension these strands after the members are set in the field and prior to establishing grades for the bottom of deck forms.
• Temporary strands may be either post-tensioned or pretensioned in the fabrication yard. Debond post-tensioned strands completely from end to end. Debond pretensioned strands completely from end to end except for a length at the end of the beam equal to the development length of the strand, but not more than 10 feet. Pretensioned strands may be used for simple span girders only.
• The stress from temporary strands may be transferred to the concrete member only after the stress from the permanent strands has been transferred to the concrete member. This requirement may be waived for pretensioned strands if calculations are submitted, and approved by the Engineer, that show acceptable stress levels in the member.
• For pretensioned temporary strands, form a hole in the girder at mid span or at each end of the debonded length, so the strand can be cut for detensioning. Ensure these holes are free draining and patched after detensioning. The detensioned strands may be left in place.
• Post-tensioned temporary strands may be placed in a conduit or debonded full length with direct contact sheathing. In either case, patch the holes formed by the conduit or sheathing to a depth of 1 1/2 inch, after the removal of the conduit or sheathing to this same depth. The detensioned strands may be left in place.
• Submit stamped calculations that predict the effect of temporary strands on initial and long term girder camber according to 00150.35. Damaged members will be rejected. Replace damaged members, or if allowed by the Engineer, repair damaged members to the Engineer's satisfaction at no additional cost to the City.

(d) Erecting and Bracing - After a member has been erected and until it is secured to the structure, provide temporary bracing as necessary to resist wind or other loads. Provide the Engineer with an erection plan and bracing details at least 2 days prior to erecting girders. Bracing details are not necessary for side-by-side slab and box beam construction.
00550.50  Tie Rods - Furnish tie rods according to the Plans and Section 02560. Install as follows:

- Clean and lubricate tie rods and nuts before installation.
- Lubricate galvanized tie rods and nuts with a lubricant from the CPL containing dye that visibly contrasts with the color of galvanizing or coating.
- Install compressible washer type direct tension indicators under the non-turned nuts and tighten the nuts at the other end of the tie rods as recommended by the manufacturer until the gaps in the indicators are nil or as shown. A nil gap is defined as a gap when the number of spaces between the protrusions of a direct tension indicator in which the 0.005 inch feeler gauge is refused at each tie rod equals or exceeds 2, 3, 3, 4, or 4, when the number of spaces between protrusions in the direct tension indicator are 4, 5, 6, 7, or 8, respectively, and a visible gap exists in at least one space.

00550.51  Keyway Grouting for Slabs, Box Beams, and Integral Deck Members - After forms have been removed from slabs, box beams and integral deck bulb tees, sandblast all keyways to remove residual form oil and any other foreign material. After the members are in place and the tie rods are tensioned (for slabs and box beams) or welded connections are made (integral deck bulb tee girders), clean the keyways of all foreign material and keep moist for 24 hours before grouting. For slabs and box beams, after the tie rods are tensioned, seal the space remaining at the bottom of the keyways with a backer rod as shown before grouting.

Do not pour keyway grout unless the air temperature is above 45 °F and at or below the maximum air temperature recommended by the manufacturer. Water cure grout for the period of time indicated by the manufacturer.

00550.52  Poured Joint Filler for Integral Deck Members with AC Wearing Surface - After grout is poured to the level of the keyway shown for slabs and box beams, remove loose grout, and other foreign material from exposed keyway walls. After keyway grout is fully cured, dry surfaces to be sealed immediately before installing poured joint filler.

Install poured joint filler according to the manufacturer's directions. Cure the filler sufficiently to resist the pressures and temperatures of the paving operation before the wearing surface is placed.

00550.53  Differential Camber Correction for Integral Deck Members with No AC Wearing Surface - Correct differential camber between adjacent slabs, box beams or integral deck bulb tees in a span (measured in place at the site) if the variance between adjacent members or stages is 1/2 inch or more at any place along the top edge corners.
Equalize the camber differences by either patching with an epoxy or nonepoxy grout deck patching material from the CPL, or other approved method, at no additional cost to the City. Before patching, clean the area by sandblasting. Water cure the patch for the period of time indicated by the manufacturer. If patching is used, slope it away from the joint on a 1V:6H slope or flatter.

**Measurement**

00550.80 Measurement - The quantities of work performed under this Section will be measured on the length basis, and will be the sum of the horizontal lengths shown for each type and size of member. Field measurement of each member length will not be made. The quantities will be determined by calculating the theoretical horizontal length shown, added together for a total for each type and size, then rounded to the nearest foot.

**Payment**

00550.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Precast Prestressed Girders</td>
</tr>
<tr>
<td>(b)</td>
<td>Precast Prestressed Slabs</td>
</tr>
<tr>
<td>(c)</td>
<td>Precast Prestressed Box Beams</td>
</tr>
</tbody>
</table>

In item (a), the girder type and depth will be inserted in the blank.

In item (b), the slab depth will be inserted in the blank.

In item (c), the box beam depth will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- reinforcement, prestressing steel, enclosures for post-tensioning steel, anchorages, plates, nuts, and all other material contained within the member
- furnishing, transporting, and placing members
- furnishing and tensioning rods and pretensioning strands
- grouting keyways and installing poured joint filler
- furnishing and installing metal diaphragms for integral deck bulb tees
- furnishing and placing anchor bolts, dowels and diaphragm threaded rods where applicable
- furnishing and installing elastomeric bearing pads
00550.91 Fabrication Inspection Expense - If fabrication of members outside of the State of Oregon creates additional shop and plant inspection expenses for the City, the Contractor's payment for members will be reduced according to 00165.91.
Section 00555 - Post-Tensioning

Description

00555.00 Scope - This work consists of post-tensioning cast-in-place and precast concrete by furnishing, placing and tensioning stressing steel according to details shown and specified. This work also includes furnishing and installing any items necessary for the stressing system used including, but not limited to, anchorage assemblies, ducts and grout for pressure grouting. Concrete that is to be stressed by the post-tensioning method will be referred to as a member.

00555.03 Anchorage Devices - Secure all post-tensioned stressing steel at the ends by means of approved permanent type anchorage devices. Design anchorage devices according to the current AASHTO LRFD Bridge Design Specifications. Identify post-tensioning anchorage systems as either "Normal Anchorage Devices" or "Special Anchorage Devices" as defined in the AASHTO LRFD Bridge Design Specifications. Provide anchorage devices that meet all testing and construction requirements of the AASHTO LRFD Bridge Design Specifications and the AASHTO LRFD Bridge Construction Specifications.

For bearing plates, provide 7 inch minimum edge distance from the top of deck and 2 inch minimum edge distance from expansion joint blockouts and any other concrete edge.

Materials

00555.10 General - Furnish materials meeting the following requirements:

Anchorage Devices ........................................ 02530 and 02540
Couplings0 .......................................................... 2515.60
Tendon Duct ....................................................... 02515.50

00555.11 Stressing Steel - Furnish stressing steel according to one of the following as the Contractor may elect, unless otherwise shown or specified:

Seven-Wire Strand .............................................. 02515.10
High Strength Steel Bars .................................. 02515.30
Seven-wire strand epoxy coated reinforcement....... 02515.40

00555.12 Tendon Grout - For grouting post-tensioning ducts, furnish a commercial, pre-packaged, thixotropic tendon grout meeting the requirements of 02080.50. Label each grout bag with application, mixing and pumping instructions, lot number, date of manufacture and shelf life. A grout expiration date may be used in lieu of the date of manufacture and shelf life. Tendon grout will be rejected if the shelf life or expiration date has been exceeded.

Use water meeting the requirements of Section 02020.

At least 48 hours prior to the trial batch, submit a detailed written mix design showing the exact brand and batch quantities of prepackaged grout and water including dosages proposed.
00555.13  Tendon Grout Trial Batch - Mix a trial batch of grout using the equipment, materials, and proportions proposed for use on the project at least 48 hours before the scheduled grouting. Grouting may proceed anytime after approval of the grout trial batch.

Perform the following tests:

(a) Flow Cone - Determine the efflux time at 0 quiescent time according to ASTM C 939 modified as follows:

- Fill the flow cone to the top of the cone.
- When thoroughly mixed, the efflux time of grout will be the time to fill a one quart container that is placed directly under the flow cone. Ensure the efflux time of the grout immediately after mixing is between 5 and 30 seconds.
- Let the grout stand for 30 minutes without agitation then retest as follows:
  - Remix for 30 seconds.
  - Ensure the efflux time of the grout immediately after remixing is 30 seconds or less.

(b) Bleeding - Determine wick induced bleeding according to ASTM C 940 as modified by the PTI “Guide Specification for Grouting of Post-Tensioned Structures” except limit the maximum allowable bleed to 0.0% at 3 hours.

(c) Mud Balance - Determine a wet density value for mud balance comparative testing during grouting operations according to API RP 13B-1 (American Petroleum Institute).

(d) Compressive Strength - Determine compressive strengths according to ASTM C 109. Provide 2 sets of 3 cubes, for informational purposes only, to the Engineer for 7 and 28-day testing.

If the proposed grout mix design does not produce acceptable trial batch results, revise the mix design and perform another trial batch. Results from previous projects will not be considered acceptable documentation. Seven and 28-day test results will be used for documentation purposes only.

Equipment

00555.20  Certified Calibrated Jacking Equipment - Equip each jack used to stress tendons with either:

- A pressure gauge with an accurate reading dial at least 6 inches in diameter and of such capacity that the final pressure reading is in the upper half of its range. Calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force, and provide a certified calibration chart; or
• A certified, calibrated load cell with an indicator by which the stressing force in the tendon may be determined, and with a range such that the lower 10% of the manufacturer's rated capacity will not be used in determining the jacking stress.

Adjustment or repair of jacks, gauges, or load cell after certification will be cause for rejection.

The certified calibration charts for the hydraulic jacks, pressure gauges or load cells used for tensioning stressing steel may be checked before and during tensioning operations by City personnel with City-furnished load cells. Perform certified calibration of stressing system not more than 180 days before use.

**00555.21 Grouting Equipment** - Provide grouting equipment with:

- Separate motors or engines for the grout mixer and the grout pump, and a system for controlling each independent of the other.
- A high speed, high shear, colloidal mechanical grout mixer that will produce uniform and thoroughly mixed tendon grout.
- Equipment which will accurately measure solids and liquids to be batched.
- An easily accessible filter screen before the grout pump with clear openings of 1/8 inch maximum size.
- A grout pump capable of producing a minimum pressure of 75 psi, with a pressure gauge reading from 0 to 300 psi, and with a relief valve that will limit grouting pressures to less than 200 psi.
- Watertight grout hoses, valves and pipe fittings.

Provide standby water flushing equipment which:

- Is in addition to and separate from the grouting equipment
- Has a different power source than the grouting equipment
- Is capable of developing a pumping pressure of 250 psi and has sufficient capacity to flush out any partially grouted ducts or vents if necessary

**Labor**

**00555.30 Personnel** - Provide the following:

- **Post-Tensioning Supervisor** - A person, skilled in the use of the system of stressing to be used, to supervise the work.
- **Grouting Technician** - An American Segmental Bridge Institute (ASBI) certified grouting technician to supervise, inspect, and document the entire grouting operation.
Construction

00555.40 Required Submittals:

(a) Test Report - Submit a certified test report to the Engineer for review and acceptance for each size and type of anchorage device showing that the device meets the requirements of the AASHTO LRFD Bridge Design Specifications and the AASHTO LRFD Bridge Construction Specifications. With the certification, include a statement that the design, materials and manufacture of the anchorage devices have not changed since testing. Ensure the concrete strength, edge clearance dimensions and amount of reinforcing for the test block is not greater than that proposed for the Project.

(b) Working Drawings and Calculations - Submit stamped working drawings and calculations for post-tensioning systems to the Engineer for review according to 00150.35.

(c) Review of Methods - Submit for review complete details of the materials, equipment, method and sequence proposed for the stressing operations, including but not limited to:

- Additions or rearrangement of reinforcing steel or changes in member dimensions from that shown.
- For normal anchorage devices, bearing stress and resistance calculations satisfying Section 5.10.9.7.2 in the LRFD Bridge Design Specifications.
- Complete specifications and details of the ducts, stressing steel including arrangement and alignment, and the anchoring devices.
- Pressure grouting materials and equipment.

Furnish reinforcement working drawings that are compatible with the approved Post-Tensioning System working drawings.

Do not cast any member to be stressed before the working drawings have been reviewed according to 00150.35.

00555.41 Ducts - Provide ducts for post-tensioning tendons according to the following:

(a) General - Make ducts mortar-tight and place them accurately at the locations shown or as directed. Provide positive, metallic, mortar-tight connection joints between sections of rigid duct which do not permit angle changes at the joints. Use waterproof tape at connections.
(b) **Vents** - Provide vents in all ducts within plus or minus 3 feet of high and low points, and other locations shown. Make vents of 3/4-inch nominal diameter standard PVC, galvanized steel or copper pipe. Make connections to ducts with compatible structural fasteners. Make the vents mortar-tight, tape as necessary, and provide means for injecting grout through the vents and for sealing the vents. Securely fasten ducts and vents in place to prevent movement. After grouting, remove the ends of vents to provide 2 inches of cover to the nearest concrete surface.

(c) **Repair** - Before placing concrete, repair all holes or openings in the ducts. Holes less than 1/4 inch may be repaired by several wraps of waterproof tape. Repair holes larger than 1/4 inch with a split metal sleeve which overlaps itself by 3 inches, extends at least 3 inches on either side of the hole, is sealed with waterproof tape, and is secured to the duct. Cut out indentations which cannot be repaired and repair as above for holes larger than 1/4 inch.

(d) **Maintenance** - After installing ducts, keep the ends covered at all times in a manner that prevents entry of moisture or debris. If the surrounding temperature is below 32 °F, keep the ducts free of water to avoid damage due to freezing.

Before placing forms for the decks of box girder cells, demonstrate to the satisfaction of the Engineer that all ducts are unobstructed.

Clean all ducts and remove accumulated water at the time of placing stressing steel.

00555.42 **Stressing:**

(a) **General** - Do not make welds, or grounds for welding equipment, on the forms or on the steel in the member after any stressing steel has been installed.

Protect stressing steel against physical damage and rust or other corrosion at all times until grouted. A corrosion inhibitor may be used. Stressing steel that has sustained physical damage, detrimental rust, pitting or other results of corrosion at any time will be rejected. Stressing steel with only light rust is acceptable if rust spots can be removed by rubbing or scraping with the fingernail and only light streaks of rust remain.

Tension stressing steel by means of hydraulic jacks so that the force in the stressing steel is not less than the value shown.

(b) **Duct Alignment** - Provide a duct alignment according to the approved working drawings to the follow tolerances:

- **Horizontal Alignment** - ± 1/2 inch unless shown otherwise
- **Vertical Alignment** - ± 3/8 inch
(c) **Timing** - Do not stress members until at least 14 days, excluding days when the surrounding temperature is below 40 °F for a total of 4 hours or more, after the last concrete has been placed in the member and not until all the concrete has reached the specified compressive strength.

Subject to prior written approval, a portion of the total stressing force may be applied to a member when the concrete compressive strength in the member is less than the value shown. Approval of such partial stressing will in no way relieve the Contractor of full responsibility for successfully constructing the member.

(d) **Procedures** - Tension stressing steel by jacking at each end of the tendon unless otherwise noted.

   (1) **Continuous Span Members** - Jacking of both ends need not be done simultaneously.

   (2) **Simple Span Members** - When jacking from one end only is allowed, tension half of the stressing steel in each member from one end of the span and the other half from the opposite end, unless otherwise allowed in writing.

   (3) **Bent Cap Members** - Subject to prior written approval, bent cap stressing steel may be tensioned by jacking from one end only.

(e) **Measuring Prestressing Force** - Conduct tensioning so the tension being applied and the elongation of the stressing steel may be measured at any time. Keep a record of gauge pressures, load cell reading and elongations. Furnish a copy of the record to the Engineer when requested.

Determine prestressing force by both of the following methods:

   (1) **Measurement of Strand Elongation** - Determine required elongation from average load-elongation curves for prestressing strand used.

   (2) **Observation of Jacking Force** - Observe jacking force on a calibrated gauge or load cell or by use of a calibrated dynamometer.

Ascertain the cause of any difference in force determination between (1) and (2) that exceeds 5% and correct the condition causing the discrepancy.
00555.43 **Bonding and Grouting** - Bond stressing steel to the concrete by filling the void space between the duct and the tendon with tendon grout consistent with the approved trial batch. Complete grouting each tendon within 14 calendar days after placing it. If projects are within 25 aerial miles of the Pacific Ocean, complete grouting each tendon within 7 calendar days after placing it. Test grout according to ASTM C 939, as modified in 00555.13(a) at least once daily at the start of grout production, and as requested by the Engineer, to verify that flow characteristics of the grout remain within the tolerances specified in 00555.13(a). Perform Mud Balance tests for each batch according to 00555.13(c). Compare and document the wet density value with the value obtained during the trial batch. If the values differ by more than 3%, rerun ASTM C 939 as modified in 00555.13(a) for continued compliance.

(a) **Pre-Grouting Procedure** - Cut stressing steel 1 inch beyond wedges or anchor nuts after stressing operations. Coat stressing strand ends and bearing plates with an epoxy bonding agent from the CPL after post tensioning stressing operations and before post tensioning duct grouting. Do not coat wedges. Prepare post tensioning blockouts according to 00540.43(a) or as approved. Encase each anchorage with concrete after completion of all post tensioning operations.

(b) **Grouting Operation** - Provide a standby flushing system and demonstrate that it is readily accessible and operable should it become necessary to flush out a partially grouted tendon.

Do not retemper grout. Continuously agitate grout until it is pumped.

(c) **Grouting Procedure** - Make all ducts clean and free of deleterious materials. Blow out each duct thoroughly with oil-free air immediately before grouting. Ducts may be flushed with water immediately before grouting if approved.

Fit grout injection pipes with positive mechanical shutoff valves. Fit vent and ejection pipes with grout-tight caps, valves or other mechanical closing devices.

Grout from the low end of the structure.

Keep the temperature of the concrete surrounding the duct at 35 °F or higher at the time of grouting and until job-cured grout cubes reach 800 psi compressive strength.

Maintain grout temperatures between 50 °F and 90 °F during mixing and pumping. If necessary, cool the mixing water.

Open all vents when grouting starts. Allow grout to flow from the first vent until residual flushing water or entrapped air is removed, then close the vent. Close remaining vents in sequence in the same manner.
Whenever the grout pumping pressure exceeds 100 psi:

- Inject grout at any other vent which has been, or is ready to be, closed as long as a one-way flow of grout is maintained. If this procedure is used, fit the vent used for injection with a mechanical shutoff valve.
- If the one-way flow of grout cannot be maintained, immediately flush the grout out of the duct with water.

Pump grout through the duct and continuously waste it at the outlet vent until:

- No visible slugs of water or air are ejected.
- The afflux time of the grout at the mixer during the grouting process is not more than 5 seconds different from the efflux time at the mixer during the initial measurements of the flow cone test during the trial batch, and is between 5 and 30 seconds.
- The efflux time of the ejected grout is not more than 5 seconds different from the efflux time at the mixer.

Do not over mix the grout.

Close the outlet vent and maintain the pumping pressure or 60 psi, whichever is greater, for at least 30 seconds; then close the valve at the injection pipe while maintaining this pressure. Do not open valves or vents until the grout sets.

Following grouting, fill all grouting and anchorage recesses with concrete and finish flush immediately after applying an epoxy bonding agent from the CPL.

Measurement

00555.80 Measurement - No measurement of quantities will be made for work performed under this Section. Estimated quantities of materials will be listed in the Special Provisions.

Payment

00555.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Post-Tensioning".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidental necessary to complete the work as specified.

No separate or additional payment will be made for anchorage devices, ducts, tendons, prestressing steel, grout, and admixtures, or for preparation and testing of grout.
Section 00560 - Structural Steel Bridges

Description

00560.00 Scope - This work consists of furnishing, fabricating, and erecting steel structures as shown or specified. It also includes miscellaneous metal work on bridges and structures, such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices, and structural steel shapes.

00560.01 Abbreviations:

| DTI | Direct Tension Indicator |

00560.02 Prefabrication Conference - Meet with the Steel Fabricator, the Engineer and the City's steel inspector for a conference at a time mutually agreed upon in advance of ordering steel materials for fabrication. At this conference, present and discuss all phases of the steel fabrication schedule and work. A prefabrication conference is not required for miscellaneous metal work, unless required by Special Provision.

00560.03 Working Drawings - Submit stamped copies of detailed working drawings according to 00150.35. Any work done before review of these drawings shall be at the Contractor's risk. When material is ordered in advance, obtain approval before placing the order.

Provide steel identification on the working drawings according to 00560.22(a).

(a) Reviews - The Engineer's review of the working drawings submitted will only cover "strength and detail" requirements. The Engineer assumes no responsibility for errors in dimensions.

(b) Revisions - Submit copies of any revisions to the detailed working drawings for review. Work done before review of these revisions shall be at the Contractor's risk.

Materials

00560.10 Materials - Furnish structural plates, shapes, bars, and miscellaneous metals meeting the requirements of Section 02530 and Section 02560.

Shop Fabrication

00560.20 Notice of Work - Give the Engineer at least 14 calendar days notice of the beginning of work at the mill, when directed, or at the shop, so inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. Do not fabricate material, or perform work at the mill or shop, before the Engineer has been notified.
00560.21 Fabrication Inspection Expense - If fabrication of structural steel outside of the State of Oregon creates additional mill, shop, and plant inspection expenses for the City, the Contractor's payment for structural steel structures will be reduced according to 00165.91.

00560.22 Test Results Certificate and Steel Identification:

(a) Test Results Certificate and Initial Identification - Furnish test results certificates, showing chemical analysis and physical tests for each heat or plate of steel, for all members according to 00165.35 and Section 02530. Identify each piece of steel to be fabricated.

Identify on working drawings each piece to be made of steel other than AASHTO M 270 (ASTM A 709), Grade 36 steel. Give pieces made of different grades of steel different assembling or erecting marks, even though they are of identical dimensions and detail.

Provide a system of marking individual pieces made of steel, other than AASHTO M 270 (ASTM A 709), Grade 36, and issue cutting instructions to the shop (generally by cross-referencing the assembly marks on the working drawings with the corresponding item on the mill purchase order) that maintain identity of the heat number.

Material that can be identified by heat number and mill test report may be furnished from stock.

Mark any unmarked excess material placed in stock for later use with the heat number and with its AASHTO M 160 (ASTM A 6) specification identification color code.

(b) Steel Identification during Fabrication - During fabrication, and until member assembly, each piece of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, shall show clearly and legibly its specification identification color code shown in AASHTO M 160 (ASTM A 6).

Individually marked pieces of steel used in furnished size, or reduced from furnished size, may be used only if end or edge trim does not disturb the heat number or color code. Any usable piece may be used without further color coding providing the heat number or color code remains legible.

Mark individual pieces, other than AASHTO M 270 (ASTM A 709), Grade 36, with the AASHTO M 160 (ASTM A 6) specification identification color code before cutting to a smaller size.

Mark individual pieces of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, which are furnished in tagged lifts or bundles with the AASHTO M 160 (ASTM A 6) specification identification color code immediately on being removed from the bundle or lift.
Pieces of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, which before assembling into members, will be subject to fabricating operations such as heating, blast cleaning, galvanizing or other coating that might obliterate paint color code marking, shall be marked for grade by steel die stamping or by a substantial tag firmly attached. Use only rounded characters when primary stress components are identified by steel die stamping. Impressions shall have a maximum allowable depth of 0.010 inch and shall be placed a minimum distance of 2 inches from edges of tension-stressed plate members. Characters shall be 1/4 inch to 3/8 inch high and shall have a minimum face radius of 0.015 inch.

(c) Check Samples - To verify the accuracy of test reports, obtain check samples from material furnished for fabrication. The plates, shapes or bars from which check samples are required will be as designated on the Plans, and shall be ordered from the mill with the extra size required for samples. The Engineer may take additional samples from drop-offs or scrap material as deemed necessary. No more than 2 samples will be required from any one plate according to AASHTO M 270 (ASTM A 709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or from any one shape or bar. Remove material for check samples in the presence of the Engineer. The Engineer will select the locations where samples are to be taken. Check samples may be ordered cut from either end of the designated steel plate, according to AASHTO M 270 (ASTM A 709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or shape or bar. To verify accuracy of test reports for HPS 50W and HPS 70W with thermo-mechanical control process, check samples of both ends of each plate is required.

Check samples in plates shall be rectangular, not less than 24 inches long in the required direction, depending on plate width, for the longitudinal axis of tensile specimens, and 5 inches wide. Bend specimens, where required, shall be not less than 24 inches long in the direction of rolling of the plate. Check samples in bars or shapes shall be the full section and at least 24 inches long. In removing the sample, take care not to damage it by overheating. The City will be responsible for the necessary machining of check test specimens and their testing. To expedite obtaining test results, the Contractor may, if approved, perform machining and testing of specimens, in the presence of the Engineer.

The normal basis of acceptance of material will be the mill report or other test report, and fabrication need not be held up pending results of check tests. If the check tests indicate material with properties failing to meet the minimum requirements of the material specification, the material may be rejected and the Contractor required to order new material at no additional cost to the City.
For purposes of determining compliance with these Specifications, if the results on an original tensile specimen are within 2,000 psi of the required tensile strength, within 1,000 psi of the required yield point, or within 2% of the required elongation, a retest will be allowed on 2 random specimens from the heat or lot. If the results from both of these retest specimens meet Specifications, the heat or lot will be accepted. The specimens shall be oriented with the final direction of rolling in the same manner as the original specimen, and may come from any location within the plate. The extra material from plates, shapes or bars that is not used for check testing shall become the property of the Contractor.

(d) Certification of Identification - Upon request, furnish an affidavit certifying that throughout the fabrication operation the identification of steel has been maintained according to this Specification.

00560.23 Shop Inspection and Testing:

(a) Facilities - Furnish facilities for the inspection of material and work in the mill and shop. Allow the Engineer free access to the material and work for inspection.

(b) Testing - Furnish samples for testing as specified according to Section 00165.

(c) Rejections - The Inspector's inspection at the mill or shop of any material, work or finished members will not prevent their subsequent rejection, if later found damaged or defective, nor relieve the Contractor of the responsibility to correct or replace the work at no additional cost to the City.

(d) Transport - Ship no member or piece of fabricated steel without the Inspectors' label or marking.

00560.24 Transporting to, Handling and Storage at Shop - In transporting, handling and storing the steel work at the shop, take care to avoid bending, scraping or overstressing the pieces. Reject pieces bent or otherwise damaged. In addition:

- Conduct the loading, transporting and unloading of pieces so the metal remains clean.
- Keep materials free from dirt, oil or other contaminants, and protect from corrosion.
- If pieces are shop-painted, handle with slings or other means that will not damage coating system.
- Handle and store girders and beams upright, and shore.
- Support and handle members so camber is maintained.
- Support long members, such as columns and chords, on skids placed near enough together to prevent damage from deflection.
- Store materials on platforms, skids or other supports above ground and high water elevations and slightly pitch all trough sections that might retain water to provide drainage.
00560.25 Plate Work:

(a) Straightening - Straighten bent or distorted plates, angles, and other shapes or built-up members according to paragraph 3.7.3 of AWS D 1.5, and as specified.

(b) Orientation of Plates - Unless otherwise shown, cut and fabricate steel plates for main members, and splice plates for flanges and main tension members, so the primary direction of rolling is parallel to the direction of the main tensile or compressive stresses.

(c) Plate Cut Edges:

1. Edge Planing - Plane, mill, grind or thermal cut to a depth of 1/4 inch all sheared edges of plate more than 5/8 inch in thickness and carrying calculated stress.

2. Flame Cutting - Flame cut structural steel according to paragraph 3.2.2 of AWS D1.5, and as specified.

3. Visual Inspection and Repair - Visually inspect and repair plate cut edges according to paragraph 3.2.3 of AWS D1.5, and as specified.

4. Re-entrant Corners - Fillet re-entrant corners to a radius of at least 3/4 inch before cutting.

5. Corners and Edges - Round all corners and edges of steel members, or bevel 1/16 inch.

(d) Bent Plates - Unwelded, cold-bent, load-carrying, rolled-steel plates shall be:

- Rounded at the corners of the plate before bending, to a radius of 1/16 inch throughout the portion of the plate at which the bending is to occur.
- Bent at right angles to the direction of rolling, except that cold-bent ribs for orthotropic-deck structures may be bent in the direction of rolling if allowed.
- Bent so no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are:

<table>
<thead>
<tr>
<th>Plate Thickness</th>
<th>Up to 1/2&quot;</th>
<th>Over 1/2&quot; to 1&quot;</th>
<th>Over 1&quot; to 1 1/2&quot;</th>
<th>Over 1 1/2&quot; to 2 1/2&quot;</th>
<th>Over 2 1/2&quot; to 4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>All grades of structural steel in this Specification</td>
<td>2 t</td>
<td>2.5 t</td>
<td>3 t</td>
<td>3.5 t</td>
<td>4 t</td>
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</tbody>
</table>

City of Portland 2010 588
Where $t =$ Plate thickness in inches

Low alloy steel in thicknesses over 1/2 inch may require hot bending for small radii

00560.26 Welding:

(a) Bridge Welding - Welding, welder qualifications, prequalification of weld details, and inspection of welds for bridge structures shall all conform to AWS D1.5.

(b) Non-Bridge Structures - Welding, welder qualifications, prequalification of weld details and inspection of welds for non-bridge structures shall all conform to AWS D1.1. Non-bridge structures include bridge railing posts, railing splices, deck expansion joints, earthquake restraints and similar structures. Submit all welding procedure specifications to the Engineer for approval.

Test earthquake restraint welds radiographically or ultrasonically. Testing will be witnessed by the Engineer. Additional inspection for earthquake restraint welds shall include:

- Ultrasonic inspection of 100% of the complete penetration welds using a straight beam transducer. A weld will be acceptable if it has no indications of cracks and no indications of lack of fusion between adjacent layers of weld metal and between weld metal and base metal.
- Magnetic particle inspection of 10% of the fillet welds.

00560.27 Bolt Holes:

(a) Punched Holes - Use a die with a diameter not exceeding the diameter of the punch by more than 1/16 inch. Ream any holes that are required to be enlarged to admit the bolts. Make clean cut holes without torn or ragged edges. Poor matching of holes will be cause for rejection.

(b) Drilled or Reamed Holes - Assemble and securely hold connecting parts requiring drilled or reamed holes. Match-mark connecting parts before disassembling.

Where practical, direct reamers by mechanical means.

Perform drilling and reaming with twist drills. Make drilled or reamed holes cylindrical, perpendicular to the member, and complying with the size requirements of these Specifications. Remove burrs on the outside surfaces. If required, take apart assembled parts for removal of burrs caused by drilling. Poor matching of holes will be cause for rejection.

(c) Accuracy of Punched and Drilled Holes - Locate all holes punched full size, subpunched, or subdrilled so accurately that after assembling (before any reaming is done) a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the
member, without drifting, in at least 75% of the connecting holes in the same plane. Non-conforming pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller than the nominal size of the hole, the non-conforming pieces will be rejected.

(d) Accuracy of Drilled and Reamed Holes - When holes are drilled or reamed, 85% of the holes in any connecting group shall, after drilling or reaming, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

Provide steel templates with hardened steel bushings in holes and accurately dimensioned from centerlines of the connections inscribed on the template. Use the centerlines in accurately locating the template from the milled or scribed ends of the members. When steel templates 1 inch or greater in thickness are used 60 or fewer times in drilling members, hardened steel bushings are not required.

(e) Fitting for Bolting - Clean surfaces of metal in contact before assembling. Assemble, well pin, and firmly draw together the parts of a member before drilling, reaming, or bolting is commenced. Take apart assembled pieces, if necessary, for the removal of burrs and shavings produced by the operation. Construct the member free from twists, bends, and other deformation.

Perform drift pinning during assembling only to bring the parts into position and not sufficient to enlarge the holes or distort the metal.

(f) Holes for High-Strength Bolts and Unfinished Bolts - Punch or drill all holes for high-strength bolts and unfinished bolts. When there are not more than 5 thicknesses of material in a member, and the material is not thicker than 3/4 inch for structural steel or 5/8 inch for high-strength steel, the metal may be punched 1/16 inch larger than the nominal diameter of the bolts unless subpunching and reaming are required by these specifications.

When there are more than 5 material thicknesses in a member, or when any material is thicker than 3/4 inch for structural steel or 5/8 inch for high-strength steel, either sub drill holes or drill full size.

When required by 00560.27(g), subpunch or sub drill all holes 3/16 inch smaller and, after assembling, ream 1/16 inch larger or drill full size to 1/16 inch larger than the nominal diameter of the bolts. Sub drill if thickness limitation governs.

Holes not more than 1/32 inch larger than the nominal diameter resulting from a drill or reamer of the nominal diameter are considered acceptable. The slightly conical hole from punching operations is considered acceptable.

(g) Holes for Ribbed Bolts, Turned Bolts, and Others - Make holes with a driving fit as specified for ribbed bolts, turned bolts, or other approved bearing-type bolts by one of these methods:
(h) Holes for Field Connections:

(1) Subpunching and Reaming Field Connections - Unless otherwise specified, subpunch (or sub drill if subdrilling is required according to 00560.27(f) or 00560.27(g)) and subsequently ream holes in all field connections and field splices of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames while assembled on a steel template, as required by 00560.43. Holes for field splices of rolled beam stringers continuous over floor beams or crossframes may be drilled full size unassembled to a steel template.

Subpunch and ream all holes for floor beam and stringer field end connections to a steel template or ream while assembled. Drill or ream full size field connection holes through a steel template after the template has been carefully located as to position and angle and firmly bolted in place. Make templates used for reaming matching members, or the opposite faces of a single member, exact duplicates. Locate templates used for connections on like parts or members so accurately that the parts or members are duplicates and require no match-marking.

For any field connection, instead of subpunching and reaming or subdrilling and reaming, the Contractor may drill holes full size with all thicknesses of material assembled in proper position.

Use templates as described above, or do not interchange splice plates.

(2) Numerically Controlled Punched or Drilled Field Connections - Alternately, for any connection or splice designated in 00560.27(f), instead of subpunching and reaming field connections according to 00560.27(h), the Contractor may punch or drill bolt holes full-size in unassembled pieces and connections, including templates, for use with matching subsized and reamed holes by means of suitable numerically controlled punching or drilling equipment subject to this Section. Punch or drill full-size holes according to 00560.27(c).

Submit for review a detailed outline of the procedures proposed for accomplishing the work from initial punching or drilling through check assembly, if required. Include the specific members of the structure that may be numerically controlled punched or drilled, the sizes of the holes, the location of common index and other reference points, composition of check assemblies, and all other pertinent information. Do not begin until written approval is received.
Punch or drill holes by numerically controlled equipment to appropriate size through individual pieces, or drill through any combination of pieces held tightly together. Use each splice plate only once as a template and do not interchange after assembly drilling is complete.

If numerically controlled punching or drilling equipment is used, the Engineer may require the Contractor, by means of check assemblies, to demonstrate that this punching or drilling procedure consistently produces holes and connections conforming to 00560.27(g) and 00560.43.

00560.28 Carbon Steel Bolt Connections - Unless otherwise shown or specified, make connections with unfinished carbon steel bolts nuts and washers conforming to Section 02560. Use holes conforming to 00560.27.

(a) Turned Bolts - Provide and install turned bolts as follows:

- The body surface shall have a surface roughness of 125 microinches, or less, according to ANSI B46.1.
- The unthreaded body shall equal total thickness of connected parts.
- The outer thread diameter shall equal the nominal diameter of the bolt specified.
- Heads and nuts shall be hexagonal with standard dimensions for bolts of the nominal size specified or the next larger nominal size.
- Install bolts in carefully reamed holes with a tight driving fit.

(b) Ribbed Bolts - Provide and install ribbed bolts as follows:

- The body shall have an approved form with continuous longitudinal ribs.
- The diameter of the body, measured on a circle through the points of the ribs, shall be 5/64 inch greater than the nominal bolt diameter specified.
- Round heads shall conform to ANSI B 18.5.2.1M unless otherwise specified.
- Ribbed bolts shall make a driving fit with the holes.
- The hardness of the ribs shall be such that the ribs do not permit the bolts to turn in the holes during tightening.
- If for any reason the bolt twists before drawing tight, ream the hole and use an oversized bolt as a replacement.
- Nuts shall be hexagonal, with standard dimensions for bolts of nominal size specified or the next larger nominal size.

(c) Washers - Use hardened washers of suitable thickness under the turning element (nut or bolt head) in tightening.

Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis.
(d) **Nuts** - Use single self-locking nuts or double nuts unless otherwise shown or specified. The finished side shall be against the washer or plate.

00560.29 **High-Strength Bolt Connections:**

(a) **General** - When shown or specified, assemble structural joint connections with high-strength bolts conforming to AASHTO M 164 (ASTM A 325) or equivalent fastener using bolts, nuts, and washers conforming to Section 02560 and in holes conforming to 00560.27.

Fit-up bolted connections as follows:

- Provide all steel material within the grip of high-strength bolts (no compressible material such as gaskets or insulation).
- Remove burrs that would prevent solid seating.
- So that parts fit solidly together after bolts are tightened.
- Make slope of surfaces in contact with the bolt head or nut less than 1:20 with respect to a plane normal to the bolt axis.
- Install all bolts, unless otherwise shown, to expose the heads on the exterior surface of the structure.

(b) **Surface Conditions** - Make all joint surfaces including surfaces adjacent to the bolt head and nut free of scale, oil, grease, dirt, foreign material, and unless otherwise shown or specified, free of paint, lacquer, rust inhibitor, galvanizing or other coating.

(1) **Coated Members** - Prepare and coat steel-to-steel contact surfaces within slip-critical bolted joints for coated steel according to Section 00594. Prior to assembly, prepare the contact surfaces with approved methods not harmful to the primer.

Coat fasteners visible to the public, as determined by the Engineer, according to Section 00594 (except the primer coat) after installation. All direct tension indicators shall be mechanically galvanized according to 02560.40(b).

a. **Non-Coastal Projects** - On projects more than 25 aerial miles, of the Pacific Ocean, all high-strength fasteners shall be either black or galvanized as the Contractor elects. The fasteners shall meet the following requirements:

1. **Black Fasteners** - Clean black fasteners, including hardened washers, and the surrounding areas stained by the black fasteners, after installation, using an approved method. Coat according to Section 00594.

2. **Galvanized Fasteners** - Clean and prepare fasteners as approved, in areas visible to the public, as determined by the Engineer, and coat according to Section 00594 after installation.
b. Coastal Projects - On projects within 25 aerial miles of the Pacific Ocean, all high-strength fasteners, including hardened flat washers, shall be galvanized according to 02560.40 prior to installation. In areas visible to the public, as determined by the Engineer, clean and prepare fasteners as approved, and coat according to Section 00594.

(2) Non-Coated Weathering Steel Members - Blast clean steel-to-steel contact surfaces within slip-critical bolted joints for non-coated weathering steel according to SSPC-SP 10 “Near-White Blast Cleaning”. The appearance of the blast-cleaned surface shall closely approximate Pictorial Standard Sa 2-1/2 of SSPC-Vis 1.

All fasteners shall be black. Do not use direct tension indicators for non-coated weathering steel connections.

(3) Galvanized Members - After galvanizing, roughen surfaces of galvanized slip-critical connections by means of hand wire brushing. Power wire brushing is not allowed.

(c) Installation and Tightening:

(1) General - Fasteners shall be assigned lot numbers (including rotational capacity lot numbers) prior to shipping, and components shall be assembled when installed. Protect fasteners from dirt and moisture at the Project Site. Take from protected storage only as many fasteners as anticipated to be installed and tightened during a work shift. Return fasteners not used to protected storage at the end of the shift. Do not remove lubricant present in as-delivered condition. Clean and lubricate fasteners, if necessary, and retest before installation. Use lubricant according to 02560.70. Do not relubricate tension control fasteners designed to automatically provide the tension without consulting with the manufacturer.

Provide a tension measuring device at the Project Site if high-strength bolts are being installed and tightened. The device shall have capacity for the bolt being installed. Confirm the accuracy of the tension-measuring device through calibration by an approved testing agency at the start of work and at least annually. Use the tension-measuring device to calibrate wrenches if applicable, to assist the bolting crew in understanding and proper use of the method to be used, and to confirm the ability of the complete fastener assembly to be used in the work, including lubrication, if required, to satisfy the requirements of Table 00560-1.

Install fasteners with washers of specified size and quality, located as described below, in properly aligned holes, and tighten according to 00560.29(c)(3) unless otherwise specified. Tighten to at least the tension specified in Table 00560-1 when all the fasteners are tight. Tightening may be done by turning the bolt while the nut is prevented from rotating when it is impractical to turn the nut. Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air to tighten each bolt in 10 seconds.
Non-galvanized fasteners may be reused, if approved, but not more than once. Retightening previously tightened fasteners loosened by the tightening of adjacent fasteners will not be considered a reuse. Do not reuse galvanized fasteners.

Use bolt, nut and washer combinations from the same rotational-capacity lot.

Verify correct lengths of all AASHTO M 164 (ASTM A 325) bolts. In the tightened connection, the unthreaded portion of the bolt shall not jam against the internal threads of the nut. The bolt shall have full nut engagement with a positive stick-through. The space between the nut and the bolt head (the grip) shall include a threaded length of bolt at least 3 threads in length.

In these Specifications, "snug" is defined as having all plies of the connection in firm contact. Snugging shall progress systematically from the most rigid part of the connection to the free edges. The snugging sequence shall be repeated until the full connection is in a snug condition.

<table>
<thead>
<tr>
<th>Nominal Bolt Size (inch)</th>
<th>Minimum Tension (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>12</td>
</tr>
<tr>
<td>5/3</td>
<td>19</td>
</tr>
<tr>
<td>3/4</td>
<td>28</td>
</tr>
<tr>
<td>7/8</td>
<td>39</td>
</tr>
<tr>
<td>1</td>
<td>51</td>
</tr>
<tr>
<td>1 1/8</td>
<td>56</td>
</tr>
<tr>
<td>1 1/4</td>
<td>71</td>
</tr>
<tr>
<td>1 3/8</td>
<td>85</td>
</tr>
<tr>
<td>1 1/2</td>
<td>103</td>
</tr>
</tbody>
</table>

(2) Washer Requirements:

- Where the outer surface of the bolted parts has a slope greater than 1:20 with respect to a plane normal to the bolt axis, use a hardened, beveled washer to compensate for the lack of parallelism.
- Use a hardened washer under the element of the fastener (nut or bolt head) turned in tightening.
- Where AASHTO M 164 (ASTM A 325) bolts of any diameter are to be installed in an oversize or short slotted hole in an outer ply, use a hardened washer conforming to ASTM F 436.
Where AASHTO M 164 (ASTM A 325) bolts of any diameter are to be installed in a long slotted hole in an outer ply, use plate washers or continuous bars of at least 5/16 inch thickness with standard holes. These washers or bars shall have sufficient size to completely cover the slot after installation. Make the plate washer from structural grade steel.

Oversize and slotted holes shall be as defined by Manual of Steel Construction Load and Resistance Factor Design (AISC).

(3) Direct Tension Indicators (DTIs):

a. General - When direct tension indicators are used to indicate bolt tension, they shall be subjected to verification testing as described below and installed according to the method specified below. Unless otherwise directed, the DTIs shall be installed under the head of the bolt and the nut turned to tension the bolt. See 00560.29(c)(2) for washer requirements. Follow the manufacturer's recommendations for the proper orientation of the DTIs and additional washers, if any, required for the correct use of the DTIs. The surface contacting the protrusions of a direct tension indicator shall not turn during the tightening operation. All direct tension indicators shall be new and unused and shall be mechanically galvanized according to 02560.40(b). Where tapered holes are found in washers that are in contact with the protrusions of DTI washers, the face with the smallest hole shall be placed against the DTI.

b. Verification Testing - Perform verification in a calibrated bolt tension-measuring device. Use a special flat insert in place of the normal bolt head holding insert. Three verification tests are required for each combination of fastener assembly rotational-capacity lot, DTI lot, and DTI position relative to the turned element (bolt head or nut) to be used on the Project. Install the fastener assembly in the tension-measuring device with the DTI located in the same position as in the work. The element not turned (bolt or nut) shall be restrained from rotation. The purpose of verification testing is to ensure that the fastener will be at or above the desired installation tension when the requisite number of spaces between the protrusions have a gap of 0.005 inches or less, and that the bolt will not have excessive plastic deformation at the minimum gap allowed on the Project.

Conduct verification tests in 2 stages. The bolt, nut, and DTI assembly shall be installed in such a manner that at least 3, and preferably not more than 5, threads are located between the bearing face of the nut and the bolt head. Tension the bolt first to the load equal to that listed in Table 00560-2 under Verification Tension for the grade and diameter of bolt. If an impact wrench is used, the tension developed using the impact wrench shall be no more than 2/3 the required tension. Subsequently, use a manual wrench to attain the required tension. Record the number of refusals of a 0.005 inch tapered feeler gauge in the spaces between the protrusions. The number of refusals for galvanized DTIs under the stationary element
shall not exceed the number listed under Maximum Verification refusals in Table 00560-2 for the grade and diameter of bolt used. The maximum number of verification refusals for galvanized DTIs when used under the turned element shall be no more than the number of spaces on the DTI less one. The galvanized DTI lot will be rejected if the gauge is refused in all spaces.

After the number of refusals is recorded at the verification load, further tension the bolt until the 0.005 inch feeler gauge is refused at all spaces and a visible gap exists in at least one space. Record the load at this condition and remove the bolt from the tension-measuring device. The nut shall be able to be run down by hand for the complete thread length of the bolt, excluding the thread runout. If the nut cannot be run down for this thread length, the DTI lot shall be rejected unless the load recorded is less than 95% of the average load measured in the rotational capacity test for the fastener lot.

If the bolt is too short to be tested in the calibration device, verify the DTI lot on a long bolt in a calibrator to determine the number of refusals at the Verification Tension listed in Table 00560-2. The number of refusals shall not exceed the values listed under Maximum Verification Refusals in Table 00560-2. Another DTI from the same lot shall then be verified with the short bolt in a convenient hole in the work. Tension the bolt until the 0.005 inch feeler gauge is refused in all spaces and a visible gap exists in at least one space. Remove the bolt from the tension-measuring device. The nut shall be able to be run down by hand for the complete thread length of the bolt excluding the thread runout. Reject the DTI lot if the nut cannot be run down for this thread length.

c. Installation - Install fastener assemblies using DTIs in 2 stages. Hold the stationary element against rotation during each stage of the installation. First snug the connection with bolts installed in all holes of the connection and tensioned sufficiently to bring all the plies of the connection into firm contact. The number of spaces in which a 0.005 inch feeler gauge is refused in the DTIs after snugging shall not exceed those listed under Maximum Verification refusals in Table 00560-2. If the number exceeds the values in the table, remove the fastener assembly and install and snug another DTI.

For galvanized DTIs under the stationary element, further tension the bolts until the number of refusals of the 0.005 inch feeler gauge is equal to or greater than the number listed under Minimum Installation Refusals in Table 00560-2. If the bolt is tensioned so that no visible gap in any space remains, remove the bolt and DTI, and replaced with a new properly tensioned bolt and DTI.

For galvanized DTIs under the turned element, the feeler gauge shall be refused in all spaces.
Table 00560-2

Direct Tension Indicators

<table>
<thead>
<tr>
<th>Bolt Diameter (inch)</th>
<th>Verification Tension (Kips)</th>
<th>Maximum Verification Refusals</th>
<th>DTI Spaces</th>
<th>Minimum Installation Refusals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>13</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5/8</td>
<td>20</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3/4</td>
<td>29</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>7/8</td>
<td>41</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>54</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1 1/8</td>
<td>59</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1 1/4</td>
<td>75</td>
<td>3</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>1 3/8</td>
<td>89</td>
<td>3</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>1 1/2</td>
<td>108</td>
<td>3</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 00560-2 Notes:

Maximum Verification Refusals are for galvanized DTIs under a stationary element. The maximum number of Verification Refusals for galvanized DTIs under a turned element shall be no more than the number of spaces on the DTI less one.

Minimum Installation Refusals are for galvanized DTIs under a stationary element. The gauge shall be refused in all spaces when galvanized DTIs are used under a turned element.

(4) Tension Control Fasteners Tightening - When fasteners automatically provide the tension required by Table 00560-1 and have been qualified according to Section 02560 are to be installed, check a representative sample of not less than 5 bolts of each diameter, length and grade at the Project Site in a device capable of indicating bolt tension. Include flat hardened washers in the test assembly, if required in the actual connection, arranged as in the actual connections to be tensioned. Demonstrate that each bolt develops a tension not less than 5% greater than required by Table 00560-1. Follow manufacturer’s installation procedure for installation of bolts in the calibrating device and in all connections.

When using tension control fasteners which automatically provide the tension, install fasteners in all holes of the connection and initially tighten sufficiently to bring all plies of the joint into firm contact, but without yielding or fracturing the control or indicator element of the fasteners. Then further tighten all fasteners in sequence, progressing from the most rigid part of the connection to the free edges in a manner that minimizes relaxation of previously tightened fasteners. Proper tensioning of the fasteners may require more than a single cycle of partial tightening (snug-tightening) before final tightening of individual fasteners.
(5) Turn-of-Nut Tightening - Perform verification testing using a representative sample of not less than three bolt and nut assemblies of each diameter, length and grade used at the start of work in a device capable of indicating bolt tension. Demonstrate that the method for estimating the snug-tight condition and controlling the turns from snug-tight to be used by the bolting crew develops a tension not less than 5% greater than the tension required by Table 00560-1.

Install bolts in all holes of the connection and bring to a snug-tight condition. Sequence snug-tightening from the most rigid part of the connection to the free edges, and then retighten the bolts of the connection in a similar manner until all bolts are simultaneously snug-tight and the connection is fully compacted. Then tighten all bolts in the connection further by the amount of rotation specified in Table 00560-3. During the tightening operation prevent rotation of the part not turned by the wrench. Sequence tightening from the most rigid part of the joint to its free edges.

**TABLE 00560-3**

Nut Rotation from Snug-Tight Condition

<table>
<thead>
<tr>
<th>Bolt Length (underside of head to end of bolt)</th>
<th>Both faces normal to bolt axis</th>
<th>One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)</th>
<th>Both faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 4 diameters</td>
<td>1/3 turn</td>
<td>1/2 turn</td>
<td>2/3 turn</td>
</tr>
<tr>
<td>Over 4 diameters but not exceeding 8 diameters</td>
<td>1/2 turn</td>
<td>2/3 turn</td>
<td>5/6 turn</td>
</tr>
<tr>
<td>Over 8 diameter but not exceeding 12 diameters</td>
<td>2/3 turn</td>
<td>5/6 turn</td>
<td>1 turn</td>
</tr>
</tbody>
</table>

1 Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30°; for bolts installed by 2/3 turn and more, the tolerance shall be plus or minus 45°.

2 No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to 00560.29(c)(5).
(6) **Lock-Pin and Collar Fastener Tightening** - Install lock-pin and collar fasteners by methods and procedures as recommended by the manufacturer and approved.

When using lock-pin and collar fasteners, install lock-pins in all holes of the connection and initially snug-tighten sufficiently to bring all plies of the joint into firm contact, progressing systematically from the most rigid part of the connection to the free edges in a manner that minimizes relaxation of previously tightened fasteners. After all fasteners in the connection are snug-tight, fully tighten the fasteners, progressing systematically from the center most rigid part of the connection to its free edges. Ping the fasteners with a hammer for soundness. Remove and replace loose or relaxed fasteners with new fasteners to the satisfaction of the Engineer.

(d) **Inspection** - Before installing fasteners in the work, the Engineer will check the marking, surface condition and storage of bolts, nuts, and washers, and DTIs if used, and the faying surfaces of joints for compliance with 00560.29(c)(1). The Engineer will observe calibration or testing procedures required in 00560.29(c)(2) through 00560.29(c)(5), as applicable, and will monitor the installation of fasteners in the work to confirm that the procedure is properly used and that, when so used with the fastener assemblies supplied, the tensions specified in Table 00560-1 are provided.

The Engineer will monitor the installation of fasteners in the work to assure that the selected installation method, as demonstrated in the initial testing to develop the specified tension, is routinely followed.

Either the Engineer or the Contractor, in the presence of the Engineer and with the Engineer’s approval, shall inspect the tensioned bolts using an inspection torque wrench, unless alternate fasteners or direct tension indicators are used, allowing verification by other methods. Conduct inspection tests in a timely manner prior to prevent possible loss of lubrication, and before corrosion influences torque.

Place three fastener assembly lots, in the same conditions as those under inspection, individually in a device calibrated to measure bolt tension. Perform this calibration operation at least once each inspection day. There shall be a washer under the turned element in tensioning each bolt if washers are used on the structure. If washers are not used on the structure, the material used in the tension-measuring device that abuts the part turned shall be of the same specification as that used on the structure. In the calibrated device, each bolt shall be tensioned by any convenient means to the specified tension. Apply the inspecting wrench to the tensioned bolt to determine the torque required to turn the nut or head 5° (approximately 1 inch at a 12 inch radius) in the tensioning direction. Take the average of the torque required for all three bolts as the job inspection torque.
Select at random 10% (at least 2) of the tensioned bolts on the structure represented by the test bolts in each connection. Apply the job inspection torque to each with the inspecting wrench turned in the tensioning direction. If this torque turns no bolt head or nut, the bolts in the connection will be considered to be properly tensioned. However, if the torque turns one or more bolt heads or nuts, apply the job inspection torque to all bolts in the connection. Retension and reinspect any bolt whose head or nut turns at this stage. The Contractor may, however, retension all the bolts in the connection and resubmit it for inspection, provided DTIs are not over-tensioned or fasteners assemblies are not damaged.

**Labor**

00560.30 **Fabricators** - Structural steel bridge fabricators shall have an American Institute of Steel Construction (AISC) Major Steel Bridges (Cbr) certification. For fracture critical structures, the fabricator shall also have an AISC Fracture Critical Endorsement (F). All fabricators of earthquake restraints shall have either a current AISC Cbr certification or a Simple Steel Bridge Structures (Sbr) certification.

**Construction**

00560.40 **Members Work:**

(a) **General** - Fabricate members true to line and free from twists, bends and open joints.

(b) **End Connection Angles** - Fabricate floor beams, stringers and girders having end connection angles to exact length shown, as measured between the heels of the connection angles, with a permissible tolerance of plus 0 to - 1/16 inch. Where continuity is required, face end connections.

Provide connection angles with a thickness of not less than 3/8 inch, nor less than shown after facing.

(c) **Stiffeners** - Fabricate end stiffeners of girders and stiffeners intended as supports for concentrated loads to have full bearing (either milled, ground, or on weldable steel in compression areas of flanges, welded as specified) on the flanges to which they transmit load or from which they receive load. Fabricate stiffeners not intended to support concentrated loads, according to paragraph 3.5.1.10 of AWS D1.5, unless specified otherwise.

(d) **Abutting Members** - Mill, sawcut or flame cut abutting members carrying compression at joints in trusses, columns and girder flanges, to give a square joint and uniform bearing. At joints not required to be faced, the opening shall not exceed 1/4 inch.

(e) **Annealing and Stress Relieving** - Perform finished machining, boring and straightening on structural members which are specified to be annealed or normalized subsequent to heat treatment. Normalize and anneal (full annealing) according to ASTM A 941. Maintain the temperatures uniformly
throughout the furnace during the heating and cooling so the temperature at no 2 points on the member will differ by more than 100 °F at any one time.

Make a record identifying the pieces in each furnace charge and show the temperatures and schedule actually used. Provide proper instruments, including recording pyrometers, for determining at any time the temperatures of members in the furnace. Provide the records of the treatment operation to the Engineer.

Stress relieve members, such as bridge shoes, pedestals or other parts that are built up by welding sections of plate together according to paragraph 4.4 of AWS D1.5, when specified.

(f) **Facing of Bearing Surfaces** - The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall conform to ANSI surface roughness requirements according to ANSI B46.1, Surface Roughness, Waviness and Lay, Part I, and the following table:

<table>
<thead>
<tr>
<th>Member</th>
<th>Maximum Surface Roughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel slabs</td>
<td>2,000 microinch</td>
</tr>
<tr>
<td>Heavy plates in contact with shoes to be welded</td>
<td>1,000 microinch</td>
</tr>
<tr>
<td>Milled ends of compression members, milled or ground ends of stiffeners and fillers</td>
<td>500 microinch</td>
</tr>
<tr>
<td>Bridge rollers and rockers</td>
<td>250 microinch</td>
</tr>
<tr>
<td>Pins and pin holes</td>
<td>125 microinch</td>
</tr>
<tr>
<td>Sliding bearings</td>
<td>125 microinch</td>
</tr>
</tbody>
</table>

(g) **Pins and Rollers** - Turn pins and rollers to the dimensions shown. Make them straight, smooth and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed carbon-steel shafting. Pins and rollers 9 inches or less in diameter may be cold-finished or forged and annealed carbon-steel shafting.

In pins larger than 9 inches in diameter, bore a hole not less than 2 inches in diameter full length along the axis after the forging has cooled to a temperature below the critical range, under conditions that prevent injury by too rapid cooling, and before annealing.

Provide threads for all bolts and pins for structural steel construction according to ASME B1.1, Unified Inch Screw Threads, Class 2A for external threads and Class 2B for internal threads, except for pin ends having a diameter of 1 3/8 inch, or more, use a thread pitch of 6 threads per inch.

(h) **Pin Holes** - Bore pin holes true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise specified. Produce the final surface by a finishing cut.

The diameter of the pin hole shall not exceed that of the pin by more than 0.02 inch for pins 5 inches or less in diameter, or by 0.03 inch for larger pins.
The distance outside-to-outside of end holes in tension members and inside-to-inside of end holes in compression members shall not vary from that specified more than 1/32 inch. Bore holes in built-up members after the fabrication is completed.

(i) **Shear Connectors** - Fabricate shear connector studs with material, welding and inspection according to Section 7 of AWS D1.5.

**00560.41 Repair of Defects** - Do not begin the repair of defects in the fabricated material until the proposed corrective procedure has been approved.

**00560.42 Cambering** - Provide a smooth, unbroken curve or camber over the full length of the member when shown.

Camber roll beams in the fabricating shop by use of heat or hydraulic jacks. The temperature of the heated area shall not exceed 1,200 °F as controlled by pyrometric stick (temperature crayon) or thermometers. Do not quench to accelerate cooling.

Trim web plates of cambered plate girders before assembly.

Camber truss spans according to 00560.46.

**00560.43 Shop Assembling:**

(a) **General** - Assemble in the shop the field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders and rigid frames with milled ends of compression members in full bearing, and then ream their subsize holes to specified size while the connections are assembled. Use full truss or girder assembly, unless progressive truss or girder assembly, full chord assembly, progressive chord assembly, or complete structure assembly is specified.

Make check assemblies with numerically controlled punched or drilled field connections and template drilled field connections of rolled beam stringers continuous over floor beams or cross frames according to 00560.43(g).

Obtain approval for each assembly, including camber, alignment, accuracy of holes, and fit of milled joints before reaming is commenced or before a numerically controlled drilled check assembly is dismantled.

Furnish a camber diagram, prepared by the fabricator, showing the camber at each panel point in the cases of trusses or arch ribs, and at the location of field splices and fractions of span length (quarter points minimum, tenth points maximum) in the cases of continuous beam and girders or rigid frames. When the shop assembly is Full Truss or Girder Assembly or Complete Structure Assembly, show the camber measured in assembly. When any of the other methods of shop assembly is used, show calculated camber.

(b) **Full Truss or Girder Assembly** - Assemble all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder or rigid frame at one time.
(c) **Progressive Truss or Girder Assembly** - Assemble, initially for each truss, bent, tower face or rigid frame, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths.

Assemble, initially for each arch rib, continuous beam line or plate girder, at least three connecting shop sections.

Make successive assemblies with at least one panel or section of the previous assembly (repositioned if necessary and adequately pinned to assure accurate alignment) plus two or more panels or sections added at the advancing end.

In the case of structures longer than 150 feet, make each assembly not less than 150 feet long regardless of the length of individual continuous panels or sections.

The sequence of assembly may start from any location in the structure and proceed in one or both directions, so long as the preceding requirements are satisfied.

Obtain approval for assemblies consisting of less than three panels or shop sections.

(d) **Full Chord Assembly** - Assemble, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower, then ream their field connection holes while the members are assembled, and ream the web member connections to steel templates set at geometric (not cambered) angular relation to the chord lines. Mill at least one end of each web member or scribe normal to the longitudinal axis of the member and accurately locate the templates at both ends of the member from one of the milled ends or scribed lines.

(e) **Progressive Chord Assembly** - Assemble connecting chord members in the manner specified for Full Chord Assembly and in the number and length specified for Progressive Truss or Girder Assembly.

(f) **Complete Structure Assembly** - Assemble the entire structure, including the floor system.

(g) **Check Assemblies with Numerically Controlled Punched and Drilled Field Connections** - A check assembly consists of at least three connecting shop sections, or in a truss, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths; that is, the length between field splices. Check assemblies shall be based on the proposed order of erection, joints in bearings, special complex points such as the portals of skewed trusses, and similar considerations, as directed. Check assemblies shall be the first such sections of each major structural type to be fabricated.
Use geometric angles (giving theoretically zero secondary stresses under dead-load conditions after erection) or cambered angles (giving theoretically zero secondary stresses under no-load conditions) as shown or specified.

No match-marking and no shop assemblies other than the check assemblies are required.

If the check assembly fails to demonstrate that the required accuracy is being obtained, further check assemblies may be required at no additional cost to the City. Acceptance of the check assembly does not relieve the Contractor of the responsibility for assuring accurate fit-up during erection.

(h) Match-Marking - Match-mark connecting parts assembled in the shop for the purpose of reaming holes in field connections, and furnish a diagram showing such marks to the Engineer.

00560.44 Coatings:

(a) Galvanizing - Galvanize as shown or specified according to 02530.70.

(b) Other Coatings - Unless otherwise shown or specified, prepare and coat all steel surfaces according to Section 00594.

00560.45 Marking and Transporting to Site - Handle members and transport to the Project Site according to 00560.24 and the following:

- Mark each member with an erection mark for identification and furnish an erection diagram showing the erection marks.
- Mark the weight of members weighing more than 6,000 pounds on the member.
- Load structural members on trucks or cars so they may be transported and unloaded without being excessively stressed, deformed or otherwise damaged.
- Ship fasteners (bolts, nuts, and washers) according to 02560.60(a-3).
- Do not allow welding to be done on the steel members for the purpose of transporting anchorage.
- List and describe the contained material plainly on the outside of each shipping container.
- Furnish as many copies of material orders, shipping statements and erection diagrams as directed and show the weights of the individual members on the statements.
- Brace the girders properly and adequately, so as to eliminate cyclic out-of-plane bending stresses in the web gap between the end of stiffener on the web and the girder flange due to cyclic swaying motion in transit. Take care to minimize dynamic loads transmitted to girder support points during transit.
Furnish the Engineer stamped detail plans of loading, unloading, supporting and bracing of the steel plate girders on trucks or cars for shipment to the Project Site, according to 00150.35. The review will not relieve the Contractor of responsibility for safe transportation of steel members.

00560.46 Erecting:

(a) General - Erect the metalwork, remove temporary construction and do all work required to complete the structure(s), including the removal of the old structure(s) according to Section 00501, if specified.

(b) Methods and Equipment - Before starting the erection work, the erection method proposed and the amount and character of equipment to be used will be reviewed. This review will not relieve the Contractor of the responsibility for the safety of the method or equipment, or from carrying out the work in full according to the plans and specifications. Do not perform work until approval has been obtained.

(c) Falsework - Design, construct, maintain and remove falsework according to 00540.41, 00540.42, and 00540.52. Review of the Contractor’s plans will not relieve the Contractor of any responsibility.

(d) Field Inspecting and Testing - All erecting work is subject to the Engineer’s inspection. Provide all facilities required for a thorough inspection of the work. Material not previously inspected, as well as previously inspected material, will be inspected after delivery to the construction site.

(e) Handling and Storing Materials - Handle and store materials at the erection site according to 00560.24 and 00560.45.

(f) Bearings and Anchorages - Test, furnish and place structure bearings according to Section 00582. Construct rockers, hangers and other anchorages made entirely of structural steel according to the following:

- Drill holes for anchor bolts and set them in portland cement grout, or preset them as specified.
- Locate anchors and set rockers or rollers considering variation from mean temperature at the time of setting, and anticipated lengthening of bottom chord or bottom flange due to dead load after setting. As nearly as practical, at mean temperature and under dead load, the rockers and rollers shall stand vertically and anchor bolts at expansion bearings shall center their slots.
- Provide full and free movement of the superstructure at moveable bearings. Make sure it is not restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

(g) Assembling Steel - Handle the material carefully so no parts will be bent, broken or otherwise damaged.

Do not perform hammering which will injure or distort the members.
Prepare bearing surfaces and surfaces to be in permanent contact before the members are assembled.

Assemble the parts accurately as shown, following any match-marks.

Unless erecting by the cantilever method, erect truss spans on blocking that gives the trusses proper camber. Leave the blocking in place until the tension chord splices are completed and all other truss connections are pinned and bolted.

Use fitting-up bolts of the same nominal diameter as the high-strength bolts, and cylindrical erection pins 1/32 inch larger.

Fill 50% of the holes in splices and field connections with equal numbers of fitting-up bolts and cylindrical erection pins before bolting with high-strength bolts. Fill 75% of the holes in splices and connections carrying added construction loads during erection with equal numbers of fitting up bolts and erection pins.

Tighten permanent bolts in butt-jointed splices of compression members and in railings after the span, if movable, has been swung.

Perform all field welding according to AWS D1.5 and all interim specifications.

(h) Pin Connection - Use pilot and driving nuts when driving pins. Drive pins so the members take full bearing on them. Screw pin nuts up tight and burr the threads at the face of the nut with a pointed tool.

(i) Misfits - The correction of minor misfits involving small amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, immediately report to the Engineer any error in the shop fabrication or deformation resulting from handling, storage and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, or by a moderate amount of reaming and slight chipping or cutting. Have the correction method approved. Make the correction in the Engineer's presence. The Contractor shall be responsible for all misfits, errors and injuries. Make the necessary corrections and replacements as approved by the Engineer.

Finishing and Cleaning Up

00560.70 Finish (Non-Coated Weathering Steel Only) - Sandblast all exposed surfaces of AASHTO M 270 (ASTM A 709), Grade 50W non-coated weathering steel, according to SSPC-SP6, Commercial Blast Cleaning, SSPC's Steel Structures Painting Manual. The appearance of the blast-cleaned surface shall approximate Pictorial Standard Sa 2 of SSPC-VIS 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces, except no mill scale particles will be allowed; only rust or mill scale stains down in the profile will be allowed. The use of acids to remove scale and stains in the field is not allowed.
Promptly clean exposed surfaces of steel contaminated with stains, oil or foreign material after the above sand blasting cleaning process, as directed, to preserve conditions for uniform weathering of steel.

**Measurement**

00560.80  **Measurement** - No measurement of quantities will be made for work performed under this Section. Estimated quantities of structural steel will be listed in the Special Provisions.

00560.81  **Miscellaneous Metal** - Minor metal parts such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices and other structural steel shapes, unless otherwise provided, will be classified as structural steel.

The weight of miscellaneous metal will be included in the estimated quantity of structural steel specified.

**Payment**

00560.90  **Payment** - The accepted quantities of structural steel will be paid for at the Contract lump sum amount for the item "Structural Steel".

Payment will be in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- bolts, studs or bearing devices made entirely of structural steel (such as rockers and hinges)
- fabricating, transporting and erecting the structure(s)
- furnishing, erecting, and removing falsework
- preparing and coating
Section 00570 - Timber Structures

Description

00570.00 Scope - This work consists of furnishing and installing timber and glued laminated timber in bridges and other timber structures as shown or directed. Timber and lumber will be identified as timber in this Section.

The terms "hardware" and "fastenings" include nails, spikes, bolts, washers and nuts, dowels, lag screws, timber connectors, truss rods and shoes, and all other metal used in timber construction.

Materials

00570.10 Materials - Furnish materials meeting the following requirements:

- Coatings for Steel ..........................................................00594
- Coatings for Timber .......................................................02210
- Connectors and Fasteners ............................................02150
- Driven Piles ...................................................................00520
- Galvanizing ...............................................................02530.70
- Glued Laminated Timber ...............................................02140
- Preservative Treatment ....................................................02190
- Timber ...........................................................................02130

When preservative treatment of timber is required, the plans or Special Provisions will indicate the type and kind of treatment.

00570.11 Metal Parts - Hot-dip galvanize all hardware and all other metal parts after fabrication according to 02530.70 or coat all hardware and all other metal parts after fabrication according to Section 00594.

00570.12 Timber Fabrication:

- Use either split ring or shear plate timber connectors as specified. Install in precut grooves of dimensions as recommended by the manufacturer.
- Fabricate all members including holes, grooves, and special cuts, requiring timber connectors before treatment.
- When prefabricating from templates or shop details, bore bolt holes not more than 1/16 inch from specified location and perpendicular to the face of the timber. Bore bolt holes according to 00570.41.
- Submit unstamped working drawings for review, according to 00150.35, for prefabricated material before fabrication.

00570.13 Timber Storage - Store timber on the site in orderly piles or stacks. Provide protection from the weather or direct sun by a suitable covering.
Open-stack untreated timber on supports at least 12 inches above the ground surface and sticker to permit air circulation between the tiers and courses. Provide 1/2 inch thick by 1 1/2 inch wide stickers. Place stickers with the wide face bearing against the timber and at a spacing that provides adequate support for the members for their full length. Align stickers vertically to prevent uneven support and warp during storage.

Store timber after fabrication in a manner that prevents alignment changes of the members before assembly.

Store, protect, and handle glued laminated timber according to the American Institute of Timber Construction AITC 111 "Recommended Practice for Protection of Structural Glued Laminated Timber during Transit, Storage, and Erection".

**Construction**

**00570.40 Treated Timber** - Handle treated timber that prevents dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. Use nylon slings to handle treated timber. Do not use cant hooks, peaveys, pikes or hooks.

When treated timbers are to be placed in a marine or brackish environments, field treated and untreated cuts, borings and other joint framings will not be allowed below high-water elevation.

Do not cut, frame, or bore treated timber after treatment unless necessary. If untreated wood is exposed by cutting, planing, sanding, or any other means, trim all cuts and abrasions in timber, and cover with 2 applications of a field preservative according to 02190.30.

Pour field preservative into all holes bored after treatment, or treat the holes with field preservative with an approved pressure hole treater. Treat all unfilled holes with field preservative and plug with treated plugs. Field treat according to 02190.30 and the recommendations of the manufacturer.

When forms or temporary braces are attached to treated timber with nails or spikes, fill the resulting holes by driving larger size galvanized nails or spikes flush with the surface, or plug holes as required for unfilled bolt holes.

**00570.41 Fasteners:**

- Bore holes for drift pins, drift bolts, and dowels either 1/32 inch smaller than or the same size of the actual pin diameter.
- Bore holes for bolts 1/32 inch to 1/16 inch larger than the bolt diameter. Accurately align holes in main members and side plates. Do not force drive bolts.
- Bore holes for truss rods with a bit 1/16 inch larger than the rod.
• Drive nails and spikes with sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces are evidence of poor work and sufficient cause for removal of damaged material.

• Bore holes for lag screws in two parts as follows:
  • Bore the lead hole for the shank the same diameter as the shank and the same depth as the length of the unthreaded shank.
  • Bore the lead hole for the threaded portion a diameter equal to approximately 2/3 of the shank diameter.

• Use a malleable iron washer of the size and type designated under all bolt heads and nuts in contact with wood except under button-head bolt heads.

• Lock all nuts after final tightening with a second nut or use self-locking nuts.

• Countersink where smooth faces are required. Coat recesses formed for countersinking with field preservative according to 02190.30 and the manufacturer's directions. After the bolt or screw is in place, fill horizontal recesses with asphalt roofing cement.

• Install all fasteners and connections according to the manufacturer's recommendations.

00570.42  Framing - Cut and frame all timber to a close fit so that the joints have even bearing over the entire contact surfaces. Shimming will not be allowed.

(a) Pile Bents - Drive piles according to Section 00520. No shimming on tops of piles will be allowed.

Select the piles for any one bent as to size, to avoid undue bending or distortion of the sway bracing.

Distribute the piles of varying sizes to secure uniform strength and rigidity in the bents of any given structure.

(b) Framed Bents - Provide true and even bearing of sills on pedestals or piles. Finish concrete pedestals so the sills or posts support framed bents with even bearing.

Fasten posts to sills as shown. Remove all earth from contact with all timber so there will be free air circulation around them.

(c) Caps - Place timber caps to obtain an even and uniform bearing over the tops of the supporting posts or piles.

(d) Bracing - Bolt or lag screw intermediate intersections of bracing.
00570.43 **Stringers** - Place stringers according to the following:

- Knots near edges will be in the top portions of the stringers.
- Outside stringers may have butt joints, but lap interior stringers to take bearing over the full width of the floor beam or cap at each end. Do not extend the stringer end more than 6 inches beyond the floor beam or cap.
- Separate the lapped ends of untreated stringers at least 1/2 inch and securely fasten where shown or specified.
- Stagger joints when stringers are two spans in length.
- Frame cross-bridging between stringers as shown, with full bearing at each end against the sides of stringers, and securely toe-nail with at least two nails in each end.

00570.44 **Decking** - Unless otherwise shown or specified, construct decking with 4 inch x 12 inch planking and covering materials.

(a) **Planking** - Provide planking that is surfaced on four sides (S4S).

Place planking heart side down with 1/4 inch opening between planks for seasoned material and with tight joints for unseasoned material. Spike planks securely to each stringer with a minimum of one 3/8 inch x 8 inch spike placed 3 inches in from each edge.

(b) **Covering Materials** - Cover the planking with one of the following:

- 2 inch x 2 inch timber strips, placed transverse to the planking and nailed with 16d galvanized common nails at 12 inch centers. Cover deck with a warranted waterproofing membrane according to Section 00591 and a Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00745; or
- 1 inch thick tongue and groove structural CD exterior grade plywood. Nail the plywood with face grain parallel to stringers using 10d galvanized or zinc coated ring shank nails. Place nails at 6 inch centers along all edges and 12 inch maximum centers intermediate. Fasten expanded metal grillage with a minimum opening of 1/4 inch and a minimum thickness of 1/8 inch to the top of the plywood for the entire roadway area. Minimum fastening shall be at 12 inch centers each direction using 8d galvanized common nails. Cover deck with a warranted waterproofing membrane according to Section 00591 and a Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00745.

00570.45 **Wheel Guards and Railings** - Frame wheel guards and railing as shown, and erect true to line and grade.

Unless otherwise specified, provide wheel guards, rails, and rail posts that are surfaced on four sides (S4S).
Lay wheel guards in sections not less then 12 feet long unless otherwise shown.

For trusses, build railings after the removal of the falsework and the adjustment of the trusses to correct alignment and camber.

**00570.46 Trusses** - Finished trusses shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and show a smooth curve through panel points conforming to the correct camber. Fit all bearing surfaces accurately. Uneven or rough cuts at the points of bearing will be cause for rejection of the piece containing the defect.

**00570.47 Coating** - When specified, coat timber bridges according to the manufacturer's recommendations.

**Measurement**

**00570.80 Measurement** - The quantities of all timber, except piling and glued laminated timber, incorporated into the permanent, finished structure, will be measured on the volume basis, based on the nominal dimensions of the members and the actual dimensioned length. No allowance will be made for waste.

The quantities of glued laminated timber members will be measured on the volume basis, based on the net dimensions of the members.

Driven piles will be measured according to 00520.80.

Warranted waterproofing membrane will be measured according to 00591.80.

Asphalt concrete wearing surface will be measured according to 00745.80.

**Payment**

**00570.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Timber and Lumber</td>
<td>MFBM</td>
</tr>
<tr>
<td>(b) Glued Laminated Timber</td>
<td>MFBM</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Driven piles will be paid for according to 00520.90.
Warranted waterproofing membrane will be paid for according to 00591.90.

Asphalt concrete wearing surface will be paid for according to 00745.90.

No separate or additional payment will be made for hardware, fastenings, preservative treatment, and coatings.
Section 00581 - Bridge Drainage Systems

Description

00581.00 Scope - This work consists of furnishing and installing metal deck drains, drain pipe and appurtenances for bridges as shown, specified or directed.

Materials

00581.10 Materials - Furnish steel pipe of standard weight meeting the requirements of ASTM A 53 and galvanized after fabrication according to AASHTO M 111 (ASTM A 123).

Furnish deck drains, hangers, clamps, and other incidentals meeting the requirements of Section 02530 and Section 02560.

Construction

00581.40 General - To prevent movement during concrete placement, support the pipe and deck drains by ties and other approved devices according to 00530.41.

00581.42 Appurtenances - Provide a watertight connection to the deck drains in the bridge deck as shown or directed.

00581.50 Test Bridge Drainage Systems - Test bridge deck drains and pipe connections to the storm drain system according to Section 00445 to ensure that the drains and drain pipe are water tight and free of obstructions.

Measurement

00581.80 Measurement - The quantities of bridge deck drains will be measured on the unit basis of each deck drain installed.

Payment

00581.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per each, for the item "Bridge Drains".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for drain pipe connected to bridge drains or for water used in testing the drain systems.

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Section 00582 - Bridge Bearings

Description

00582.00 Scope - This work consists of the following:

(a) Composite Bearings - Design, fabricate, test and install composite bearings according to the latest AASHTO LRFD Design Specifications and Section 02570. The bearing fixity (fixed bearing, guided bearing, nonguided bearing) and restrictions about type of bearing (disc, fabric pad, pot, spherical) will be shown or specified.

(b) Elastomeric Bearings - Furnish, test, and install elastomeric bearings according to the AASHTO LRFD Construction Specifications and Section 02571.

(c) Rockers and Hangers - Furnish and install bearings, such as rockers and hangers, which consist entirely of structural steel, according to Section 00560.

00582.02 Definitions:

Composite Bearing - Bearing having a rotational element between an upper and a lower unit. This includes disc bearings, fabric pad bearings, pot bearings and spherical bearings.

Disc Bearing - Composite bearing whose rotational element is comprised of a polyether urethane disc with an upper and lower unit.

Elastomeric Bearing - Bearing consisting of a single layer of elastomer (plain) or of several layers of elastomer alternated with steel plates (reinforced).

Fabric Pad Bearing - Composite bearing whose rotational element is a preformed fabric pad.

Fixed - Restrained against all horizontal structural movement.

Guide Bars - The elements that restrain the lateral movement of a sliding bearing.

Guided - Able to accommodate structural movement in a specified horizontal direction.

Nonguided - Able to accommodate structural movement in all horizontal directions.

Pot Bearing - Composite bearing whose rotational element is a piston supported on an elastomeric disc, totally confined within a base pot cylinder.

Spherical Bearing - Composite bearing whose rotational element consists of an upper plate with a spherical concave bottom surface and a lower plate with a spherical convex top surface.
Materials

00582.10 Materials - Furnish materials from the CPL and meeting the requirements of Section 02570 and Section 02571, as applicable.

00582.20 Composite Bearings - Unless otherwise shown, use only one type of composite bearing per bridge, subject to the following requirements:

- Make composite bearings, including all plates except distribution plates and masonry plates, removable and replaceable.
- Provide rotational elements between upper and lower units to meet the following:
  - **Upper Unit** - The upper unit shall consist of a distribution plate that is permanently attached to the superstructure and a sole plate attached to the distribution plate with cap screws. For a guided or nonguided bearing, a stainless steel sheet shall be welded to the bottom surface of the sole plate.
  - **Lower Unit** - The lower unit shall consist of a masonry plate permanently anchored to the structural support and a base plate attached to the masonry plate with cap screws. A separate masonry plate and base plate are not necessary for fabric pad bearings fabricated as outlined in 00582.27, third paragraph.
- **Bearing-to-Base Connection**:
  - The base pot of a pot bearing, the lower bearing plate of a disc bearing, or the convex plate of a spherical bearing shall be welded to the base plate.
  - For guided or nonguided bearings, a polytetrafluoroethylene (PTFE) sheet shall be recessed into and bonded to the top surface of the piston of a pot bearing, the upper bearing plate of a disc bearing, the top surface of the concave plate of a spherical bearing, or a steel backing plate bonded to the top surface of a fabric pad forming a sliding surface with the stainless steel surface of the sole plate.
  - For fixed bearings, the piston of a pot bearing, the upper bearing plate of a disc bearing, or the concave plate of a spherical bearing shall be welded to the sole plate.

Provide bearings that accommodate the loads, movements, and rotations as shown.

Use schematic drawings, or details of bearings shown, to describe the attachment of the upper unit to the superstructure, and the attachment of the lower unit to the substructure.
00582.21 **Disc Bearings** - Design disc bearings according to the following:

- The shear restriction mechanism shall allow free rotation but prevent any shear being applied to the rotational element.
- Each guided bearing shall resist the total horizontal load at the bent or hinge where it is located.

00582.25 **Composite Bearings with Polytetrafluoroethylene (PTFE) Sliding Surface:**

(a) **PTFE Sliding Surfaces** - Recess PTFE 1/16 inch into the material it is bonded to for all composite bearings.

Bond PTFE to the steel substrate sufficiently to develop a horizontal force as shown and not less than 10% of the vertical design capacity shown, in addition to the shear force developed as a result of the natural bearing friction shear force.

(b) **PTFE Rotational Surface for Spherical Bearings** - Use only woven PTFE having a minimum thickness of 1/8 inch. The PTFE shall be recessed 1/16 inch into the spherical element.

PTFE fabric minimum thickness shall be 1/16 inch when measured according to ASTM D 1777.

(c) **Stainless Steel Sliding Surfaces** - Provide a flat stainless steel sliding surface which completely covers the PTFE surface in all operating positions, plus at least 2 inches more in every direction of possible movement.

Provide a spherical stainless steel rotational surface attached to the convex surface of the spherical convex plate of each spherical bearing so that it completely covers the convex surface of the plate.

00582.26 **Guide Bars for Composite Bearings** - Provide a sliding surface between the guide bars and the guide element made of polished stainless steel against virgin PTFE. The virgin PTFE shall be bonded and mechanically fastened to the guide bars. Provide guide bars that:

- Resist the horizontal design forces on the bearing, but not less than 10% of the vertical design load of the bearing.
- Resist the total horizontal load at the bent or hinge where it is located. Do not include the resistance due to bearing friction as part of the horizontal load capacity of guided bearings and fixed bearings.
- Are Integral and machined from a solid plate, or attached by welding or with cap screws, or fabricated from a single steel plate.
• Have a space equal to 3/16 inch plus or minus 1/16 inch to the guided member.
• Allow the guided member to be always within the guides at all points of translation and rotation of the bearing. Avoid guiding the member off the fixed base or any extension of it where transverse rotation is anticipated.

00582.27 Sole, Base, Distribution, and Masonry Plates for Composite Bearings - Make the bottom surface of sole plates flat and level. Make the top surface flat, and sloped as required to mate with the bottom surface of the distribution plate.

Use 3/4 inch minimum plates, except sole plates may taper to 5/8 inch at the thinnest edge.

For fabric pad bearings, keeper bars at least 1/4 inch thick shall be fastened to the top surface of the base plate, around the perimeter of the fabric pad, with high-strength cap screws. Provide a gap at all bar ends to allow drainage.

Provide studded anchors or threaded bolts, as shown or specified, to anchor the masonry plates to the supported and supporting members. Locate anchoring devices to avoid conflict with metal reinforcement and prestressing systems.

00582.30 Fabrication - Fabricate bearings according to the reviewed working drawings and these Specifications.

(a) Working Drawings - Submit unstamped working drawings according to 00150.35 for both composite bearings and elastomeric bearings.

(1) Composite Bearings - For composite bearings, include:

• Complete details of the anchor layout
• Plan and elevation of the bearing showing dimensions and tolerances
• Complete details of all components with sections showing all materials incorporated into the bearing
• All ASTM or other material designations
• Vertical and horizontal force capacity
• Compressive stresses on all sliding surfaces, and on elastomeric polyether urethane and cotton duck surfaces, at maximum and minimum design loads
• Rotational capacity
• Translation capacity for guided and nonguided bearings
• Instructions for installation of the bearing
(2) **Elastomeric Bearings** - For elastomeric bearings, include:

- The overall dimensions of the bearings
- The durometer hardness of the elastomer and the ASTM designation of reinforcing materials, if any
- The thicknesses of the components of reinforced bearings and the cover over edges of reinforcements

(b) **Minimum Requirements for Composite Bearings:**

(1) **Edges** - Grind edges of all parts of the bearing so that sharp edges are eliminated.

(2) **Welding** - Perform all welding and inspection of welding for structural steel according to 00560.26.

(c) **Special Requirements for Horizontal Capacity of Composite Bearings**
- Submit stamped calculations supporting the design for horizontal force capacity, according to 00150.35. Calculations are not required when the design horizontal capacity is less than, or equal to, 10% of the design vertical capacity. A horizontal proof load test report may be submitted instead of engineer's calculations. See 002570.20(b) for test requirements.

00582.31 **Disc Bearings** - Fabricate upper and lower bearing plates as follows:

- Connect the lower bearing plate to base plate by means of a fillet weld around entire perimeter of the lower bearing plate.
- For a fixed bearing, connect upper bearing plate to the sole plate by means of a fillet weld around the entire perimeter of upper bearing plate.

00582.32 **Fabric Pad Bearings** - Fabricate fabric pad bearings according to the following:

(a) **Steel Backing Plate** - Minimum thickness of the steel backing plate shall be 3/8 inch.

Bond the backing plate to the top surface of the fabric pad under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the fabric pad manufacturer.

Finish the surface of steel recess to a surface roughness of 250 microinches or better, and to Class A flatness:

(b) **Fabric Pad** - Maximum allowable bearing pad thickness is 4 inches. For pads over 2 inches thick, place an 11 gauge steel shim at mid-depth.
00582.33  **Pot Bearings** - Fabricate pot bearings according to the following:

(a) **Pot** - Fabricate the pot from one solid plate by machining.

Finish the top and bottom surfaces of the pot cylinder to Class A flatness.

Connect the pot cylinder to the base plate by means of a fillet weld around the entire perimeter of the pot cylinder.

(b) **Piston** - Fabricate the piston from one solid plate by machining.

Finish the top surface to Class A flatness.

Finish the bottom surface to Class C flatness.

For a fixed bearing connect the piston to the sole plate by means of a fillet weld around the entire perimeter of the piston.

(c) **Elastomeric Disc** - Make the disc in one piece.

Recess the upper edge of the elastomeric disc to accommodate the flat brass sealing rings.

Lubricate the disc with a material compatible with the elastomer.

00582.34  **Spherical Bearings** - Fabricate spherical bearings according to the following:

(a) **Spherical Concave Plate**:

Finish top surface to a roughness of 125 microinches or better, and Class A flatness.

Fabricate the concave radius of the bottom surface to have a positive tolerance not to exceed 0.010 inch according to ANSI Y14.5.

For a fixed bearing, connect to the sole plate by means of a fillet weld around the entire perimeter of top surface of spherical concave plate.

(b) **Spherical Convex Plate** - Fabricate the top convex stainless surface from one of the following:

- Solid stainless steel ASTM A 240, Type 304 or 304L
- Stainless steel weld overlay a minimum of 3/32 inch thick

Fabricate convex radius of the top surface to have a negative tolerance not to exceed 0.010 inch according to ANSI Y14.5.

Finish the top surface to a roughness of 20 microinches or better, and other surfaces to a roughness of 250 microinches or better.
00582.35
Finish the bottom surface to Class B flatness.

Connect to base plate by means of a fillet weld around entire perimeter of bottom surface of spherical convex plate.

00582.35 Composite Bearings with Polytetrafluoroethylene (PTFE) Sliding Surfaces:

(а) PTFE Sliding Surfaces - Bond PTFE to steel substrate under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the PTFE manufacturer.

After completion of the bonding operation, the PTFE surface shall be smooth and free of bubbles.

(b) Stainless Steel Sliding Surfaces - Attach stainless steel to steel substrate by a seal weld around entire perimeter of stainless steel sheet. Clamp stainless steel sheet down to have full contact with the steel substrate during welding. Fabricate so welds do not protrude beyond the sliding surface of the stainless steel.

00582.36 Guide Bars for Composite Bearings - Construct guide bars parallel to the surface on which they bear and to other guide bars to within a tolerance of plus or minus 1/32 inch for the full length of the bar.

The tolerance for section dimensions is plus or minus 1/16 inch.

If guide bars are welded to the sole plate, weld before attaching the stainless steel surface.

00582.38 Coatings for Steel Bearings - Coat all exposed steel surfaces, except stainless steel, according to Section 00594.

00582.39 Elastomeric Bearings - Fabricate elastomeric bearings according to the following:

(a) Pads - Pads 1/2 inch and less in thickness shall be made entirely of elastomer. Pads over 1/2 inch in thickness shall consist of alternate laminations of elastomer and metal.

(b) Pad Sizing - Mold pads individually to the sizes required. No shearing to size or drilling of holes will be allowed except pads 1/2 inch and less in thickness may be sheared.

(c) Tolerances and Finishes - Tolerances and finishes shall be according to 002571.20(d).

00582.40 Shipping and Handling - Protect all bearings from damage during shipment, and keep them dust-free. Protect composite bearings as follows:
• Fully assemble each bearing at the manufacturing plant and deliver to the construction site as a complete unit ready for installation.
• Mark centerlines on the sole plate and base plate for checking alignment in the field.
• Hold bearings together with removable restraints so the sliding surfaces are not damaged.
• Ship and store bearings in lightproof, moisture-proof and dustproof packages.

Construction

00582.50 Installation - Use only one type of bearing on any one bridge unless shown, specified or directed otherwise.

(a) Composite Bearings - Install composite bearings as follows:

• Obtain approval of the bearing assembly proposed for use before constructing the upper portions of the supporting structure so bearing elevations may be properly determined.
• Before constructing bridge bearing seats, inform the Engineer in writing, of the total bearing thickness.
• Do not place bridge bearings on concrete bearing areas that are irregular or improperly prepared.
• Install bearings level and according to the manufacturer’s recommendations, subject to these Specifications.
• Install bearings in exact positions, and with full and even bearing.
• Protect the sliding surfaces of PTFE bearings from contact with concrete or other foreign matter.
• To prevent gouging and contamination, install bearing with the stainless steel surface on top of the PTFE interface.

(b) Elastomeric Bearings - Construct bearing seats for elastomeric bearings parallel to the bottom surfaces of the members which will bear on them. Install as follows:

• Set elastomeric bearing pads directly on the concrete pad surface.
• Provide for a uniform bearing over the entire area of the bearing seat and over the entire area of the superstructure member in contact with the bearing pad.
• Keep pads in correct position during erection of superstructure members.

(c) Cleanup - Remove all forms and debris that interfere with the free action of the bearing assemblies.
Measurement

00582.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Composite Bearings - Composite bearings will be measured on the unit basis, of bearing devices in place which includes all components from the bearing seat attachment through the superstructure attachment.

(b) Elastomeric Bearing Pads - Elastomeric bearing pads will not be measured.

Payment

00582.90 Payment - The accepted quantities of bridge bearings will be paid for according to the following:

(a) Composite Bearings - Composite bearings will be paid for at the Contract unit price, per each, for the item "Bearing Devices, Bent ______".

The bent number will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary for complete the work as specified.

No separate or additional payment will be made for designing, fabricating, and testing composite bearings.

(b) Elastomeric Bearing Pads - No separate payment will be made for elastomeric bearing pads. This item is included in one or more of the listed items.
Section 00583 - Electrical Conduit In Structures

Description

00583.00 Scope - This work consists of furnishing and installing electrical conduit in structures as shown or as directed.

Materials

00583.10 Materials - Furnish galvanized rigid metal or intermediate metal conduit meeting the requirements of 02920.10, and nonmetallic Schedule 40 conduit meeting the requirements of 02920.11. Furnish other materials meeting the requirements of Section 00960 and Section 02920.

Construction

00583.40 General - Install conduit as shown and specified, according to the applicable portions of 00530.41 and Section 00960.

Install galvanized steel conduit on all runs externally attached to structures, and all runs stubbing out of the structure or entering conduit expansion devices. Where nonmetallic conduit is installed elsewhere in the run, the conduit segment stubbing out or entering the expansion device shall have a minimum length of 5 feet of galvanized rigid metal embedded within the concrete.

Install embedded conduit in concrete members with 2 inch clearance from the nearest face of concrete.

Measurement

00583.80 Measurement - The quantities of electrical conduit in structures will be measured on the length basis, including the stub-outs if shown.

Payment

00583.90 Payment - The accepted quantities of electrical conduit in structures will be paid for at the Contract unit price, per foot, for the item "_______ inch Electrical Conduit".

The size of the conduit will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for junction boxes, cabinets, expansion joints, fittings, or fasteners.
00584.00  **Scope** - This work consists of furnishing and placing elastomeric concrete nosing to form a bulkhead at bridge ends or at expansion joints, including cleaning and preparing the concrete or steel surfaces as shown and specified.

00584.10  **Materials** - Furnish elastomeric concrete nosing using materials from the QPL and the following:

Provide materials delivered in their original, undamaged containers bearing the manufacturer's label with the following information:

- Product name
- Component part
- Name and address of manufacturer
- Date of manufacture
- Use-by date
- Batch number
- Mixing ratio

Provide sufficient materials in storage at the site prior to beginning construction to complete the entire elastomeric concrete nosing as detailed on the plans or as directed. Store the materials to prevent damage by the elements and to ensure the materials maintain their original quality.

Store the materials so that the storage space is dry and maintains a temperature as recommended by the manufacturer. Use only stored materials that meet these requirements at the time of use.

If used, the promoter/initiator for the methacrylate resin may consist of a metal drier and peroxide. Do not mix the metal drier directly with the peroxide. Store the containers so that no leakage from one material contacts the containers of the other materials.

00584.20  **Equipment** - Use equipment recommended by the product manufacturer and approved by the Engineer.
00584.30 **Manufacturer's Representative** - Provide a manufacturer's representative on-site during the installation of the elastomeric concrete nosing. The manufacturer's representative shall be either someone independent of the Contractor's work force or a member of the Contractor's work force that possesses certification from the manufacturer that the Contractor's representative has the knowledge, skills, and training to install the elastomeric concrete nosing. Discuss the work to be done with the manufacturer's representative to review the methods of installation and the equipment needed before beginning the work.

The representative shall advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of the elastomeric concrete nosing.

Mix, place, and cure the elastomeric concrete nosing according to the recommendations of the manufacturer's representative.

**Construction**

00584.40 **General** - Construct elastomeric concrete nosing according to the following:

(a) **Training** - Use installers trained in application methods and in the health and safety requirements specific to the materials used.

(b) **Safety** - Make available to workers any manufacturer's safety precautions for hazardous chemicals. Ensure that all workers wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) **Weather Conditions at Time of Installation** - Do not proceed with installation until the weather conditions meet the requirements of the manufacturer's representative.

00584.41 **Surface Preparation** - Ensure that all surfaces to receive elastomeric concrete nosing material are sound, dry, clean, frost free, and sand blasted at the time of nosing installation. Sandblast steel contact surfaces to SSPC-10, "Near-White Blast Cleaning", immediately before constructing the nosing. Prepare the deck surface according to these Specifications and the material manufacturer's recommendations.

00584.43 **Elastomeric Concrete Placement** - When an asphaltic concrete overlay is to be used as the wearing surface, place a bond breaker on the area where the concrete nosings are to be constructed before placing the asphaltic concrete overlay over the bridge deck joints. After the overlay is placed, sawcut the overlay to the width shown on the plans, remove the overlay material in the joint area and construct the elastomeric concrete nosing.
Prepare the elastomeric concrete nosing material by mixing the aggregate at the recommended temperature with the mixed binder. Clean and dry the bonding surfaces and prepare joint surfaces according to the manufacturer's recommendations. Place the properly mixed elastomeric concrete into the prepared area on each side of the expansion joint. Compact and trowel the elastomeric concrete to the required shape.

Form and cast the elastomeric concrete nosing to smoothly match the surface of the finished roadway. Finish the surface to a moderately rough texture such as that produced by a wood float.

Protect the elastomeric concrete nosing material from damage, and allow the nosing to cure properly prior to opening the work area to traffic. Do not open up to traffic without the approval of the manufacturer's representative.

00584.75 Warranty - Provide a manufacturer's warranty that the elastomeric concrete will not delaminate, debond, rut, or otherwise fail to perform for 2 years. Acts of god or failures adjacent to the installation would not be included. The manufacturer will replace or repair the installation using specification materials.

The Warranty period will start on the date the Engineer accepts the work and authorizes final payment.

The Warranty shall recite that the manufacturer is required to repair or replace, at the discretion of the Engineer, all elastomeric joint nosings that fail during the warranty period at no additional cost to the City. The repairs shall be made within 6 months of the City's written request to do so.

Perform Warranty repair work when weather permits. At the discretion of the Engineer, temporary repairs may be required at the manufacturer's expense to protect traffic until permanent repairs can be made.

Measurement

00584.80 Measurement - The quantities of elastomeric concrete nosing will be measured on the length basis, from face of curb to face of curb taken along the centerline of the joint, between the outer limits of the installed material. Only one measurement will be taken along each installed joint, regardless of the number of recesses, openings, or voids filled with the elastomeric concrete nosing material.

The estimated quantities of elastomeric concrete nosing is based on a nominal depth of 2 inches.

The quantities of elastomeric concrete nosing deeper than 2 inches will be measured on the volume basis to the nearest 0.05 cubic yard. Joint seal material will be measured according to 00585.80.
Payment

00584.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Elastomeric Concrete Nosing</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Elastomeric Concrete Nosing Material</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

Item (a) includes elastomeric concrete nosing installed to a nominal depth of 2 inches.

Item (b) includes materials only for concrete nosing depths greater than 2 inches.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for the elastomeric concrete nosing will be limited to 75% of the amount due until the City has received the signed warranty.

Joint seal material will be paid for according to 00585.90.

No separate or additional payment will be made for providing the manufacturer's representative or for furnishing the warranty.
Section 00585 - Expansion Joints

Description

00585.00 Scope - This work consists of the fabrication, joint preparation, and installation of expansion joints as shown or specified.

00585.01 Definitions:

Armored Corner - Steel armoring to protect the vertical edges of a joint opening. The armor may be steel angles or steel shapes.

Asphaltic Plug Joint - A closed expansion and contraction joint system composed of aggregate and flexible binder material placed over a steel bridging plate.

Closed Expansion Joint - A joint in which a seal material is placed to prevent water or debris from entering the joint. This includes poured joint seals, preformed compression joint seals, asphaltic plug joints, performed strip seal systems, and modular expansion joint systems.

Filled Joint - A joint using a preformed filler, poured joint filler, traffic loop sealant, or a combination of these materials.

Modular Expansion Joint System - A closed expansion and contraction joint using a series of continuous preformed polychloroprene strip seals inserted into steel shapes to seal the joint.

Poured Joint Seals - A closed expansion and contraction joint sealed with a rapid-cure poured joint sealant.

Preformed Compression Joint Seal - A closed expansion and contraction joint sealed with a continuous preformed polychloroprene elastomeric compression gland.

Preformed Strip Seal System - A closed expansion and contraction joint using a continuous preformed polychloroprene elastomeric gland (strip seal) inserted into an extruded or formed steel retainer bar with steel anchors.

Materials

00585.10 Materials - Furnish expansion joints using materials from the CPL and meeting the following requirements:

Asphaltic Plug Joint Binder ........ as specified or as recommended
............................................................ by the manufacturer
Asphaltic Plug Joints ..........................................02440.19
Backer Rod ......................................................02440.14
Elastomer ..........................................................02570.10
Hot Poured Joint Filler ........................................02440.30
Lubricant/Adhesive ...........................................02440.15
Polytetrafluoroethylene (TFE) .............................02570.10
00585.11 Approval of Materials - Submit CPL listed products to the Engineer for Project specific approval.

Equipment

00585.20 Equipment - Use approved equipment as recommended by the product manufacturer.

Labor

00585.30 Closed Expansion Joint Installers - Use installers trained by the manufacturer in application methods of materials and health and safety to install closed expansion joints as detailed.

00585.31 Closed Expansion Joint Manufacturer’s Representative - Provide a manufacturer's representative on site during the installation of closed expansion joints. The manufacturer’s representative shall be either someone independent of the Contractor's work force or a member of the Contractor's work force that possesses certification from the manufacturer that the Contractor's representative has the knowledge, skills, and training to install the expansion joints.

The representative shall advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of expansion joints.

Construction

00585.40 Filled Joints - Unless otherwise specified, form filled joints with preformed joint filler by placing concrete directly against the preformed joint filler material. Provide formwork behind the preformed joint filler material firm enough to prevent deflection of the joint material when placing the concrete or place preformed joint filler against formed concrete. If shown or specified, place traffic loop sealant or pour joint filler at the top of the joint.

00585.41 Closed Expansion Joints - The following requirements apply to all closed expansion joints:

(a) Submittals - Submit stamped working drawings according to 00150.35 for each expansion joint at least 21 calendar days before beginning work.
(1) **Design** - Joints shall be designed to:

- Prevent the entrance of water and incompressible materials into the joint.
- Produce no appreciable elevation changes in the deck surface plane with the expansion and contraction movements of the structure.
- Accommodate the required structure movements shown on the plans.
- Support a wheel load (plus impact) corresponding to the design load shown on the plans.

(2) **Shop Drawings** - Submit shop drawings including, but not limited to:

- Plan, elevation and section of the joint system with dimensions and tolerances.
- Complete details of all joint materials with all ASTM, AASHTO or other material designations.
- Method of installation including sequence and installation details at traffic barriers, roadway surfaces, curbs and sidewalks.

(3) **Additional Submittals for Modular Joints** - See 00585.47(b) for submittals for modular joints.

(4) **Notification** - Notify the Engineer in writing at least 7 calendar days prior to installation of the joint. Include the Contract number, bridge number, joint seal material, product name and the approximate date of installation.

(5) **Certificate of Compliance** - Provide the Engineer with a certificate of compliance 21 calendar days before beginning work, including the manufacturer's name, prior to joint installation, verifying that the materials as furnished will meet the requirements of these Specifications.

(b) **Safety** - 21 calendar days before beginning work, provide safety precautions from the manufacturer for hazardous chemicals. Wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) **Joint Preparation** - Prepare the joint surfaces as directed in this Section and the material manufacturer's recommendations. Ensure that all joint surfaces to receive a seal are sound, dry, clean and frost-free at the time of joint installation. Remove expansion joint material from existing joints and construct the required joints as detailed. Repair existing joints of spalled, cracked or deteriorated concrete as shown or as directed to provide a uniform and smooth surface along the joint.

(d) **Weather Conditions at Time of Installation** - Install joint seals when the joint is dry and meets the manufacturer's technical representative's approval.
(e) Leakage Check - Check joints for leakage after rainfall has occurred or by flooding the joint with water. If leakage is observed, repair the joints at no additional cost to the City and according to the manufacturer’s recommendations.

00585.42 Armored Corners - Provide joint corner armoring and anchors as shown or specified, and according to the following:

(a) Tolerance - Install armored corners that are straight and do not deviate from a true line by more than 1/4 inch horizontal and 1/8 inch vertical over the length of the joint, nor more than 1/16 inch in either direction from a 12 foot straight edge.

Maintain a minimum cross sectional thickness of 3/8 inch when measuring the vertical backwall and the flanges of the steel retainers that act as the locking edge rails for strip seal joints. The steel retainer rails may be manufactured from rolled shapes and plates or may be hot-rolled steel with the gland groove milled after rolling.

(b) Installation - Furnish armored corners in the longest practical length as controlled by transportation and installation.

Fabricate steel according to Section 00560. Sandblast steel shapes just prior to installation. Use welding procedures conforming to AWS D1.1.

For new construction, install armored corners in preformed blockouts a minimum of 14 days after the deck is cast with the joint opening as shown. Support the armored corners securely in position before placing concrete or elastomeric concrete in the joint blockout. Install the preformed seal a minimum of 7 days after the concrete blockouts have been cast and after the deck concrete reaches 3,000 psi. For elastomeric concrete installations, install the preformed seal a minimum of 24 hours after placing the strip rails in the elastomeric concrete.

00585.43 Asphaltic Plug Joints - Furnish and install asphaltic plug joints according to the following:

(a) General - Provide a plane surface on which to place the steel bridging plate. Use elastomeric concrete as needed to repair the deck surface of new or existing concrete.

(b) Installation Procedures - Install asphaltic plug joints according to the binder manufacturer’s recommendations.

Place poured joint sealant in curbs and sidewalks.

00585.44 Poured Joint Seals - Install poured joint seals according to the manufacturer's recommendations.

00585.45 Preformed Compression Joint Seals - Install preformed compression joint seals according to the manufacturer’s recommendations and the following:

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- In one continuous strip that extends across the full roadway width and into the curbs without splices.
- So they remain in compression throughout the design movement range. Provide for maximum and minimum compressive pressures according to AASHTO M 297 (ASTM D 3542).

Base the compression joint seal nominal size on the design movement of the joint and the seal’s anticipated compression set.

**00585.46  Preformed Strip Seal Systems** - Install preformed strip seal systems according to the manufacturer's recommendations and the following:

(a) **General** - Use steel retainers acting as the locking edge rails that have a minimum cross sectional thickness of 3/8 inch for the vertical backwall and flanges. The steel retainers may be manufactured from extruded or hot-rolled steel.

Furnish steel extrusions in the longest practical length as controlled by transportation and installation. Make steel extrusion splices with an approved weld according to AWS D1.1.

Field weld rail segments that are too long to ship in one piece according to AWS D1.1.

Base the joint opening between retainer bars on structure temperature at the time of joint placement and the designed temperature movement rating.

(b) **Installation Procedure** - Install seals in one continuous strip, extending across the full roadway width and into the curbs without splices.

Remove all lubricant/adhesive from the top of the installed seal before the adhesive sets.

**00585.47  Modular Expansion Joint Systems** - Design, fabricate, install, inspect, and water test modular expansion joint systems according to the manufacturer's recommendations and the following:

(a) **General** - Furnish factory-fabricated modular expansion joints of multi-cell assemblies preset by the manufacturer before shipment, according to the approved working drawings.

Use expansion joint seals of one continuous strip extending across the full roadway width and into the curbs as shown.

Field weld rail segments that are too long to ship in one piece.

(b) **Submittals** - In addition to the requirements of 00585.41(a), submit the following to the Engineer for review or approval at least 21 calendar days before beginning work:
(1) Manufacturer's Experience - Written certification that the joint manufacturer has at least three years experience in designing and manufacturing modular expansion joints. Include the following:

- Bridge locations
- Names of owning agencies or other entities
- Names, addresses and telephone numbers of the owners' representatives

(2) Shop Drawings and Calculations - In addition to the requirements of 00585.41(a)(1) and 00585.41(a)(2), stamped drawings and calculations according to 3

- Design calculations for all structural elements including springs and bearings, including fatigue design for all structural elements, connections and splices. Show all details for welded splices on the shop drawings.
- Requirements for storage of the joint and details of temporary support of the joint for shipping, handling and job site storage.
- Installation procedures.
- Allowance for replacement of parts subject to wear in the design. Submit a written maintenance and part replacement plan prepared by the joint manufacturer to the Engineer for approval. Include a list of parts and instructions for maintenance inspection, acceptable wear tolerances, methods for determining wear, procedures for replacing worn parts and procedures for replacing the watertight seals.
- Modification of blockout reinforcing to accommodate the expansion joint unit.
- Tables showing the total anticipated movements for each joint and the required setting width of the joint assemblies at various structure temperatures.

(3) Certificates of Compliance - The following certifications:

- A manufacturer's certificate of compliance with the AISC Quality Certification Program, Simple Steel Bridges.
- A manufacturer's certificate of compliance verifying that the materials as furnished will meet the requirements of these Specifications.
- Manufacturer's certification that all PTFE sheeting, PTFE fabric and elastomer meet the requirements of Section 18 of the AASHTO LRFD Bridge Construction Specifications. Do not use reprocessed material.
- Certification that welding inspection personnel are qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors.
Certification that personnel performing nondestructive testing (NDT) are qualified and certified as NDT Level II under the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1a.

Mill test reports for all steel and stainless steel in the joint assemblies with shop drawings and calculations.

(4) Quality Assurance Inspection Program - Arrange for an independent inspection agency to provide quality assurance inspection. Submit the forms to be used by the independent inspection agency and the proposed Quality Assurance Inspection Program to the Engineer for approval prior to the start of fabrication. Quality assurance inspection is not required to be full-time inspection, but shall cover each phase of the manufacturing process. Include the frequency of inspection in the Quality Assurance Inspection Program.

(c) Shipping and Handling - Deliver the expansion joint units to the job site and store according to the manufacturer's written recommendations and as approved by the Engineer.

Do not weld lifting mechanisms, temperature setting devices and construction adjustment devices to the centerbeams or edgebeams.

Damage to the joint unit during shipping and handling will be cause for rejection of the joint.

(d) Design Requirements:

(1) General - Design and fabricate modular expansion joints from steel components so:

- Individual components conform to the applicable portions of 00585.46.
- Metal to metal contact surfaces meet the requirements of Section 00560 and welded according to AWS D 1.5.
- That joint openings of all individual cells remain equal throughout the full movement range of the joint.
- Sliding surfaces of internal joint components are made of stainless steel and PTFE.
- The expansion joint seals do not protrude above the top of the extrusions. Split extrusions may be used at curb upturns.

Design the elastomeric or urethane springs and bearings so that they are removable and replaceable. Provide for the removal and reinstallation of the strip seal from above the joint by using a 1 1/4 inch minimum joint gap width.

Account for the effects of vertical and horizontal rotations and longitudinal movements of the superstructure.
(2) **Limit States Fatigue Wheel Loads** - Design the centering beams or transverse seal separation beams, including edge beams, support bars, bearings and other structural elements for the simultaneous application of the vertical and horizontal limit states fatigue wheel load ranges shown below:

<table>
<thead>
<tr>
<th>Limit States Fatigue Vertical Wheel Load Range</th>
<th>Limit States Fatigue Horizontal Wheel Load Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Normal to the roadway surface)</td>
<td>(Parallel to the roadway surface)</td>
</tr>
<tr>
<td>26,000 pounds/wheel</td>
<td>8,100 pounds/wheel</td>
</tr>
</tbody>
</table>

These limit states fatigue wheel loading ranges include impact. Increase the limit states fatigue wheel loading range for the effect of roadway grades when the grade exceeds 4%. For roadway grades 4% or less, the loads shown can be used without modification.

Alternate wheel load ranges may be used, providing that the absolute magnitude of the wheel load ranges (i.e., sum of positive and negative loads along the same axis) is not less that the total wheel load ranges shown above.

(3) **Application of Limit States Fatigue Wheel Load Ranges** - For the design of the center beams and edge beams, apply simultaneously the 2 vertical and horizontal load ranges described above, spaced 6 feet apart, at the roadway surface as a rectangular patch loading. Use a rectangular patch 9 inches in length in the direction of traffic and 20 inches in width perpendicular to the direction of traffic. When the roadway grade exceeds 4%, add the additional horizontal component due to grade to the horizontal limit states fatigue wheel range described previously.

As shown below, the percentage of the load applied to the center beams and edge beams is based on the midrange position of the seals and the width of the top flange of the center beams.

<table>
<thead>
<tr>
<th>Width of Top Flange of Center Beams or Edge Beams</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2 inches</td>
<td>40</td>
</tr>
<tr>
<td>3 inches</td>
<td>50</td>
</tr>
<tr>
<td>4 inches</td>
<td>60</td>
</tr>
</tbody>
</table>

(4) **Fatigue Limit States Design** - Design the expansion joint structural steel members, connections both welded and bolted, and steel components to remain free of cracks after 100 million cycles, which represents the endurance limit. Perform fatigue testing to satisfy the fatigue limit states equation shown below for all expansion joint steel structural members, connections both welded and bolted, and steel components.
\[(0.5) f_{sr\, calc} \leq f_{sr\, test} \]

Fatigue Limits States Equation

where:

\[ f_{sr\, calc} = \text{calculated stress range based on the simultaneous application of 2 sets of vertical and horizontal limit states fatigue wheel ranges at 6 feet spacing.} \]

\[ f_{sr\, test} = \text{allowable limit states fatigue stress range at the endurance limit of 100 million cycles.} \]

(5) Fatigue Testing - Perform constant amplitude fatigue testing to determine \( f_{sr\, test} \), for all structural members, connections both welded and bolted, and components.

Base the allowable limit states fatigue stress range at 100 million cycles with a survival probability of 95%.

Apply the test loadings so that the vertical and horizontal loadings are applied simultaneously. Perform testing so that the horizontal load is 20% of the vertical load.

Use an independent testing laboratory for the fatigue testing. Contact the Engineer for information on facilities capable of performing fatigue testing.

(e) Fabrication - Fabricate the modular joint seals according to the dimensions, shapes, designs and details shown in the approved shop drawings. All modular joint seals for the Project shall be fabricated by the same manufacturer. Weld seal retainer clips continuously on the top and bottom, if welded to the seal separation or edge beams.

(1) PTFE Sliding Surface - Bond the PTFE under controlled conditions and according to written instructions provided by the manufacturer of the PTFE. Complete the bonding operation so that the PTFE surface is smooth and free from bubbles.

(2) Stainless Steel Sliding Surface - Finish the stainless steel sliding surface to a finish of 8 microinches (RMS) or less.

Weld the stainless steel sheet all around to the steel backing plate by a tungsten-arc welding process according to the current AWS specifications. Clamp the stainless steel sheet so that it has full contact with the steel backing plate during welding. Stop the welds so that they do not protrude beyond the sliding surface of the stainless steel.
(f) **Installation** - Install the joint assembly according to the shop drawings submitted under 00585.47(b)(2), and as follows:

- Install so that the joint matches the roadway profile and grade.
- Fill the blockout opening with the same class of concrete that is used in the deck. Place concrete after the modular expansion joint has been set to final line and grade.
- Construct the bottom inside edge of the outside extrusions so that the concrete-steel interface below the joint is at the same elevation and distance from the centerline of the joint, full length of the joint.
- Place modular expansion joint seal units only in preformed blockouts. Coordinate the shop drawings with City-furnished details to provide a proper fit. Protect the joint unit and the blockout from damage prior to installation and after installation. Submit to the Engineer for approval details for bridging the joint for construction loads. Do not subject the joint to construction loads for a minimum of 7 days after placing the blockout concrete.
- Set the modular expansion joint unit to the proper width for the structure temperature at the time of installation. Record the temperature of the underside of the concrete deck slab on both sides of the expansion joint. Take the average of the readings to adjust the joint width for the ambient temperature setting. In lieu of surface readings, internal slab temperature readings may be taken by drilling a 1/4 inch diameter hole 3 inches deep into the deck slab; filling the hole with water and inserting a probe thermometer. Read the probe thermometer after 30 minutes. See the plans for change in joint opening per change in structure temperature from ambient temperature.
- Remove all forms and debris that interfere with the free action of the expansion joint unit after casting the joint blockouts.
- Any mechanical devices supplied by the manufacturer to set the joint unit to the proper joint width shall remain the property of the fabricator.

(g) **Inspection and Acceptance** - Expansion joint units will be accepted after satisfying the following three levels of inspection. The manufacturer shall provide for both Quality Control inspection and Quality Assurance inspection. A description of the three levels of inspection follows:

1. **Quality Control Inspection** - During the fabrication of major components, the manufacturer shall provide full-time quality control inspection to ensure that the materials and workmanship meet or exceed the requirements of the Contract.

2. **Quality Assurance Inspection** - Provide quality assurance inspection according to the plan submitted under 00585.47(b)(4).

No kinks or bends are allowed in the expansion joint units, except those necessary to match the roadway grades. Remove any expansion joint unit exhibiting bends or kinks, other than those shown on the approved shop drawings from the Project Site.
Replace polychloroprene strip seals not fully bonded to the steel extrusions with fully bonded seals at no additional cost to the City.

Perform fatigue testing of all structural members, splices, connections and components according to 00585.47(d)(5). Retest any revised details of material substitutions developed after the initial fatigue testing.

(3) **Field Inspection** - The manufacturer's representative shall provide full-time quality control inspection to ensure that workmanship meets these specifications.

(4) **Acceptance** - Expansion joint units shall satisfy each of the three levels of inspection described above prior to acceptance. Replace or repair expansion joint units that fail any one of the three levels of inspection at no additional cost to the City.

Submit any proposed corrective procedures to the Engineer for approval before undertaking corrective work.

**00585.48 Hot-Dip Galvanizing** - Hot-dip galvanize steel expansion joint surfaces, except stainless steel, according to AASHTO M 111 (ASTM A 123).

The contact surfaces at all galvanized slip critical structural bolted connections shall meet Class C (slip coefficient 0.33) surface preparation requirements.

**00585.75 Manufacturer's Warranty** - Furnish a Manufacturer's Warranty according to 00170.85(c)(1), for a Warranty period of 2 years.

For purposes of the Warranty, expansion joints will be deemed to have failed when:

- Leakage is detected
- Delamination is detected
- Debonding is detected
- Rutting that is greater than the surrounding pavement surfaces is detected

The Warranty shall recite that, upon written notification by the City, that the expansion joint, or portions of the expansion joint, used according to the manufacturer's recommendations, have failed, the manufacturer will replace expansion joint or portions of the expansion joint, within 6 months of the City's written notification.

The Warranty shall also recite that if the manufacturer fails to replace the expansion joint of portions of expansion joints within the given 6 month period after written notification, the City at it's discretion, will replace the expansion joints or portions of the expansion joint, or have the expansion joints or portions of the expansion joint replaced by an independent contractor, with the total cost of replacement, including all materials, equipment, labor, associated mobilization, and traffic control costs will be paid for by the manufacturer.

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Provide materials and use procedures to replace failed expansion joints that meet the specifications in effect at the time of original installation, or if no longer available, use current expansion specifications.

**Measurement**

**00585.80 Measurement** - No measurement of quantities will be made for closed expansion joints. Estimated quantities of closed expansion joints will be listed in the Special Provisions.

The estimated quantities of asphaltic plug joints is based on a nominal depth of 2 1/4 inches.

The quantities of asphaltic plug joint material for joints deeper than 2 1/4 inches will be measured on the volume basis.

No measurement will be made for elastomeric concrete used to provide a plane surface on which to place the steel bridging plate.

**Payment**

**00585.90 Payment** - The accepted quantities for work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Asphaltic Plug Joint Seals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Asphaltic Plug Joint Seal Material</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(c) Poured Joint Seals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Type ___ Preformed Polychloroprene Compression Joint Seals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(e) Performed Elastomeric Strip Seals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) Type _____ Modular Expansion Joint Seals</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Item (a) includes sawcutting, steel bridging plate, and installation of the asphaltic plug joint to a nominal depth of 2 1/4 inches.

Item (b) includes materials only for asphaltic plug joint depths greater than 2 1/4 inches.

In items (d) and (f), the type of joint seal will be inserted in the blank.

Payment will not be made before joints have passed the leakage test of 00585.41(e). No payment will be made for any material installed as replacement material for that removed, unless the Engineer determines that the reason for the removal was beyond the Contractor's control, or that the plans specifically required the removal.
00585.90

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for work under this Section will be limited to 75% of the amount due until the City has received the signed warranty.

No separate or additional payment will be made for:

- preformed expansion joint filler, poured joint filler, traffic loop sealant, or sawcutting
- providing the manufacturer's representative or for furnishing the warranty
Section 00587 - Bridge Rails

Description

00587.00 Scope - This work consists of constructing bridge rails of the material or combination of materials shown or specified.

Bridge rails will be classified as concrete or steel according to the predominant material used in the rail.

Materials

00587.10 Materials - Furnish materials meeting the following requirements:

- Cast Steel Posts ......................................................... 02810.40
- Concrete ......................................................................... 02001
- Concrete Coating ........................................................ 02210.30
- Galvanizing ..................................................................... 02530.70
- Grout ........................................................................ 02080.30
- Reinforcement ................................................................. 00530
- Structural Steel ................................................................ 02530
- Structural Steel Tubing ............................................... 02810.20
- Thrie Beam Rail .......................................................... 02810.50
- Tube ........................................................................... 02810.30

Construction

00587.40 General - Construct bridge rails:

- True to line, grade and dimensions shown or established, with a smooth, even top rail without following any unevenness in the superstructure.
- Vertical, rather than normal to the deck, whether the deck is superelevated or not, unless shown otherwise.
- After falsework has been removed, so that the span is self-supporting.

00587.42 Concrete Rails:

(a) General - Construct concrete rails according to Section 00540 and the following:

- Cast-in-place rails may be slipformed as the Contractor elects subject to paragraph (c) of this subsection.
- Construct expansion joints which permit freedom of movement. After all other work is completed, use a sharp chisel to remove all loose or thin shells of concrete likely to spall under movement at expansion joints.
(b) **Fixed Forms** - Forms shall be smooth and tight fitting, rigidly held in line and grade, and removed without damage to the concrete. Make form joints in vertical planes. Construct all moldings, panel work, and bevel strips as shown. Make corners in the finished work true, sharp and free from cracks, spalls or other defects.

(c) **Slipformed** - Concrete rails may be slipformed if the plans contain details for slipforming. Before slipforming any permanent rail, the Contractor shall meet one or both of the following requirements (1) and (2) as directed:

1. Cast a test section at least 20 feet long as follows:
   - Place the test section off the structure.
   - Use the same section and reinforcement as detailed for use on the structure.
   - Include one typical contraction or open joint.
   - Remove at no additional cost to the City.

2. Identify, for the purposes of evaluating work quality, at least 2 recent slipformed rail projects completed by the Contractor.

The Engineer will make the final decision about the use of slipforming on the Project based on work quality. If slipforming is used, conform to the following:

- Provide concrete with a slump of 1 inch ± 1/2 inch.
- Keep the top and faces of the finished rail free from sags, humps, and other irregularities.
- Maintain contraction joints, open joints, and expansion joints to the dimensions shown until the concrete sets.
- Use slipforming only for sections of rail with constant dimensions. Use fixed forms where dimensions vary, as at luminaire or signal supports and at rail end transitions.
- Brush-finish exposed rail surfaces with vertical strokes. Do not grind brush-finished surfaces that are to receive a Class 1 finish.
- Remove and replace any unsatisfactory work at no additional cost to the City.

(d) **Surface Finish** - Give all exposed concrete surfaces a general surface finish followed by a Class 1 surface finish (ground and coated) according to 00540.53 except as provided in 00587.42(c).

(e) **Latex Paint Cure for PCC** - As an option to curing cast-in-place or slipformed bridge rails, according to the Specifications, the following procedure may be used:
Allow free moisture to flash off, but only until the concrete surface does not glisten, and never for more than one hour.

Apply the first coat of a latex paint approved for bridge use and meeting the requirements of 02210.30(c) at an application rate of 150 square feet per gallon.

Allow the first coat to air-dry for one hour.

Apply the second coat of latex paint at the same rate as above, with application direction transverse to the direction of the first coat.

00587.43 Metal Rails:

(a) Construction - Provide structural steel tubing, tube or metal thrie beam rail as shown or specified. Fabricate and erect metal rails according to Section 00560. Adjust metal rails before fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout their length.

(b) Coating - Unless otherwise specified, galvanize steel portions of the railing. Galvanize after fabrication of the rail according to 02530.70. If galvanized portions of the rail are to be coated, coat according to Section 00594.

Measurement

00587.80 Measurement - No measurement of quantities will be made for work performed under this Section. Estimated quantities of bridge rails will be listed in the Special Provisions.

Payment

00587.90 Payment - The accepted quantities of bridge rails will be paid for at the Contract lump sum amount for the appropriate bridge rail items listed in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for anchor bolts and anchorage devices, except those cast in precast concrete members.

Payment for anchor bolt and anchorage devices in cast-in-place concrete members and for reinforcement extending from a precast unit, cast-in-place deck, wall or bridge end panel into the rail will be included in payment made for the precast unit, cast-in-place deck, wall or end panel, as appropriate.

Payment for guardrail terminal connectors, connection plates, spacer blocks and other connection hardware will be included in the payment for the guardrail transition item according to 00810.90.
Section 00591 - Waterproofing Membrane

Description

00591.00 Scope - This work consists of furnishing and placing bridge deck waterproofing membrane on the decks of bridges as shown.

Materials

00591.10 Materials - Furnish a warranted waterproofing membrane system from the CPL that complies with the maximum profile grades and superelevations shown. Profile grade and superelevation limitations for products are listed in the CPL and are available from the manufacturer.

(a) Concrete Patching Material - If concrete repairs are required, furnish a PCC patching material from the QPL that is compatible with the membrane.

(b) Tack Coat - Furnish hot asphalt tack coat meeting the requirements of 00745.11(a), or a primer coat as recommended by the membrane manufacturer. An emulsified tack will not be allowed.

Labor

00591.30 Manufacturer's Representative - Provide the services of a manufacturer's representative authorized to sign a warranty on behalf of the manufacturer to observe the installation of each membrane system, including the wearing course. The manufacturer's representative may be an employee of the Contractor if written documentation from the manufacturer is provided stating that the Contractor is certified to install warranted materials and the identified employee is certified to serve as the manufacturer's representative. Follow the recommendations of the manufacturer's representative in all matters pertaining to proper installation of the membrane system. Instruct the manufacturer's representative to immediately alert the Contractor and the Engineer of anything that could affect the performance of the waterproofing membrane or the warranty.

Construction

00591.40 General - Do not begin membrane installation until all materials and equipment necessary to perform the installation and any required repairs are at the job site.

(a) Weather and Other Restrictions - Place tack coats, surface patching, and waterproofing membrane when the deck is dry, the air temperature is between 40 °F and 90 °F, and the surface temperature of the deck is below 120 °F.

(b) Handling Materials - Load and unload waterproofing membrane and primer without damage to the materials. Store membrane indoors at a temperature between 60 °F and 120 °F until it is placed on the bridge deck. Do not allow the membrane to sit in direct sunlight longer than necessary.
(c) Pre-Placement Meeting - Hold a pre-placement meeting with the Engineer at least 10 days prior to application of each membrane. For each membrane proposed for use, submit for the Engineer’s approval a manufacturer approved procedure for preparing the deck surface, applying the membrane, and placing an asphalt concrete protective course if one is required. Include details such as the number of persons required, equipment, installation sequence, traffic control, and the estimated time schedule for installing the membrane and opening the bridge to traffic. For bridges with curbs or concrete rails, submit unstamped manufacturer shop drawings according to 00150.35, detailing membrane placement at the curbs or rail. Do not proceed with the work until the proposed procedure, and shop drawing, if applicable, have been approved by the Engineer.

(d) Area of Application - On bridges without curbs, apply the waterproofing membrane from outside edge to outside edge of the deck, or within the limits of the AC wearing course.

Protect adjacent surfaces not to be covered with the membrane from spatter or coating.

00591.42 Preparing Existing Bridge Decks:

(a) Surface Removal - Unless otherwise specified, remove the existing asphalt concrete wearing surface from the deck, according to Section 00503, before placing the waterproofing membrane. Ensure that the deck is smooth and free of obstructions. Small areas of asphalt and asphalt stain need not be removed if smooth and tightly bonded to the deck, as determined by the Engineer. The nominal thickness of the wearing surface on the bridge(s) will be identified in the plans.

Completely remove any existing paint and pavement markers.

Remove any spalled or loose surface concrete to sound concrete. Prepare the deck surface so that it is smooth and free of voids, sharp projections, form release agents, concrete curing agents and other contaminants.

Prior to placing the membrane, verify that the deck is free from loose rocks, or other debris. Clean the deck with compressed air immediately prior to placing the membrane.

Dispose of all removed materials according to 00290.20.

(b) Surface Patching - Leave the final surface smooth enough to allow placing the waterproofing membrane directly on the deck, yet rough enough to provide good adhesion.

Use hand-placed grout or other approved material to smooth or fill all gaps, breaks, or edges that are more than 1/4 inch deep, including the offset in adjacent slabs with different camber, vertical edges adjacent to different milling passes or striations left by milling machine teeth. If a water-based grout is used, allow for proper cure time as recommended by the membrane manufacturer, prior to applying the membrane.
00591.43 **Tack Coat** - Place a hot tack coat, or primer as applicable, on a dry deck only.

00591.45 **Installation** - Construct waterproofing membrane according to the manufacturer's recommendations and as approved.

Release bubbles or pockets of trapped air or vapor and repair in a manner satisfactory to the Engineer.

00591.46 **Protection During Construction:**

(a) **General** - Do not use the waterproofing membrane as a temporary wearing surface or haul road. Until the membrane is protected by pavement, keep Contractor traffic on the membrane to a minimum. Allow Contractor traffic only with the approval of the Engineer and the membrane manufacturer.

Immediately repair and damage to the membrane caused by the paving operation. Make repairs before resuming paving.

(b) **Protective Course and Tack Coat** - If the wearing course will be 3/4 inch open-graded HMAC, place a protective course of 3/8 inch dense-graded HMAC conforming to Section 00744, at least 3/4 inch thick, over the membrane. Treat the top surface of the membrane with a hot asphalt tack coat according to the membrane manufacturer's recommendations prior to placing the protective course, or prior to placing a 3/4 inch or 1/2 inch dense-graded HMAC wearing course, if applicable. The mix may be Level 3 or Level 4 as directed.

00591.47 **Leakage Test** - As soon as the deck is ready for traffic, flood the deck with water to test the membrane for leakage. No water leakage will be allowed. Make appropriate repairs and re-test, at no additional cost to the City, until no leakage is detected.

00591.75 **Manufacturer's Warranty** - Furnish a warranty, for a warranty period of 2 years, from the manufacturer and signed by a manufacturer's representative, against failure of the product or the installation, conforming to the following requirements:

(a) **Warranty Period** - The warranty period will begin on the date the Engineer authorizes final payment for the Work under this Section.

When the City makes written request to the manufacturer for repair or replacement, the Warranty period will stop until the requested repair(s) or replacement(s) are made and accepted.

(b) **Failure** - For purposes of the warranty, failure is defined as:

- Leakage of the membrane, or
- Delamination of the membrane from the underlying or overlying pavement.
(c) **Remedy** - Upon notification by the Engineer of a failure as defined above, provide the following remedy:

- Repair failures within 60 days at no additional cost to the Agency.
- Use materials and procedures meeting these Specifications.
- Match repairs to finished grade.
- Coordinate timing of repair work with the Engineer.

(d) **Traffic Control; City's Right to Make Repairs** - If, in the opinion of the Engineer, a failure of the membrane causes a traffic hazard, the failure may be temporarily corrected by City or other forces at the manufacturer's expense. Replace temporary repairs with permanent repairs at the manufacturer's expense and according to these Specifications.

**Measurement**

00591.80 **Measurement** - The quantities of waterproofing membrane will be measured on the area basis, and will be the sealed surface area, excluding curb and rail faces, and will be limited to the neat lines and dimensions shown.

**Payment**

00591.90 **Payment** - The accepted quantities of waterproofing membrane will be paid for at the Contract unit price, per square foot, for the item "Warranted Waterproofing Membrane".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals required to complete the work as specified.

Payment for work done under this Section will be limited to 75% of the amount due until the City has received the signed warranty.

No separate or additional payment will be made for:

- overlaps
- removing the existing asphalt concrete wearing surface and pavement markings, preparing the surface, surface patching, asphalt used as a protective course, and for providing tack coat, and primer
- providing the manufacturer’s representative, furnishing the warranty
Section 00593 - Powder Coating Metal Structures

Description

00593.00 Scope - This work consists of preparing and powder coating new and existing metal structures and features, including all steel, galvanized, aluminum, and other specified surfaces.

00593.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

AAMA - American Architectural Manufacturers Association

(b) Definitions:

Apparent Magnetic Surface - The magnetic surface that a magnetic gauge senses, somewhere between the peaks and valleys of the profile, after the steel is roughened by abrasive cleaning.

Cleaning - Removing detrimental material in preparation for coating.

Coat - Apply powder to a substrate to form a single uniform layer. A coat is comprised of as many applications as necessary to achieve the specified coat thickness.

Coating - Protective material after it is applied to a structure.

Coating System - All specified coats applied separately in a predetermined order.

Hold Point - A time at which the Contractor is required to stop a particular activity until a phase of work is inspected or tested. If the Engineer finds this phase conforms to the Specifications, the subsequent phase of work may proceed.

Manufacturer's Recommendation - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

Phase - An activity or step of the preparation and coating procedures to be inspected or tested. The transition from one phase to another represents a hold point.

Preparation - Measures taken to provide a suitable surface ready to coat.

Substrate - A surface to which a coating is to be applied. This may be the prepared surface of the metal structure or a previous coating.
Surface Profile - Roughness of a cleaned steel surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

00593.03 Precoating Conference - Before beginning work, the Contractor's supervisory personnel, together with any subcontractors and their supervisory personnel who are to be involved in the preparation and coating work, and a representative from the coating manufacturer shall meet with the Engineer for a precoating conference at a time mutually agreed upon. Submit the following 14 calendar days before the precoating conference:

- The name, location, and contact information (mail address, phone, and e-mail) for the firm performing the powder coating operation.
- Quality assurance and quality control (QA/QC) programs established and followed by the firm performing the powder coating operation.
- A product data sheet and material safety data sheet of each type of coating material to be used, including the products to be used for field repair of damaged areas.
- Project specific powder coating plan, including a specific cleaning, surface preparation, pre-heating, application, curing, shop and field coating repair, handling, and storage processes to be taken for the assemblies being coated for the Project.
- Letter from galvanizer that neither water quenching nor a chromate conversion coating will be used on the surfaces that are to be powder coated.

00593.04 Notice - Notify the Engineer, in writing, at least 7 calendar days in advance of the date that preparation and coating operations are to begin.

Materials

00593.10 Materials - Furnish material meeting the requirements of this Section and the Special Provisions.

(a) Coating Systems:

(1) Steel Substrates - Provide a two coat system for steel substrates consisting of a zinc-rich epoxy primer and a polyester topcoat.

(2) Galvanized and Other Non-Steel Metallic Substrates - Provide a two coat system for galvanized and non-steel metallic substrates consisting of an epoxy primer and polyester topcoat.

(b) Specifications - Furnish an epoxy powder primer meeting the following requirements:
<table>
<thead>
<tr>
<th>Test</th>
<th>Zinc-rich Epoxy</th>
<th>Epoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion (ASTM D 3359, Method B)</td>
<td>B5 (no failure)</td>
<td>B5 (no failure)</td>
</tr>
<tr>
<td>Flexibility (ASTM D 522, Method B)</td>
<td>Pass 1/4&quot; Mandrel Bend</td>
<td>Pass 1/8&quot; Mandrel Bend</td>
</tr>
<tr>
<td>Pencil Hardness (ASTM D 3363)</td>
<td>H Plus</td>
<td>H Plus</td>
</tr>
<tr>
<td>Specific Gravity (ASTM D 792)</td>
<td>2.30 minimum</td>
<td>1.25 minimum</td>
</tr>
<tr>
<td>Zinc in Dry Film (calculated weight)</td>
<td>50% minimum</td>
<td>–</td>
</tr>
</tbody>
</table>

Furnish a polyester topcoat meeting the requirements of the American Architectural Manufacturers Association (AAMA) Specification 2605.

Before notice required by 00593.04, submit a manufacturer’s certification stating that each coating material in the coating system:

- Meet the requirements of this Section.
- Meet the specifications of the manufacturer’s data sheets.
- Are compatible, including coating repair materials.

The color of the topcoat will be specified in the Special Provisions. Obtain approval of the Engineer before applying any coating.

00593.12 **Caulking** - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. The caulking color shall be clear or match the color of the top coating.

Furnish industrial grade polystyrene or polyurethane backing material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer’s approval of the caulking and backing material before using.

**Construction**

00593.40 **General** - Structures to be prepared and powder coated include new and existing steel, galvanized, and non-steel metallic substrates.

00593.41 **Special Fabrication, Preparation, and Coating:**

(a) **Inaccessible Surfaces** - Coating inside of rolled sections, such as poles and rail tubes, is not required unless otherwise specified.

(b) **Fabrication Areas** - Schedule fabrication, preparation, and coating so that the coating system is not damaged by the welding or fabricating process.
Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00593.42.

Do not apply coatings within 4 inches of the weld before finishing the welding operation.

00593.42 Preparation of Surfaces:

(a) **Steel Substrates** - Clean new and existing steel surfaces to be coated according to SSPC-SP 10, "Near-White Blast Cleaning". The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1 and have a 1.0 to 2.5 mil profile finish.

Apply a phosphate conversion coating as a surface treatment immediately after blasting. Use heat to dry the phosphate coating immediately after it is applied.

(b) **Galvanized Substrates** - Clean and prepare galvanized surfaces to be coated according to ASTM D 6386, the approved project specific powder coating plan, and the following:

- **Newly Galvanized Steel** - Smooth and clean surfaces according to ASTM D 6386, Section 5 and prepare surfaces according to ASTM D 6386, Section 5.4.1.
- **Partially Weathered Galvanized Steel** - Check and prepared according to ASTM D 6386, Section 6, then smooth and clean surfaces according to ASTM D 6386, Section 5, then prepare surfaces according to ASTM D 6386, Section 5.4.1.
- **Weathered Galvanized Steel** - Prepare according to ASTM D 6386, Section 7.

(c) **Other Non-Steel Metallic Substrates** - Solvent clean non-steel metallic substrate surfaces according to SSPC-SP 1 then either light brush blast, according to SSPC-SP 7, with a non-ferrous blasting media or hand sand. The prepared surface shall have a 1.0 to 2.5 mil profile finish.

(d) **All Substrates** - Remove fins, tears, slivers, and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing, or similar operations.

00593.43 Coating Metal Structures:

(a) **Description** - When not in conflict with this Section and the Special Provisions, perform powder coating application according to the following:

- The recommendations of the coating manufacturer.
- The best practices of the trade.
(b) **Application of Coating** - Apply the powder coating system according to the following requirements:

1. **Surface Condition** - Ensure that the surface to be coated is free of moisture, dust, grease, rust, or other substance which would prevent the bond of succeeding applications. Prepare contaminated surfaces to the Engineer's satisfaction before applying the coating.

2. **Application Methods** - After surface preparation, apply the two coat system according to the powder coating manufacturer's recommendations, the approved Project specific powder coating plan and the following:
   
   - Pre-heat surface.
   - Apply the epoxy primer coat, followed by a partial cure.
   - Apply the polyester finish coat, followed by the finish cure.

   Apply each coat in a uniform layer, completely covering the preceding coat. Finish each individual coat by the manufacturer in a sufficiently different shade so that skips and holidays can be easily detected. Correct skips or other deficiencies before application of succeeding coats.

(c) **Coating Requirements**:

1. **Minimum Dry Film Thickness** - Apply all coats to the following minimum thicknesses:
   
   - **Primer**: 2.5 mils
   - **Topcoat**: 2.5 mils

2. **Coating Thickness and Coverage Requirements** - Each coat shall consist of as many applications as necessary to cover the work and achieve the minimum thickness specified. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the steel substrate.

   The dry film thickness will be measured for acceptance using a Type 2 gauge according to SSPC-PA 2. If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D 4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness the total coating system will be rejected even if the thickness of the total system equals or exceeds the total specified thickness.

3. **Additional Top Coat Requirements** - Even if the total thickness of prime coat exceeds the prime coat specified thickness, apply the top coat to at least the minimum required topcoat thickness, as well as provide uniform and complete coverage and appearance.
(d) **Time of Application** - Apply the prime coat within 4 hours of the final cleaning and before any visible indication of rust forms.

(e) **Caulking** - Apply the caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch. Apply caulk over the backing material to form a watertight seal.

00593.44 **Inspecting and Testing** - The powder coating firm shall conduct or make arrangements for powder coating tests required in the approved Project specific powder coating plan. Tests include the following:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanness of Abrasive Material</td>
<td>ODOT TM 616</td>
</tr>
<tr>
<td>Cleanness of Compressed Air</td>
<td>ASTM D 4285</td>
</tr>
<tr>
<td>Pictorial Surface Preparation Standards</td>
<td>SSPC-VIS 1</td>
</tr>
<tr>
<td>Surface Profile by Replica Tape</td>
<td>ASTM D 4417</td>
</tr>
<tr>
<td>Hardness</td>
<td>AAMA 2605 and ASTM D 3363</td>
</tr>
<tr>
<td>Dry Film Thickness by Magnetic Gauge</td>
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<tr>
<td>Dry Film Thickness by Tooke Gauge</td>
<td>ASTM D 4138</td>
</tr>
<tr>
<td>Pull-off Strength of Coating [min. 400 psi]</td>
<td>ASTM D 4541</td>
</tr>
</tbody>
</table>

Provide access to the Engineer, at the powder coating facility, to visually inspect the assemblies for the presence of coating holidays and other unacceptable surface imperfections, and to witness the coating thickness testing, the hardness testing, and the adhesion testing.

Provide documentation of the QA/QC testing to the Engineer.

Assemblies failing these tests will be rejected. Repair and recoat the rejected assemblies as directed.

Do not ship assemblies to the Project site without Engineer's approval.

00593.45 **Protecting Against Damage:**

(a) **Contaminated Surfaces** - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00593.42 and recoat with all specified coats. Clean, reprepare and recoat at no additional cost to the City.
(b) **Surfaces Not to Be Coated** - Protect surfaces that are not to be coated from blast-cleaning, overspray, and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the City.

(c) **Handling, Shipping, or Surface Damage** - After curing and acceptance, individually wrap the coated assemblies with multiple layers of bubble wrap, or other protective wrapping materials specified in the approved Project specific powder coating plan.

During storage and shipping, separate each wrapped assembly with expanded polystyrene spacers and other spacing materials specified in the approved plan.

After erection, repair marred and damaged coated surfaces due to the Contractor's shipping, storage, handling, and erection operations according to 00593.60.

**00593.60 Repair of Damaged and Unacceptable Coatings** - Repair damaged surfaces as follows:

(a) **Surface Preparation** - Prepare the surface according to SSPC-SP 1, SSPC-SP 2, and SSPC-SP 3. Use a solvent that is acceptable to the paint manufacturer or approved by the Engineer. Extend the prepared area at least 2 inches into adjacent, tightly adhering, intact coating.

(b) **Feathering of Repair Areas** - Feather the existing coating system surrounding each repair location. Feather the repair area for a distance of 1 inch to 2 inches to provide a smooth, tapered transition into the existing intact coating.

(c) **Coating Application in Repair Areas** - When steel substrate is exposed in the repair area, apply a coat of zinc rich primer before applying the topcoat.

When the damage does not extend to the bare substrate, apply only the affected coats.

**Measurement**

**00593.80 Measurement** - No measurement of quantities will be made for work performed under this Section.

**Payment**

**00593.90 Payment:**

(a) **New Metal Structures** - No separate payment will be made for preparing and powder coating new metal work. Payment for this work, including correction of damages, will be included in payment made for furnishing and placing the new metal structures.
(b) Existing Metal Structures - The accepted quantities for preparing and powder coating existing metal structures will be paid for at the Contract lump sum amount for the item "Prepare and Powder Coat Existing Structures".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for correction of damages described in 00593.44.
Section 00594 - Preparing and Coating Metal Structures

Description

00594.00 Scope - This work consists of preparing and coating new metal structures and features in the shop and in the field, and preparing and coating existing metal structures. This includes all:

- Interior and exterior steel surfaces
- Steel railings, bridge bearings, and bridge expansion joint assemblies
- Other miscellaneous steel
- Galvanized and aluminum surfaces

00594.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

- AAMA - American Architectural Manufacturers Association
- DFT - Dry Film Thickness
- FTMS - Federal Test Method Standard

(b) Definitions:

Apparent Magnetic Surface - The magnetic surface that a magnetic gauge senses, somewhere between the peaks and valleys of the profile, after the steel is roughened by abrasive cleaning.

Cleaning - Removing detrimental material in preparation for coating.

Coat - Apply paint or other protective material to a substrate to form a single uniform layer. A coat is comprised of as many applications as necessary to achieve the specified coat thickness.

Coating - Protective material after it is applied to a structure.

Coating Material - Protective material in the liquid state before application.

Coating System - All specified coats applied separately in a predetermined order.

Field Coating - The on-site coating of new or existing metal structures before or after erection.

Hold Point - A time at which the Contractor is required to stop a particular activity until a phase of work is inspected or tested. If the Engineer finds this phase conforms to the Specifications, the subsequent phase of work may proceed.

Maintenance Coating - The coating of existing steel structures that have been previously coated and need recoating.

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**Manufacturer's Recommendation** - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

**Paint** - A pigmented liquid, applied as a thin layer, which is converted to a solid colored film after curing. This film provides a decorative and protective coating to the substrate. The binder is a resin that may or may not be modified with natural vegetable oils, fish oils, or other ingredients.

**Phase** - An activity or step of the preparation and coating procedures to be inspected or tested. The transition from one phase to another represents a hold point.

**Preparation** - Measures taken to provide a suitable surface ready to coat.

**Shop Coating** - The coating of steel surfaces in the fabrication shop before the metal is transported to the erection site.

**Skin** - A solid or semi-solid membrane that forms on paint in a container.

**Skimming** - The process in which a film forms over a liquid coating, either during storage or after application.

**Solvent** - Liquid used to solvate or put materials into solution or to clean equipment and tools.

**Stripe Coat** - Separate, independent coating that is applied to complex details and irregular surfaces before the application of the full coat. Complex details and irregular surfaces include but are not limited to edges, seams, corners, gaps, crevices, weld lines, pitted surfaces, holes, nuts, bolts, rivets, and threads. Brushes are used to push the coating around and into complex details and irregular surfaces. Each stripe coat is a different color than the preceding and subsequent full coat, extends a minimum of 1 inch from the irregular surface, and completely hide the substrate.

**Substrate** - A surface to which a coating is to be applied. This may be the prepared surface of the metal structure or a previous coating.

**Surface Profile** - Roughness of a cleaned metal surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

**Thinner** - Volatile liquids used to thin compatible coating materials. Thinners may be a blend of solvents.

(c) **References** - In this Section, references such as SSPC-SP 1 and SSPC-PA 1 refer to Volume 2, "Systems and Specifications", of SSPC's "Painting Manual".
In these Specifications, references are made to FTMS 141, "Paint, Varnish, Lacquers, and Related Materials: Methods of Inspection, Sampling and Testing", which is distributed by the U.S. General Services Administration.

00594.03 Precoating Conference - Before beginning work, the Contractor's supervisory personnel, together with any subcontractors and their supervisory personnel who are to be involved in the preparation and coating work and a representative from the coating manufacturer, shall meet with the Engineer for a precoating conference at a time mutually agreed upon. 14 calendar days before the precoating conference, submit a plan for accomplishing all phases of the preparation and coating work including but not limited to the following:

- ventilation
- containment
- surface preparation
- painting
- coating materials
- quality control plan
- waste handling and disposal

00594.04 Notice - Notify the Engineer, in writing, at least 7 calendar days in advance of the date that preparation and coating operations are to begin.

00594.05 Access and Containment for Field Preparation and Coating - Contain work debris that is generated from dry blast cleaning operations according to the Class 1A requirements of SSPC-Guide 6, with the following parameters:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials may be used where rigid containment materials are not specified. Provide flexible containment materials that are air impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Type H1 instrument verification of air pressure in rigid containment.
- Type H2 visual verification of air pressure in flexible containment.
- Type I1 minimum specified air movement 50 feet per minute cross draft. Use portable fans as needed to provide air movement in stagnant areas.
- Type J1 exhaust air filtration 99% cleaning efficiency for particulate diameters above 39 microinches and less than 2 grains of particulate per thousand cubic feet of exhaust air (or air recycled to work area).
- Operate dust collection, air flow, and air movement equipment during blowdown to prevent settling of dust on the structure or within the containment.

Contain work debris that is generated from water jet cleaning operations according to the Class 2W requirements of SSPC-Guide 6, with the following parameters:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials may be used where rigid containment materials are not specified. Provide flexible containment materials that are water impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Ceiling not required.
- Wall height shall effectively prevent loss of contaminated water.

Contain work debris that is generated from hand tool cleaning or power tool cleaning operations according to the Class 1P requirements of SSPC-Guide 6. For hand tool cleaning or vacuum shrouded power tool cleaning, ground covers or free-hanging tarpaulins are an acceptable alternate means of containment provided the debris is captured and controlled to the same degree as Class 1P. Provide Type A1 rigid flood decking work access platforms regardless of containment methods.

Emission from various containment systems will be assessed visually. Address any visible emissions immediately.

Maintain all traffic clearances shown. Do not allow the containment and cables, hoses, supplies and equipment to encroach on the indicated traffic clearances at any time.

For containment using forced air ventilation, submit a sketch showing the size (length x width x height) and location of each containment that will be used, and identifying the air moving equipment (manufacturer, model, and capacity in cubic feet per minute) for each containment, to the Engineer for review 21 calendar days prior to precoating conference.

Structural design requirements include:
• Dead load, live load, and wind load when designing loads for containment structures and work platforms. Dead load is the self-weight of the containment and work platforms, live load is all personnel, equipment, and materials, including collected debris, required for normal operations, and wind load is a basic wind speed of 90 mph applied in the most critical direction.

• Design a factor of safety of least 6 for wire ropes and connecting hardware and at least 4 for all other components for containment structure and work platform components. Factor of safety is the ultimate failure load of the component divided by the maximum working load combination applied to the component.

• Verify structural adequacy of bridge with added loading from containment structures and work platforms using either AASHTO Standard Specifications for Highway Bridges, Group II, III, V, and VI load combinations, or AASHTO LRFD Bridge Design Specifications, Strength III loading combination.

• Submit for review at least 21 calendar days before the precoating conference the containment structure plans, specifications, shop drawings, welding procedures, and design calculations assuring that the containment system, work platforms, and the structural members of the bridge can safely resist the combined effects of dead loads, live loads, and wind loads. The plans, specifications, and calculations shall be prepared and stamped by a civil or structural engineer licensed to practice in the State of Oregon, who has designed at least one bridge painting containment structure.

Comply with Section 00290 for spill response, spill containment and cleanup of spills, and contamination.

Comply with all applicable requirements of the Occupational Safety and Health Administration, including but not limited to applicable portions of 29 CFR Ch. XVII, Sections 1926.55 through 1926.57, 1926.62, 1926.65, 1926.450 through 1926.454, and 1926.500 through 1926.503.

**00594.06 Waste Handling and Disposal** - Dispose of waste material according to 00290.20, and the requirements of SSPC Guide 7 that do not conflict with 00290.20.

**Materials**

**00594.10 Materials** - Furnish materials meeting the requirements of this Section, the Special Provisions, and the applicable portions of SSPC-PA 1, "Shop, Field and Maintenance Painting", when not in conflict with either this Section or the Special Provisions.
Coating Materials:

(a) Coating System - Furnish coating materials from the CPL and the following:

- Shop coating of steel or iron surfaces, 3 coat system with inorganic zinc primer.
- Shop coating or maintenance coating of steel or iron surfaces, 3 coat system with organic zinc primer.
- Field rehabilitation of coated steel or iron surfaces, 3 coat system with surface tolerant organic zinc primer.
- Shop coating or maintenance coating of non-ferrous surfaces, 2 coat system.

Application of coating materials will not be allowed until certifications required by 00165.35(a) and 00165.35(b) have been provided and the materials are accepted for use by City check testing.

(b) Manufacturing - Furnish coating material meeting the following requirements:

- Be prepared at the factory ready for application or mixing of multi-component coatings. Proportion multi-component coating materials by the manufacturer with each component in its correct proportion and furnished in separate containers ready for field mixing. No field mixing will be allowed for moisture-cured urethane coating system components unless approved by the Engineer.
- Be homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Include additives for control of sagging, pigment settling, leveling, drying, dryer absorption, skimming, and other qualities and properties that affect its application and curing.
- Not require a pretreatment chemical or material prior to application of the prime coat except as stipulated in these Specifications.
- Include required tinting and coloring materials at the time of manufacture. Do not use gray for the first prime coat. To provide contrast between coats, when successive coats are specified, use a different color for each coat of the system. Use tinting material that is compatible with the coating material and is not detrimental to performance.
- Unless otherwise specified, conform to the following colors:
  - Federal Standard 595B color #24272 for ODOT Green top coat
  - Federal Standard 595B color #30059 for weathering steel top coat
  - Federal Standard 595B color #26357 for miscellaneous metal on concrete bridges
• Not vary in composition without prior notice by the manufacturer and approval of the Engineer. No reformulation will be allowed.
• Be applied before expiration of manufacturer’s recommended shelf life.

(c) Packaging - Furnish each container meeting the following requirements:

• Be the manufacturer’s original unopened container.
• Be new steel or plastic of not more than 6 gallon capacity.
• Meet U.S. Department of Transportation’s Hazardous Material Shipping Regulations.
• Be lined, if necessary, to prevent attack by the coating material. The lining shall not delaminate from the container wall so as to contaminate the coating.
• Be labeled with a quality compliance certificate according to 00165.35, showing the following:
  • Manufacturer’s name
  • Exact title of coating material
  • Manufacturer’s batch number
  • Date of manufacturer
  • Identification of all toxic substances
  • Handling and application precautions

(d) Sampling and Testing - Have the coating material manufacturer furnish the following to the City’s Materials and Research Section:

• One unopened 1 quart container of each coating material, each component of multi-component coating material, and each thinner, from each batch of each coat. The City may, at its discretion, place an inspector at the site of manufacture and obtain check samples at the jobsite.
• Test results certification according to 00165.35 for each batch of each coat, and if the coating material is specified for use on steel-to-steel contact surfaces, certification that the coating material meets the requirements of 00594.11(e).
• A product data sheet for each type of coating material and thinner.
• A material safety data sheet with the initial sample of each type of coating material and thinner.

City testing will include the following tests necessary to ensure that the coating materials conform to Specifications, manufacturer’s product data sheet, and other testing as the City deems appropriate.
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density of Liquid Coatings, Inks, and Related Products</td>
<td>ASTM D 1475</td>
</tr>
<tr>
<td>Determination of Zinc in Dry Films of Paints and Coatings</td>
<td>ODOT TM 614</td>
</tr>
<tr>
<td>Coarse Particles in Pigments, Pastes, and Paints</td>
<td>ASTM D 185</td>
</tr>
<tr>
<td>Consistency of Paints Using the Stormer Viscometer</td>
<td>ASTM D 562</td>
</tr>
<tr>
<td>Fineness of Dispersion of Pigment-Vehicle System</td>
<td>ASTM D 1210</td>
</tr>
<tr>
<td>Drying, Curing, or Film Formation of Organic Coatings at Room Temperatures</td>
<td>ASTM D 1640</td>
</tr>
<tr>
<td>Volatile Content of Paints</td>
<td>ASTM D 2369</td>
</tr>
<tr>
<td>Pigment Content of Solvent-type Paints</td>
<td>ASTM D 2371</td>
</tr>
<tr>
<td>Volume Nonvolatile Matter in Clear or Pigmented Coatings</td>
<td>ASTM D 2697</td>
</tr>
<tr>
<td>Vehicle Solids (Ordinary Centrifuge)</td>
<td>FTMS 141, Method 4051</td>
</tr>
<tr>
<td>Nonvolatile vehicle Content</td>
<td>FTMS 141, Method 4053</td>
</tr>
</tbody>
</table>

City testing is not to be construed as determining or predicting the performance or compatibility of the individual coating material or the total coating system.

(e) **Specifications** - The coatings on steel-to-steel contact surfaces at all slip-critical structural bolted connections using high strength bolts shall meet Class B (slip coefficient of 0.5) coating requirements according to "Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints", as adopted by the Research Council on Structural Connections.

00594.12 **Caulking** - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. The caulking color shall be clear, approximate the color of the top coating, or be over coated.

Furnish industrial grade polystyrene or polyurethane backing material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer's approval of the caulking and backing material before using.

**Construction**

00594.40 **General:**

(a) **New Steel Structures** - Prepare and coat new steel structures and features erected at locations shown. Except as provided in these Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site.

(b) **Existing Steel Structures** - Prepare and coat the existing steel structures described in the Special Provisions.

(c) **Rehabilitating Coated Steel Structures** - Prepare and coat new steel members and existing steel structures impacted by erection. This includes all existing steel surfaces uncovered by the removal of existing steel, wood, and concrete members, except top flanges. Impacted areas include, but are not
limited to areas, where rivets or bolts are removed, and existing steel surfaces damaged during erection or other Contractor operations. Except as provided in these Specifications, perform all required preparation and coating of new steel members at the fabrication shop after completion of fabrication and before transporting to the Project Site. Perform preparation and coating of existing steel structures impacted by erection in the field.

(d) Non-Steel Metallic Substrates - Prepare and coat new non-steel substrates and features erected at locations shown. Except as provided in these Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site. Prepare and coat existing non-steel substrates described in the Special Provisions.

00594.41 Special Fabrication, Preparation and Coating:

(a) Inaccessible Surfaces - Before fabrication, prepare and coat with all coats steel surfaces inaccessible to preparation and coating after fabrication. Prepare and coat contact surfaces within slip-critical joints, constructed as part of the work under Section 00560, according to 00594.42 and 00594.43(d-1).

(b) Welded Areas - Schedule fabrication, preparation, and coating so that the coating system is not damaged by the welding or fabricating process. Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00594.42.

Do not apply coatings within 4 inches of the weld before finishing the welding operation.

00594.42 Preparation of Surfaces:

(a) New Steel Structures - Clean new steel structure surfaces to be coated according to SSPC-SP 10, "Near-White Blast Cleaning", except as modified by this Section. The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1.

(b) Existing Steel Structures - Blast-clean existing steel structure surfaces to be coated according to SSPC-SP 10, "Near White Blast Cleaning" with the appearance of the blast-cleaned surface to closely approximate Pictorial Standard SP 10 of SSPC-Vis 1 or clean to SSPC-SP 12, "High and Ultrahigh Pressure Water Jetting", cleaned to visual condition WJ-2.

(c) Rehabilitating Existing Coated Steel Structures - Clean all existing steel surfaces to be coated according to SSPC-SP 15, "Commercial Grade Power Tool Cleaning". The cleaned surface shall have a minimum surface profile of 1 mil.
The areas to be prepared shall include all areas of existing coated surfaces exposed by the removal of the existing components involved in the rehabilitation, all areas in which rivets, bolts, or plates are to be removed, and areas damaged by erection or other Contractor operations. Completely clean all existing lead-based coatings exposed by the removal of any structural or miscellaneous member to SSPC-SP 15 "Commercial Grade Power Tool Cleaning" requirements. Extend all prepared areas at least 2 inches into tightly adhering, intact paint. Overlap the subsequent coating and the still intact coating by a minimum of 2 inches. Lightly sand the overlap area of the intact coating to provide a profile for the subsequent repair coating to adhere to.

(d) Non-Steel Metallic Substrates:

(1) Galvanized Surfaces - Prepare surfaces to be coated according to ASTM D 6386.

(2) Aluminum - Solvent clean surfaces to be coated according to SSPC-SP 1 then follow by a light brush blast according to SSPC-SP 7, with a minimum nozzle pressure of 75 psi, or hand sand the surface to create a minimum 1 mil profile, or clean the surface according to the manufacturer's recommendation.

(e) All Metal Structures - Remove fins, tears, slivers, and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing, or similar operations.

Clean all surfaces of material detrimental to the application of the coating system as follows:

(1) Cleaning Methods - Blast-clean surfaces using one or more of the following methods to discharge the abrasive:

- A stream of high-pressure air
- A rotating centrifugal paddlewheel
- A stream of high-pressure water

Surfaces shall be dry before cleaning unless a wet blast cleaning method is used. Use methods specified in SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning", SSPC-SP 3, "Power Tool Cleaning", and SSPC-SP 15 "Commercial Grade Power Tool Clean", as necessary to augment blast-cleaning.

(2) Abrasives - Perform blast-cleaning using an abrasive of a size which will continually produce a surface profile of at least 1 mil, but not more than 4 mils, as measured by ASTM D 4417 using replica tape on the prepared surface. The blast-cleaning shall result in a roughened steel surface comparable to a Keane-Tator Surface Profile Comparator for sand or grit using ASTM D 4417.
If a centrifugal wheel with a grit mixer is used for blast-cleaning, inspect each member and for those members not meeting the comparator or profile requirements, perform a final blast-cleaning with high-pressure air with an abrasive to obtain the specified profile.

Provide abrasives that have no corrosion products, water, oil, or any other material detrimental to the application and adherence of the coatings. Provide abrasives that conform to SSPC-AB 1 or SSPC-AB 3. Cleanliness will be tested according to ODOT TM 616 and ASTM D 4940. The conductivity results from ASTM D 4940 shall not exceed 100 microsiemen/cm. Wet abrasives are allowed if wet sandblasting methods are used.

(3) Air - The high-pressure air used for blast-cleaning or blowing down shall be free of water, oil or any other material detrimental to the coating system. Provide adequate separators and traps. Compressed air cleanliness will be tested according to ASTM D 4285 by the Engineer.

(4) Rust Inhibitor - If a rust inhibitor is not used with wet surface preparation methods, brushblast any rust bloom on the surface before applying the coating. If an effective rust inhibitor is used, it shall be compatible with the coating system and be applied to the freshly cleaned surface or contained in the liquid used in cleaning. Use a rust inhibitor from the CPL, or prepare a test panel at least 14 calendar days before beginning work to show that the rust inhibitor does not cause loss of bond between the prepared steel substrate and the primer. If bond failure occurs, no further use of the rust inhibitor will be allowed.

(5) Cleaning Procedures - Perform blast-cleaning operations without damaging partially or entirely completed portions of the work. Do not blast-clean adjacent to areas being coated.

The blast-cleaned surface will be examined for any traces of corrosion, water, oil, grease, and other material deposited during the cleaning operations. If present, remove any detrimental material by solvent cleaning and reblast the surface.

(6) Final Preparation - Before coating, the prepared surface shall be:

- Blown down using high pressure air, within the fully enclosed containment with the specified ventilation operating and supplemented by brushing if required.
- Free of all residue.
- Repair any damaged galvanizing according to ASTM A 780.
- Acceptable to the Engineer.
00594.43 Coating Metal Structures:

(a) Description - When not in conflict with this Section and the Special Provisions, perform coating application according to the following:

- The applicable portions of SSPC-PA 1.
- The recommendations of the coating manufacturer.
- The best practices of the trade.

(b) Application Site Mixing, Thinning, and Storage of Coating Materials:

(1) Rejection - The container contents will be rejected, and not be used if:

- The material arrives at the application site in other than original, unopened containers.
- The container has a break in the lid seal or a puncture.
- The coating materials have begun to polymerize, solidify, gel or deteriorate in any other manner.
- The recommended shelf life, as stated in the manufacturer’s product data sheets, has expired.
- A skin forms on the surface of the material or on the sides of the container and the volume of the skin exceeds 2% of the material. If there is not more than 2% skin, remove and discard only the skin.

(2) Mixing - Thoroughly mix coating materials by mechanical means to ensure a uniform composition. Do not mix coating materials by means of air stream bubbling or boxing. Mix in the original container and continue until all pigment or metallic powder is in suspension. Ensure that all solid coating material that may have settled to the bottom of the container is thoroughly dispersed. After mixing, inspect the coating materials for uniformity and to ensure that no unmixed pigment or lumps are present.

Add separately packaged catalysts, curing agents, hardeners, initiators or dry metallic powders to the base coating material only after the base coating material is thoroughly mixed to achieve a uniform mixture with all particles wetted. Add the proper volume of curing agent to the correct volume of base with constant agitation. Use the mixture within the pot life specified by the manufacturer. Discard unused portions at the end of each workday.

(3) Thinning - Do not add additional thinner at the application site unless approved. The amount and type of thinner, if allowed, shall conform to the manufacturer’s specifications.

(4) Straining - Strain all coating materials after mixing to remove undesirable matter, but not pigment or metallic powder.
(5) **Agitation** - Constantly agitate coating materials as recommended by the manufacturer, and all inorganic zinc primers during application, using paint pots equipped with mechanical agitators.

(6) **Storage** - Store the coating material and solvents in original containers. Store the containers in a weather-tight space where the temperature is maintained between 40 °F and 100 °F or according to the manufacturer recommendations, whichever is more restrictive.

c) **Application of Coating:**

(1) **Surface Condition** - Ensure that the surface to be coated is free of moisture, dust, grease or other substance which would prevent the bond of succeeding applications. Protect freshly coated surfaces from contamination by abrasives, dust or foreign materials from any source. Prepare contaminated surfaces to the Engineer's satisfaction before applying succeeding coats.

(2) **Application Methods** - Apply coating materials by air or airless spray, brush, roller, any combination of these methods, or as recommended by the coating material manufacturer unless otherwise specified. Regardless of which application method is used to apply the coating, push the coating into complex details, crevices, gaps, difficult to access areas and areas with brushes where spraying does not adequately cover or penetrate. All application techniques shall conform to Section 7, SSPC-PA 1.

Apply each coat in a uniform layer, completely covering the preceding coat. Each individual coat shall be furnished by the manufacturer in a sufficiently different shade so that skips and holidays can be easily detected. Do not tint the coating material in the field unless approved. Correct runs, sags, skips or other deficiencies before application of succeeding coats. Corrective work may require recleaning, application of additional coating, or other measures as directed, at no additional compensation.

d) **Coating Requirements:**

(1) **Number of Coats and Film Thickness** - Apply all coats to the minimum thickness specified in the manufacturer's product date sheet for the coatings.

Apply the coating system in the number of coats specified in the CPL, with each coat consisting of as many applications as necessary to cover the work and achieve the minimum thickness specified for the coat.

Apply only a coating of zinc primer to all steel-to-steel and steel-to-concrete, except top flanges, contact surfaces, whether in the shop or field. The dry film thickness shall not be less than 3 mils nor more than the manufacturer's class "B" certification allows.
Do not assemble coated joints before the coatings have cured for at least the time used in the qualifying test, or as recommended by the manufacturer.

On steel-to-wood contact surfaces, apply all coatings specified.

(2) **Stripe Coats** - On maintenance coating projects apply a prime stripe coat before applying the full prime coat and apply an intermediate stripe coat before applying the full intermediate coat.

The stripe coat shall be a different color and be approximately 3 mils thick. Each stripe coat will have its own hold point and shall not be used to correct deficiencies in the preceding or subsequent coats.

The full prime coat may be applied prior to the prime stripe coat to prevent flash rusting of the cleaned steel surfaces if approved. In either case, the first application of prime coat shall be accomplished by the use of brushes as described in the definition of “Stripe Coat” in 00594.01(b).

(3) **Coating Thickness and Coverage Requirements** - Coating thickness measurements will be made by the Engineer after the application of each coat and before application of the succeeding coat. In addition to coating thickness measurements, a visual inspection for complete coverage will be made by the Engineer after each coat. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the metal substrate.

The dry film thickness will be measured for acceptance using a Type 2 gauge according to SSPC-PA 2. The frequency of measurements will be based on the following:

- A single gauge reading will be taken for each 10 square feet of surface area.
- A spot measurement is only taken at locations where a gauge reading is less than 100% of the Project specified minimum DFT.
- All spot measurements shall meet 100% of the project specified minimum DFT.
- Additional readings may be required to identify the limits of the non-compliant areas.

If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D 4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness, or reveals a missing intermediate coat, the total coating system will be rejected even if the thickness of the total system equals or exceeds total specified thickness.

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In areas where dry film thickness measurements are impractical, wet film thickness measurements will be made according to ASTM D 4414.

(4) Additional Top Coat Requirements - Even if the total thickness of prime and intermediate coats exceed the prime and intermediate coats specified thicknesses, apply the top coat to at least the minimum required topcoat thickness, as well as provide uniform and complete coverage and appearance.

(e) Time of Application - Within 3 aerial miles of the Pacific Ocean, prime existing steel structure surfaces on the same day they are cleaned, apply an approved rust inhibitor to the entire surface on the same day as cleaning, and prime within 48 hours after inhibitor application, or reblast all surfaces prior to coating.

Beyond 3 aerial miles of the Pacific Ocean, prime existing steel surfaces as soon as possible within 3 calendar days of cleaning.

All surfaces shall be free of flash rust and dry before priming.

Apply each coat over the preceding coat as soon as possible, allowing for drying time of the preceding coat, weather, temperature, and similar factors, as well as the manufacturer's recommendation.

Each coat shall be dry before recoating, and sufficiently cured so the succeeding or additional coat can be applied without delamination, blistering, wrinkling, or loss of adhesion or cohesion. Recoat times shall conform to the manufacturer's recommendations unless they conflict with this Section or any coating problems develop. Revision of recoat times requires approval of the Engineer before recoating.

(f) Caulking - Apply the caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch.

Apply caulk over the backing material to form a watertight seal.

In areas that collect or channel water, apply caulk even if coating fills the gap.

(g) Adhesion - Minimum adhesion shall be 350 psi within one week of application of each coat to its substrate. The Engineer will perform adhesion tests according to ASTM D 4541, using test method "B".
(h) **Environmental Conditions** - Apply coating materials only during periods when, according to testing by ASTM E 337, the:

- Air temperature is above 45 °F
- Steel surface temperature is:
  - Greater than 45 °F
  - Less than 115 °F
  - At least 5 °F above the dew point
- Relative humidity is within the manufacturer's recommended range

Application of coating materials will not be allowed if the Engineer determines that conditions are not favorable for proper application and performance of the coating.

If fresh coatings are damaged by the elements, replace or repair at no additional cost to the City.

If a coating system allows application in environmental conditions different from those specified, submit a letter from the manufacturer stating the conditions under which the coatings can be applied. Application under conditions other than specified will not be allowed without the Engineer's written approval.

Cover and protect the metal if coating is to be applied in adverse weather conditions. Heat the metal and surrounding air to the temperature specified in this subsection. Continue protecting the newly coated steel until the coating achieves proper cure.

(i) **Stenciling** - Stencil the month and year of application and the type of coating used in block letters 2 inches high at a location on each end of each span on the structure being coated. The exact location of stenciling will be determined by the Engineer. Use flat black color stenciling unless otherwise directed.

00594.44 **Inspecting** - The Engineer will inspect each phase of preparation and coating. Do not proceed with succeeding phases until approved. Provide the inspector timely access to areas where work is being performed. Allow adequate time for inspection at each hold point. Hold points are the following:

- Before cleaning operations begin
- After cleaning operations are completed and before application of any coating materials
- After each stripe coat
- After each full coat
- After cleaning in conjunction with coating repairs
- After application of each coat in coating repairs
- After application of last coat, before moving work platforms and containment structures

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Repair coating system damages resulting from City inspection and testing at no additional cost to the City.

Aspects of the preparation and coating process to be inspected and tested include, but are not limited to:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Conditions for Coating</td>
<td>ASTM E 337</td>
</tr>
<tr>
<td>Cleanness of Abrasive Material</td>
<td>ODOT TM 616</td>
</tr>
<tr>
<td>Ionic Contamination of Abrasive Material</td>
<td>ASTM D 4940</td>
</tr>
<tr>
<td>Cleanness of Compressed Air</td>
<td>ASTM D 4285</td>
</tr>
<tr>
<td>Pictorial Surface Preparation Standards</td>
<td>SSPC-VIS 1, 3, 4, and 5</td>
</tr>
<tr>
<td>Surface Profile by Keane -Tator Comparator</td>
<td>ASTM D 4417</td>
</tr>
<tr>
<td>Surface Profile by Replica Tape</td>
<td>ASTM D 4417</td>
</tr>
<tr>
<td>Wet Film Thickness</td>
<td>ASTM D 4414</td>
</tr>
<tr>
<td>Dry Film Thickness by Magnetic Gauge</td>
<td>SSPC-PA2 (modified)</td>
</tr>
<tr>
<td>Dry Film Thickness by Tooke Gauge</td>
<td>ASTM D 4138</td>
</tr>
<tr>
<td>Pull-off Strength of Coating</td>
<td>ASTM D 4541 (Method B)</td>
</tr>
</tbody>
</table>

00594.45  Protecting Against Damage:

(a) Contaminated Surfaces - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00594.42 and recoat with all specified coats. Clean, reprepare, and recoat at no additional cost to the City.

(b) Surfaces Not to Be Coated - Protect surfaces that are not to be coated from blast-cleaning, overspray and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the City.

Do not clean or coat galvanized steel members such as ladders, safety rails and stanchions unless otherwise directed in the Special Provisions. Protect them from damage during preparation and application operations. Repair damaged galvanizing at no additional cost to the City.

Protect navigation lights and conduits. If navigation lights or lenses are damaged by the preparation or coating operations, immediately repair or replace at no additional cost to the City. Keep navigation lights operating and visible during the hours of darkness.

(c) Handling, Shipping, or Surface Damage - Exercise care in moving or handling steel in the shop, during shipping and during erection. Do not move or handle coated metal until the coating has cured.

Repair marred or damaged coated surfaces at no additional cost to the City, with the same materials and to the same condition as specified. At the completion of all work, the coating shall be complete and the surfaces undamaged and clean.

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(d) Other Damage - Prevent, at no additional cost to the City, damage resulting from preparation and coating work, including:

- Damage to marine or vehicular traffic or harm to pedestrians in the vicinity of the work.
- Abrasive material or debris falling into an area which would create a traffic hazard.
- Damage to the bridge substructure, superstructure or motorized equipment.
- Damage to other property as a result of the Contractor's operations.

00594.60 Repair of Damaged and Unacceptable Coatings - Repair damaged surfaces and surfaces not in compliance with requirements of 00594.43 as follows:

(a) Surface Preparation - Repair localized damage, corrosion, and unacceptable coatings.

Prepare areas exhibiting coating defects down to the metal substrate, whether exhibiting visible corrosion or not, according to SSPC-SP 10.

If approved, prepare small areas according to SSPC-SP 15 so it does not damage adjacent areas. Extend the prepared area at least 2 inches into adjacent tightly adhering, intact coating.

In areas exhibiting coating defects which do not extend down to the metal substrate remove all loose, delaminating, non-intact, non-sound coating, or otherwise defective coating down to sound, still performing coating. Extend the prepared areas at least 2 inches into adjacent tightly adhering, intact coating.

(b) Feathering of Repair Areas - Feather the existing coating system surrounding each repair location. Feather for a distance of 1 inch to 2 inches to provide a smooth, tapered transition into the existing intact coating.

Verify that the edges of coating around the periphery of the repair areas are tight and intact by probing with a putty knife according to SSPC-SP 3. Roughen the existing coating in the feathered area to ensure proper adhesion of the repair coats overlap the intact, still sound surfaces at least 2 inches.

(c) Coating Application in Repair Areas - When the bare metal substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

When the damage does not extend to the bare metal substrate, apply only the affected coats.

Maintain the thickness of the system in overlap areas within the specified total thickness tolerances and overlap the intact, sound existing coating at least 2 inches.
Measurement

00594.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00594.90 Payment:

(a) New Metal Structures - No separate payment will be made for preparing and coating new metal work. Payment for this work, including correction of damages, will be included in payment made for structural steel according to 00560.90 and metal sign supports according to 00930.90 as appropriate.

(b) Existing Metal Structures - The accepted quantities for preparing and coating existing metal structures will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Containment</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Moving Bridge Containment System</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Surface Preparation</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Coating Application</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(e) Coating Materials</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Item (a) includes designing, erecting, and securing access platforms and containment structure, and containment worker protection requirements.

Item (b) includes moving and removing the access platforms and containment structure.

Item (c) includes preparing existing metal surfaces.

Item (d) includes coating existing metal surfaces.

Item (e) includes the coating material.

Partial payments of items (c), (d), and (e) will be made only for portions of the structure that have been prepared and coated with all coats specified. The partial payment will represent an estimate of the work completed as a percentage of the total coating system work to be done.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for correction of damages described in 00594.45.
Section 00595 - Reinforced Concrete Box Culverts

Description

00595.00 Scope - This work consists of constructing cast-in-place reinforced concrete box culverts (RCBC) and precast reinforced concrete boxes to the lines, grades, and dimensions shown or directed.

Materials

00595.10 Cast-in-Place Materials - For cast-in-place RCBC, cast-in-place ends, and cast-in-place wingwalls and aprons, furnish materials meeting the following requirements:

- Reinforcement ............................................................... 00530
- Concrete ........................................................................ 00540

Unless otherwise shown, provide Class 3300 - 1 1/2" or 3/4" portland cement concrete.

00595.11 Precast Materials - For precast boxes, furnish materials meeting the requirements of AASHTO M 259 or AASHTO M 273. Furnish joint seals meeting the requirements of 02440.40.

Unless otherwise shown, provide Class 5000 - 1 1/2" or 3/4" portland cement concrete.

Construction

00595.40 Cast-in-Place - Construct cast-in-place RCBC, cast-in-place ends, and cast-in-place wingwalls and aprons according to the following:

(a) Reinforcement - Place reinforcing steel according to Section 00530.

(b) Portland Cement Concrete - Place portland cement concrete according to Section 00540 and the following:

(1) Placing Concrete - Allow base slabs or box culvert footings to set at least 12 hours before constructing the remainder of the box culvert.

When constructing box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as a monolith, with sidewalls constructed full height. If this method is used, place construction joints vertical and at right angles to the axis of the culvert.

When constructing box culverts more than 4 feet in height, place concrete in the walls to at least the bottom elevation of the top slab. Allow 3 days before placing the top slab according to 00595.40(b)(2).

Construct each wingwall as a monolith.
(2) Removal of Forms and Falsework and Subsequent Loading - Do not remove forms and falsework or place subsequent loads until the following conditions are met:

<table>
<thead>
<tr>
<th>Form and Falsework Removal</th>
<th>Counting Days ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stems and walls.........................</td>
<td>1</td>
</tr>
<tr>
<td>Top Slabs.................................</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsequent Loading ²</th>
<th>Counting Days ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stems and walls over 4 feet in height..................</td>
<td>3</td>
</tr>
</tbody>
</table>

¹ From the time of the last placement of concrete in the forms or falsework supports and excluding days when the surrounding temperature is below 40 °F for 8 hours or more.

² Except loads from form work and reinforcing steel for further concrete placements.

(3) Concrete Finish - Finish all exposed concrete surfaces with a general finish according to 00540.53(a).

00595.41 Precast - Construct precast boxes according to AASHTO M 259 except as shown. A production run will be considered continuous if it is not interrupted for more than 3 calendar days.

Place a continuous flexible watertight seal in the joint, on the sides and top, between each precast reinforced concrete box section.

Measurement

00595.80 Measurement - The quantities of reinforced concrete box culverts will be measured on the length basis, along the centerline of the box culvert, from end to end of the cast-in-place ends.

No measurement of quantities will be made for wingwalls and aprons.

No separate measurement will be made for concrete and reinforcement used in the box culverts. Estimated quantities of concrete and reinforcement will be listed in the Special Provisions.

Payment

00595.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

(a) Reinforced Concrete Box Culverts ...................... Foot
(b) Wingwalls and Aprons .................................. Lump Sum
Item (a) includes cast-in-place ends regardless of the type of box culvert constructed.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00596 - Retaining Walls

Description

00596.00 Scope - This work consists of furnishing and constructing retaining walls as shown or specified, and in close conformity to the lines, grades, and dimensions shown or established.

The Special Provisions will list the types and locations of walls to be constructed.

00596.02 Definitions - Geosynthetic terms not defined in this subsection are identified in ASTM D 123, ASTM D 4439, or 00350.01. If there is a conflict, definitions in this subsection take precedence.

Alternate Fasteners - Spiral binders or high tensile locking spring steel clip or clamp-on ring type fasteners specified as an alternate to tie wire for assembling and joining gabions.

Bin Walls - Concrete or metal gravity retaining structures filled with granular backfill material. Bin walls consist of interlocking, prefabricated modules or bolted lightweight steel members constructed like building blocks.

Company - In the case of a proprietary retaining wall, the firm or other entity that identifies lawful claim to the retaining wall or design of the retaining wall. In the case of non-proprietary retaining wall, the firm or other entity that produces, provides, or designs the retaining wall.

Conventional Segmental Retaining Walls:
- A basic gravity retaining wall type, and
- Retaining walls composed of segmental retaining wall units only (i.e., no soil reinforcements).

Crib Walls - Prefabricated, interlocking reinforced or unreinforced gravity retaining structures backfilled with granular backfill material. Crib walls consist of alternating transverse and longitudinal beams.

Extensible Tensile Reinforcements - Reinforcements in which the deformation at failure is comparable to or greater than the deformability of the reinforced backfill (e.g., geotextile and polymeric materials).

Gabion Retaining Walls:
- A basic gravity retaining wall type, and
- Retaining walls composed of assembled wire baskets, connected together, filled with specified rock, and placed with a riprap geotextile between the back face of the basket and the backfill material.

Geogrid - See 00350.01 for geogrid definition.
Geosynthetic - See 00350.01 for geosynthetic definition.

Geotextile - See 00350.01 for geotextile definition.

Inextensible Tensile Reinforcements - Reinforcements in which the deformation at failure is significantly less than the deformability of the reinforced backfill (for example, metallic materials).

Internal Connecting Wires - Internal wires used to prevent gabions from bulging.

Mechanically Stabilized Earth (MSE) Retaining Walls:

- A basic gravity retaining wall type, and
- Retaining walls composed of granular backfill and either extensible or inextensible tensile reinforcements in the granular backfill mass. Examples of facing include precast concrete panels, cast-in-place facades, and segmental retaining wall units.

Prefabricated Modular Block Retaining Walls - Unreinforced, prefabricated concrete block gravity (non-MSE) retaining walls composed of concrete blocks greater than 3 cubic feet.

Proprietary Retaining Walls:

- Retaining walls in which a private company identifies lawful claim to the product or design of the product,
- Retaining wall products typically associated with a trade name or name brand, or
- Retaining walls designed by someone other than the retaining wall Contract Documents engineer of record.

Retaining Wall or Retaining Structure - A group of interrelated components designed to resist earth pressures.

Rigid Gravity Retaining Walls - A basic gravity retaining wall type that includes cast-in-place concrete gravity retaining walls.

Segmental Retaining Wall Unit - A machine-formed solid or hollow modular concrete block less than 3 cubic feet.

Semi-Gravity Retaining Walls - A basic gravity retaining wall type that includes cast-in-place concrete cantilever or counterfort retaining walls.

Tie Wire - Wire used to assemble and join gabion units.

00596.03 Variables - The amount and type of work required to construct a proprietary retaining wall varies according to the wall selected. The Contractor is responsible for making a careful study of the work required for each wall and for determining the quantities.
Variables could involve shoring, excavation, backfilling, excess material, staging work, corrosion protection, utilities and drainage systems adjustments and other details of the work.

00596.04 Proprietary Retaining Wall Submittals - Submit stamped working drawings and design calculations, and field construction manuals and product brochures prepared by the manufacturer of the proprietary retaining wall selected, as necessary, according to 00150.35. Submit this information at least 30 calendar days before beginning retaining wall fabrication or construction. Obtain the Engineer's written approval before fabricating retaining walls.

(a) Working Drawings - Provide working drawings that include at least the following information:

(1) General:

- **General Notes** - Necessary information on design and construction of the retaining wall.
- **Materials and Quantity Summary List** - Show all items of each wall.
- **Plan View** - Show the construction centerline and related horizontal curve data, the offset from the construction centerline to the face of the wall at all changes in horizontal alignment, and the centerline of any utility or drainage structure or pipe that is behind or passes under or through the wall.
- **Elevation View** - Show the elevation at the top of the wall at all horizontal and vertical break points, and at least every 65 feet along the wall; vertical curve data; the location of the original and final ground line at both the heel and face of the wall; elevations at the base of the wall (for example, top of cast-in-place footings and leveling pads); the distance along the face of the wall to all steps in the wall base; and the applied bearing pressures.
- **Typical Sections** - Show wall construction and limits of backfill.
- **Structural and Geometric Details** - The following minimum structural and geometric details:
  - Loading conditions
  - Footing or leveling pad details
  - Final front face batter
  - Reinforcing bar bend details
  - Details for appurtenances not detailed in the plans, including connections to concrete barriers, coping, parapets, soundwalls, fences, and attached lighting
  - Construction around utility and drainage facilities, overhead sign support footings, abutment piles, or other structures
(2) MSE Retaining Walls:

- **Plan View** - Show soil reinforcement limits.
- **Elevation View** - Show the type and size of facing components; the length, size and number of soil reinforcements; and the distance along the face of the wall to where changes in the length of the soil reinforcement occur.
- **Typical Section** - Show soil reinforcement limits.
- **Facing Components** - Show all dimensions, including thickness; all details necessary to construct the facing components; all reinforcing steel in the component; and the location of tensile soil reinforcement attachment devices embedded in the facing. Show the type of concrete finish.
- **Soil Reinforcements** - Show all dimensions and details necessary to construct the soil reinforcements.

(b) Design Calculations - The design calculations shall include but not be limited to:

(1) General:

- **Design Input** - Show wall geometry; soil parameters; and both permanent and temporary design loads, including applied loads from pedestrian rails, fencing, guard rail, concrete barrier, soundwalls, sign supports, or luminaire supports.
- **External Stability Calculations** - Indicate factors of safety against sliding and overturning.
- **Foundation Bearing Pressure Calculations** - Indicate the factor of safety against foundation bearing failure.
- **Appurtenances** - Show calculations for the design of pedestrian rails, fencing, guard rail, concrete barrier, soundwalls, sign supports or luminaires when not fully detailed on the plans. Design concrete barriers according to AASHTO Standard Specifications for Highway Bridges, and Interim Revisions, to withstand a horizontal force of 10,000 pounds per 5 feet applied at the top of the barrier and conforming to the National Cooperative Highway Research Program (NCHRP) Report 350, unless otherwise indicated.

(2) MSE Retaining Walls:

- **Internal Stability** - Indicate reduction factors and factors of safety against soil reinforcement rupture, pullout, and facing connection strength.
- **Local Stability** - Indicate factors of safety against sliding and bulging of segmental retaining wall facing units.
(c) Field Construction Manual - Provide a field construction manual, prepared by the manufacturer of the proprietary retaining wall selected, including step-by-step directions for constructing the retaining wall.

**Materials**

00596.10 **Materials** - Furnish materials meeting the following requirements:

(a) City Approval - Use only retaining wall materials, products or systems that have met the requirements of the City Retaining Structures Program and have an "Approved" status according to the City Retaining Structures Program prior to the Project Bid Opening. Information regarding approval or any other aspect of the City Retaining Structures Program may be obtained from the City Retaining Structures Coordinator in Salem.

(b) City-Furnished Designs - For retaining wall designs shown (i.e., non-proprietary retaining walls), either provide specified materials according to these applicable material Specifications or provide products from the QPL also according to these applicable material Specifications. Obtain like materials for the retaining wall from the same company.

(c) Proprietary Retaining Wall Systems - For proprietary retaining walls, provide products from the selected company according to the company’s specifications and these applicable material Specifications. If there is a conflict between the company’s specifications and the City’s Specifications the City’s Specifications will take precedence. Obtain all materials for the selected proprietary retaining wall from the same company. Use only one proprietary retaining wall on the Project unless different proprietary retaining walls are specified.

Do not use materials from unlisted sources without written approval. Acceptance will be based on manufacturer’s test results and certificates of compliance according to 00165.35, visual inspection and other criteria in this Section.

(d) Quality Control - Provide quality control according to Section 00165.

00596.11 **Backfill** - Furnish backfill meeting the requirements of Section 00510 and the following:

(a) Granular Drain Backfill Material - Provide granular drain backfill material according to 00430.11. Provide a Type 1 drainage geotextile according to Section 02320.

(b) Special Filter Material - Provide special filter material according to Section 02610.

(c) Gabion Retaining Walls - Provide a well-graded 4 inch to 10 inch rock fill material inside the gabion baskets meeting the requirements of 00390.11(b).
Provide granular wall backfill material behind the gabion baskets according to 00510.12.

(d) **Metal Bin Retaining Walls** - Provide granular structure backfill material for the interior cell of the metal bin retaining wall units according to 00510.13.

Provide granular wall backfill material behind the metal bin retaining wall units according to 00510.12.

(e) **Leveling Pads** - Provide granular structure backfill material for gravel leveling pads according to 00510.13.

(f) **Segmental Retaining Wall Units** - Provide granular structure backfill material for the interior cell of hollow segmental retaining wall units according to 00510.13.

Provide backfill material behind the segmental retaining wall units as specified.

(g) **MSE Granular Backfill** - Provide MSE granular backfill material meeting the following requirements:

(1) **Gradation** - Gradation shall meet all requirements in Section 02630 and Table 02630-1. Use either 1” - 0 or 3/4” - 0 base aggregate conforming to the requirements of 02630.10(a) through 02630.10(c). Test the MSE granular backfill at the frequency specified in the ODOT Manual of Field Testing Procedures (MFTP) for aggregate base material. Additionally, MSE granular backfill placed in the spread footing foundation support zone shall have between 90% to 100% passing the 3/4 inch sieve for all “Separated Sizes” as determined by AASHTO T27.

(2) **Other Requirements:**

   a. **Material Passing No. 200 Sieve** - The percent, by weight, passing the No. 200 sieve shall not exceed 15% when tested according to AASHTO T 27 and AASHTO T 11.

   b. **Plasticity Index** - The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T 90.

   c. **Electrochemical Properties** - The electrochemical properties of the material shall meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Limits</th>
<th>Test Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.0 - 10.0</td>
<td>AASHTO T 289</td>
</tr>
<tr>
<td>Resistivity</td>
<td>5,000 Ω-cm (min.)</td>
<td>AASHTO T 288</td>
</tr>
</tbody>
</table>
MSE granular backfill material with resistivities of less than 5,000 \(\Omega\)-cm but greater than 3,000 \(\Omega\)-cm and meeting all other requirements may be accepted if they meet the following additional requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Limits</th>
<th>Test Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorides</td>
<td>100 PPM (max.)</td>
<td>AASHTO T 291</td>
</tr>
<tr>
<td>Sulfates</td>
<td>200 PPM (max.)</td>
<td>AASHTO T 290</td>
</tr>
</tbody>
</table>

### d. Organic Content
- The organic content shall meet one of the following conditions:
  - Organic content as computed according to AASHTO T 267 for material finer than the No. 10 sieve does not exceed 1.0%.
  - The ratio (expressed as a percentage) of the weight of organic material (as determined by AASHTO T 267) to the weight of the total sample does not exceed 0.75%.

#### 00596.12 Gabion Baskets
- Furnish gabion baskets meeting the requirements of Section 02340.

#### 00596.13 Concrete:

(a) **ODOT Standard Cast-in-Place Concrete Gravity Retaining Wall**
- Provide commercial grade concrete according to Section 00440.

(b) **ODOT Standard Cast-in-Place Concrete Cantilever Retaining Wall**
- Provide structural concrete according to Section 00540.

(c) **Leveling Pads**
- Provide commercial grade concrete according to Section 00440.

(d) **MSE Retaining Wall Cast-in-Place Concrete Facades**
- Provide commercial grade concrete according to Section 00440.

(e) **MSE Retaining Wall Precast Concrete Facing Panels**
- Provide commercial grade concrete according to Section 00440 and the following:
  1. **Portland Cement Concrete**
     - Use the class of concrete listed in the Special Provisions.
  2. **Casting**
     - Set soil reinforcement connection devices on the rear face of the precast panel and secure to prevent displacement during concrete placement and consolidation. Do not allow devices used to connect soil reinforcements to facing panels (e.g., loop embeds tie strips, etc.) to contact the face panel reinforcement steel. Place concrete in each panel without interruption and consolidate with an approved vibrator.
     - Use clear form oil throughout the casting operation.
  3. **Curing**
     - Follow the curing procedure given in the Special Provisions.
(4) Finish - Give the front face a general surface finish according to 00540.53(a), unless otherwise specified. Screed the back face to eliminate surface distortions and open pockets of aggregate.

(5) Tolerance - Manufacture all units within the following tolerances:

a. Panel Dimensions - Do not exceed a difference of 1/2 inch between diagonals. All other dimensions are not to exceed a difference of 3/16 inch. Angular distortion, with regard to the height of the panel, is not to exceed 1/8 inch in 3 feet.

b. Soil Reinforcement Connection Devices:

1. Tie Strips - Locate tie strip connection devices within 1 inch of the plan location.

2. Loop Embeds - Locate loop embeds within 3/16 inch of the plan location.

3. Retention Slots - Locate retention slots within 1 inch of the plan location. Slot openings are not to exceed 1/8 inch. Check the slot opening with the supplied "feeler" gauge according to the company's recommendations. Reject panels from which the "feeler" gauge is pulled from the slot.

c. Panel Face - Smooth formed surfaces are not to vary over 3/32 inch when measured over a length of 3 feet. Textured-finished surfaces are not to vary over 3/16 inch when measured over a length of 3 feet.

d. Rear Face - Eliminate surface distortions in excess of 1/4 inch.

(6) Acceptance of Panels - Acceptance will be according to 00540.17 except as follows:

- Acceptance of precast panels will be determined based on production sublots. A production sublot will be represented by a single compressive strength sample and will consist of either 40 panels or a single day's production, whichever is less. Cast one set of cylinders for each production sublot.

- Acceptability of the precast panel will be determined based on conditional compressive strength tests results, check tests, and visual inspection. Panels may be placed in the wall if 7-day initial strength exceeds 85% of the 28-day requirements. Final acceptance will be based on the 28-day test results.

(7) Marking - Clearly scribe on the rear face of each panel the date of manufacture, the production sublot number, and the piecemark.
(8) Handling, Storage, and Shipping - Handle, store, and ship all units in a manner that eliminates chipping, discoloration, cracks, fractures and connecting device damage. Support stored panels on firm blocking.

(9) Rejection - Any of the following defects will be cause for rejection:

- Imperfect molding
- Honeycombed or open texture concrete
- Exposed reinforcing steel
- Improperly installed soil reinforcement connection devices
- Broken or chipped concrete
- Excessive color variation on front face of panel
- Nonspecification strength
- Cross-sectional thickness of the wall facing component less than the minimum thickness indicated on the plans or working drawings

(f) Segmental Retaining Wall Units - Provide a minimum compressive strength after 28 days of 4,000 psi and a maximum absorption rate of 5% by weight.

(1) Portland Cement - Use portland cement meeting the requirements of 02010.10.

(2) Blended Cement - Use blended cement meeting the requirements of 02010.20.

(3) Aggregate - Use aggregate meeting the requirements of ASTM C 33.

(4) Tolerance - Molded dimensions are not to differ more than 1/8 inch from the manufacturer’s published dimensions, except height, which is not to differ more than 3/16 inch.

(5) Color - Provide gray units unless specified otherwise.

(6) Finish - Provide split-face units unless specified otherwise.

Provide units that are sound and free of cracks or other defects that would interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction.

Provide units that are free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused light.

(7) Acceptance of Units - Acceptability will be determined based on compressive strength, moisture absorption, and dimension tests according to ASTM C 140 and visual inspection. Segmental retaining wall units may be placed in the wall if 7-day initial strength exceeds 85% of the 28-day requirements. Final acceptance will be based on the 28-day test results.
(8) **Marking** - Indicate the date of manufacture and the production lot number on each lot of segmental retaining wall units.

(9) **Handling, Storage, and Shipping** - Handle, store, and ship all units in a manner that eliminates chipping, discoloration, cracks and fractures.

(10) **Rejection** - Any one of the following defects will be cause for rejection:

- Imperfect molding
- Honeycombed or open texture concrete
- Broken, cracked or chipped units
- Extreme color variation on front face of unit
- Nonspecification strength
- Absorption

(g) **Prefabricated Modular Concrete Blocks:**

(1) **Concrete** - Provide concrete suitable for common structural applications. Concrete tests are not required.

(2) **Grade** - Provide Standard Grade blocks.

(3) **Color** - Provide gray blocks unless specified otherwise.

(4) **Finish** - Provide smooth face blocks unless specified otherwise.

Provide blocks that are sound and free of cracks or other defects that would interfere with the proper placement of the block or significantly impair construction of the wall.

Provide blocks that are free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused light.

(5) **Tolerance** - Molded dimensions are not to differ more than 1/4 inch from the manufacturer's published dimensions, except height, which is not to differ more than 5/32 inch.

(6) **Handling, Storing, and Shipping** - Handle, store, and ship all blocks in a manner that eliminates chipping, discoloration, cracks and fractures.

(7) **Acceptance of Blocks** - Acceptability will be determined based on tolerances specified in (5) of this subsection and visual inspection.
(8) Rejection - Any one of the following defects will be cause for rejection:

- Concrete not suitable for common structural applications
- Imperfect molding
- Honeycombed or open texture concrete
- Broken, cracked or chipped blocks
- Extreme color variation on front face of block

00596.14 Steel Reinforcement for Concrete - Furnish steel reinforcement for concrete meeting the requirements of Section 00530.

00596.15 Steel - Furnish structural steel meeting the requirements of Section 00560 and the following:

(a) Metal Bin Retaining Walls - Provide metal bin retaining walls according to Section 02350.

(b) Inextensible Soil Reinforcements, Facing Components and Attachment Hardware - Shop-fabricate true size and defect-free soil reinforcements, facing components and attachment hardware as follows:

Galvanize soil reinforcements, facing components and attachment hardware according to 02530.70, except where noted. If specified, epoxy coat according to AASHTO M 284 (ASTM A 775), except where noted.

(1) Reinforcing Strips - Use steel reinforcing strips of the required shape and dimensions conforming to ASTM A 36 or equal. Provide a minimum 2.0 ounce per square foot galvanized coating. If specified, provide a minimum 18 mils epoxy coating.

(2) Reinforcing Mesh - Furnish welded wire reinforcement according to 02510.40 supplemented and modified as follows:

a. Galvanized Reinforcement - Provide a minimum 2.0 ounce per square foot galvanized coating for welded wire embedded in either concrete or soil according to ASTM A 641.

b. Epoxy Coated Reinforcement - When specified, provide a Class A coating for welded wire reinforcement embedded in concrete and a Class B coating for welded wire fabric embedded in soil according to ASTM A 884.

(3) Tie Strips - Provide tie strips of steel conforming to the requirements of ASTM A 1011, Grade 50, or equivalent.

(4) Loop Embeds - Fabricate 1 inch loop embeds from cold drawn steel wire conforming to AASHTO M 32 (ASTM A 82). Weld loop embeds according to AASHTO M 55 (ASTM A 185). Galvanize loop embeds according to ASTM B 633 or equal.
(5) **Fasteners** - Use galvanized high-strength bolts according to 02560.20.

(6) **Connectors** - Fabricate connectors from cold drawn steel wire according to AASHTO M 32 (ASTM A 82).

00596.16 **Geosynthetics** - Furnish geosynthetics meeting the following requirements:

(a) **Gabion Wall Filter** - Provide Type 2 riprap geotextile according to Section 02320.

(b) **Precast Concrete Facing Panel Joint Cover** - Provide Type 1 drainage geotextile according to Section 02320.

(c) **Extensible Soil Reinforcements**:

   (1) **Geotextile** - Provide geotextile according to the Special Provisions.

   (2) **Geogrid** - Provide geogrid according to the Special Provisions.

00596.17 **Elastomeric Bearing Pads for Precast Concrete Facing Panels** - In horizontal joints between precast concrete panels, furnish either preformed ethylene propylene diene monomer (EPDM) rubber pads meeting the requirements of ASTM D 2000, M2AA 810 A13B33C12F17 having a durometer hardness of 80 plus or minus 5, or neoprene elastomeric pads having a durometer hardness of 55 plus or minus 5, or other bearing material as recommended by the supplier, certified by the manufacturer and approved by the Engineer.

00596.18 **Timber** - Furnish timber meeting the requirements of Section 00570.

00596.19 **Piles** - Furnish piling meeting the requirements of Section 00520.

**Labor**

00596.30 **Quality Control Personnel** - Provide certified technicians in the following fields:

- CAgT
- CDT
- CEBT
Construction

00596.40 General:

(a) Proprietary Retaining Walls - Provide for a field representative from the selected proprietary retaining wall company to be present at the start of retaining wall construction. Supervisory personnel of the Contractor, the company field representative, and any subcontractors who are to be involved in the construction of the proprietary retaining wall shall meet with the Engineer for a retaining wall preconstruction conference. At this conference, discuss methods of accomplishing all phases of the work required to construct the proprietary retaining wall. If all representatives are not in attendance, the retaining wall preconstruction conference and start of retaining wall construction shall be rescheduled.

In addition to the retaining wall preconstruction conference, the company field representative shall be available as needed during the erection of the proprietary retaining wall to provide instructions and recommendations, and to assist the Contractor or Engineer. Follow instructions and recommendations of the representative if approved by the Engineer.

(b) All Retaining Walls - All retaining walls, regardless of design, shall conform to the applicable top of wall profile shown. Retaining walls detailed in the City-provided plans shall conform to the applicable bottom of wall elevations shown for walls without footings, the applicable top of footing elevations for walls with footings, or the applicable top of leveling pad elevations for walls with leveling pads. Verify existing ground elevations and bottom of wall elevations for proprietary retaining walls prior to final design.

00596.41 Excavation, Backfill, and Compaction Requirements:

(a) General - Perform structure excavation and backfill for all retaining walls according to Section 00510 to the limits and stages shown.

Construct all retaining walls on suitable foundation materials. Excavate any unsuitable foundation materials below elevations shown and backfill with suitable material as directed. Grade the foundation for the structure level for a width equal to the width of the footing or the bottom soil reinforcement and facing component thickness, or as shown. Do not reinforce overexcavated foundations with geosynthetic or similar materials without prior approval.

Do not construct backfill when the backfill, the foundation, or the embankment on which it would be placed is frozen, unstable, or not compacted, unless otherwise directed. Place backfill material in nearly horizontal layers not more than 8 inches thick or to the top of the facing component if the height of the facing component is less than or equal to 8 inches.
Unless otherwise specified, compact the entire surface of each layer in place with a minimum of three coverages, using equipment made specifically for compaction. Select compaction equipment based on the type of material being compacted and the layer thickness. Normal compaction equipment consists of sheepsfoot rollers, tamping foot rollers, grid rollers, pneumatic tired rollers, and vibratory rollers. Routing of hauling and grading equipment will not be accepted as adequate to achieve compaction.

Compact backfill material within 3 feet of the backface of the retaining wall using a low weight mechanical tamper, roller or vibratory system.

Avoid any damage or misalignment of retaining wall components as the backfill is placed. Remove any wall materials that become damaged during backfill placement and replace at no additional cost to the City. As directed, correct misaligned units not meeting the limits specified due to backfill placement at no additional cost to the City.

(b) Testing - Except for backfill material within 3 feet of the back face of the retaining wall, test for compaction as follows:

- **Moisture and Density** - Determine according to AASHTO T 310.

- **Optimum Moisture and Maximum Density** - Determine as required by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224.

Meet each of the following moisture content, density and deflection requirements:

- **Moisture Content** - Prepare material to within -4% to +2% of optimum moisture content at the time of compacting. Add water to material that does not contain sufficient moisture and thoroughly mix as directed. Remove excess moisture by manipulation, aeration, drainage, or other means before compacting.

- **Density:**
  - Compact MSE granular backfill to 100% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224.
  - Where spread footings for bridges or other structures are founded behind free standing retaining walls, including in or on MSE granular backfill material, compact the spread footing foundation zone to 100% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224. The spread footing foundation zone depth is twice the footing width or 6 feet, whichever is greater, and extends a horizontal distance equal to the footing width beyond the outside bottom edge of the footing in all directions. Begin compaction of the backfill material at the backface of the wall or the wall facing component.
- **Deflection Requirement** - In addition to moisture-density testing, each compacted layer will be observed for deflection or reaction under moving loaded equipment according to ODOT TM 158 to verify that no soft or pumping areas remain in any layer or foundation soil. Correct all such areas at no additional cost to the City.

00596.42 **Cast-in-Place Concrete Retaining Walls:**

(a) **Wall Drainage Systems** - Construct the retaining wall drainage system according to the applicable sections of 00430 and as shown. A drainage geotextile is required when using granular drain backfill material.

(b) **ODOT Standard Cast-in-Place Concrete Gravity Retaining Wall** - Construct cast-in-place concrete gravity retaining walls according to Sections 00440 and 00530.

(c) **ODOT Standard Cast-in-Place Semi-Gravity (Cantilever) Retaining Wall** - Construct cast-in-place concrete semi-gravity retaining walls according to Sections 00530 and 00540.

00596.43 **Gabion Retaining Walls** - Erect gabion retaining walls according to the City-provided plans and approved working drawings, if applicable, and the company’s field construction manual as approved, supplemented and modified as follows:

(a) **General** - Select and use the same style of mesh for the gabion panel bases, ends, sides, diaphragms, and lids; the same method of joining the edges of a single gabion unit; and the same method of tying successive gabion units together throughout each structure.

If the height of the constructed gabion wall is less than 95% of the design height, add additional gabion baskets as directed to attain the design height, at no additional cost to the City.

Place riprap geotextile according to Section 00350 and the following:

- Minimum overlap shall be 12 inches.
- Against the back of the gabion wall before placing backfill material.

(b) **Assembly** - Assemble each style of gabion by rotating the panels into position and joining the vertical edges with tie wire or alternate fasteners.

If twisted wire panels are tied with tie wire, join the selvage vertical edges with alternating single and double loops at 4 inch nominal spacing.

If welded wire panels are tied with tie wire, pass the tie wire through each mesh opening along the vertical edges joint and secure with a half hitch locked loop.

Leave no openings greater than 4 3/4 inches (line dimension) along the edges or at corners of tied or spiral bound gabions of either mesh style. Crimp the edges of spiral binding wire to secure the spiral in place.
If high tensile fasteners are used in lieu of tie wire, install one fastener in each mesh opening according to the manufacturer’s recommendations.

(c) Placement - Set the empty gabions in place and connect each gabion to the adjacent gabion along the top and vertical edges with tie wire or spiral binders. Connect each layer of gabions to the underlying layer along the front, back and sides with tie wire or spiral binders in the same manner as specified for assembly of baskets. Common wall construction will not be allowed.

Before filling each gabion with rock, remove all kinks and folds in the wire fabric and properly align all baskets. Remove all temporary clips and fasteners. The assembled gabion baskets may be placed in tension before filling.

(d) Filling - Place the rock by hand or machine to ensure proper alignment, avoiding bulges and assuring a minimum of voids. All exposed rock surfaces shall have a smooth, neat appearance with no sharp edges projecting through the wire mesh.

Place the rock in layers to allow placement of internal connecting wires in each outside cell of the structure or when directed by the Engineer at the following intervals:

- None required for 1 foot high baskets
- At the 1/2 point for 1 1/2 foot high baskets
- At 1/3 points for 3 foot high baskets

Completely fill the basket so the lid will bear on the rock when it is closed. Secure the lid to the sides, ends, and diaphragms with tie wire or spiral binders in the same manner as specified for assembly of baskets.

(e) Repairs - During construction, repair and secure any breakage of the wire mesh that results in mesh or joint openings larger than 4 3/4 inches (line dimension). Make repairs using 13 1/2 gauge galvanized tie wire as directed.

Repair any damage to PVC wire coating in a manner that provides the same degree of corrosion resistance as the undamaged wire, according to the manufacturer's recommended repair procedures and as approved.

00596.44 Prefabricated Modular Retaining Walls - Erect retaining wall components according to the City-provided plans and approved working drawings, if applicable, and the company's field construction manual as approved, supplemented and modified as follows:

(a) Metal Bin Retaining Walls - Concurrently with the assembly of the bins, backfill within and around the bins of the assembled wall to the limits shown. Keep the backfill around the outside approximately level with the inside fill. Exercise care to completely fill the depressions of stringers and spacers, and compact without displacing them from line and batter.
(b) Prefabricated Modular Concrete Blocks:

(1) Leveling Pad - Construct a gravel leveling pad at each foundation level as shown. Compact gravel leveling pads according to 00596.41(b).

(2) Block Installation and Backfill Placement - Place blocks as shown. Blocks should typically be placed in a running bond pattern unless placed perpendicular to the face of the wall. Place blocks so the final position is battered as shown. Place the first course of blocks on top of and in full contact with the prepared leveling pad surface. Closely follow erection of each course of blocks with placement of Granular Wall Backfill material. Remove excess backfill from the top of the blocks prior to installing the next course of blocks.

(3) Construction Tolerances - During construction of the wall and placement of blocks maintain a vertical tolerance and tangent horizontal alignment tolerance not in excess of 1 1/4 inch when measured with a 10 foot straightedge. Check the plumbness and tolerances of each course of blocks before erecting the next course.

00596.45 Conventional Segmental Retaining Walls - Erect retaining wall components according to the Cityprovided plans and approved working drawings, if applicable, and the company’s field construction manual as approved, supplemented and modified as follows:

(a) Leveling Pad - Construct a gravel or unreinforced cast-in-place concrete leveling pad at each foundation level as shown. Compact gravel leveling pads according to 00596.41(b). Cure cast-in-place leveling pads for a minimum of 12 hours before placing the segmental retaining wall units.

(b) Segmental Unit Installation and Backfill Placement - Place segmental retaining wall units so the final position is battered as shown. Place the first course of segmental units on top of and in full contact with the prepared leveling pad surface. If applicable, install shear connectors and place unit fill. Closely follow erection of each course of segmental units with placement of granular wall backfill material. Remove excess backfill from the top of the segmental units prior to installing the next course of units. Glue the uppermost row of segmental units or caps to underlying units with an adhesive recommended by the manufacturer. For walls in which the manufacturer does not provide an adhesive for this purpose use an epoxy adhesive from the QPL. Clean the completed wall face of foreign material deposits on exposed horizontal portions of the segmental units.

(c) Construction Tolerances - During construction of the wall and placement of segmental retaining wall units maintain a vertical tolerance and tangent horizontal alignment tolerance not in excess of 1 1/4 inch when measured with a 10 foot straightedge. Check the plumbness and tolerances of each course of segmental retaining wall units before erecting the next course.
00596.46 MSE Retaining Walls - Erect retaining wall components according to the City-provided plans and approved working drawings, if applicable, and the company’s field construction manual as approved, supplemented and modified as follows:

(a) Leveling Pad:

(1) Precast Concrete Facing Panels - Provide a precast concrete leveling pad, or construct an unreinforced cast-in-place concrete leveling pad at each facing panel foundation level as shown. Place precast concrete leveling pads in full contact with the foundation. Cure cast-in-place leveling pads for a minimum of 12 hours before placing the wall facing panels.

(2) Segmental Retaining Wall Units - Construct a gravel or unreinforced cast-in-place concrete leveling pad at each facing unit foundation level as shown. Compact gravel leveling pads according to 00596.41(b). Cure cast-in-place leveling pads for a minimum of 12 hours before placing the segmental retaining wall units.

(b) Facing Components - Place facing components so the final position is vertical or battered as shown. Place the first course of facing components on top of and in full contact with the prepared leveling pad surface. As backfill placement proceeds place the facing components and applicable hardware in successive horizontal courses in the sequence shown.

(1) Precast Concrete Facing Panels - Erect precast panels using the lifting devices connected to the upper edge of the panel. Attach geotextile joint cover as shown to the rear of the facing panels with an approved adhesive recommended by the company. Use a minimum 12 inch wide geotextile with a minimum overlap of 4 inches. Maintain the panels in position by means of temporary wedges or bracing according to the company’s recommendations.

(2) Wire Facing Components - Attach soil retention material as shown to the rear of the facing component as recommended by the company and as approved.

(3) Segmental Retaining Wall Units - If applicable, install shear connectors and place unit fill. Remove excess backfill from the top of the segmental retaining wall units prior to installing the next course of units or soil reinforcements. Glue the uppermost row of segmental retaining wall units or caps to underlying units with an adhesive recommended by the company. On walls for which the company does not provide an adhesive for this purpose, use an epoxy adhesive from the QPL. Clean the completed wall face of foreign material deposits on exposed horizontal portions of the segmental units.
(c) **Soil Reinforcement Components** - Before placing the soil reinforcement components, compact the foundation according to 00596.41. If skewing of the soil reinforcements is required due to obstructions in the reinforced volume, submit design computations to the Engineer justifying the effect of skewing on the performance of the soil reinforcements.

(1) **Inextensible Soil Reinforcement Components** - Place the soil reinforcement components normal to the face of the wall unless otherwise shown or directed. Repair damaged galvanized or epoxy-coated components before placing backfill material, to provide a coating comparable to that provided by 02530.70 or AASHTO M 284 (ASTM A 775), respectively.

(2) **Extensible Soil Reinforcement Components** - Orient geosynthetic reinforcements with the highest strength axis normal to the face of the wall unless otherwise shown or directed. Prior to placing backfill, pull geosynthetic reinforcements taut, and anchor them. Geosynthetic reinforcements shall be continuous throughout their embedment lengths. Spliced connections will not be allowed.

a. **Non-Proprietary Geosynthetic Wrapped-Face Retaining Walls** - Construct geosynthetic wrapped-face retaining walls according to 00350.20, 00350.40 and 00350.41 supplemented as follows:

   1. **General** - Begin wall construction at the lowest portion of the excavation and place each layer horizontally as shown. Complete each layer in its entirety before the next layer is started. Seams will be allowed only at the wall face. Either overlap geotextile sheets 24 inches minimum and perpendicular to the wall face, or sew seams parallel to the wall face according to 00350.41(a-3). Stretch the geotextile in a direction perpendicular to the wall face to eliminate slack before backfilling.

   2. **Wall Forming** - Use a temporary form system at the wall face during construction. A typical temporary form system and a sequence of wall construction required will be shown. Use pegs, pins, or the manufacturer’s recommended method as approved, in combination with the forming system, to hold the geotextile in place until the cover material is placed.

(d) **Backfill Placement** - Closely follow erection of each course of facing components with placement of MSE granular backfill material. Construct adjacent general embankment layers at the same time the MSE layers are constructed.

Do not operate tracked or rubber tired construction equipment directly upon geosynthetic reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over geosynthetic reinforcement. Avoid sudden braking and sharp turning movements.
At the end of each day, if rain is anticipated, slope the MSE granular backfill away from the MSE retaining wall face to direct surface runoff away from the wall. Do not allow surface runoff from adjacent areas to enter the MSE retaining wall construction site.

(e) Construction Tolerances - During construction of walls and placement of facing components, maintain the following tolerances:

1. Precast Concrete Facing Panels:
   - Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 3/4 inch when measured with a 10 foot straightedge.
   - Maximum allowable offset in any facing component joint shall be 3/4 inch.
   - Horizontal, vertical and sloped joint openings between components shall be uniform, no larger than 1 1/4 inch, and no smaller than 5/8 inch.

2. Wire Facing Components:
   - Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 2 inches when measured with a 10 foot straightedge.

3. Cast-in-Place Concrete Facades:
   - Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 3/4 inch when measured with a 10 foot straightedge.

4. Segmental Retaining Wall Units:
   - Vertical tolerance and tangent horizontal alignment tolerance shall not exceed 1 1/4 inch when measured with a 10 foot straightedge.

Check the plumbness and tolerances of each course of facing components before erecting the next course.

Measurement

00596.80 Measurement - The quantities of retaining walls will be measured on the area basis, and will be the area shown, in a vertical plane, for each retaining wall. Field measurement of each retaining wall area will not be made. The quantity will be the theoretical area of each retaining wall unless changes are ordered in writing by the Engineer. If changes are ordered, an adjustment will be made only for the quantity difference involved in the ordered plan changes.
The estimated quantities of excavation, shoring, footings, leveling pads, and specified backfill will be listed in the Special Provisions.

The quantities of Type "F" coping will be measured on the length basis, from end to end of coping.

The quantities of sidewalk coping will be measured on the area basis, from end to end and from top of curb to exterior edge of coping.

Excavation below elevations shown will be measured according to 00510.80(b).

**Payment**

<table>
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<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
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<tr>
<td>(a) Retaining Wall, Cast-In-Place Concrete</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Retaining Wall, Gabion</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Retaining Wall, Prefabricated Modular</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(d) Retaining Wall, Conventional Segmental</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(e) Retaining Wall, MSE</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(f) Retaining Wall, Contractor’s Option</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(g) Type &quot;F&quot; Coping</td>
<td>Foot</td>
</tr>
<tr>
<td>(h) Sidewalk Coping</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Item (f) consists of two or more wall type options that would generally be paid for as individual walls under items (a) through (e). These options will be listed in the Special Provisions.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Excavation below elevations shown and backfill will be paid for according to 00510.90(c).

No separate or additional payment will be made for reinforcing steel and concrete in Type "F" coping and sidewalk coping.

No separate or additional payment will be made for technical representatives, excavation, shoring, footings, leveling pads, specified backfill, or for wall drainage and filter systems, including perforated pipe, drain material, geotextile, and drain pipe, cast-in-place or precast standard coping, including coping reinforcing steel and concrete, and other appurtenances.
Section 00597 - Sound Walls

Description

00597.00 Scope - This work consists of furnishing and constructing sound walls at the locations shown or as directed.

Use one of the following sound wall types:

- Concrete block walls
- Precast concrete panel walls
- Concrete panel fence walls

00597.01 Variables - The amount and kind of work required to construct a sound wall varies according to the type of wall selected. Be responsible for determining the work required for each wall type and for the variables in quantities, including shoring, excavation, backfilling, excess material, staging work and other details of the work.

Materials

00597.10 Materials - Obtain all manufactured materials for the selected sound wall type from the same company. Only one type of wall will be allowed on the Project unless otherwise specified.

Store concrete masonry units and cementitious materials at the jobsite in a manner which will protect the materials from contact with soil and weather. Store mortar and grout materials in original unbroken packages.

00597.11 Concrete Block Sound Walls:

(a) Concrete Blocks - Furnish concrete blocks meeting the following requirements:

- Hollow, load-bearing blocks, graded N-1, f'm = 1,300 psi with 2,000 psi 28-day strength on net cross sectional area, according to ASTM C 90
- Kiln dried to 33% total absorption
- Split ribbed (York) pattern on exposed areas
- Standard block on unexposed areas
- Nominal 8 inch x 8 inch x 16 inch size

Do not tint concrete blocks. Use uniform colored blocks along the length of individual walls.
00597.12

(b) Concrete Caps - Construct concrete caps meeting the following requirements:

- Nominal 4 inch x 8 inch x 16 inch size
- Same color as concrete blocks

(c) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(d) Concrete - For pile footings, furnish concrete according to Section 00440. For all other components, including spread footings, furnish concrete according to Section 00540.

(e) Mortar and Grout - Furnish mortar meeting the requirements of ASTM C 270 that attains an ultimate compressive strength of at least 2,500 psi at 28 days. Furnish coarse grout meeting the requirements of ASTM C 476 with a suitable consistency for pouring without segregation of materials.

(f) Preformed Expansion Joint Filler - Furnish expansion joint filler meeting the requirements of 02440.10.

(g) Fillers, Sealers and Damp-proofing - Furnish fillers, sealers, and damp-proofing materials from the CPL.

00597.12 Precast Concrete Panel Sound Walls:

(a) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(b) Concrete - For footings, furnish commercial grade concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.

00597.13 Concrete Panel Lock Fence Sound Walls:

(a) General - Furnish concrete panel lock fence material and necessary components. Provide the manufacturer’s test results and certificate of compliance according to 00165.35.

(b) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(c) Concrete - For footings, furnish commercial grade concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.
Construction

00597.40 General - Perform structure excavation according to Section 00510 to the limits and stages shown. All sound walls, regardless of type, shall conform to the top of wall profile shown. Provide footings as shown or approved.

00597.41 Concrete Block Sound Walls:

(a) General - Construct all masonry walls plumb, level and true. Build walls in running bond pattern. Place masonry according to accepted standards of good practice and work in masonry construction and as shown.

If work is discontinued, protect the top of the wall with a well-secured waterproof cover.

Do not perform masonry work when the surrounding temperature is less than 35 °F unless provisions are made for heating and drying materials and for protecting the work.

Do not backfill walls until at least 24 hours after damp-proofing is applied.

Use clean, dry, ice-free, and frost-free masonry units. Do not dampen units before or during laying unless approved.

Place the first course of masonry on the footing in a full mortar bed. Mortar joints between units shall be 3/8 inch thick with full mortar coverage on vertical and horizontal face shells only. Vertical joints shall be shoved tight.

Discard mortar when:

- Not used within 2 hours of initial mixing
- Stiffened due to hydration past initial set
- Stiffened due to evaporation
- Allowed to stand one hour without mixing

Grout all cells containing reinforcing bars. Walls and crosswebs forming cells to be filled shall be full-bedded in mortar to prevent leakage of grout. Grout may stop in cells containing bars where, and if, the reinforcement stops. Position vertical steel in the center of the cell and securely tie in place at intervals of not more than 5 feet. Use grout that is sufficiently fluid to flow into all grout spaces, leaving no voids. Perform grouting according to either "low-lift grouting" or "high-lift grouting" as follows:
(1) **Low-Lift Grouting** - When the wall is grouted as the wall is laid up, do the following:

- Do not exceed 4 feet high wall construction before placing grout.
- Construct vertical cores or cells of a clear, unobstructed size measuring not less than 2 inches by 3 inches.
- Rod or vibrate grout when placed.
- Position reinforcing steel and tie in place.
- Do not proceed with constructing the wall above a bond beam course until the vertical cells below the bond beam course and the bond beam course itself have been filled with grout.
- When the time interval between lifts will exceed one hour, stop the lifts 1 1/2 inches below the top of the course.

(2) **High-Lift Grouting** - When the wall is to be grouted full height or if the height to be grouted will exceed 4 feet, do the following:

- Leave cleanouts, with a minimum opening of 3 inches by 4 inches as shown, in the bottom course of the placement at each vertical cell. Keep cleanouts open until all mortar droppings have been removed and vertical reinforcing steel has been placed and inspected.
- Remove excess mortar from vertical cores and expose an unobstructed vertical hole with a dimension of at least 2 inches and a cross-sectional area of at least 10 square inches.
- Do not start grout work until 24 hours after the portion of the wall to be grouted has been constructed.
- Do not place grout in lifts greater than 4 feet in height. Rod or vibrate grout not later than 10 minutes after placing and before the preceding lift takes its permanent set. Extend rodding or vibrating 12 inches to 18 inches into the preceding lift.
- Do not begin grouting successive lifts until at least 30 minutes have elapsed after rodding or vibrating the preceding lift.
- If the time interval between lifts will exceed one hour, stop the lifts 1 1/2 inch below the top of the course.
- Place wire screen, small mesh, expanded metal lath or other approved material in mortar joints under each bond beam course to prevent filling vertical cells not intended to be filled.

**(b) Waterproofing** - Treat all masonry wall cap surfaces with a waterproofing application of a high-build filler and rubber sealer. Treat at least 14 calendar days after the wall is completed. Apply filler by spraying or rolling according to the manufacturer’s recommendations. Apply 2 coats of sealer to a minimum thickness of 10 mils. The finished product shall be the color "Summer Gray".

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(c) **Damp-Proofing** - After the cap is waterproofed, damp-proof the vertical surfaces of the masonry walls. Apply damp-proofing at least 14 calendar days after the walls are completed and according to the manufacturer’s recommendations.

**00597.42 Precast Concrete Panel Sound Walls** - Construct precast concrete panel sound walls plumb, level and true. Panels shall be free of major cracks. Cracks in panels will be measured after the panel is placed and walls have been backfilled. Cracks greater than 0.02 inch may require repairs or panel replacement, at the discretion of the Engineer.

**00597.43 Concrete Panel Lock Fence Sound Walls** - Construct concrete panel lock fence walls according to the manufacturer’s recommendations.

**Measurement**

**00597.80 Measurement** - The quantities of sound walls will be measured on the area basis, to the nearest square foot, of the wall face area projected onto a vertical plane along one side of the wall.

**Payment**

**00597.90 Payment** - The accepted quantities of sound walls will be paid for at the Contract unit price, per square foot, for the item "Sound Walls".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidental necessary to complete the work as specified.

No separate or additional payment will be made for excavation, backfill, footings, concrete, reinforcement, waterproofing, and damp-proofing.
Section 00599 - Concrete Slope Paving

Description

00599.00 Scope - This work consists of constructing concrete slope paving on bridge end slopes as shown, specified, or directed.

Materials

00599.10 Materials - Furnish materials meeting the following requirements:

- Commercial Grade Concrete ...........................................00440
- Grout ..........................................................................02080.40
- Reinforcement .................................................................00530

Construction

00599.40 Slope Preparation - Grade the slopes for slope and berm paving, and curbs to the lines and grades established. Finish the area to a smooth, firm, compacted condition.

Dispose of excess materials according to 00330.41(a)(4).

If slopes constructed under a separate contract require additional materials to prepare slopes to the established lines and grades, furnish such materials as Extra Work according to Section 00196.

00599.42 Slope Paving - Pave slopes with precast or cast-in-place blocks as the Contractor elects. Give the tops of blocks a wood float and brush finish parallel with the long dimension of the block.

(a) Precast Blocks - Manufacture precast blocks according to the plans and Section 00440.

(b) Cast-in-place Blocks - Place concrete for cast-in-place blocks according to Section 00440.

00599.43 Berm Paving - Construct berm paving according to the plans and Section 00440, except finish the berm paving to a neat, smooth surface.

00599.44 Slope Paving Curbs - Construct slope paving curbs according to the plans and to Section 00440 and Section 00530.

Measurement

00599.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Slope Paving - Concrete slope paving will be measured on the area basis, to the nearest square foot, on the slope paving surface for each bridge end slope.
(b) Berm Paving - Berm paving will be measured on the area basis, to the nearest square foot, on the berm paving surface for each berm.

(c) Slope Paving Curbs - Slope paving curbs will be measured on the length basis, to the nearest foot.

**Payment**

**00599.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Concrete Slope Paving</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Berm Paving</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Slope Paving Curbs</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for furnishing additional embankment materials required for slope preparation constructed under a separate contract will be made as Extra Work.
PART 00600 - BASES

Section 00620 - Cold Plane Pavement Removal

Description

00620.00 Scope - This work consists of removing existing pavement and bridge deck surfaces to prepare a foundation for placing new surfacing.

Equipment

00620.20 Equipment - Provide self-propelled planing machines or grinders:

- Capable of loosening pavement material
- Capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing pavement or from independent grade control
- With a positive means for controlling cross-slope elevations
- With a totally enclosed cutting drum with replaceable cutting teeth
- With an effective means of removing loosened material from the surface and preventing dust from escaping into the air
- Capable of providing a true cross-slope grade that will allow placement of overlay pavement to a uniform thickness

Construction

00620.40 Pavement Removal:

(a) General - Remove the existing pavement to the depth, width, grade and cross section shown or as directed. The use of a heating device to soften the pavement is not allowed.

(b) Depth 1 inch to 2 inches - If the depth of the existing pavement to be removed is 2 inches or less, but more than 1 inch and the section will be under traffic, schedule the work so the full width and length of travel lanes pavement can be removed during the same shift. Remove the shoulder area within 24 hours.

(c) Depth over 2 inches - If the depth of the existing pavement to be removed is over 2 inches and the section will be under traffic, schedule the work so the full width and length of the travel lanes and shoulders can be removed, leaving no longitudinal or transverse drop-offs, during the same shift.
(d) Pavement Removal Alternative  - If unable to complete the pavement removal according to 00620.40(b) and (c), then within the same day construct a wedge of asphalt concrete, at a slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at intersections, points of beginning and ending of the milling operation, and around manholes, valve boxes and other structures. Longitudinal drop-offs of 1 inch or less do not require a wedge. Maintain wedges as long as the area remains under traffic or until pavement is replaced. Remove and dispose of wedges before placing new pavement.

(e) Warning Signs  - Provide warning signs as required where abrupt or sloped drop-offs occur at the edge of the existing or new surface according to Section 00225.

00620.41 Surface Tolerance  - Test with a 12 foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.

00620.42 Disposal of Materials  - Dispose of all materials according to 00290.20.

00620.43 Maintenance Under Traffic  - If the cold-planed pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the roadway.

Measurement

00620.80 Measurement  - The quantities of cold plane pavement removal will be measured on the area basis in place.

When depth of pavement to be removed is variable, the depth as shown is an estimate and is approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00620.90 Payment  - The accepted quantities of work will be made at the Contract unit price per square yard for the item "Cold Plane Pavement Removal, ________ Deep".

The depth will be inserted in the blank. If the depth is variable, the range will be inserted in the blank.

Payment will be payment in full for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for temporary wedges constructed, maintained, and removed under 00620.40(d) or for replacement of cutting teeth.

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Section 00640 - Aggregate Base and Shoulders

Description

00640.00 Scope - This work consists of furnishing and placing one or more courses of aggregate base or shoulders on a prepared surface to the lines, grades, thicknesses and cross sections shown or established.

Materials

00640.10 Materials:

(a) Base and Shoulders Aggregate - Aggregate for bases and shoulder shall be either 1" - 0 or 3/4" - 0 as the Contractor elects or sized as specified. Base aggregate shall be dense-graded unless otherwise specified. Shoulder aggregates shall be either 1" - 0 or 3/4" - 0 size as the Contractor elects.

Furnish base and shoulder aggregates meeting the following requirements:

| Dense-Graded Base Aggregate                     | 02630.10 |
| Open-graded aggregate                           | 02630.11 |
| Shoulder Aggregate                               | 02640    |

(b) Subbase Aggregate - Aggregate subbase will be accepted based on the Engineer's visual inspection. Samples will be obtained and tested for compliance by the Engineer if it is suspect that the material does not meet Specifications.

Maximum size aggregate shall not exceed 75% of the compacted thickness of the layer in which it is incorporated. Aggregates passing the 1/4 inch sieve shall not be less than 10% nor more than 50% of the whole, by weight. No more than 10% of the aggregate shall pass the No. 100 sieve. Within these limits, the subbase aggregate gradation shall be adequate to produce a dense, firm base when placed and compacted.

All of the grading requirements are given as percentages by weight. The gradation will be determined by sieve analysis according to AASHTO T 27.

00640.12 Limits of Mixture - Provide a mixture of aggregate and water having a uniform moisture content sufficient to obtain the required compaction. Water may be introduced in a mixing plant, or on the grade. Determine the proportion of aggregate and water according to AASHTO T 99 and AASHTO T 224. Proportions will be in percentages by weight and will be known as the "Mix Design". The amount of water required in the mix design will normally be within a range of 5% to 10% of the mixture, based on dry weight of the aggregates. The mixture furnished shall conform to the mix design with a tolerance in optimum water content of plus or minus 2%. Any mixture having water content in excess of 2% over the Mix Design may be accepted for use if approved.

00640.16 Acceptance of Aggregates - Acceptance will be visual by the Engineer.
Equipment

00640.21 Hauling Equipment - Provide mixture hauling vehicles capable of hauling and depositing the mixture with a minimum of mix segregation.

00640.22 Spreading Equipment - Provide equipment capable of spreading the material and striking it off to designated line, grade, and transverse slope without segregation, dragging, or fracture of aggregate.

00640.24 Compacting Equipment - Provide self-propelled rollers and compactors capable of reversing without backlash. Rollers and compactors shall have a gross static weight of at least 8 tons, and shall be capable of compacting to specified density while the mix is still moist.

Construction

00640.40 Preparation of Foundation - Provide a firm surface on which aggregates are to be placed according to Sections 00320 or 00330 as applicable.

00640.41 Hauling and Placing - Transport the aggregate to the job site, add water to obtain proper moisture content, and place on the prepared surface or material by means acceptable to the Engineer.

Do not place shoulder aggregates on the top lift of newly constructed EAC or open-graded pavement.

00640.42 Thickness and Number of Layers:

(a) Base - If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.

(b) Shoulders - Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00640.43 Shaping and Compacting - Compact each layer of material placed in shoulder and base areas as directed.

(a) Aggregates Base Courses:

(1) Dense-graded Aggregates - Begin compaction of each layer of dense-graded aggregates immediately after the material is spread and continue until a density of not less than 95% of the maximum density has been achieved when tested according to the MFTP.
(2) Dense-graded Aggregates (Small Quantities) - Begin compaction of each layer of dense-graded aggregates immediately after the material is spread. Roll until there is no appreciable reaction or yielding under the compactor.

(3) Open-graded Aggregates - Compact the surface of each layer of open-graded aggregates using rollers conforming to 00640.24. Roll until there is no appreciable reaction or yielding under the compactor.

Shape and maintain the surface of each layer during the compaction operations to meet the requirements of 00640.44. Produce a uniform texture and firmly key the aggregates.

Apply water over the materials for proper compaction according to Section 00340, and as directed.

(b) Aggregate Subbase and Shoulder Courses - Compact each layer of aggregate subbase and shoulder material until no reaction or yielding is observed under the compactor.

00640.44 Surface Tolerance - The finished surface and the surface of each underlying layer of the aggregate shall parallel the established grade and cross section for the finished surface within 1/2 inch.

The finished surface of the compacted aggregate base, when tested with a 12 foot straightedge, shall not vary from the testing edge by more than 1/2 inch at any point. Furnish and operate the straightedge as directed.

Maintenance

00640.60 Care of the Work - After construction of each layer and completion of base, maintain the layer to specified conditions and prevent or repair segregation, raveling, or rutting, until it is covered with a following layer or until all work is completed.

Measurement

00640.80 Measurement - The quantities of aggregate will be measured on the weight basis, on the volume basis or on the area basis according to the following:

(a) Weight Basis - When measurement is by weight, quantities will be measured in the hauling vehicle, after mixing.

(b) Volume Basis - When measurement is by volume, quantities will be measured in the hauling vehicle.
(c) **Area Basis** - When measurement is by area, the quantity will be the number of square yards of aggregate base constructed to the full thickness. The surface area will be determined by horizontal measurements. Each area constructed with varying thicknesses, as directed or shown, will be adjusted by converting it to an equivalent area at the pay item thickness on a proportionate volume basis.

(d) **Adjustment of Water in Mixture** - If the water in the aggregate mixture placed exceeds the percentage established in the mix design by more than 2%, the excess percentage of water will be deducted from the measurement of the mixture. Determination of excess water will be made by the same procedure used in setting the water content of the Mix Design.

**Payment**

00640.90  **Payment** - The accepted quantities of aggregates will be paid for at the Contract unit price per unit of measurement, for the following item(s):

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Aggregate Base</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(b) Aggregate Shoulders</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(c) Aggregate Base</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(d) Plant Mix Aggregate Base</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(e) Plant Mix Aggregate Base</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(f) Aggregate Shoulders</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(g) Aggregate Base, _______ Inches Thick</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

Items (b) and (d) will apply when the Contractor has the option of furnishing one or another of two or more designated sizes of aggregates.

In items (c) and (e), the designated size of aggregate to be used will be inserted in the blank.

In item (g), the depth of aggregate base will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for water used to obtain proper compaction and in the care of the work.

00640.91  **Material on Hand** - Payment for stockpiled materials on hand may be allowed according to 00195.50(i)(5).
Section 00646 – Recycled Concrete and Asphalt Products

Description

00646.00 Scope - This work consists of furnishing and placing one or more courses of recycled concrete and asphalt products (RCAP), mixed with water, on a prepared surface to the lines, grades, thicknesses and cross sections shown or established.

Materials

00646.10 General - Base RCAP shall be 1 1/2" - 0 or 1" - 0 and shoulder RCAP shall be either 1" - 0 or 3/4" - 0 as the Contractor elects. Use 50% each of recycled concrete and asphalt materials in the mixture. RCAP shall conform to grading requirements of Section 02630 for bases and Section 2640 for shoulders.

00646.12 Limits of Mixture - Provide a mixture of RCAP and water having uniform moisture content sufficient to obtain the required compaction. Water may be introduced in the mixing plant, or on the grade.

00646.15 Quality Control - Provide quality control according to Section 00165.

00646.16 Acceptance of Aggregates - Acceptance will be visual by the Engineer.

Equipment

00646.21 Hauling Equipment - Provide RCAP hauling vehicles capable of hauling and depositing the RCAP material with a minimum of material segregation.

00646.22 Watering and Spreading of Material - Provide equipment to add water to the RCAP and spread to the lines and grades shown or directed.

00646.23 Compacting Equipment - Provide self-propelled rollers and compactors capable of reversing without backlash and meeting the following requirements.

- A gross static weight of at least 10 tons
- Adequate to compact to specified density while the RCAP is still moist

Labor

00646.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT
00646.40 Preparation of Foundation - Provide a firm surface or material on which RCAP is to be placed according to 00320 and 00330 as applicable.

00646.41 Mixing, Hauling and Placing - Add water to RCAP while mixing to provide moisture content according to 00646.12.

Thoroughly mix the combined RCAP and water for as long as necessary to produce a homogenous mixture. Mix, haul, and place the material by one of the following methods:

(a) Stationary Mixing Plant - Combine materials in a pug mill or rotary mixer.

Deliver and deposit the moisture without delay. Deliver the mixture to the spreading equipment by direct deposit into its receiving device, or by placing in uniform windrow(s) in front of equipment.

(b) Road Mix - Place materials for each layer, add water, and mix with a motor grader until a homogenous mixture is achieved.

Do not place RCAP shoulder material on the top lift of newly constructed open-graded pavement.

00646.43 Thickness and Number of Layers:

(a) Base - If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.

(b) Shoulders - Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00646.44 Shaping and Compacting - Begin compaction of each layer immediately after the material is spread. Determine optimum roller pattern according to ODOT TM 306 C “Control Strip Method of Compaction”. Maintain optimum roller pattern throughout.

Shape and maintain the surface of each layer during the compaction operations to meet the requirements of 00646.45.

Apply additional water over the materials for proper compaction.

00646.45 Surface Tolerance - The finished surface of the RCAP and the surface of each underlying layer shall parallel the established grade and cross section for the finished surface within 5/8 inches.
The finished surface of the compacted RCAP base, when tested with a 12 foot straightedge, shall not vary from the testing edge by more than 5/8 inch at any point. Furnish and operate the straightedge as directed.

**Maintenance**

**00646.60 Care of the Work** - After construction of each layer and completion of base, maintain the layer to specified conditions and prevent or repair segregation, raveling, or rutting, until it is covered with a following layer or until all work is completed.

**Measurement**

**00646.80 Measurement** - The accepted quantities of RCAP will be measured by the ton according to Section 00190. No separate measurement will be made for water used to obtain proper compaction according to 00646.44 or in the care of the work according to 00646.60.

**Payment**

**00646.90 Payment** - The accepted quantities of RCAP will be paid for at the Contract price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Recycled Concrete and Asphalt Products Base</td>
<td>Ton</td>
</tr>
<tr>
<td>(b) Recycled Concrete and Asphalt Products Shoulders</td>
<td>Ton</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for water used to obtain proper compaction according to 00646.44 or in the care of the work according to 00646.60.
Section 00680 - Stockpiled Aggregates

Description

00680.00  Scope - This work consists of furnishing crushed rock or other aggregates in stockpiles at the places and in the manner specified.

Materials

00680.10  Sources of Material - Obtain the material to be furnished in stockpiles from sources according to 00160.60.

00680.11  Aggregates - Furnish aggregates meeting the following requirements:

(a) Aggregate Base and Shoulder Aggregate - Furnish aggregates in stockpiles of the sizes specified and conforming to the requirements of 00640.10.

(b) Emulsified AC Aggregate - Furnish aggregates in stockpiles of the following sizes or as specified:

   1" - 1/2"
   3/4" - 1/2"
   1/2" - 1/4"
   3/8" - 1/4"
   3/8" - No. 4
   3/8" - No. 8

Aggregates in stockpiles shall conform to the following requirements:

1) Quality - Provide aggregates meeting the requirements of 00715.10(a), (c), (d), (e) and (f).

2) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading for the designated size aggregate according to the following:
Aggregate Production Quality Control - Provide quality control during production of aggregate according to Section 00165. Sampling and testing shall be performed by a CAgT at the minimum frequency schedule indicated in the MFTP for Section 00640, or according to Section 00715, as applicable. Aggregates will be evaluated for compliance according to the following:

(a) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(b) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

Acceptance of Aggregate - The Contractor's quality control tests will be used for acceptance of aggregates if verified by the City's quality assurance program.
Equipment

00680.20 Rock Crusher - Comply with the following:

(a) Permits - Before crushing rock for the Project, provide the City with copies of permits according to 00160.70.

(b) Crusher - Furnish rock crusher(s) capable of producing rock meeting these Specifications. Use an impact crusher of sufficient size and capable of producing aggregate in cubical form, free from sharp points or slivers.

00680.21 Conveyor - Provide conveyor(s) capable of reaching a minimum distance of 70 feet, to stockpile sanding materials in sand sheds without segregation during stockpiling.

00680.22 Hauling Equipment - Provide vehicles for hauling aggregates capable of discharging the materials without segregation.

Labor

00680.30 Quality Control Personnel - Provide a Certified technician in the following field:

- CAgT

Construction

00680.40 Preparation of Sites:

(a) Source Sites - Prepare and develop the source site according to the terms of the source permit and source development plan in the Special Provisions.

(b) Stockpile Sites - Clear, level and prepare stockpile sites as directed.

00680.41 Piling of Materials - Place each separate designated size of material to be stockpiled at a given site in a separate stockpile. Locate each stockpile to occupy as small an area as practical, and separate each pile so that working room will be adequate for removing the materials later. Height of the piles shall not be greater than 8 feet, nor side slopes flatter than 1V:1.5H, unless directed. Except in sand sheds, stockpile sanding materials to a height of 15 feet, or as directed.

Place the material in stockpiles with a minimum of segregation. Unless otherwise allowed, place the material in stockpiles in horizontal layers not more than 4 feet in thickness.

00680.42 Places of Delivery - Places of delivery and the tentative plans of distribution of the materials will be shown or specified.
City's Right to Materials - If the Engineer finds it necessary, the City may take materials from stockpiles before the stockpiles have been completed and measured, or may take a part of the materials intended for placement in stockpiles, in trucks or other vehicles at the plant.

Finishing and Cleaning Up

Cleaning Up Source Sites - Clean up the source sites according to the terms of the source permit and source development plan in the special provisions.

Measurement

Measurement - The quantity of each designated size of material will be measured according to the following:

- Weight Basis - When measurement is by weight, the quantities of each designated size of material will be measured on the weight basis, in the hauling vehicle.

- Volume Basis - When measurement is by volume, the quantities of each designated size of material will be measured on the volume basis, by cross-section measurement of the completed stockpiles, with no allowance for settlement or shrinkage.

Materials Taken from Stockpiles Prior to Completion - Materials taken by the City according to 00680.43 will be measured in the City’s hauling vehicles. If measurement is on the volume basis, the vehicle measurement will be converted to equivalent stockpile measurement at the ratio of 1.00 cubic yard, vehicle measurement to 0.95 cubic yard, stockpile measurement. If measurement is on the weight basis, the weight will be determined in the same manner and by the same means as used in determining the weight of materials stockpiled and paid for under the Contract.

Payment

Payment - The accepted quantities of each size of specified material will be paid for at the Contract unit price, per ton or cubic yard for the item "_______ Material in Stockpile".

The respective sizes of stockpiled aggregates will be inserted in the blank.

Payment will be in full for furnishing and placing materials in stockpiles and sand sheds, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for source development and clean-up, preparation of stockpile sites, hauling of stockpile materials, or placing materials in sand sheds.
Section 00705 - Emulsified Asphalt Prime Coat and Emulsified Asphalt Fog Coat

Description

00705.00 Scope - This work consists of applying asphalt, with or without aggregate cover materials, to a prepared surface. The prime coat referred to in these Specifications is a penetration treatment to aggregate surfaces to coat and bind the material into a hard surface. The fog coat referred to in these Specifications is a treatment applied to existing asphalt concrete pavement surfaces to renew and seal the pavement surface.

Materials

00705.10 Aggregate Cover Material - When required by the Special Provisions, provide aggregate cover material consisting of crushed or uncrushed rock free of clay, loam or other harmful substances and meeting the following gradation. Sieve analysis will be determined according to AASHTO T 27. Sieve analysis may be waived and the aggregate cover material accepted visually if allowed.

<table>
<thead>
<tr>
<th></th>
<th>Fine Cover</th>
<th></th>
<th>Coarse Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve</td>
<td>Percent Passing (by Weight)</td>
<td>Sieve</td>
<td>Percent Passing (by Weight)</td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>90 - 100</td>
<td>3/4&quot;</td>
<td>90 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>30 - 66</td>
<td>3/8&quot;</td>
<td>55 - 75</td>
</tr>
<tr>
<td>No. 30</td>
<td>8 - 28</td>
<td>1/4&quot;</td>
<td>40 - 60</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 5</td>
<td>No. 8</td>
<td>*</td>
</tr>
</tbody>
</table>

* Of the fraction passing the 1/4 inch sieve, 40 to 60% shall pass the No. 8 sieve.

00705.11 Emulsified Asphalt - Furnish asphalt meeting the following requirements:

(a) General - Provide emulsified asphalt conforming to the requirement of ODOT's publication, "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Obtain samples of emulsified asphalt according to AASHTO T 40, prior to dilution with water, at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the City, within 30 calendar days from the day the sample was taken.
(b) **Prime Coat** - Provide CSS-1, CSS-1h, or CMS-2S emulsified asphalt for the prime coat.

(c) **Fog Coat** - Provide CSS-1, CSS-1h or HFRS-P1 emulsified asphalt for the fog coat.

For every part emulsified asphalt, add not more than one part water. Add water at point of supply or point of application as directed, and mix with emulsified asphalt. The exact proportion of added water will be determined in a manner acceptable to the Engineer.

### Equipment

00705.20 **Equipment** - Provide a pressure distributor, hauling vehicles, and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in such number and capacities as will provide coordinated and uniform progress of the work.

00705.21 **Asphalt Distributor** - Provide an asphalt distributor designed, equipped, maintained, and operated so the emulsified asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00705.22 **Aggregate Spreaders** - When aggregate cover material is required, provide a mechanical spreading device that will spread the aggregate cover material in a manner acceptable to the Engineer.

00705.23 **Power Brooms** - When aggregate cover material is required, provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

### Construction

00705.40 **Season and Weather Limitations** - Do not place the prime coat or fog coat when the air temperature is below 60 °F, or when the Engineer determines that weather or surface conditions are detrimental to proper construction.

00705.41 **Preparation of Foundation for Prime Coat** - Bring aggregate bases and other bases or foundations, when constructed under the Contract, to the completed and finished condition according to the applicable Specifications.
Bring old bases and foundations, constructed by others, to the applicable condition according to Section 00610, and within 1/2 inch of established grade and cross section if other than a bituminous surface.

### 00705.42 Sequence of Operations
- Construct the prime coat or fog coat with a single spread of asphalt followed immediately with a single spread of aggregate cover material, if required.

### 00705.43 Application of Asphalt
- Apply asphalt according to the following:
  
  (a) **Prime Coats** - Apply asphalt at a uniform rate, normally within a range of 0.25 - 0.75 gallons per square yard of surface. The exact rate of application will be determined.

  (b) **Fog Coats** - Apply the diluted emulsified asphalt within the range of 0.07 - 0.15 gallons per square yard. The exact rate of application will be determined.

Discontinue application of the emulsified asphalt fog coat sufficiently early in the day to permit the termination of traffic control prior to sunset. Apply emulsified asphalt to only one designated traffic lane at a time.

### 00705.44 Spreading Aggregate Cover Material
- When aggregate cover material is required, spread the aggregate cover material within the range of 0.004 to 0.013 cubic yards per square yard as directed.

### Maintenance

### 00705.60 Curing, Maintaining and Opening Prime Coats to Traffic
- Cure the prime coat for a minimum of 3 calendar days after construction, as directed, before a succeeding course is placed upon it. If directed, traffic may be allowed to travel over the prime coat at any time after its construction. During the curing period, when in use by traffic and until it is covered by a succeeding course, maintain the prime coat to the specified shape and condition, as directed.

### 00705.61 Power Brooming Fog Coats
- Following the applications of all aggregate cover material, carefully broom the entire surface unless brooming damages the fog coat, to remove loose aggregate that could damage vehicles. Use a minimum of 2 power brooms.

Subsequent brooming the following 2 days may be directed to ensure that the surface is free of loose aggregate that could cause vehicle damage.

In curbed areas, use a pickup type power broom. On bridges, sidewalks and other areas off the roadway, remove all extraneous aggregates as directed.
Measurement

The quantities of emulsified asphalt will be measured on the weight basis.

The quantities of aggregate cover material will be measured on the weight basis or on volume basis in the hauling vehicle.

Payment

The accepted quantities of work performed under this Section will be paid for at the Contract unit price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Emulsified Asphalt in Prime Coat</td>
<td>Ton</td>
</tr>
<tr>
<td>(b) Emulsified Asphalt in Fog Coat</td>
<td>Ton</td>
</tr>
<tr>
<td>(c) Aggregate Cover Material</td>
<td>Cubic Yard or Ton</td>
</tr>
</tbody>
</table>

Item (b) includes water required to dilute the emulsified asphalt, according to 00705.11(c).

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for materials used during the maintenance period.
Section 00706 - Emulsified Asphalt Slurry Seal Surfacing

Description

00706.00 Scope - This work consists of applying one or more layers of slurry seal consisting of emulsified asphalt, water, aggregate, and additives on a prepared surface as shown or directed.

00706.02 Abbreviations:

ISSA - International Slurry Surfacing Association

Materials

00706.10 Emulsified Asphalt - Furnish CQS-1h emulsified asphalt meeting the following requirements when tested according to AASHTO T 59:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Viscosity, seconds at 77 °F</td>
<td>15 - 50</td>
</tr>
<tr>
<td>Residue from Distillation, Weight %</td>
<td>57% minimum</td>
</tr>
<tr>
<td>Sieve Test, % Retained on No. 20 Sieve</td>
<td>0.1 maximum</td>
</tr>
<tr>
<td>Particle Charge, Electroplate</td>
<td>(informational)</td>
</tr>
<tr>
<td>Settlement (Storage Stability), 24 hour</td>
<td>1% maximum</td>
</tr>
<tr>
<td>Cement Mixing Test</td>
<td>(informational)</td>
</tr>
</tbody>
</table>

The residue shall pass the following specifications:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration at 77 °F, 3.5 ounces, 5 sec</td>
<td>40-90 minimum</td>
</tr>
<tr>
<td>Solubility in CS₂ or TCE</td>
<td>97.5 minimum</td>
</tr>
<tr>
<td>Ductility at 77 °F, inch</td>
<td>15.7 Minimum</td>
</tr>
</tbody>
</table>

00706.11 Polymer Modified Emulsion - Furnish CQS-1h polymer modified emulsion. The polymer modifier shall be either a solid synthetic rubber or latex material. Combine the polymer modifier with the base asphalt or asphalt emulsion, prior to loading at the manufacturing plant, at the minimum rate of 2.5% to 3% polymer solids by weight of asphalt. The polymer modified emulsion shall be compatible with the mix design developed for the conventional slurry seal. Each shipment of emulsified asphalt shall be accompanied by a certificate of analysis or certificate of compliance from the manufacturer.

00706.12 Aggregate - The aggregate used shall be clean, angular, durable, well graded and uniform. The aggregate shall consist of broken stone, crushed gravel, slag or a combination of them. To assure the material is totally crushed, 100% of the parent aggregate shall be larger than the largest stone in the gradation to be used.

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Aggregate gradation shall meet one of the following types:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
<th>Sieve Size</th>
<th>Percent Passing</th>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>No. 4</td>
<td>100</td>
<td>No. 4</td>
<td>90 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>90 - 100</td>
<td>No. 8</td>
<td>65 - 90</td>
<td>No. 8</td>
<td>45 - 70</td>
</tr>
<tr>
<td>No. 16</td>
<td>65 - 90</td>
<td>No. 16</td>
<td>45 - 70</td>
<td>No. 16</td>
<td>28 - 50</td>
</tr>
<tr>
<td>No. 30</td>
<td>40 - 65</td>
<td>No. 30</td>
<td>30 - 50</td>
<td>No. 30</td>
<td>19 - 34</td>
</tr>
<tr>
<td>No. 50</td>
<td>25 - 42</td>
<td>No. 50</td>
<td>18 - 30</td>
<td>No. 50</td>
<td>12 - 25</td>
</tr>
<tr>
<td>No. 100</td>
<td>15 - 30</td>
<td>No. 100</td>
<td>10 - 21</td>
<td>No. 100</td>
<td>7 - 18</td>
</tr>
<tr>
<td>No. 200</td>
<td>10 - 20</td>
<td>No. 200</td>
<td>5 - 15</td>
<td>No. 200</td>
<td>5 - 15</td>
</tr>
</tbody>
</table>

The job mix gradation shall be within the gradation band for the desired type. After the target gradation has been submitted then the percent passing each sieve shall not vary by more than the stockpile tolerance and still remain within the gradation band.

00706.13 Additives and Mineral Filler - Liquid retardant and mineral fillers may only be used when their quantity can be metered. The use of additives in the slurry mix, (or individual materials), shall comply initially with the quantities predetermined by the mix design, or with field adjustments if required, after approval.

Portland cement, hydrated lime, limestone dust, fly ash or other approved filler required by the mix design shall meet the requirements of ASTM D 242, and shall be considered as part of the dry aggregate.

00706.14 Water - Water shall be potable, free of harmful salts and contaminants, and compatible with the slurry mix. Water used in mixing or curing shall be reasonably clean and free of oil, sugar, organic matter or other substance injurious to the finished product.

00706.15 Job Mix Formula (JMF) - Prior to the preconstruction conference, submit a signed slurry seal mix design for the specific materials to be used on the Project. Show the percentages of each individual material required on the mix design report. The complete mix design shall be made with the same aggregate gradation that will be used on the Project. After the mix design has been approved no substitution will be allowed unless approved. Water, not exceeding 11% by weight to asphalt emulsion, shall be used to develop a good mix.
(a) **Laboratory Evaluation** - Have the mix design prepared and tested by a laboratory which has experience in designing emulsified asphalt slurry seal surfacing. Determine the proportions of component materials and perform the tests described in 00706.15(b). The final mix design shall meet the limits described in 00706.15(b) and 00706.15(c).

(b) **Mix Design Tests:**

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSA TB-106</td>
<td>Slurry Seal Consistency</td>
<td></td>
</tr>
<tr>
<td>ISSA TB-139</td>
<td>Wet Cohesion, 30 minutes set 60 minutes set</td>
<td>0.10 lb-in min.</td>
</tr>
<tr>
<td>(For quick-traffic systems)</td>
<td></td>
<td>0.17 lb-in min.</td>
</tr>
<tr>
<td>ISSA TB-109</td>
<td>Excess Asphalt by LWT and Sand Adhesion</td>
<td>1 lb/yd² max.</td>
</tr>
<tr>
<td>(For heavy traffic areas only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISSA TB-114</td>
<td>Wet Stripping</td>
<td>Pass (90% minimum)</td>
</tr>
<tr>
<td>ISSA TB-100</td>
<td>Wet Track Abrasion Loss One hour soak</td>
<td>1.5 lb/yd² max.</td>
</tr>
<tr>
<td>ISSA TB-113</td>
<td>Mix Time *</td>
<td>Controllable to 180 sec. Minimum</td>
</tr>
</tbody>
</table>

* The mixing test and set time test should be done at the highest temperatures expected during construction.

The wet track abrasion test is used to determine the minimum asphalt content.

The mixing test is used to predict how long the material can be mixed in the machine before it begins to break.

The laboratory shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). The report shall clearly show the proportions of aggregate, the minimum and maximum proportions of mineral filler and water, additive usage, and asphalt emulsion based on the dry weight of the aggregate.

All the component materials used in the mix design shall be representative of the materials proposed for use on the Project.

Show the percentages of each individual material required in the laboratory report. Adjustments may be required during the construction, based on the field conditions. The Engineer will give final approval for all such adjustments.

(c) **Component Materials** - The Engineer will approve the mix design, all slurry seal materials and methods prior to use. The component materials shall be within the following limits:
• **Residual Asphalt:**
  Type I - 10% - 16%
  Type II - 7.5% - 13.5%
  Type III - 6.5% - 12%
  Based on dry weight of aggregate.

• **Mineral Filler:**
  0.5% - 2.0%
  Based on dry weight of aggregate.

• **Additives** - As needed.

• **Water** - As needed to achieve proper mix consistency. Total mix liquids shall not exceed the loose aggregate voids. Use ISSA T106 to check optimum liquids.

**00706.16 Tolerances and Limits** - Tolerances for individual materials as well as the slurry seal mixture during production are as follows:

- After the designed residual asphalt content is determined, a plus or minus 1% variation will be **allowed**.
- The percentage of aggregate passing each sieve shall be within the stockpile tolerance range as stated in 00706.12.
- The percentage of aggregate passing shall not go from the high end to the low end of the specified range of any 2 successive sieves.
- The slurry consistency shall not vary more than plus or minus 2 inches from the job mix formula after field adjustments.
- The rate of application, once determined by the Engineer, shall not vary more than plus or minus 2 pound per square yard while remaining within the design application rate.

**00706.17 Quality Control** - Be responsible for quality control as required by Section 00165. Perform quality control sampling and testing as follows:

(a) **QC/QA Slurry Seal Program** - Test gradation, mixture, moisture, and asphalt according to the MFTP.

(b) **Slurry Seal Production (Gradation):**

- **Stockpile** - 60,000 square yards.
- **Tanker** - 60,000 square yards.
- **Mixture** - To be taken directly out of pugmill every 60,000 square yards.
(c) Verification Testing - If comparisons of test results are outside the allowable differences, the Contractor and Engineer will investigate the reason. The Engineer may stop production while the investigation is in progress if the potential for pavement failure is present. The investigation may include review of calculation, testing of the remaining samples, review and observation of Contractor testing procedures and equipment, and a comparison of sample test results.

Equipment

00706.20 Equipment - Provide suitable surface preparation equipment, traffic control equipment, hand tools and any other support equipment required as necessary to perform the work.

00706.21 Mixing Equipment - The machine(s) shall be specifically designed and manufactured to lay slurry seal. Mix slurry seal in continuous pug mill mixers; a self-propelled machine specifically designed and manufactured to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive and water to a revolving blade mixer that discharges the thoroughly mixed product on a continuous flow basis. Concrete transit mixer trucks shall not be used. Minimum slurry seal machine size shall be 7 cubic yards. In the case of equipment failure have a minimum of 2 machines on site with another off site for immediate backup. The machine shall be capable of mixing materials at pre-set proportions regardless of the speed of the machine and without changing machine settings.

The mixing machine shall be equipped with an approved fine feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed. Use the fine feeder whenever added mineral filler is a part of the aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog type spray bar adequate for complete fogging of the surface preceding spreading equipment.

(a) Proportioning Devices - Provide and properly mark individual volume or weight controls, such as revolution counters or similar devices, for proportioning each material to be added to the mix (for example: aggregate, mineral filler, additive, emulsified asphalt and water). Instruct the Engineer how to calculate the application rate per square yard utilizing the Contractor’s proportioning devices.

(b) Calibration - Calibrate, in the presence of the Engineer, each slurry mixing unit to be used on the Project prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machines metering devices. No machine will be allowed to work on the Project until the calibration has been completed or accepted.
00706.22 **Spreading Equipment - Spreader Box** - Attach to the mixer machine a mechanical type squeegee distributor equipped with flexible material that is in contact with the pavement surface to prevent the loss of slurry from the distributor. Adjust the distributor to prevent the loss of slurry on varying grades and crown and to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. Keep the spreader box reasonably clean, and do not allow buildups of asphalt and aggregate. Only one tail rubber will be allowed. Any type of drag used shall be subject to approval by the Engineer and kept in a completely flexible condition at all times.

00706.23 **Rollers** - If required by Special Provision, rollers shall be self-propelled, steel-wheeled or pneumatic-tired type and be equipped with a water spray system. Steel-wheeled rollers shall be capable of providing a weight of not less than 2,400 pounds per foot width of the compression roll or rolls. Pneumatic-tired rollers shall be capable of exerting a ground pressure of not less than 80 pounds per square inch of tire contact area.

**Labor**

00706.30 **Quality Control Personnel** - Provide a certified technician in the following field:

- CAT-I

**Construction**

00706.40 **Weather Limitations** - Do not apply the slurry seal if either the pavement or air temperature is below 50 °F and falling. The slurry seal may be applied when both the pavement and air temperature are above 45 °F and rising. Do not apply if there is a danger that the finished product will freeze before 24 hours. Do not apply when weather conditions prolong opening to traffic beyond a reasonable time. Do not apply in the rain. Replace slurry damaged by rain after application according to the Specifications, and as determined by Engineer, at no additional cost to the City. Clean the street of all remaining slurry mix materials prior to re-application.

Adjust the rate of application of the fog spray during the day to suit temperatures, surface texture, humidity and dryness of pavement surface. Do not spray additional water into the spreader box.

00706.41 **Preparation of Surface** - Submit details of the proposed street cleaning for approval by the Engineer prior to the preconstruction conference.

Remove any organic materials in cracks or joints not removed during crack sealing as part of the pavement preparation.
Pavement preparation shall consist of removal of all oil spills, flushing and sweeping. Complete flushing, as needed, prior to sweeping. Finish sweeping with a vacuum sweeper no more than 24 hours prior to application of the slurry seal. If there is a delay of more than 48 hours between sweeping and slurry sealing caused by weather conditions or other unforeseen circumstances, re-sweep as determined by the Engineer, at no additional cost to the City.

Prepare the pavement on which the slurry seal is to be placed as follows, as directed.

(a) **Base Repairs** - Where determined by the Engineer, excavate and replace surfacing materials according to Section 00748.

(b) **Surface Repairs** - Where the pavement is severely cracked, rutted, deformed or otherwise distressed, place a leveling course or patch using 3/4 inch or 1/2 inch dense graded asphalt concrete. The class of mix to be used shall conform to Section 00744. Place the mixture according to Section 00744.

(c) **Crack Sealing** - Clean and fill cracks 1/8 inch and larger inside the proposed slurry seal area.

(d) **Tack Coat** - On old, dry bituminous pavements and on rigid pavements, the Engineer may direct that tack coats be applied prior to placing the slurry seal. The tack coat shall be a diluted asphalt emulsion of the same type and grade specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1:3. Apply the diluted material uniformly with a pressure distributor at a rate between 0.05 to 0.10 gallon per square yard, as determined by the Engineer. The tack coat shall be cured thoroughly prior to the application of the slurry seal.

(e) **Street Equipment and Procedure** - Immediately prior to applying the slurry seal, clear the surface of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable. If water is used, allow cracks to dry thoroughly before slurry sealing. The Engineer will approve the surface preparation prior to sealing.

(f) **Utility Covers** - Protect manholes, valve boxes, drop inlets and other service entrances from the slurry seal by a suitable method. Clean these covers as quickly as possible after the application of the slurry seal and definitely prior to the final set. If necessary, clean slurry residual from the interior of the utilities.

(g) **Pavement Markings** - Cover, or remove, all reflector buttons before slurry seal is to be applied to any area, as determined by the Engineer. Cover all thermo-tape markings and do not slurry seal over, or remove and replace as directed. Remove all paint pavement markings to prevent bleeding through the slurry seal and to allow proper adhesion.
00706.42 **General** - The surface may be wetted by fogging ahead of the slurry box, if required by local conditions. Apply water used in wetting the surface at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry box. The slurry mixture shall be of the desired consistency upon leaving the mixer. Do not add additional elements. Carry a sufficient amount of slurry in all parts of the spreader at all times so that complete coverage is obtained. Do not allow lumping, balling or unmixed aggregate in the spreader box. Do not allow segregation of the emulsion and aggregate fines from the coarse aggregates. If the coarse aggregate settles to the bottom of the mix, remove the slurry from the pavement. Do not allow excessive breaking of the emulsion in the spreader box. Do not leave streaks, such as caused by oversized aggregate, in the finished pavement. Maximum mixing time in the pugmill shall be 4 minutes.

00706.43 **Application Rate** - The minimum rate of application of dry aggregate per square yard will be determined by the Engineer. The depth of the slurry seal shall be sufficient to correct surface conditions, fill surface voids, and provide sealing and a minimum wearing surface. The maximum allowable vehicle speed for the rate of application shall be 180 feet per minute. Failure to demonstrate the proper rate of application will result in suspension of the work until the Contractor can demonstrate otherwise, at no additional cost to the City.

ISSA TB112 gives a method to determine expected application rates.

The slurry seal mixture shall be of proper consistency at all times to provide the application rate required by the surface condition. The average application rate, as measured by the Engineer, shall be according to the following table:

<table>
<thead>
<tr>
<th>Recommended Use</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE I Parking Areas, Urban and</td>
<td>6.7 - 10.0 lbs/yd²</td>
</tr>
<tr>
<td>Residential Streets, Airport</td>
<td></td>
</tr>
<tr>
<td>Runways</td>
<td></td>
</tr>
<tr>
<td>TYPE II Urban and Residential</td>
<td>10.0 - 16.7 lbs/yd²</td>
</tr>
<tr>
<td>Streets, Airport Runways</td>
<td></td>
</tr>
<tr>
<td>TYPE III Primary and Interstate</td>
<td>15.0 - 25.0 lbs/yd²</td>
</tr>
<tr>
<td>Routes</td>
<td></td>
</tr>
</tbody>
</table>

00706.44 **Applying Slurry Seal Sample Strip** - The strip shall consist of 2 panels approximately 50 feet long, placed side by side to form a typical seam between them. The width of the panels shall be the same as the Contractor plans to use on the streets. Place the strip at least 24 hours prior to the beginning of the actual work. Use the strip to calculate and monitor the rate of application in relation to weight of material per area, and to define the speed of the equipment related to the rate of application. If it is determined by the Engineer on the basis of this test strip that there are deficiencies in the mix design, method of application and rate of application, the Engineer may require the Contractor to revise the mix design, or repair or modify the equipment or application. After all changes are made, lay a new sample strip.
00706.45  **Joints** - Construct a uniform line along the edge and a good seal at curb lines. Construct the flow line at curbs to allow storm drainage flow to catch basins without bonding along the curb line. In the case of a concrete gutter, cover the gutter line joint with the slurry seal, but do not overlap onto the gutter. Remove any overlap, as determined by the Engineer, at no additional cost to the City. Streets that have been recently slurry sealed that cross this Project shall not be slurry sealed again.

The slurry joints and panels shall be straight, neat and uniform and follow the contour of the existing curb or concrete gutter. The width of the panels shall be the same as demonstrated in the sample strip. Floating (adding additional water other than what is required for the approved mix design) of the emulsion or slurry mixture in the pugmill or spreader box to cover or overlap missed areas will be prohibited. Keep lines straight at intersections to provide a good appearance.

00706.46  **Handwork** - Use approved squeegees to spread slurry in areas not accessible to the slurry mixer.

Limit handwork at the beginning and end of the panels to prevent segregation of the rock from the emulsion and to minimize cosmetic drag mop marks or defects in the finished product.

The same type finish as applied by the spreader box shall be required. Complete handwork prior to setting of the slurry.

00706.47  **Curing** - The rate of curing of the slurry seal shall be such that a street may be opened to traffic after application without tracking or damage to the surface. Protect the area for the full curing period with suitable barricades or markers.

The City will not be responsible for any damage to the slurry seal prior to opening the area. Repair all damage to the slurry, to the satisfaction of the Engineer, at no additional cost to the City.

00706.48  **Rolling** - If required by Special Provision, apply a minimum of 2 full coverage passes to the surfaced areas by the roller, or as directed.

00706.49  **Cleanup** - Remove all debris associated with the performance of the work on a daily basis.

**Temporary**

00706.51  **Provision for Traffic** - Be responsible for notifying all abutting property owners along the streets according to the approved schedule, or an approved revision, 48 hours prior to the specific work.

Remove all traffic control promptly when it is determined that the street may be open to traffic. Do not seal any street that requires closing overnight without the approval of the Engineer.
If the slurry seal does not cure in a timely manner and remains trackable overnight, apply a covering of 1/4 inch minus material to prevent tracking and related property damage prior to permitting traffic on the street at no additional cost to the City.

Be responsible for all damage to the uncured slurry or to private or public property due to tracking of the uncured material.

Measurement

**00706.80 Measurement** - Crack sealing will be measured on the length basis, of material in place.

Slurry seal will be measured on the area basis and calculated to the nearest square yard.

Asphalt concrete pavement repair will be measured according to 00748.80.

Payment

**00706.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Slurry Seal Crack Sealing</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Slurry Seal</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Asphalt concrete pavement repair will be paid for according to 00748.90

When the Contract Schedule of Items does not indicate payment for work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00710 - Single Application Emulsified Asphalt Surface Treatment

Description

00710.00 Scope - This work consists of applying emulsified asphalt and graded aggregates as shown or directed.

The surface treatment design will be designated on the plans or in the Special Provisions.

Materials

00710.10 Aggregates - Furnish aggregates meeting the following requirements:

(a) Size Designation - Provide the size of aggregate for the single application emulsified asphalt surface treatment design designated in the plans or Special Provisions according to the following:

<table>
<thead>
<tr>
<th>Chip Seal Design</th>
<th>Size of Screenings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>3/8&quot; - No. 8</td>
</tr>
<tr>
<td>Single Size Medium</td>
<td>3/8&quot; - 1/4&quot;</td>
</tr>
<tr>
<td>Graded Medium</td>
<td>3/8&quot; - No. 4</td>
</tr>
<tr>
<td>Coarse</td>
<td>1/2&quot; - 1/4&quot;</td>
</tr>
</tbody>
</table>

(b) Fractured Faces - Provide aggregates consisting of broken stone, crushed gravel or a combination of both. Crush aggregate such that at least 90% by weight of the total aggregate retained on the No. 8 and larger sieves is fractured on 2 faces, as determined according to AASHTO TP 61.

(c) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading for the designated single application emulsified asphalt surface treatment design according to the following:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Coarse 1/2&quot; - 1/4&quot;</th>
<th>Single Size Medium 3/8&quot; - 1/4&quot;</th>
<th>Graded Medium 3/8&quot; - No. 4</th>
<th>Fine 3/8&quot; - No. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>85 - 100</td>
<td>100</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>-</td>
<td>85 - 100</td>
<td>80 - 100</td>
<td>100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>10 - 40</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>45 - 65</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 - 4</td>
<td>-</td>
<td>0 - 6</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 30</td>
<td>-</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>-</td>
</tr>
<tr>
<td>No. 200 (wet)</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
</tr>
<tr>
<td>No. 200 (wet)*</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
</tr>
</tbody>
</table>

* in gravels

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(d) **Unit Weight of Aggregate** - Provide aggregate with a minimum unit weight of 90 pounds per cubic foot according to AASHTO T 19.

(e) **Soundness** - Provide coarse and fine aggregate with a weighted loss not exceeding 12% when subjected to 5 cycles of the soundness test using sodium sulfate solution according to AASHTO T104.

(f) **Durability** - Provide aggregates meeting the following durability requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>T 96</td>
<td>-</td>
<td>-</td>
<td>30.0%</td>
</tr>
<tr>
<td>Degradation (Coarse Aggregate)</td>
<td>TM 208</td>
<td>-</td>
<td>-</td>
<td>30.0%</td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td>TM 208</td>
<td>-</td>
<td>-</td>
<td>3.0&quot;</td>
</tr>
</tbody>
</table>

(g) **Harmful Substances** - Provide aggregates meeting the following harmful substances requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T113</td>
<td>-</td>
<td>-</td>
<td>1.0% Maximum</td>
</tr>
<tr>
<td>Wood Particles</td>
<td>TM225</td>
<td>-</td>
<td>-</td>
<td>0.1% maximum</td>
</tr>
<tr>
<td>Elongated Pieces</td>
<td>TM229</td>
<td>-</td>
<td>-</td>
<td>10.0% maximum</td>
</tr>
<tr>
<td>(Coarse Aggregate at a 1 ratio of 5:1)</td>
<td>TM229</td>
<td>-</td>
<td>-</td>
<td>10.0% maximum</td>
</tr>
<tr>
<td>Cleanness Value</td>
<td>TM 227</td>
<td>-</td>
<td>-</td>
<td>75 minimum</td>
</tr>
</tbody>
</table>

(h) **Taking Aggregates from City Stockpiles** - When it is specified that aggregates are to be taken from City-controlled stockpiles, take the material in an orderly manner. Do not contaminate the materials. Salvage all material possible from the area which the material is taken. Shape unused portions of a stockpile to neat lines. The Contractor will be charged for materials wasted through negligence or used without authority.

(i) **Stockpiling Contractor-Furnished Aggregates on City Property** - Aggregates may be temporarily stockpiled at approved sites on City property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

**00710.11 Emulsified Asphalt** - Furnish polymer-modified emulsified asphalt or non-polymer-modified emulsified asphalt as specified for the single application emulsified asphalt surface treatment design designated in the plans or Special Provisions. When non-polymer-modified emulsified asphalt is designated, the Contractor may elect to substitute a polymer-modified emulsified asphalt; however, selection of the polymer-modified emulsified asphalt will not be cause for additional compensation.
(a) **Non-Polymer-Modified Emulsified Asphalt** - When non-polymer-modified emulsified asphalt is specified, use CRS-2, or HFRS-2 emulsified asphalt as the Contractor elects.

(b) **Polymer-Modified Emulsified Asphalt** - When polymer-modified emulsified asphalt is specified, use CRS-2P or HFRS-P1 as the Contractor elects.

(c) **Acceptance of Emulsified Asphalt** - Provide emulsified asphalt conforming to the requirements of ODOT's publication, "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for surface treatment use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Obtain samples of emulsified asphalt according to AASHTO T 40 at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the City. Non-polymer-modified emulsified asphalt will be tested within 30 calendar days from the date it is sampled. Polymer-modified emulsified asphalt will be tested within 14 calendar days from the date it is sampled.

**00710.15 Aggregate Production Quality Control** - Provide quality control during production of aggregate according to Section 00165. Sampling and Testing shall be performed by a CAgT at the minimum frequency schedule indicated in the MFTP.

(a) **Quality Control Compliance** - Evaluate aggregates for compliance according to the following:

(1) **Gradation** - Analyze gradation statistically according to Section 00165. A stockpile contains specification aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.
(2) **Other Tests** - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(3) **Preproduced Aggregate** - Compliance of aggregates produced and stockpiled before the award of this Contract will be determined by either of the following:

- Continuing production records meeting the requirements of 00710.10 and 00710.15
- Sampling according to AASHTO T 2 and testing the entire stockpile at the minimum frequency schedule indicated in the MFTP. The material shall meet the requirements of 00710.10 and 00710.15.

(b) **Materials on Hand** - Payment for stockpiled materials on hand may be allowed as described in 00195.60 subject to meeting the requirements of 00710.10 and 00710.15.

**00710.16 Acceptance of Aggregate** - The Contractors quality control tests will be used for acceptance of aggregates if verified by the City’s quality assurance program. The City will perform aggregate production quality assurance according to the following:

(a) **ODOT Administered Projects** - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Manual.

(b) **Projects Administered by Other Agencies** - The quantity of quality assurance testing on projects administered by other Agencies will be at the discretion of the City or as designated in the Special Provisions.

**Equipment**

**00710.20 Equipment** - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in sufficient number and capacities that will provide coordinated and uniform progress of the work.

Provide two-way radio communication between the asphalt distributor and chip spreader.
00710.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00710.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an aggregate segregator assembly. Chip spreaders without an aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified panel and without placing joints in the travel lanes.

00710.23 Compactors - Provide self-propelled pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the surface treatment operation. A minimum of 2 pneumatic tired rollers and 1 steel-wheeled roller is required.

(a) Pneumatic-tired Rollers - Provide self-propelled, tandem or multiple axle, multiple wheel type pneumatic-tired rollers with smooth-tread pneumatic tires of equal size. The tires shall be staggered on the axles at such spacings and overlaps that will provide uniform compacting pressure for the full compacting width of the roller. The minimum load per tire shall be 2,800 pounds, with tire inflation pressures of 45 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00710.24 Power Brooms - Provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00710.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT
00710.40 Season and Weather Limitations - Do not apply emulsified asphalt when the pavement temperature is below 70 °F, nor if the humidity is higher than 75%. Complete the application of the emulsified asphalt and the aggregate 3 hours before sunset. Remove by milling, or other methods approved by the Engineer, and replace all surface treatments damaged by weather during the first 24 hours after application at no additional cost to the City. The placing of single application emulsified asphalt surface treatments will not be allowed before July 1 or after August 31.

00710.41 Rate of Progress and Scheduling - Do not apply more surface treatment in any one day than can be broomed the following morning, unless approved by the Engineer. Provide a traffic control plan for approval by the Engineer if operations exceed 3 centerline miles or 6 lane miles per day.

00710.42 Preparation of Underlying Surfaces - Immediately before applying the emulsified asphalt, clean and dry the surface to be treated in a manner approved by the Engineer.

00710.43 Sequence of Operations - Construct the single application emulsified asphalt surface treatment with a single spread of emulsified asphalt followed immediately with a single spread of aggregate and initial rolling, unless otherwise directed by the Engineer. Surface treatment is not required for guardrail flares, driveways, or other irregular areas as directed.

00710.44 Application Rates - Apply the emulsified asphalt and spread the aggregate within the following ranges of rates for the specified surface treatment design. The exact application and spread rate will be determined by the Engineer.

<table>
<thead>
<tr>
<th>Chip Seal Design</th>
<th>Emulsified Asphalt Application Rate (gal/yd²)</th>
<th>Aggregate Spread Rate (yd³/yd²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>0.25 - 0.40</td>
<td>0.004 - 0.009</td>
</tr>
<tr>
<td>Single Size Medium</td>
<td>0.40 - 0.65</td>
<td>0.005 - 0.015</td>
</tr>
<tr>
<td>Graded Medium</td>
<td>0.40 - 0.65</td>
<td>0.005 - 0.015</td>
</tr>
<tr>
<td>Coarse</td>
<td>0.33 - 0.70</td>
<td>0.009 - 0.018</td>
</tr>
</tbody>
</table>

00710.45 Applying Emulsified Asphalt - Apply emulsified asphalt at the rates specified in 00710.44 and according to the following:

- Apply the emulsified asphalt working toward the aggregate stockpile at all times, unless otherwise approved by the Engineer.
- Leave a minimum of 200 gallons of emulsified asphalt in the distributor tank at all times.
Do not apply emulsified asphalt to more than 1/2 the width of the travel way at one time with the remaining width remaining open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new surface treatment. Apply the surface treatment, weather permitting, to both sides of the travel way so that the end of the work is squared up 3 hours before sunset.

Do not apply emulsified asphalt a greater distance than can be immediately covered by aggregates before the emulsion breaks.

Place building paper over the treated surface at the beginning of each spread to ensure that the nozzles are operating properly before the uncovered surface is reached. Remove and dispose of building paper in a manner satisfactory to the Engineer.

If requested by the Engineer, demonstrate that the distribution of the emulsified asphalt does not vary between the individual nozzles by more than 15% transversely from the average, and no more than 10% longitudinally from the specified rate of application.

Apply the emulsified asphalt at a temperature between 140 °F and 185 °F as recommended by the manufacturer.

00710.46  Hauling and Spreading Aggregates - Spread aggregates at the rates specified in 00710.44.

Do not operate hauling and spreading equipment on uncovered emulsified asphalt. During the first hour after application of the emulsified asphalt and aggregate, operate at speeds no more than 10 mph and after the first hour, not more than 15 mph until otherwise allowed by the Engineer. Carefully operate hauling equipment at all times, at moderate speeds that will not damage the new surface treatment or create a hazard to the traveling public. Route hauling equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the emulsified asphalt surface with aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this aggregate within 10% of specified rate. Using approved methods, remove or repair emulsified asphalt that has set or "broke" before being covered with aggregate, at no additional cost to the City.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the aggregate surface) on the aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.
Construct neat transverse cut off of aggregates and remove any excess aggregates from the surface prior to resuming operations.

**00710.47 Shaping and Compacting** - After the aggregates have been placed on the emulsified asphalt, spread or remove all piles, ridges, or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of 2 coverages with a pneumatic tired roller and one coverage with a steel-wheeled roller. Continue compacting until the material is interlocked, firm and partially bound with the underlying emulsified asphalt. The sequence of roller coverages may be adjusted at the discretion of the Engineer.

Operate rollers at speeds such that the rollers do not pick up aggregates from the surface. Do not exceed rolling speeds of 5 mph.

In the event aggregates begin to pick up under traffic or from the rolling operation, immediately cover and roll the area with additional quantities of aggregate.

**Maintenance**

**00710.60 Power Brooming** - Following the application of the surface treatment, carefully broom the entire surface to remove loose aggregate. Discontinue the operation if brooming damages the surface treatment. Use a minimum of 2 power brooms.

Subsequent brooming the following 2 days may be directed by the Engineer to ensure that the surface is free of loose aggregate that could cause vehicle damage.

In curbed areas, use a pick-up type power broom. On bridges, sidewalks and other areas off the roadway, remove all loose aggregates to the satisfaction of the Engineer.

**Measurement**

**00710.80 Measurement** - The quantities of aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

The quantities of emulsified asphalt will be measured on the weight basis.

The quantities of asphalt surface treatment of approaches will be measured on the unit basis for each street connection and road approach.

**Payment**

**00710.90 Payment** - The accepted quantities will be paid for at the Contract unit price per unit of measurement for the following items:
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Aggregate in Emulsified Asphalt Surface Treatment</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(b) Asphalt in Emulsified Asphalt Surface Treatment</td>
<td>Ton</td>
</tr>
<tr>
<td>(c) Extra for Emulsified Asphalt Surface Treatment Approaches</td>
<td>Each</td>
</tr>
</tbody>
</table>

Item (c) applies to the extra costs of placing the aggregates and asphalt in single application emulsified asphalt surface treatments only on street connections, and road approaches. Payment will be in addition to payment made for the materials used in the work.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for preparing the road surface, placing materials in final position, or brooming.
Section 00715 - Multiple Application Emulsified Asphalt Surface Treatment

Description

00715.00 Scope - This work consists of applying multiple layers of emulsified asphalt and graded aggregates, applied in successive spreads, to form a firm, finished surface as shown or directed.

The surface treatment design will be designated on the plans or in the Special Provisions.

Materials

00715.10 Aggregates - Furnish aggregates meeting the following requirements:

(a) Fractured Faces - Provide aggregates consisting of broken stone, crushed gravel, or a combination of both. Crush aggregate such that at least 90% by weight of the total aggregate retained on the No. 8 and larger sieves is fractured on 2 faces, as determined according to AASHTO TP 61.

(b) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide designated gradings for the specified multiple application emulsified asphalt surface treatment design according to the following:

<table>
<thead>
<tr>
<th>Designated Size (inch)</th>
<th>1 - 1/2</th>
<th>3/4 - 1/2</th>
<th>1/2 - 1/4</th>
<th>3/8 - No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>1&quot;</td>
<td>3/4&quot;</td>
<td>1/2&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>95 - 100</td>
<td>90 - 100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60 - 90</td>
<td>0 - 10</td>
<td>85 - 100</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>15 - 30</td>
<td>0 - 2</td>
<td>0 - 15</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
<td></td>
<td>45 - 65</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 - 7</td>
<td>0 - 2</td>
<td>0 - 4</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 200 (wet)</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
</tr>
<tr>
<td>No. 200 (wet)*</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
</tr>
</tbody>
</table>

*in gravels

(c) Unit Weight of Aggregate - Provide aggregate with a minimum unit weight of 90 pounds per cubic foot according to AASHTO T 19.

(d) Soundness - Provide coarse and fine aggregate with a weighted loss not exceeding 12% when subjected to 5 cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.
(e) Durability - Provide aggregates meeting the following durability requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>T96</td>
<td></td>
<td></td>
<td>30.0%</td>
</tr>
<tr>
<td>Degradation (coarse aggregate)</td>
<td>TM 208</td>
<td></td>
<td></td>
<td>30.0%</td>
</tr>
<tr>
<td>Passing NO. 20 Sieve</td>
<td>TM 208</td>
<td></td>
<td></td>
<td>3*</td>
</tr>
<tr>
<td>Sediment Height</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(f) Harmful Substances - Provide aggregates meeting the following harmful substances requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T 113</td>
<td></td>
<td></td>
<td>1.0% Maximum</td>
</tr>
<tr>
<td>Wood Particles</td>
<td>TM 225</td>
<td></td>
<td></td>
<td>0.1% Maximum</td>
</tr>
<tr>
<td>Elongated Pieces (coarse aggregated at a ratio of 5:1)</td>
<td>TM 229</td>
<td></td>
<td></td>
<td>10.0% Maximum</td>
</tr>
<tr>
<td>Cleanness Value</td>
<td>TM 227</td>
<td></td>
<td></td>
<td>75 Maximum</td>
</tr>
</tbody>
</table>

(g) Taking Aggregates from City Stockpiles - When it is specified that aggregates are to be taken from City-controlled stockpiles, take the material in an orderly manner. Do not contaminate the materials. Salvage all material possible from the area which the material is taken. Shape unused portions of a stockpile to neat lines. The Contractor will be charged for materials wasted through negligence or used without authority.

(h) Stockpiling Contractor Furnished Aggregates on City Property - Aggregates may be temporarily stockpiled at approved sites on City property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

00715.11 Emulsified Asphalt - Furnish polymer-modified emulsified asphalt or non-polymer-modified emulsified asphalt as specified for the multiple application emulsified asphalt surface treatment design designated in the plans or Special Provisions. When non-polymer-modified emulsified asphalt is designated, the Contractor may elect to substitute a polymer-modified emulsified asphalt, however, selection of the polymer-modified emulsified asphalt will not be cause for additional compensation.

(a) Non-Polymer-Modified Emulsified Asphalt - When non-polymer-modified emulsified asphalt is specified, use CRS-2, or HFRS-2 emulsified asphalt as the Contractor elects.
(b) Polymer-Modified Emulsified Asphalt - When polymer-modified emulsified asphalt is specified, use CRS-2P or HFRS-P1 as the Contractor elects.

(c) Acceptance of Emulsified Asphalt - Provide emulsified asphalt conforming to the requirement of ODOT’s publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for surface treatment use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Obtain emulsified asphalt samples according to AASHTO T 40 at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the City. Non-polymer-modified emulsified asphalt will be tested within 30 calendar days from the date it is sampled. Polymer-modified emulsified asphalt will be tested within 14 calendar days from the date it is sampled.

00715.15 Aggregate Production Quality Control - Provide quality control during production of aggregate according to Section 00165. Sampling and Testing shall be performed by a CAgT at the minimum frequency schedule indicated in the MFTP.

(a) Quality Control Compliance - Evaluate aggregates for compliance according to the following:

(1) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(2) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.
(3) **Preproduced Aggregate** - Compliance of aggregates produced and stockpiled before the award of this Contract will be determined by either one of the following:

- Continuing production records meeting the requirements of 00715.10 and 00715.15.
- Sampling according to AASHTO T 2 and testing the entire stockpile at the minimum frequency schedule indicated in the MFTP. The material shall meet the requirements of 00715.10 and 00715.15.

**Materials on Hand** - Payment for stockpiled materials on hand may be allowed as described in 00195.60, subject to meeting the requirements of 00715.10 and 00715.15.

**Acceptance of Aggregate** - The Contractor's quality control tests will be used for acceptance of aggregates if verified by the City's quality assurance program. The City will perform aggregate production quality assurance according to the following:

(a) **ODOT Administered Projects** - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Manual.

(b) **Projects Administered by Other Agencies** - The quantity of quality assurance testing on projects administered by other Agencies will be at the discretion of the City or as designated in the Special Provisions.

**Equipment**

00715.20 **Equipment** - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms, and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in sufficient number and capacities that will provide coordinated and uniform progress of the work.

Provide two-way radio communication between the asphalt distributor and chip spreader.
00715.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00715.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an aggregate segregator assembly. Chip spreaders without an aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified panel and without placing joints in the travel lanes.

00715.23 Compactors - Provide self-propelled, pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the multiple application emulsified asphalt surface treatment operation. A minimum of 2 pneumatic-tired rollers and 1 steel-wheeled roller is required.

(a) Pneumatic-tired Rollers - Provide self-propelled, tandem or multiple axle, multiple wheel type pneumatic-tired rollers with smooth-tread pneumatic tires of equal size. The tires shall be staggered on the axles at such spacings and overlaps that will provide uniform compacting pressure for the full compacting width of the roller. The minimum load per tire shall be 2,800 pounds, with tire inflation pressures of 45 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00715.24 Power Brooms - Provide pickup or nonpickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00715.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT
Construction

00715.40  **Season and Weather Limitations** - Do not apply emulsified asphalt when the pavement temperature is below 70 °F, nor if the humidity is higher than 75%. Complete the application of the emulsified asphalt and the aggregate 3 hours before sunset. Remove by milling, or other methods approved by the Engineer, and replace at the Contractor's expense, any surface treatments damaged by weather during the first 24 hours after application. The placing of multiple application emulsified asphalt surface treatments will not be allowed before July 1 or after August 31.

00715.41  **Preparation of Underlying Surfaces** - Prepare underlying surfaces according to the following:

(a) **Asphalt Surfaces** - Immediately before applying the emulsified asphalt, clean and dry the surface to be sealed and trim the shoulders in a manner approved by the Engineer.

(b) **Aggregate Surfaces** - Bring aggregate bases and other bases or foundations, when constructed under the Contract, to the completed and finished condition according to the applicable Specifications.

Bring old bases and foundations, constructed by others, to the applicable condition according to Section 00610, and within 1/2 inch of established grade and cross section.

00715.42  **Sequence of Operations and Application Rates** - Construct the number of spreads, the size of aggregates, and the application rates for both emulsified asphalt and aggregates for the multiple application emulsified asphalt surface treatment design specified according to Table 00715-1. Vary the rates of spread as directed during the progress of the work to produce the best results.
<table>
<thead>
<tr>
<th>Spreading Order and Rate of Spread*</th>
<th>Fine Double Chip Seal</th>
<th>Medium Double Chip Seal</th>
<th>Type E-9 Oil Mat</th>
<th>Type E-11 Oil Mat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>.20</td>
<td>0.25</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>1&quot; - 1/2&quot; Aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; - 1/2&quot; Aggregate</td>
<td></td>
<td>0.015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>1/2&quot; - 1/4&quot;</td>
<td>0.008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>3/8&quot; - No. 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>0.30</td>
<td>0.30</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>1&quot; - 1/2&quot; Aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2&quot; - 1/4&quot; Aggregate</td>
<td></td>
<td>0.010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>3/8&quot; - No. 8</td>
<td>0.006</td>
<td>0.007</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Third Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td></td>
<td></td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td><strong>Fourth Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td></td>
<td></td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td><strong>Total Quantities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>0.50</td>
<td>0.55</td>
<td>0.95</td>
<td>1.30</td>
</tr>
<tr>
<td>Aggregates</td>
<td>0.014</td>
<td>0.017</td>
<td>0.033</td>
<td>0.052</td>
</tr>
</tbody>
</table>

* The rates of spread are in the following units:

- Emulsified Asphalt - gallons per square yard
- Aggregates - cubic yards per square yard

(a) **Type E-9 and E-11 Oil Mats** - Use one of the following procedures as mutually agreed to by the Engineer and Contractor for Type E-9 and E-11 oil mats:
• Complete first and second course (and third course for Type E-11) of the oil mat throughout the entire section (including the dry key) to which the oil mat is to be applied. Square up these courses 3 hours prior to sunset each day.

Prior to applying third course (fourth course for Type E-11), lightly broom any loose aggregates from surface. Apply third or fourth course (seal coat) throughout entire section. Square up the courses 3 hours prior to sunset each day.

• Square up first and second course (and third course for Type E-11) of the oil mat 3 hours prior to sunset.

• The following day, prior to applying third course (fourth course for Type E-11), lightly broom any loose aggregates from surface. Place the third or fourth course (seal coat) of the oil mat and square up 3 hours prior to sunset.

• Complete all courses the same day. Square up all courses 3 hours prior to sunset.

(b) Taper at Project Ends - Stop succeeding courses of each surface treatment 16 feet beyond the preceding course, or as directed by the Engineer, at Project ends to provide a smooth transition to the existing pavement.

00715.43 Applying Emulsified Asphalt - Apply emulsified asphalt at the rates specified in 00715.42 and according to the following:

• Apply emulsified asphalt, working toward the aggregate stockpile at all times, unless otherwise approved by the Engineer.

• Leave a minimum of 200 gallons of emulsified asphalt in the distributor tank at all times.

• Do not apply emulsified asphalt to more than 1/2 the width of the travel way at one time with the remaining width remaining open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new surface treatment. Apply the surface treatment, weather permitting, to both sides of the travel way so that the end of the work is squared up 3 hours before sunset.

• Do not apply emulsified asphalt a greater distance than can be immediately covered by aggregates before the emulsion breaks.

• Place building paper over the treated surface at the beginning of each spread to ensure that the nozzles are operating properly before the uncovered surface is reached. Remove and dispose of building paper in a manner satisfactory to the Engineer.

• If requested by the Engineer, demonstrate that the distribution of the emulsified asphalt does not vary between the individual nozzles by more than 15% transversely from the average, and no more than 10% longitudinally from the specified rate of application.

• Apply the emulsified asphalt at a temperature between 140 °F and 185 °F as recommended by the manufacturer.
00715.44 **Hauling and Spreading Aggregates** - Spread aggregates at the rates specified in 00715.42.

Do not operate hauling and spreading equipment on uncovered emulsified asphalt. During the first hour after application of the emulsified asphalt and aggregate, operate at speeds no more than 10 mph and after the first hour, not more than 15 mph until otherwise allowed by the Engineer. Carefully operate hauling equipment at all times, at moderate speeds that will not damage the new surface treatment or create a hazard to the traveling public. Route hauling equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the emulsified asphalt surface with aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this aggregate within 10% of specified rate. Using approved methods, remove or repair emulsified asphalt that has set or "broke" before being covered with aggregate, at no additional cost to the City.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the aggregate surface) on the aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of aggregates and remove any excess aggregates from the surface prior to resuming operations. Stagger cut-offs of successive courses a minimum of 16 feet prior to the end of a proceeding course.

00715.45 **Shaping and Compacting** - After the aggregates have been placed on the emulsified asphalt and spread, remove all piles, ridges or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of 4 complete coverages immediately behind the chip spreader. Perform additional coverages as directed by the Engineer until the material is interlocked, firm, and partially bound with the underlying emulsified asphalt. The sequence of rollers will be as directed by the Engineer.

Operate rollers at speeds that do not damage the surface. Do not exceed rolling speeds of 5 mph. In the event aggregates begin to pick up under traffic or from the rolling operation, immediately cover and roll the area with additional quantities of aggregate.
Begin rolling at the low side of the cross section and progress with passes parallel to the roadway centerline. Overlap each preceding pass by at least one half the width of the roller.

Along curbs, walls and at all other places not accessible to specified rollers, thoroughly compact the aggregate with mechanical tampers or hand tampers. Provide hand tampers with a weight of not less than 50 pounds and a tamping face of not more than 0.7 square foot.

Correct irregularities in emulsified asphalt distribution, surface smoothness, non-uniformity of texture, segregation of materials, dirt pockets, spots of excess asphalt and other deficiencies and defects. Accomplish this by the removal, replacement, addition of material, repetition of construction operations or other suitable means, as directed or approved by the Engineer.

**Maintenance**

**00715.60 Establishment** - During periods when partial construction is open to traffic and for one calendar week following original completion of the final course throughout the entire length of the Project, perform the following operations:

- Maintain the surface to correct bleeding of asphalt, keep the surface free of ravel, traffic grooves, holes and other deformations, and eliminate other defects that may appear.
- Roll and compact the surface to maintain or restore firmness and stability to the materials.
- Broom the surface to ensure that the surface is free of loose aggregate. Discontinue brooming if the operation damages the surface. In curbed areas, use a pick up type power broom. On bridges, sidewalks and other areas off the roadway, remove all loose aggregates to the satisfaction of the Engineer.

Perform the above operations under traffic and at frequencies which the Engineer determines as being necessary to develop and establish the course to uniform firmness and stability throughout.

**Finishing and Cleaning Up**

**00715.70 Surface Tolerance** - Provide a finished surface, after brooming, that does not vary by more than 1/2 inch either transverse or perpendicular to centerline when tested with a 12 foot straightedge. Furnish and operate the straightedge under the observation of the Engineer.

**00715.71 Correction of Surface Deficiencies** - Correct all deficiencies in surface tolerance in a manner acceptable to the Engineer. Perform all corrective work within 14 calendar days following notification at no additional cost to the City.
Measurement

- The quantities of aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

- The quantities of emulsified asphalt will be measured on the weight basis.

- The quantities of asphalt surface treatment of approaches will be measured on the unit basis for each street connection and road approach.

Payment

- The accepted quantities will be paid for at the Contract unit price per unit of measurement for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Aggregate in Multiple Application Emulsified Asphalt Surface Treatment</td>
<td>Cubic Yard or Ton</td>
</tr>
<tr>
<td>(b) Asphalt in Multiple Application Emulsified Asphalt Surface Treatment</td>
<td>Ton</td>
</tr>
<tr>
<td>(c) Extra for Multiple Application Emulsified Asphalt Surface Treatment Approaches</td>
<td>Each</td>
</tr>
</tbody>
</table>

- Item (c) applies to the extra costs of placing the aggregates and asphalt in emulsified asphalt surface treatment only on street connections and road approaches. Payment will be in addition to payment made for the materials used in the work.

- Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

- No separate or additional payment will be made for preparing the road surface, placing material in final position, or blading and brooming.
Section 00730 - Asphalt Tack Coat

Description

00730.00  Scope - This work consists of furnishing and placing emulsified asphalt on a prepared asphalt concrete, portland cement concrete, or other paved surface to ensure bond between lifts as specified.

Materials

00730.11  Emulsified Asphalt - Furnish CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-1, CRS-2, HFRS-2, or HFMS-2 as selected by the Contractor.

Furnish emulsified asphalt meeting the requirements of ODOT's publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for tack coat use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Dilution of the tack coat material may be allowed to a maximum 1:1 ratio. Determine the proportion of water to be added to the emulsified asphalt. Do not dilute the emulsified asphalt until the Engineer approves the dilution ratio. Add the water to the emulsified asphalt and mix according to the asphalt supplier.

Obtain samples according to AASHTO T 40 prior to dilution with water, if allowed, at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the City. Emulsified asphalt will be tested within 30 calendar days from the date it is sampled.
Equipment

**00730.22 Asphalt Distributor** - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

Construction

**00730.40 Temperature Limitations** - Apply tack coat only when the surface temperature in the shade is not less than the appropriate minimum surface temperature according to 00735.40 or 00744.40 as applicable.

**00730.41 Traffic Control** - Do not apply the tack to more than 1/2 the width of the travel way at one time. The remaining width shall remain open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new surface.

**00730.42 Preparation of Underlying Surfaces** - Immediately before applying the tack coat, the surface to be tacked shall be clean and dry. Clean all loose material by brooming, flushing with water or other approved methods.

**00730.44 Applying Tack Coat** - Apply the emulsified asphalt with a pressure distributor conforming to 00730.22, unless otherwise allowed. Apply the emulsified asphalt to the prepared surface at a rate between 0.05 and 0.20 gallons per square yard as directed and with the emulsified asphalt temperature between 140 °F and 185 °F as recommended by the manufacturer.

Application rates for tack coat diluted according to 00730.11 will be increased as necessary to provide the same amount of residual asphalt as the application rates specified above.

Do not place hot mixed asphalt concrete pavement or emulsified asphalt concrete pavement on the tack coat until the emulsified asphalt separates from the water (breaks), but before it loses its tackiness.
Measurement

00730.80 Measurement - There will be no measurement of the asphalt tack work. The estimated quantity of asphalt tack coat will be listed in the Special Provisions.

00730.81 Water - Water added to dilute the emulsified asphalt tack coat after it is manufactured will not be measured.

Payment

00730.90 Payment - There will be no separate payment of asphalt tack coat, as the cost will be included in the payment for the particular items of work using asphalt tack coat.

00730.91 Water - Water added to dilute the emulsified asphalt tack coat after it is manufactured will not be paid for and will be considered incidental to the item above.
00735.00  

Section 00735 - Emulsified Asphalt Concrete Pavement  

Description  

00735.00  **Scope** - This work consists of constructing an emulsified asphalt concrete (EAC) pavement composed of aggregate and emulsified asphalt, plant mixed into a uniformly coated mixture, spread on a prepared base, covered with choke aggregate, and compacted to the lines, grades, thicknesses, and cross sections shown or established.  

00735.05  **Precrushing and Prepaving Conferences:**  

(a) **Precrushing Conference** - Supervisory personnel of the Contractor and any subcontractors who are to be involved in aggregate crushing of EAC aggregates shall meet with the Engineer at a mutually agreed time, to discuss methods of accomplishing all phases of the crushing work. The Crusher Supervisor and the Contractor’s CAgT shall attend the meeting.  

(b) **Prepaving Conference** - Supervisory personnel of the Contractor, including the CAT-I and any subcontractors who are to be involved in the paving work, shall meet with the Engineer at a mutually agreed time to discuss methods of accomplishing all phases of the paving work.  

Materials  

00735.10  **Aggregates** - Furnish aggregates for EAC meeting the following requirements:  

(a) **General** - Scalp the rock material used to produce aggregates on a 3/4 inch sieve covering the entire screen deck (after it has passed through the primary crusher if quarry rock is used). The material remaining may be accepted for use by visual inspection. The Engineer may perform verification testing of the gradation. The material shall meet the following:  

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>5 Max.</td>
</tr>
</tbody>
</table>

(b) **Soundness** - Provide coarse and fine aggregate with a weighted loss not exceeding 12% when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.  

(c) **Durability** - Provide EAC aggregates meeting the following durability requirements:
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method ODOT</th>
<th>Test Method AASHTO</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>T 96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degradation (coarse aggregate)</td>
<td>TM 208</td>
<td></td>
<td>30.0%</td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td>TM 208</td>
<td></td>
<td>30.0%</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>TM 208</td>
<td></td>
<td>3.0&quot;</td>
</tr>
</tbody>
</table>

(d) Fractured Faces - Determine fracture of aggregates according to AASHTO TP 61. Crush aggregate to provide at least two fractured faces on 90% of the material retained on a 1/4 inch sieve, and 1 fractured face on 75% of the material retained on a No. sieve.

(e) Harmful Substances - Provide EAC aggregates meeting the following harmful substances requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method ODOT</th>
<th>Test Method AASHTO</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T 113</td>
<td></td>
<td>1.0% maximum</td>
</tr>
<tr>
<td>Wood Particles</td>
<td>TM 225</td>
<td></td>
<td>0.1% maximum</td>
</tr>
<tr>
<td>Elongated Pieces (coarse aggregate at a ratio of 5:1)</td>
<td>TM 229</td>
<td></td>
<td>10.0% maximum</td>
</tr>
<tr>
<td>Cleanness Value</td>
<td>TM 227</td>
<td></td>
<td>75 minimum</td>
</tr>
</tbody>
</table>

(f) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading of EAC aggregate conforming to the following:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
<th>Leveling or Patching Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>95 - 100</td>
<td>95 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60 - 90</td>
<td>15 - 40</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>15 - 30</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 - 7</td>
<td>0.0 - 2.0</td>
</tr>
<tr>
<td>No. 200</td>
<td>0.0 - 2.0</td>
<td>0.0 - 2.0</td>
</tr>
<tr>
<td>No. 200*</td>
<td>0.0 - 1.0</td>
<td>0.0 - 1.0</td>
</tr>
</tbody>
</table>

* in gravels

If the aggregates are produced in two or more separate sizes, the gradation of the blended sizes shall conform to the above grading requirements.

(g) Stockpiling - Prepare the ground for the stockpile site to prevent contamination. Prevent segregation, as much as possible, when stockpiling and removing the aggregate.
00735.11 **Emulsified Asphalt** - Furnish CM-2, CMS-2S, or HFMS-2 emulsified asphalt meeting the requirements of ODOT's publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project. Acceptance of the selected emulsified asphalt is subject to the production of a suitable JMF.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for EAC use. Limit pumping between the bulk storage tank, hauling transportation, field storage tanks, and plant to an absolute minimum to maintain viscosity.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for EAC use. Limit pumping between the bulk storage tank, hauling transportation, field storage tanks, and plant to an absolute minimum to maintain viscosity.

Obtain emulsified asphalt samples according to AASHTO T 40 at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the City, within 30 calendar days from the day the sample was taken.

00735.13 **Job Mix Formula (JMF)** - Provide a mixture comprised of aggregate and emulsified asphalt in the proportions established in the JMF. The emulsified asphalt content shall be between 5.0% and 8.0%, by weight, of the total aggregate. Vary the proportions of materials as directed.

The CMDT shall prepare, sign and submit a JMF and samples to the Engineer for each mixture required at least 10 calendar days prior to anticipated use in EAC, and according to the latest copy of the ODOT Contractor Mix Design Guidelines for Asphalt Concrete.

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Coarse Aggregate</td>
<td>55 pounds</td>
</tr>
<tr>
<td>Emulsified asphalt</td>
<td>4 quarts in 1 quart plastic containers</td>
</tr>
<tr>
<td>Cement</td>
<td></td>
</tr>
</tbody>
</table>

Provide a JMF meeting the following mixture requirements:

<table>
<thead>
<tr>
<th>EAC Mixture</th>
<th></th>
</tr>
</thead>
</table>
| Air Voids, %         | 15 - 30 according to AASHTO T 269*
| IRS                  | Report according to ODOT TM 313* |
| Percent Coating      | 90% minimum                |

* AASHTO T 269 and ODOT TM 313 procedures available from ODOT Materials Laboratory.

00735.14 **Choke Aggregate** - Furnish choke aggregate meeting the gradation below. Perform sieve analysis according to AASHTO T 27. Use crushed or uncrushed rock free of clay, loam or other harmful substances.
00735.15 Aggregate Production Quality Control - Provide quality control during production of EAC aggregate according to Section 00165. Sampling and testing shall be performed by a CAgT at the minimum frequency indicated in the MFTP.

(a) Quality Control Compliance - Evaluate EAC aggregates for conformance according to the following:

(1) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(2) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(3) Preproduced Aggregate - Compliance of aggregates produced and stockpiled before the award of this Contract will be determined by either of the following methods:

- Continuing production records meeting the requirements of 00735.10, 00735.14 and 00735.15.
- Sampling according to AASHTO T 2 and testing the entire stockpile at the minimum frequency schedule indicated in the MFTP. The material shall meet the requirements of 00735.10, 00735.14 and 00735.15.
00735.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of EAC aggregates if verified by the City's quality assurance program. The City will perform aggregate production quality assurance according to the following.

(a) ODOT Maintained Projects - Quality assurance testing on ODOT maintained projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Manual.

(b) Projects Maintained by the City - The quantity of quality assurance testing on projects administered by the City will be at the discretion of the City or as designated in the Special Provisions.

00735.17 EAC Mixture Production Quality Control - Provide quality control during production of EAC mixture according to Section 00165 and the following:

(a) Personnel Requirements - Maintain quality control by:

- Providing at least one CAT-I full-time at each plant site used to furnish mixture to the Project.
- Obtaining samples under the direct supervision of a CAT-I.
- Having all testing, data analysis and reporting of test results performed by a CAT-I.

(b) Laboratory Requirements - Furnish and maintain an ODOT certified laboratory at the plant site furnished with the necessary equipment and supplies for performing Contractor quality control testing.

The laboratory shall be on-site and operational prior to the beginning of EAC production. Provide laboratory equipment meeting the requirements of the test methods identified in these Specifications.

Calibrate all testing equipment according to the required test methods. The Engineer may inspect measuring and testing devices to confirm both calibration and condition.

(c) Plant Calibration - Calibrate the plant according to ODOT TM 322. The plant calibration shall be witnessed and documented by a CAT-I. Do not begin production until calibration tests indicate that the specified proportions can be obtained.

(d) Required Tests - Randomly sample and test the aggregate and emulsified asphalt during EAC mixture production according to Section 00165 and the MFTP.

(e) Quality Control Compliance - Evaluate EAC mixture for compliance according to Section 00165 and the MFTP.
00735.18 **Acceptance of EAC Mixture** - The Contractor’s quality control tests will be used for acceptance of EAC mixture if verified by the City’s quality assurance program. The City will perform EAC mixture production quality assurance according to the following:

(a) **ODOT Maintained Projects** - Quality assurance testing on ODOT maintained projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Manual.

(b) **Projects Maintained by the City** - The amount of quality assurance testing on projects administered by other Agencies will be at the discretion of the City or as designated in the Special Provisions.

**Equipment**

00735.20 **EAC Mixing Plant** - Mix the EAC at a plant capable of providing a mix of aggregate and emulsified asphalt of uniform proportions and consistency as designated.

Provide mixing plants with the following operating equipment:

- A positive control linking the aggregate and emulsified asphalt feed so that a constant ratio of emulsified asphalt to aggregate is maintained.
- Totalizers for the emulsified asphalt metering device and the aggregate scales.
- A metering device that can determine percent of emulsified asphalt in mixture at any time the plant is in operation.
- An adjustable emulsified asphalt spray bar.
- Provide and operate a mechanical sampling device that produces a representative sample of the quantity of material required for the appropriate tests, when sampling at or around crushing, screening, mixing plants, conveyors, or other similar mechanical equipment.

Proportion the aggregate by weight. Proportion the emulsified asphalt by either weight or metering. Provide equipment capable of feeding and maintaining a constant rate of aggregate within a tolerance of plus or minus 5%, by weight, of the designated amount, and feeding a constant rate of emulsified asphalt within plus or minus 0.5%, by weight, of the designated amount.

00735.21 **Hauling Equipment** - Provide hauling vehicles in good operating condition with tight, clean, metal beds and a cover. Equip beds of hauling vehicles with a positive system to prevent materials from leaking onto the surfaces over which the hauling vehicle travels. If leakage occurs, remove any spilled material and repair any damage according to 00170.85.

Coat the beds with a minimum amount of an approved material to keep the EAC from sticking to the beds. Do not use diesel oil. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.
Do not use vehicles that cause segregation or delay operations.

**00735.22 EAC Pavers** - Provide EAC pavers meeting the following requirements:

(a) **Power and Support** - Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

(b) **Augers and Screed** - Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

- Can spread and finish EAC to a uniform texture, in the specified widths, thicknesses, lines, grades, and cross sections.
- Will not segregate, tear, shove, or gouge EAC.
- Produce a finished surface to specified evenness and texture.

(c) **Control System** - Equipped with a paver control system which:

- Controls EAC placement to specified slope and grade.
- Maintains the paver screed in proper position.
- Provides specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

**00735.23 Compactors** - Provide self-propelled, steel-wheeled and pneumatic-tired rollers capable of reversing without backlash according to the following:

(a) **Steel-Wheeled Rollers** - Provide steel-wheeled rollers with:

- A gross static weight of at least 8 tons.
- A gross static weight of at least 6 tons for finish rolling.

(b) **Pneumatic-tired Rollers** - Provide pneumatic-tired rollers meeting the following:

- Be tandem, or multiple axle, multiple wheel type.
- Have smooth-tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width.
- Have a minimum load of 2,800 pounds per tire with tire inflation pressures of 45 psi to 90 psi.

**00735.24 Chip Spreaders** - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders of adequate width to provide full coverage of the specified panel.
00735.25  **Power Brooms** - Provide pickup and/or nonpickup power brooms that have a positive means to control vertical pressure.

00735.26  **Release Agents** - Do not use diesel oil as a release agent to coat or clean equipment at the mixing plant, or on hauling equipment beds or compactors.

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**Labor**

00735.30  **Quality Control Personnel** - Provide certified technicians in the following fields:

- CAgT
- CAT-I
- CMDT

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**Construction**

00735.40  **Season and Weather Limitations** - Place EAC from May 1 to August 31, inclusive, when the pavement temperature is 60 °F or above. Seasonal limitations for EAC will not supersede seasonal limitations for emulsified asphalt surface treatments on the Project.

Do not place EAC:

- When the underlying layer is frozen.
- During rain or other adverse weather conditions.

Correct mixtures damaged by weather by milling and replacement or other approved methods at no additional cost to the City.

00735.41  **Rate of Progress and Scheduling** - Do not begin work until there is enough mixing, hauling, spreading and compacting equipment on the Project to assure that the paving machine can place the EAC without stopping, as nearly as possible.

00735.42  **Preparation of Underlying Surfaces** - Clean all deleterious material, dirt and dust from existing and new bases, surfacings, and pavements in a manner acceptable to the Engineer.

Bring the existing surface to uniformity by patching irregular or depressed surfaces and potholes with EAC thoroughly compacted until it conforms with the surrounding surface. Prepare individual potholes for patching by cutting the edges vertically to the depth of the deepest portion of the hole.

When designated in the plans or Special Provisions, place leveling courses of EAC on existing pavements before constructing the final paving course. Perform the leveling work to the lines and grades established. Place leveling material with either a paving machine or motor grader as directed.
Apply a tack coat to the existing surface according to Section 00730 prior to placing EAC.

**00735.43 Mixing:**

(a) **General** - Mix the aggregate and emulsified asphalt until a uniform consistency is obtained. Use the temperature of the emulsified asphalt cement recommended by the supplier.

(b) **Moisture** - At the time it is mixed with the emulsified asphalt, provide aggregate with a moisture content adequate to allow distribution of the emulsion, but not so great that moisture or emulsion runs from the mixture. Provide special processing necessary to attain an acceptable moisture content at no additional cost to the City.

1. **No Moisture Problem** - A visual moisture content determination by the Engineer will suffice when there are no apparent moisture problems.

2. **Moisture Problems** - If there are unresolved moisture problems, the maximum allowable moisture shall be the saturated surface dry (SSD) moisture content for the aggregate submitted for the JMF, as determined by AASHTO T 84 and AASHTO T 85.

**00735.44 Control of Grade** - Use a floating beam device of adequate length and sensitivity on either or both sides of the paver to provide adequate reference to control the grade of the paver. Where this method is impractical, manual control of grade for the paver will be allowed when approved.

**00735.45 Hauling, Depositing, and Placing:**

(a) **Hauling** - Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the Contractor matches the delivery rate of mixture with the capacity of the paving machine.

If rain or cold weather conditions are encountered any time between loading and placement:

- Suspend mixing operations.
- Cover the mixture in transit.
- Do not place mixture that is in transit until conditions improve, unless placed at Contractor's risk according to 00735.40.
- Take action to prevent emulsion run-off from entering drainage channels or facilities.
The EAC will be rejected before placing if it is found to be:

- Segregating or separating.
- Solidifying or crusting.

Work with the Engineer to make appropriate adjustments if an excessive amount of emulsified asphalt is leaking from trucks.

No more EAC will be accepted until corrective action has been taken.

Dispose of rejected loads at no additional cost to the City.

(b) Depositing - Deposit the EAC material in windrows from the hauling vehicles so segregation is prevented. Alternate methods of depositing may be used if specified in the Special Provisions or allowed.

Provide pick-up equipment that can:

- Pick up substantially all of the material deposited on the roadway.
- Be self-supporting, not exert any vertical load on the paving machine, or cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement.

(c) Placing - Place the EAC on dry, prepared surfaces with pavers meeting the requirements of 00735.22. Spread and finish to established widths, thickness, line, grade and cross section.

When approved, the EAC may be spread with other equipment and means where irregularities or obstacles make the use of specified equipment impractical.

00735.46 Compaction - Compact the EAC as follows:

(a) General - After the EAC has been spread, struck off, and surface irregularities or other defects remedied roll it uniformly until compacted as specified.

(b) Rolling - Compact the EAC with rollers conforming to 00735.23. Provide sufficient rollers of type and weight to compact the mixture while it is in a workable condition. Operate rollers at a uniform speed not more than 3 mph, with the drive roll or wheels nearest the paver.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, and gradually progressing towards the center, unless otherwise directed. On superelevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously paved lane, roll the longitudinal joint first, followed by the regular rolling pattern.
Do not make sharp turns or park rollers on the EAC. Stop each pass at least 5 feet longitudinally from preceding stops. Do not displace the line and grade of edges. Prevent the EAC from sticking to the wheels and spotting or defacing the EAC by wetting them with a minimum of water or other approved material.

1. **Breakdown Rolling** - Use nonvibratory, three-wheel steel, or tandem-wheeled-steel rollers. Make at least three complete roller coverages.

2. **Intermediate Rolling** - Use a self-propelled, pneumatic-tired roller following the placement of choke aggregate according to 00735.47. Make at least two complete roller coverages with the pneumatic-tired roller immediately following application of choke aggregate.

3. **Finish Rolling** - Use nonvibratory, tandem-wheeled steel rollers, and continue until roller marks are eliminated.

Compact areas inaccessible to rollers with mechanical tampers as directed.

**00735.47 Choke Aggregate** - Provide at least two choke aggregate trucks. After breakdown compaction and before intermediate compaction, place choke aggregate with a chip spreader capable of obtaining a rate between 0.003 to 0.006 cubic yard per square yard.

If aggregate ravels or picks from the fresh EAC pavement during rolling operations or after opening to traffic, cover immediately with additional choke aggregate and roll with a tandem-wheeled steel roller, unless otherwise directed.

Be prepared to place additional choke aggregate for a period of 48 hours after the fresh EAC pavement is open to traffic. Spread excess aggregate uniformly across the fresh EAC pavement by brooming or other suitable means.

**00735.48 Longitudinal Joints** - Bond, compact and finish the new EAC at longitudinal joints equal to the EAC against which it is placed.

(a) **Location** - Place EAC in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.

1. **Base Course** - Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

2. **Wearing Course** - Do not construct longitudinal joints in the wearing course within the area or width of a traffic lane. On median lanes and on shoulder areas, construct joints only at lane lines or at points of change in the transverse slopes, as shown or as directed.
(b) Drop-offs:

- Provide warning signs and markings according to Section 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.
- If unable to complete the pavement without drop-offs according to 00735.48(c):
  - Construct and maintain a wedge of EAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.
  - Remove and dispose of the wedge before continuing paving operations.
  - Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the City. EAC for the temporary wedge will be paid for at the pay item price.

(c) Placing EAC Under Traffic - When placing EAC pavement under traffic, schedule work for the nominal thickness being laid as follows or as required by the Special Provisions:

1. **More Than 2 inches** - Schedule work so at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.

2. **More Than 1 inch But Not More Than 2 inches** - Schedule work so at the end of each working shift one panel of new travel lane pavement does not extend beyond the adjoining panel of new travel lane pavement more than the distance normally covered by each shift. At the end of each workweek complete the full width of the area to be paved, including shoulders, to the same elevation with no longitudinal drop-offs.

00735.49 Transverse Joints - Construct transverse joints according to the following:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified pavement courses, except leveling courses, as follows:

1. **Project Ends** - Construct transverse joints at Project ends as shown or as directed.

2. **Temporary End Panel** - Maintain pavement depth, line and grade at least 5 feet beyond the selected transverse joint location, and from that point wedge down on the appropriate slope until it meets the surface beneath the EAC, assuming a pavement course thickness of 2 inches, as follows:

   - For wedges that will be under traffic for less than 24 hours, the wedge length shall be 8 feet (1V:50H taper rate).
   - For wedges that will be under traffic for 24 hours or longer, the wedge length shall be 25 feet (1V:160H taper rate).
When the pavement course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 5 feet or longer panel form the "temporary end panel".

(3) **Vertical Face** - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, cutting or other approved methods.
- Remove EAC material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth panel at least 5 feet long, beginning at the sawed or cut joint, and taper it according to 00735.49(a)(2) to zero thickness.

(4) **Excess EAC** - After completing a temporary end panel as specified, dispose of the unused remainder of EAC as directed. Payment will be made for the entire load of EAC, but will be limited to one load only per joint per panel.

(5) **Resume Paving** - When permanent paving resumes, remove the temporary end panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(6) **Joint Requirements** - Compact both sides of the joint to specified density. When tested with a straightedge placed across the joint, provide a joint surface meeting specified surface tolerances.

(b) **Abutting Bridge Ends** - Compact the EAC abutting bridge ends, and other rigid type structures, in the transverse and/or diagonal direction, as well as longitudinally, as directed.

**Maintenance**

00735.60  **Correction of Defects** - Correct all defects in material and work, as directed, at no additional cost to the City. Defects include segregation of materials, nonuniform texture and fouled surfaces preventing full bond between successive spreads of mixture. No adjustment in Contract time will be made for corrective work.

(a) **Slicks** - Remove and replace slicks immediately with suitable materials.

(b) **Roller Damage Surface Repair** - Correct all displacements of any course at once, with rakes and addition of fresh mixture when required, regardless of thickness.
(c) **Other Defects** - Remove, replace with fresh EAC, and compact to conform to the surrounding area all EAC that:

- Is loose, broken or mixed with dirt.
- Shows visually too much or too little asphalt.
- Is defective in any way.

If a seal coat is required by the Special Provisions, or if directed, remove and replace the EAC that contains defects, excesses, or deficiencies prior to placing the seal coat at no additional cost to the City.

00735.61 **Brooming** - Remove loose choke aggregate by carefully brooming the entire surface. Do this as directed, unless brooming damages the new EAC pavement.

Subsequent brooming the following two days may be directed by the Engineer to ensure that the surface is free of loose aggregate that could cause vehicle damage.

In curbed areas, use a pick up type power broom. On bridges, sidewalks and other areas off the roadway, remove all loose aggregates as directed.

00735.62 **Curing** - After each lift of EAC has been placed, allow the EAC to cure a minimum of 72 hours after laydown or as directed, before placing the next lift of EAC.

### Finishing and Cleaning Up

00735.70 **Pavement Smoothness** - Furnish a 12 foot straightedge and/or a 12 foot rolling straightedge and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

Perform pavement smoothness testing immediately after initial brooming of choke aggregate.

(a) **Single Course Construction** - Test with the 12 foot straightedge parallel to and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch.

(b) **Multiple Course Construction** - Test the surface of the course on which the wearing course is placed according to 00735.70(a).

Test the wearing course of EAC with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout the Project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.
Also test the wearing course of EAC with a 12 foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, both wheel paths of the entire mile shall be tested.

00735.71 Correction of Pavement Roughness - Correct equipment or paving operation immediately when tests show the pavement smoothness is not meeting the tolerance in 00735.70.

Correct the surface roughness to the required tolerances by a means that is acceptable.

Complete correction of all surface roughness within 14 calendar days following notification unless otherwise directed at no additional cost to the City.

00735.72 Fog Coat - After the EAC has cured at least 14 calendar days, apply a fog coat to the EAC surface according to Section 00705. Place the fog coat at least one day prior to placing a single or multiple application surface treatment if a surface treatment is required by the Special Provisions.

00735.73 Emulsified Asphalt Surface Treatment - After the EAC has been placed and has cured at least 14 calendar days, apply a single or multiple application emulsified asphalt surface treatment according to Section 00710 or Section 00715 if required by the Special Provisions.

Measurement

00735.80 Measurement - The quantities of EAC will be measured on the weight basis. No deduction will be made for the weight of the emulsified asphalt used in the EAC.

The quantities of emulsified asphalt in the EAC will be measured on the weight basis.

The quantities of choke aggregate will be measured on the weight basis, or on the volume basis in the hauling vehicle.

Payment

00735.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Emulsified Asphalt Concrete Mixture</td>
<td>Ton</td>
</tr>
<tr>
<td>(b) Emulsified Asphalt in Mixture</td>
<td>Ton</td>
</tr>
<tr>
<td>(c) Choke Aggregate</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(d) Emulsified Asphalt Concrete in Leveling and/or Patching</td>
<td>Ton</td>
</tr>
<tr>
<td>(e) Haul and Place Emulsified Asphalt Concrete Mixture</td>
<td>Ton</td>
</tr>
<tr>
<td>(f) Haul and Place Choke Aggregate</td>
<td>Ton</td>
</tr>
</tbody>
</table>

Item (d) applies when EAC is used in leveling, patching, or leveling and patching.

Item (e) applies to EAC that is furnished by the City and hauled and placed by the Contractor.

Item (f) applies to choke aggregate that is furnished by the City and hauled and placed by the Contractor.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for water used in brooming operations.
Section 00744 - Minor Hot Mixed Asphalt Concrete (MHMAC) Pavement

Description

00744.00 Scope - This work consists of constructing minor hot mixed asphalt concrete (MHMAC) pavement to the lines, grades, thicknesses, and cross sections shown or established. Typically used on low to moderate volume traffic roadways with low to moderate volume of bus or trucks.

00744.01 Abbreviations:

- Gmm - Maximum Specific Gravity of Mixture
- MAMD - Moving Average Maximum Density
- MDT - Maximum Density Test
- MDV - Mix Design Verification
- SDC - Surface Damp Condition
- TSR - Tensile Strength Ratio
- VFA - Voids Filled with Asphalt
- VMA - Voids in Mineral Aggregate

00744.02 Definitions:

Lot Size - A lot is the total quantity of material or work produced per JMF per project. The following circumstances will require a different lot:

- A new JMF is used. A JMF adjustment is not considered a new JMF.
- The method for measuring compaction is changed.
- A change from one test procedure for measuring asphalt content to another test procedure for measuring asphalt content occurs.

Minor Hot Mixed Asphalt Concrete (MHMAC) - A hot plant mixed, uniformly coated mixture of asphalt cement, graded aggregate and additives as required.

Level 1 MHMAC - MHMAC for use in applications with very low traffic and only limited exposure to trucks.

Level 2 MHMAC - MHMAC for use in applications with low traffic volumes and low volume truck traffic.

Level 3 MHMAC - MHMAC for use in applications exposed to moderate bus and truck traffic.

Sublot Size - A sublot is 1000 tons of MHMAC.

Surface Damp Condition (SDC) - When the outside of the aggregates are damp with moisture, but little or no free water present.
00744.03  Reclaimed Asphalt Pavement (RAP) Material - RAP used in the production of new MHMAC is optional. No more than 30% RAP material will be allowed in the new MHMAC pavement.

Materials

00744.10  Aggregate - Furnish coarse, fine, and RAP aggregates for MHMAC meeting the following requirements:

Testing of aggregates for soundness, durability, and harmful substances will be at the discretion and expense of the City.

(a)  Soundness - Provide coarse and fine aggregate with a weighted loss not exceeding 12% when subjected to 5 cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(b)  Durability - Provide aggregate not exceeding the following maximum values:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test</th>
<th>ODOT</th>
<th>AASHTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion Degradation Passing No. 20 Sieve</td>
<td>TM 208</td>
<td>30.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>TM 208</td>
<td>3.0”</td>
<td>4.0”</td>
</tr>
</tbody>
</table>

(e) Fractured Faces - Provide crushed aggregate with not less than the minimum number of fractured faces as determined by AASHTO TP 61 as follows:

<table>
<thead>
<tr>
<th>Percent of Fracture (by weight)</th>
<th>Material retained on 1 1/2&quot;, 1&quot;, 3/4&quot;, 1/2&quot; and No. 4 Sieve</th>
<th>Material Retained on No. 8 Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Mix</td>
<td>(2 fractured faces)</td>
<td>(1 fractured faced)</td>
</tr>
<tr>
<td>All Dense Graded MHMAC, ATPB</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>All Open Graded MHMAC</td>
<td>90</td>
<td>75</td>
</tr>
</tbody>
</table>

(f)  Course Aggregate – Produce course aggregate from crushed rock or other inert material of similar characteristics.
(g) Fine Aggregate - Produce fine aggregate from crushed rock or other inert material of similar characteristics.

Blend sand is allowed for Levels 1, 2 and 3 mixes. Do not blend more than 10% by weight of natural or uncrushed blend sand into the total fine aggregate unless approved. Provide a means of verifying and documenting the amount of blend sand added to the aggregate.

(h) RAP Aggregate - Use RAP aggregates in MHMAC, according to 00744.03 that are no larger than the specified maximum allowable aggregate size before entering the cold feed. Blend the RAP material with new aggregate to provide a mixture conforming to the JMF within the tolerances specified.

00744.11 Asphalt Cement and Additives - Furnish the followings:

(a) Asphalt Cement - Use PG 64-22 or PG 70-22 asphalt unless otherwise specified in the Contract documents. Provide asphalt cement conforming to the requirement of ODOT's publication, "Standard Specifications for Asphalt Materials". Copies of the publication are available from ODOT's Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised.

Testing of the asphalt cement used on this Project will be at the discretion and expense of the City.

Asphalt in RAP material, when blended with new asphalt shall provide properties similar to the above specified asphalt. When RAP material is used at a rate of less than 15%, no adjustment to the new asphalt will be required. When utilizing RAP at a rate at or above 15%, the combined RAP and new asphalt shall provide blended properties equivalent to the specified grade. Determine the blended properties according to ASTM D 4887. Determine asphalt cement properties for the RAP material from asphalt cement recovered from the RAP according to AASHTO T 170.

(b) Asphalt Cement Additives - When required by the JMF, add antistripping additives meeting the requirements below and satisfying the Tensile Strength Ratio (TSR) specified in 00744.13.

Additives to prevent stripping or separation of asphalt coatings from aggregates, and admixtures used to aid in the mixing or use of asphalt mixes or for experimental purposes, shall be standard recognized products of known value for the intended purpose and approved for use on the basis of laboratory tests. They shall have no deleterious effect on the asphalt material and be completely miscible. Do not use silicones as an additive.

00744.12 Mix Type and Broadband Limits - Mix type and broadband limits shall meet the following:

(a) Mix Type - Furnish the type(s) of MHMAC shown or as directed. The broadband limits for each of the mix types are specified in (b) below. When the plans allow an option of two types for a course of pavement, use only one type throughout the course.
(b) Broadband Limits - Provide a JMF for the specified mix type within the control points listed below:

### Dense Graded Mixes

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>3/4&quot; Dense</th>
<th>1/2&quot; Dense</th>
<th>3/8&quot; Dense</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% passing by Weight</td>
<td>% passing by Weight</td>
<td>% passing by Weight</td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>23</td>
<td>49</td>
<td>28</td>
</tr>
<tr>
<td>No. 8</td>
<td>2</td>
<td>8.0</td>
<td>2.0</td>
</tr>
<tr>
<td>No. 200</td>
<td>2.0</td>
<td>8.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

### Open Graded Mixes

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>3/4&quot; Open</th>
<th>1/2&quot; Open</th>
<th>3/8&quot; Open</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% passing by Weight</td>
<td>% passing by Weight</td>
<td>% passing by Weight</td>
</tr>
<tr>
<td>1&quot;</td>
<td>99</td>
<td>100</td>
<td>99</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>85</td>
<td>96</td>
<td>99</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>55</td>
<td>71</td>
<td>90</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>16</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>No. 8</td>
<td>6</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0</td>
<td>6.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Asphalt Cement: *per JMF

---

Job Mix Formula (JMF) Requirements – Provide a JMF for the mixture to be used on the project meeting the criteria set forth below. The JMF shall have been performed or verified according to the ODOT Contractor Mix Design Guidelines for Asphalt Concrete within 3 years of the date the Contract was advertised. Perform a new TSR when the source of the asphalt cement changes.
(a) Contractor Provided JMF – The CMDT shall prepare, sign and submit a JMF to the Engineer for each mixture required at least 10 days prior to the anticipated use in MHMAC, and according to the latest copy of the ODOT Contractor Mix Design Guidelines for Asphalt Concrete. If requested, submit material samples 10 calendar days prior to use.

(b) JMF Requirements - The JMF shall meet the following mixture requirements

<table>
<thead>
<tr>
<th></th>
<th>Dense Graded Mixture</th>
<th>Open Graded Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 1</td>
<td>Level 2</td>
</tr>
<tr>
<td>Design Method</td>
<td>Superpave</td>
<td>Superpave</td>
</tr>
<tr>
<td>Compaction Level</td>
<td>65 Gyrations</td>
<td>65 Gyrations</td>
</tr>
<tr>
<td>Air Voids, %</td>
<td>3.5</td>
<td>4.0</td>
</tr>
<tr>
<td>VMA, % minimum</td>
<td>1/2&quot; - 14.0</td>
<td>3/4&quot; - 13.0</td>
</tr>
<tr>
<td></td>
<td>3/8&quot; - 15.0</td>
<td>1/2&quot; - 14.0</td>
</tr>
<tr>
<td>VMA, % maximum</td>
<td>min + 2.0%</td>
<td>min + 2.0%</td>
</tr>
<tr>
<td>P No. 200/ Eff AC ratio</td>
<td>0.8 to 1.6</td>
<td>0.8 to 1.6</td>
</tr>
<tr>
<td>TSR, % minimum</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>VFA, %</td>
<td>70 - 80</td>
<td>65 - 78</td>
</tr>
<tr>
<td>3/8 inch: 70</td>
<td>80</td>
<td>70 - 80</td>
</tr>
<tr>
<td></td>
<td>3/8 inch: 70</td>
<td>3/8 inch: 70</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

*Run the TSR for open graded mixtures on a surrogate dense graded mixture. If a dense graded JMF has been prepared for the same material sources in the last year, the results for the most recent TSR may be applied to the open graded mixture. If not, prepare the TSR test samples for a dense graded mix using the equivalent top size stone and materials from the same sources, which will represent the open graded mixtures.

**17% +2 for Pervious Pavement.

(c) Performance Test - For dense graded Level 3 wearing course mixes, the mix design submittal shall include the results of performance testing as outlined in the latest ODOT Contractor Mix Design Guidelines for Asphalt Concrete.
00744.14 **Tolerances and Limits** - Produce and place MHMAC within the following JMF tolerances and limits:

<table>
<thead>
<tr>
<th>Gradation Constituent</th>
<th>MHMAC Type 3/4&quot;</th>
<th>1/2&quot;</th>
<th>3/8&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>JMF ±5%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90 - 100%</td>
<td>JMF ±5%*</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>JMF ±5%</td>
<td>90 - 100%</td>
<td>JMF ±5%*</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>–</td>
<td>–</td>
<td>90 - 100%</td>
</tr>
<tr>
<td>No. 4</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>No. 8</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
</tr>
<tr>
<td>No. 30</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
</tr>
<tr>
<td>No. 200</td>
<td>JMF ±2.0%</td>
<td>JMF ±2.0%</td>
<td>JMF ±2.0%</td>
</tr>
</tbody>
</table>

* Maximum not to exceed 100%

**Constituent of Mixture**

- Asphalt Cement - ODOT TM 321 (Cold Feed/Meter) JMF ±0.20%
- Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323 JMF ±0.50%
- RAP Content - ODOT TM 321 JMF ±2.0%
- Moisture content at time of discharge from the mixing plant - WAQTC TM 6
  - Open-graded*: 1.10% max
  - Dense-graded: 0.80% max

*Does not apply to 3/4" ATPB

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the Control Points established in 00744.12(b).

00744.15 **Pre-Approved Mix Designs** - Contact the Project Manager for list of pre-approved MHMAC mixes.

00744.16 **MHMAC Acceptance** - A CAT-1 shall perform a minimum of one asphalt content, gradation, mix moisture, and Maximum Specific Gravity (AASHTO T 209) test per day and provide results to the Engineer by the middle of the following work shift. The Contractor shall also provide split samples to the Engineer when requested. Testing may be waived upon written notice and accepted visually by the Engineer according to Section 4(B) of the MFTP.

When 3 or more tests are performed on a project, a price adjustment will be calculated according to 00745.95.
00744.17 Small Quantity Acceptance - When less than 3 test results are obtained on a project and testing has not been waived by the Engineer, the MHMAC will be accepted according to the following:

(a) **Within Specification Limits** - If all sublot sample test results are within specification limits for all constituents (including compaction) the material will be accepted and the full bid price will be paid for the material represented by that test.

(b) **Outside Specification Limits** - If a sublot sample test result for any constituent is outside the specification limit the Engineer will have the backup sample tested.

(1) **Backup Within Specifications** - If the backup sample test results for all constituents are within specification, the material will be accepted and the full bid price will be paid for the material represented by that test.

(2) **Backup Out of Specifications** - If the backup sample test results are out of specification, the Contractor may choose to accept the price adjustment calculated according to 00744.95 or may choose to sample the in-place material for further testing. The price adjustments will be computed using all original test results as well as all backup test results. (If there are less than three tests, average the two tests you have and use the average as the third test result). In no case will the composite pay factor (CPF) be greater than 1.0.

(3) **In-Place Samples** - If the in-place material is sampled, the Engineer will select and sample from three random locations from the area represented by the lot in question. Those samples will be tested and if found to be within specification the material will be accepted and paid for at the full bid price. If the material proves to be outside of the specification limits, the material will be accepted and paid for at an adjusted price according to 00744.95. In no case will the CPF be above 1.0.

00744.18 Tack Coat - Tack coat for sealing the edges of asphalt concrete paving shall be as specified in 00495.11.

00744.19 Edge Sealing Sand - Sand used for edge sealing shall be as specified in 00495.12.

**Equipment**

00744.21 MHMAC Mixing Plant - Provide MHMAC plants that comply with the following:

(a) **Scales** – Provide required scales to assure a uniform mixture. Check and adjust scales according to 00190.30.

(b) **Thermometers** - Provide the following:

- A direct reading, full operating range thermometer in the asphalt feed line near the mixer unit.
MHMAC Pavers - Pavers shall comply with the following:

(a) Power and Support - Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

(b) Augers and Screed - Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

- Can spread and finish the MHMAC to a uniform texture, in the specified widths, thicknesses, lines, grades and cross sections.
- Will not segregate, tear, shove, heave or gouge the MHMAC.

(c) Control System - Equipped with a paver control system which:

- Control the MHMAC placement to specified slope and grade.
- Maintains the paver screed in proper position.
- Provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

(d) Illumination - Provide adequate lighting to illuminate the paver and roadway in front of and behind the paver during the period from 30 minutes after sunset to 30 minutes before sunrise, or as deemed necessary by the Engineer. Shield lighting from adjacent traffic as necessary. Provide a minimum light level of 10 foot candles as measured by the Engineer on the roadway surface at a distance of 16 feet from the front and back edges of the paver.

Compactors - Provide self-propelled rollers capable of reversing without backlash as follows:

(a) Steel-Wheeled Rollers - Steel-wheeled rollers shall have:

- A gross static weight of at least 8 tons.

If steel-wheeled rollers are used for finish rolling, they shall have:

- A gross static weight of at least 6 tons.
- Not be operated in the vibratory mode.

(b) Vibratory Rollers - Vibratory rollers shall be:

- Equipped with amplitude and frequency controls.
- Specifically designed to compact MHMAC.
- Capable of at least 2000 vibrations per minute.
- Have a gross static weight of at least 8 tons.
Do not operate in vibratory mode for lifts thinner than 2 times the maximum aggregate size for the type of MHMAC being compacted.

(c) Pneumatic-Tired Rollers - Pneumatic-tired rollers shall:

- Be tandem, or multiple axle, multiple wheel type.
- Have smooth – tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width.
- Have a minimum total load of 2,800 pounds per tire with tire inflation pressures of 45 to 90 psi.
- Be fully skirted to reduce tire heat loss and mixture pick-up.

Labor

00744.30 Quality Control Personnel - Provide certified technicians in the following fields if required:

- CAgT
- CAT-1
- CAT - II
- CMDT
- CDT

Construction

00744.40 Season and Temperature Limitations - Place MHMAC when the temperature of the surface that is to be paved is not less than the temperature indicated:

<table>
<thead>
<tr>
<th>Nominal Compacted Thickness of Individual Lifts and Courses as shown on the typical section of the plans</th>
<th>All Levels</th>
<th>Level 1 and Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense Graded Mixes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2 inches</td>
<td>Surface Temperature*</td>
<td>60 °F</td>
<td>All Year**</td>
</tr>
<tr>
<td>2 inches - 2 1/2 inches</td>
<td>50 °F</td>
<td>All Year**</td>
<td></td>
</tr>
<tr>
<td>Greater than 2 1/2 inches</td>
<td>40 °F</td>
<td>All Year**</td>
<td></td>
</tr>
<tr>
<td>Temporary</td>
<td>40 °F</td>
<td>All Year**</td>
<td></td>
</tr>
</tbody>
</table>

* If placing MHMAC between March 15 and September 30, temperature requirement may be lowered 5 °F.
** Do not use field burners or other devices to heat the pavement surface to the specified minimum temperature.
00744.43 **MHMAC Mixing Temperatures** - Produce MHMAC within the temperature ranges recommended by the asphalt cement supplier for the grade of asphalt being used on the Project.

00744.44 **Tack Coat** - Construct a tack coat prior to placing each lift of MHMAC according to Section 00730. A tack coat is not required prior to placing MHMAC on aggregate base.

00744.48 **Hauling, Depositing and Placing** - Haul, deposit, and place MHMAC as follows:

(a) **Hauling** - Cover MHMAC if rain or cold air temperatures are encountered any time between loading and placement.

MHMAC will be rejected before placing if one or more of the following is found:

- Below specified placing temperature limit
- Slumping or separating
- Solidifying or crusting
- Absorbing moisture

Dispose of rejected loads at the Contractor’s expense.

Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

(b) **Depositing** - Deposit MHMAC from the hauling vehicles so segregation is prevented.

When MHMAC is windrowed, the pick-up equipment shall:

- Pick up substantially all of the MHMAC deposited on the roadway.
- Be self-supporting, not exerting any vertical load on the paving machine, nor causing vibrations or other motions which could have a harmful effect on the riding quality of the completed pavement.

(c) **Placing** - Alternative equipment and means may be allowed by the Engineer if the use of a paver is impractical.

Do not place MHMAC during rain or other adverse weather conditions, unless allowed by the Engineer. MHMAC in transit at the time adverse conditions occur may be placed if:
It has been covered during transit.
The MHMAC temperature is satisfactory.
It is placed on a foundation free from pools or flow of water.
All other requirements are met.

When leveling irregular surfaces and raising low areas, do not exceed 2 inches actual compacted thickness of any one lift, except the actual compacted thickness of intermittent areas of 1,000 square feet or less may exceed 2 inches, but not more than 4 inches. This may require portions of the mixture to be laid in 2 or more lifts.

Place the mixture in the number of lifts and courses, and to the compacted thickness for each lift and course, as shown. Place each course in one lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any lift. Limit the minimum lift thickness to twice the maximum aggregate size in the mix.

Compaction - Immediately after the MHMAC has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly with rollers meeting the requirements of 00744.24 until compacted as specified. Perform finish rolling and continue until all roller marks are eliminated. Perform a minimum of one subplot density test per day unless waived by the Engineer.

Perform breakdown and intermediate rolling until the entire surface has been compacted by at least 6 coverages of the roller(s). Complete breakdown and intermediate compaction before MHMAC temperature drops below 180 °F, unless otherwise directed. Perform additional coverages for finish rolling until all roller marks are eliminated.

Correction of Defects – Correct all defects in materials and work, as directed, at no additional cost to the Owner, as follows:

(a) Fouled Surface - Immediately repair, clean and re-tack fouled surfaces that would prevent full bond between successive lifts of mixture.

(b) Boils, Slicks, and Oversized Material — Immediately replace boils, slicks, and oversized materials with fresh mixture.

(c) Segregation – Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved.

(d) Roller Damage to the Surface – Immediately correct surface damage from rollers with additional fresh mixture or by other means approved.

(e) Longitudinal Joints - Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved.
(f) **Other Defects** – Remove and replace any MHMAC that:

- Is loose, broken, or mixed with dirt.
- Shows visually too much or too little asphalt.
- Is defective in anyway.

**Maintenance**

**00744.61 Longitudinal Joints** - At longitudinal joints, bond, compact and finish the new MHMAC equal to the MHMAC against which it is placed.

(a) **Location** - Place the MHMAC in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.

1. **Base Course** - Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

2. **Wearing Course** - Longitudinal joints shall not occur within the width of a traffic lane. They shall be located at either skip lines or fog lines unless approved by the Engineer. On median lanes and on shoulder areas the joints shall occur only at lane lines or at points of change in the transverse slopes, as shown or as directed.

(b) **Drop-offs**:  
- Provide warning signs and markings according to Section 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.
- Construct and maintain a wedge of MHMAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.
- Remove and dispose of the wedge before continuing paving operations.
- Construct, maintain, remove and dispose of the temporary wedge at no expense to the Agency, except that MHMAC for the temporary wedge will be paid for at the pay item price.

(c) **Placing MHMAC under Traffic** - When placing MHMAC pavement under traffic, schedule work for the nominal thickness being laid as follows:

1. **More Than 2 Inches** - Schedule work so at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.
00744.62 Transverse Joints:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified pavement courses, except leveling courses, as follows:

(1) Temporary End Panel - Maintain pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate slope until the top of the course being laid meets the underlying surface (assuming a pavement course thickness of 2 inches) as follows:

- For wedges that will be under traffic for less than 24 hours, construct a 8 foot long wedge (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, construct a 25 foot long wedge (1V:160H taper rate).
- Construct, maintain, remove and dispose of the temporary wedge at no expense to the Agency. MHMAC for the temporary wedge will be paid for at the pay item price.

When the pavement course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 4 feet or longer panel form the "temporary end panel".

(2) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, cutting or other approved method.
- Remove the MHMAC material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth panel at least 4 feet long, beginning at the sawed or cut joint, and taper it on a 1V:50H slope to zero thickness.

(3) Excess MHMAC - After completing a temporary end panel as specified, dispose of unused, remaining MHMAC as directed. Payment will be made for the entire load of MHMAC, but will be limited to only one load per joint per panel.
(4) Resume Paving - When permanent paving resumes, remove the temporary end panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(5) Joint Requirements - Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances.

(b) Abutting Bridge Ends - Compact the MHMAC abutting bridge ends and other rigid type structures in the transverse or diagonal direction, as well as longitudinally, as directed.

(c) Bridge Deck Overlays - Sawcut the wearing course of pavement directly over the joints in bridge decks, bridge end joints and end panel end joints as soon as practical but within 48 hours of paving each stage of the wearing course, unless otherwise directed. The sawcut shall be 3/8 inch wide, plus or minus 1/8 inch, and 1/2 inch less than the thickness of the panel of pavement, to a maximum depth of 1 1/2 inches.

Flush the sawcut thoroughly with a high-pressure water stream immediately after the cut has been made. Before the cut dries out, blow it free of water and debris with compressed air. Fill the joint with poured filler from the QPL. No separate payment will be made for this work.

Finishing and Cleaning Up

00744.70 Pavement Smoothness - Furnish a 12 foot straightedge. Test with a 12 foot straightedge parallel to and in each wheel path of each travel lane. Test other lane wheel paths and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch. Mark areas not meeting the surface tolerance.

00744.71 Edge Sealing Tack Coat Application - Seal all adjoining asphalt concrete pavement surfaces as specified in 00495.40(e).

00744.75 Correction of Pavement Roughness - Immediately correct equipment or paving operation procedures when tests show the pavement smoothness does not comply with 00744.70. In addition, do the following:

(a) Methods - Correct surface roughness to the required tolerances, using one of the following methods as approved by the Engineer:

- Remove and replace the wearing surface lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades, and apply an emulsion fog seal as directed.

(b) Time Limit - Complete correction of all surface roughness within 14 calendar days following pavement placement, unless otherwise directed.
(c) **Pavement Markings** - If pavement correction is done after installation of the pavement markings, repair any damaged markings as directed.

**Measurement**

00744.80  **Measurement** - The accepted quantities of M HMAC will be measured on the weight basis.

No deductions and no separate measurement will be made for asphalt cement, mineral filler, lime, anti-strip, or any other additive used in the mixture.

No separate measurement will be made for asphalt tack coat. An estimated amount of asphalt in tack coat will be listed in the Special Provisions under Section 00730.

**Payment**

00744.90  **Payment** - The accepted quantities of M HMAC incorporated into the Project, whether or not recycled materials are used, will be paid for at the Contract unit price per ton for the item "Level ___, ______, M HMAC Mixture, ______".

The following will be inserted in the blanks:

- The level(s) of M HMAC (1, 2, 3) will be inserted in the first blank.
- The type(s) of M HMAC (3/4 inch Dense, 1/2 inch Dense, 3/8 inch Dense will be inserted in the second blank.
- The words "in Leveling", "in Temporary", or "in Leveling and Temporary" will be inserted in the third blank when applicable.

Payment will be payment in full for furnishing and placing the materials and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for the asphalt tack coat.

No separate or additional payment will be made for sawing, cleaning, and filling joints on bridge deck overlays.

00744.95  **M HMAC Price Adjustments** - The Composite Pay Factor (CPF), calculated according to 00165.40 will be applied to the Contract unit price for the pay items of 00744.90 and to the applicable lot quantities. The CPF will be made available to the Contractor within 24 hours of receipt of the required quality control test results. If less than three samples are tested, the CPF will be computed as outlined in 00744.17. The maximum CPF for any case will be 1.0.
Use the following table to determine price adjustments in the CPF for constituents of MHMAC.

<table>
<thead>
<tr>
<th>Gradation Constituents</th>
<th>Dense Graded MHMAC Type</th>
<th>Weighting Factor (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Aggregate Passing</td>
<td>3/4&quot; 1/2&quot; 3/8&quot;</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>1 1</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>– – 1</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>5 5 5</td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>5 6 6</td>
<td></td>
</tr>
<tr>
<td>No. 30</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>10 10 10</td>
<td></td>
</tr>
<tr>
<td>Other Constituents</td>
<td>26 26 26</td>
<td></td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Moisture Content</td>
<td>8 8 8</td>
<td></td>
</tr>
<tr>
<td>Compaction</td>
<td>40 40 40</td>
<td></td>
</tr>
</tbody>
</table>

Those MHMAC constituents statistically evaluated will be eligible for a maximum PF of 1.00 (see 00165.50(b)(1), unless otherwise specified.

If these specifications do not require measurement of a constituent, its individual PF will be considered 1.00 in calculating the CPF according to 00165.40.

A price adjustment will be determined by the following formula:

\[
\text{(CPF - 1) x } \left( \frac{\text{JMF}\% + 100 \times \text{Asphalt unit price}}{100} \right) + \text{MHMAC Unit Price} \times \text{LQ} = \_ \\
\]

Where: JMF% is the asphalt cement % from JMF
LQ is the quantity of mixture in the lot
Section 00746 - Crack Sealing Flexible Pavements

Description

Scope - This work consists of repairing and resealing cracks in flexible pavements at locations designated by the Engineer.

Materials

00746.10 Sealants - Furnish all sealant materials for crack repair of flexible pavements that is approved by the Engineer before being incorporated into the work. Before beginning work, furnish a complete written statement of the origin, composition and manufacturer of materials that are to be used.

Furnish hot-poured sealants of the type intended for use in sealing cracks in asphalt concrete pavement that meet the requirements of 02440.30.

Equipment

00746.20 Equipment - Use proper sealing equipment for the specific material listed according to the manufacturer's recommendations. The equipment for sealing compounds shall be a melting kettle of the double boiler, indirect heating type, using oil as a heat-transfer medium. The kettle shall be an effective, mechanically operated agitator equipped with a positive, thermostatic temperature control.

Construction

00746.40 General - Provide traffic control according to Sections 00220 and 00225.

00746.41 Mixing and Heating - Follow the manufacturer's recommendations for application. Mix and heat the sealant materials to a minimum temperature of 280 °F. Do not heat the material above 400 °F.

00746.42 Installation Procedure - Where installation procedures, or any part of the procedures are required to be done according to the recommendations of the manufacturer of the sealing compound, submit catalogue data and copies of the recommendations before installing the materials.

Clean all cracks designated for sealing of loose and foreign matter. Use a hot lance to perform this cleaning. Use this wand to both clean and dry the crack just prior to sealing.

Do not place any sealant without the prior approval of the Engineer. The Engineer will inspect all cracks.

The face of the crack shall be surface dry, and the ambient and pavement temperatures shall both be at least 45 °F and rising at the time of application of the sealant.
Install the sealant so that the in-place sealant is well bonded to the pavement and free of voids or entrapped air.

Seal the cracks from the bottom up in a neat manner, so that upon completion of the work the surface of the sealant material is flush to 3/16 inch below the adjacent pavement surface. Refill or "spot" all low areas before continuing work.

Level sealant material flush to the surface with a "V" shaped squeegee device. Squeegee the excess material so it does not exceed 1 1/2 inches on either side of the crack. If any sealant remains in the squeegee when the end of the crack is reached, distribute this excess material over the crack in a return motion.

**00746.43 Cleaning and Sanding** - Perform the following work when crack sealing prior to a hot mix asphalt overlay or to prevent traffic damage and "pickup":

- Completely cover the sealed cracks with a clean sanding material, then sweep the pavement surface and leave in a clean condition.
- Do not allow any traffic or construction equipment on the newly sealed cracks for at least one hour after placement of the sealant and refilling has been completed.

**Measurement**

**00746.80 Measurement** - The quantities of sealed cracks will be measured on either the length basis or the weight basis.

**Payment**

**00746.90 Payment** - The accepted quantities of sealed cracks will be paid for at the Contract unit price per foot or pound, as appropriate, for the item "Crack Sealing".

Payment will be payment in full for furnishing and placing all material, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for required cleaning and routing.
Section 00748 - Asphalt Concrete Pavement Repair

Description

00748.00 Scope - This work consists of excavating and removing existing asphalt concrete surfaces, aggregate bases, and aggregate subbases and constructing new subbases, bases, and asphalt concrete surfaces to the lines and grades shown or directed.

Materials

00748.10 Materials - Furnish materials meeting the following requirements:

- Aggregate Base ............................................................................. 02630
- Aggregate Subbase ...................................................................... 00640.10(b)
- MHMAC ...................................................................................... 00744
- Stone Embankment .................................................................... 00330.16
- Subgrade Geotextile, Level B ..................................................... 02320
- Water .......................................................................................... 00340

00748.16 Acceptance of Material - All material will be accepted by visual inspection by the Engineer. The Engineer may perform tests to verify that the materials meet the appropriate specifications.

Equipment

00748.20 Equipment - Provide appropriate equipment necessary to perform the work according to Sections 00320, 00330, 00340, 00350, 00640, and 00744.

Construction

00748.40 Excavation - Excavate and remove material to the lines and grades shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00748.41 Geotextile - Place geotextile as shown.

00748.42 Embankment and Aggregate Backfill - Place the backfill to lines and grades shown or directed. Compact each layer of material until there is no reaction or yielding under the compactor.

00748.43 Asphalt Concrete - Place EAC or MHMAC to the lines and grades shown or directed. Compact the EAC according to 00735.46. Compact MHMAC according to 00744.49.
Measurement

00748.80 Measurement - The quantities of asphalt concrete pavement repair will be measured on the area basis, of surfacing area repaired to the full depth as shown. The surfacing area will be determined by horizontal measurements. In areas where directed to repair to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

MHMAC will be measured according to 00744.80 as applicable.

Payment

00748.90 Payment - The accepted quantities of asphalt concrete pavement repair will be paid for at the Contract unit price, per square yard, for the item "_____ inch Asphalt Concrete Pavement Repair". The depth will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

MHMAC will be paid for according to 00744.90 as applicable.

No separate or additional payment will be made for excavation, geotextile, stone embankment, aggregate, and water.
Section 00749 - Miscellaneous Asphalt Concrete Structures

Description

00749.00 Scope - This work consists of furnishing and placing asphalt concrete in road approaches, street connections, driveways, guardrail flares, mailbox turnouts, raised traffic islands, sidewalks, footpaths, gutters, ditch linings, spillways, dikes, and other miscellaneous or minor items of asphalt concrete except asphalt curbs as shown, specified, or directed. These items in this Section will be collectively referred to as "structures." See Section 00480 for asphalt curbs.

This work does not include asphalt concrete construction on traffic lanes, auxiliary lanes, shoulders, median areas, tapers, widenings, parking areas, exit and entrance ramps, patching and leveling on similar areas.

00749.02 Limited Application - This Section applies only when separate pay items for the work appears in the Schedule of Items according to 00749.91 and 00749.92, or when called for by the special provisions.

Materials

00749.11 Aggregate Base - Furnish aggregate base materials for base, foundation courses, leveling courses, or bedding meeting the requirements of Section 02630. If a designated size is not shown, or given, provide 1" - 0 or 3/4" - 0, as the Contractor elects.

00749.12 Asphalt Tack Coat - Furnish asphalt tack coat material meeting the requirements of Section 00730.

00749.13 Asphalt Concrete - Unless another class is shown, furnish Level 2, 1/2 inch Dense MHMAC according to Section 00744. When conditions justify, the mixture may be varied, if approved. Acceptance will be based on testing the Engineer deems appropriate. Statistical analysis will not apply.

Equipment

00749.20 Equipment - Plant and equipment shall conform to Section 00744.

Construction

00749.41 Earthwork - Make excavations and backfills for the structures according to Section 00330 and to the depths, widths and cross-sections shown, specified, or directed.

00749.42 Foundations - Construct foundations or other bedding using selected granular backfill material according to Section 00330 or using aggregate base when shown or directed.
For aggregate base, do one of the following:

- When existing aggregate base materials of the kind specified in 00749.11 are already in place, salvage and reuse.
- Use new aggregate base materials conforming to 00749.11.

00749.43 Foundation Preparation - Bring areas on which structures are to be constructed to established grade, and make firm, dry and free of unsuitable material before placing asphalt concrete.

Tack contact areas where asphalt concrete is to come in contact with previously placed portland cement concrete, asphalt concrete, or bituminous surfaces according to Section 00730.

00749.44 Placing Asphalt Concrete - Place asphalt concrete according to 00744.48(c) except place asphalt concrete structures of uniform width by either mechanical extrusion methods or between suitable forms, as the Contractor elects. Other structures may be constructed without the use of forms unless otherwise directed.

The Engineer may allow small or special pavers, spreader boxes, or blade graders for placing asphalt concrete. Where warranted the Engineer may allow mixture to be placed by hand methods.

Construct all structures within the following lines and grades:

- 1 inch of true line
- 0.04 foot of established surface grade, cross section and slope
- 0.04 foot of specified thickness

00749.45 Compacting Asphalt Concrete - Compact asphalt concrete according to the following or as directed:

- Compaction to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least 4 coverages by the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the MHMAC.
- Along curbs and walls, on walks, irregular areas not practically accessible to rollers conforming to 00744.24, compact the mixture with small, self propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.
**Pavement Smoothness** - Finish asphalt concrete to a uniform texture.

Test top surfaces with a 12 foot straightedge furnished and operated by the Contractor under the Engineer's direction. The surface shall not vary more than 1/4 inch from the straightedge except at grade changes.

**Measurement**

**Measurement** - Work covered under this Section will be measured for payment by one of the methods provided in 00749.81 and 00749.82. Street connections which occur at the beginning or end of the Project, or which have a line designation, typical section and profile, and are not noted on the plans as being pay items will not be measured for payment.

The quantities of structures will be measured on the following basis:

- **Unit Basis** - Measurement will be the actual count of each location where the structure is constructed.
- **Area Basis** - Measurement will be the ground surface, limited to the neat lines of the structure and converted to the nearest square foot.
- **Length Basis** - Measurement will be from end to end of the pertinent structure along its longitudinal axis for each separate item or continuous run.

**Method "A" - Weight and Extras Basis** - Under this method, asphalt concrete actually incorporated into the structure will be measured for payment according to 00744.80. In addition, measurement will be made for extra costs of placing asphalt concrete in the structures if pay items are included in the Schedule of Items.

**Method "B" - Complete in Place Basis** - Under this method, measurement will be of the structure complete in place.

**Payment**

**Payment** - The accepted quantities of structures placed under this Section will be paid for at the Contract unit price, per unit of measurement, for items listed in 00749.91 and 00749.92.

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate pay items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90.
Payment for street connections, or the extra costs for them, which meet the criteria described in 00749.80 will be included in payment for the pavement items.

00749.91 Method "A" - Weight and Extras Basis - The pay items to be paid for under Method "A" are as follows:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Extra for Asphalt Approaches</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Extra for Asphalt Drains</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Extra for Pedestrian Landings</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Extra for Asphalt Dikes</td>
<td>Foot</td>
</tr>
<tr>
<td>(e) Extra for Asphalt Islands</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(f) Extra for Asphalt Walks</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(g) Extra for Asphalt Ditch Lining</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(h) Extra for Asphalt Slope Paving</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(i) Extra for Pavement Repair</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, and mailbox turnouts.

Item (d) is for dikes.

Item (e) includes raised traffic islands and raised traffic separators.

Item (f) includes sidewalks, footpaths, and narrow strips of asphalt concrete abutting curbs not intended for vehicular use.

Item (g) includes gutters, ditch linings, spillways, and other such structures specifically designed and provided for conveyance of surface water.

Payment will be payment in full for all extra or additional costs involved in placing asphalt concrete in the respective structures as specified. These costs are in addition to those which are included in the payment made for the asphalt concrete incorporated into the structures.

00749.92 Method "B" - Complete in Place Basis - The pay items to be paid for under Method "B" are as follows:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Asphalt Approaches</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Asphalt Dikes</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Asphalt Islands</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(d) Asphalt Walks</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(e) Asphalt Ditch Lining</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(f) Asphalt Slope Paving</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, and mailbox turnouts.
Item (b) is for dikes.

Item (c) includes raised traffic islands and traffic separators.

Item (d) includes sidewalks, footpaths, and narrow strips of asphalt concrete abutting curbs, not intended for vehicular use.

Item (e) includes gutters, ditch linings, spillways and other such structures specifically designed and provided for conveyance of surface water.

Payment will be payment in full for furnishing and placing all materials, including asphalt concrete and asphalt tack coat, and for furnishing all equipment, labor, and incidentals necessary to complete the respective structures in place as specified.
Section 00756 - Plain Concrete Pavement

Description

00756.00 Scope - This work consists of constructing portland cement concrete pavement as shown and specified.

00756.01 Abbreviations:

- GPT - Graphic Profile Test
- LSL - Lower Specification Limit
- PI - Profile Index
- PCC - Portland Cement Concrete
- SSD - Saturated Surface-Dry
- SSFC - Stationary Side Form Construction
- SSTV - Sublot Strength Test Value
- USL - Upper Specification Limit

00756.04 Aggregate Production and Pre-paving Conference:

(a) Aggregate Production Conference - Supervisory personnel of the Contractor and any subcontractor's or supplier's who are to be involved in the aggregate production work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing aggregate production.

(b) Pre-paving Conference - Supervisory personnel of the Contractor and any subcontractor's who are to be involved in the concrete paving work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving work.

Materials

00756.10 Materials - Furnish materials meeting the following requirements:

- Bar Reinforcement ......................................................... 02510
- Concrete Materials ....................................................... 02001
- Curing Materials ......................................................... 02050
- Epoxy and Non-Epoxy Bonding Agents ......................... 02070
- Epoxy and Non-Epoxy Grouts ......................................... 02080
- Galvanizing ............................................................. 02530.70
- Poured Joint Fillers ..................................................... 02440.30
- Preformed Expansion Joint Filler .................................... 02440.10
- Structural Steel .......................................................... 02530
- Welded Wire Fabric .................................................... 02510.40

00756.11 Classes of Concrete - Furnish Class 4000 - 1 1/2 paving concrete unless otherwise shown or indicated in the Special Provisions.
Concrete Mix Designs - Prepare and submit either new mix designs or current mix designs for each class of concrete required according to Section 02001.

Quality Control - Provide quality control according to Section 00165, Section 02001, and the following.

(a) Concrete Mixture - If the results of any test are outside of the specification limits, stop the placement of the load. Correct the load or reject it and do not incorporate it into the work. Test subsequent loads before any further concrete placement. Correct the subsequent loads if any of the tests are still outside the specification limits. If the load cannot be corrected, reject it and do not incorporate it into the work. Testing of subsequent loads may return to the specified frequency when the test results from two consecutive loads are shown to meet the specification limits.

(b) Records - Deliver all batch tickets, water-cement ratio calculations, and all other records required in (b) above to the Engineer upon availability but no later than the morning of the next day.

Acceptance of Concrete:

(a) General - Acceptance of concrete will be based on the results of the Contractor’s quality control testing according to Section 00165.

(b) Aggregate - Acceptance will be based on the Contractor’s quality control testing, if verified by the City according to Section 00165.

(1) Aggregate Gradation - A stockpile contains specification aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level indicated in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled aggregates that contain non-specification aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(c) Plastic Concrete - Acceptance of the plastic concrete will be based on the tests performed by the Contractor’s QCT, according to the tolerances and limits of Section 02001.

(d) Hardened Concrete - Cast and cure the test specimens according to AASHTO T 23 in 6 inches x 12 inches single-use plastic molds and test at 28 days according to AASHTO T 22.
(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test the cylinders at an ODOT certified laboratory.

(2) Actual Strength Test Value (28 day) - The ASTV is the average compressive strength of the 3 cylinders tested. If the compressive strength of a single test specimen varies by more than 10% from the average of the other 2 specimens, that compressive strength value will be discarded. The average compressive strength test of the 2 remaining specimens will be the ASTV.

(3) Sampling and Testing - Sampling and testing shall be according to the MFTP.

(4) Acceptance - The ASTV shall exceed the $f'c$ (specified strength) for the mix design. If a set of cylinders has an ASTV less than $f'c$, the Engineer will review the results to determine if the concrete represented by the cylinders shall be removed. In any case, concrete that has an ASTV of less than 85% of the specified strength shall be removed unless otherwise authorized, in writing, by the Engineer. The cost of removal, replacement and all related work shall be the Contractor’s responsibility, subject, if the concrete is allowed to remain in place, to a price adjustment according to 00150.80(g).

If an ASTV falls below the $f'c$, the Contractor may submit a written plan within 3 days of the test for review by the Engineer. The plan shall outline a proposed alternate method of evaluating compressive strength. The plan shall provide evidence that a reasonable $f'cr$ (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. If the Engineer determines that the compressive strength test results are suspect from definable external factors, the Engineer may allow an alternate method of acceptance.

00756.17 Temporary Plating - Temporary plating shall conform to Section 00275.

Equipment

00756.20 Batch Plant - Provide batch plants according to Section 02001.

00756.21 Mixers - Provide mixers according to Section 02001 except mix concrete in the batch plant mixer. Truck mixers may be used only as allowed in 00756.45.

00756.22 Hauling Equipment - Transport concrete in non-agitating equipment. Truck mixers may be used to transport concrete only as allowed in 00756.45. Hauling equipment shall conform to AASHTO M 157.12 or AASHTO M 157.11.6 when allowed.
00756.23  Paving Equipment - Place the PCC with either a slip form paving machine, a paving machine riding on stationary side forms, or both as the Contractor elects. Provide self-propelled paving machines that conform to the following:

(a) Placer/Spreader - Provide a Placer/Spreader that will:

- Receive the concrete mixture in its hopper on the shoulder area.
- Deliver the concrete mixture to the slipform paver and uniformly spread at the proper thickness for the full width of the area being paved.
- Not segregate the concrete mixture or displace the reinforcing steel.

(b) Slipform Paver - Provide a Slipform Paver that is:

- Equipped with electronic or hydraulic controls to automatically control line and grade from both sides.
- Able to vibrate, consolidate and finish the slab to proper grade and cross section for the full width and depth of the concrete being placed.
- Equipped with vibrating tubes or arms to work in the concrete.
- Equipped with sliding forms held together rigidly to prevent them from spreading.
- Equipped with sliding forms long enough so that slumping of the concrete does not exceed 1/4 inch, according to 00756.49(a).

(c) Paving Machine - If a paving machine riding on stationary side forms is used, conform to the following:

- The machine used for initial strike-off and consolidation of PCC shall be self-propelled, screening type and shall ride on and be guided by steel side forms or the edge of contiguous PCC pavement. The machine shall be designed and operated to strike-off, consolidate and compact the PCC to prescribed line, grade and cross section. Make provision to prevent chipping or marring previously placed PCC.
- Vibratory equipment shall be of the surface pan type or internal type with immersed tube or multiple spuds. The vibrator shall provide full slab width vibration to the concrete at frequencies of not less than 3,500 impulses per minute and as necessary for proper consolidation and compaction.
- Floating and finishing machines shall be self-propelled and shall ride on and be guided by steel side forms or the edge of contiguous PCC pavement. The machine shall provide floating action to the PCC surface by means of screens, floats, rollers or combinations of them. Screed type machines shall have at least two oscillating type transverse screens. The machines shall have sufficient wheel base length, weight, float surface and adjustments to true up the PCC surface to accurate cross section and grade without dragging, marking or defacing the surface.
00756.24 **Concrete Saws** - Provide power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. Also provide a standby saw on the jobsite.

00756.25 **Smoothness Testing Equipment** - Provide all equipment and supplies for determining smoothness according to 00756.55.

(a) **Straightedge** - Provide two 12 foot straightedges.

(b) **Profilograph** - When required, provide a California-type profilograph, computerized or not computerized, complete with recorder for determining the profile index of the pavement according to ODOT TM 770.

Have the profilograph on the Project, calibrated, in good working condition and ready for operation before construction of any concrete pavement begins. Provide a competent operator experienced in the operation of the equipment.

(c) **Profilometer** - Provide a profiling device that employs an accelerometer established inertial profiling reference and a laser height sensing instrument to produce a true profile of the pavement surface. The device shall be capable of reporting elevations with a resolution of 0.004 inch or finer at an interval of 6 inches or less. The unit must also be able to generate the equivalent California-type profilograph plot and values according ODOT TM 770 as well as the locations and heights of bumps and dips as required in this specification. The profilometer shall be calibrated, in good working condition, and ready for operation prior to performing smoothness measurements.

Provide competent and experienced operator(s) for the equipment. The profilometer operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the project.

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**Labor**

00756.30 **Quality Control Personnel** - Provide certified technicians in the following fields:

- CAgT
- CCT
- CSTT
- QCT

Additional Contractor quality control responsibilities include the following:

- Provide and designate an individual who shall be present at the placement site at all times during concrete placements, and who is authorized and responsible for acceptance and rejection of materials.
- Reject loads which arrive at the jobsite without a batch ticket.
• Require the truck driver to record on the batch ticket and initial the amounts of water added in transit and at the jobsite.
• Reject plastic concrete that is outside of the specified limits.

**00756.31 Profilometer Operator** - Provide competent and experienced operators for the equipment. The profilometer operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of the smoothness measurement on the Project.

**Construction**

**00756.40 Weather Limitations** - Coordinate all operations involved in constructing the pavement so the work will result in a finished pavement conforming to the Specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the work is permitted to proceed.

Do not place PCC during periods of rain. Do not place PCC on frozen bases, or when descending air temperature falls below 35 °F. Placement shall not resume until ascending air temperature reaches 35 °F. Measure air temperature in the shade and away from artificial heat.

Protect the pavement from weather damage. Protect unhardened PCC from precipitation with protective material. When PCC is being placed during cold weather, and the air temperature is forecast to drop below 33 °F, prevent the PCC from freezing for a minimum of 7 days after placing.

Remove and replace weather-damaged pavement at no additional cost to the City.

**00756.41 Preparation of Base** - Before paving operations begin, bring the base to the finished condition required by the Specifications. If the equipment used by the Contractor requires additional width for support, provide the support necessary to assure the equipment maintains proper grade and cross section.

Manholes, inlets and other such structures shall be completed, adjusted, cured and otherwise prepared, as applicable. Make and ready to have concrete placed in contact with them. Prepare manhole frames and other independent metal structures in the pavement area with an approved bond-preventing agent.

**00756.42 Construction Widths** - When the pavement consists of 2 or more traffic lanes, construct at least 2 traffic lanes in 1 strip panel unless shown otherwise.

If the Contractor proposes a method of placement other than that shown or specified, the Contractor shall pay all costs to implement the change. Any changes require the Engineer's approval.
00756.43  **Placing Dowel Bars** - Provide smooth, round dowel bars. Coat with plastic, grease, heavy oil, or other approved material that will neither bond with nor be harmful to the PCC. Place dowels in a supporting framework that holds the dowels parallel with each other, parallel with the surface of the pavement and perpendicular to the joint. Maximum alignment tolerance shall be 5° or 3/16 inch in the length of the dowel. Place dowels within 3/8 inch of the center of the slab vertically.

00756.44  **Handling, Measuring, and Batching Materials** - The plant site, layout, equipment and provisions for transporting material shall be adequate to assure a continuous supply of material to the worksite.

(a) **Aggregates** - Stockpile and remove the aggregate from stockpiles in a manner that holds segregation to a minimum.

Do not use aggregates that become segregated, mixed with earth or foreign material or contain lumps of hardened material. Thaw frozen aggregates or aggregates containing frozen lumps before use.

(b) **Batching** - Batch materials according to 02001.40

00756.45  **Mixing Concrete** - Mix materials according to 02001.40. Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving equipment.

00756.46  **Placing Concrete** - Place concrete by either the slip form method as described in (a), (b), (c) and (d) below, or by the stationary side form method as described in (e) below.

(a) **Delivery To Spreader** - Deliver the concrete from the hauling vehicles to the placer/spreader hopper on the shoulder area. Do not permit equipment schlepping concrete on the subgrade or on the base, except for a minimum number of approved right angle or near right angle crossings. Correct any damage to the subgrade or base due to the Contractor's operations, to the satisfaction of the Engineer, at no additional cost to the City. Keep the surface of the subgrade or base moist in front of the paving operation.

(b) **One Lift** - Place the concrete in final position by the slipform method in one lift, so a minimum of finishing will be necessary to provide a dense, homogenous pavement conforming to true grade and cross section.

(c) **Two Separate Machines** - Except for concrete pavement to be placed and finished near obstructions, place the concrete with two separate machines, one a placer/spreader and one a slipform paver. The machines shall operate in tandem and spread, consolidate, screed and float-finish the freshly placed concrete in one pass with a minimum of hand finishing. Where impractical to use, a placer/spreader is not required.
(d) **Continuous Forward Motion** - Coordinate all operations of mixing, delivering and spreading concrete to provide uniform progress. Operate the slipform paver with as nearly continuous forward movement as possible. Hold stopping and starting the paver to an absolute minimum. If, for any reason, it is necessary to stop the forward motion of the paver, immediately stop the vibratory and tamping elements. Apply no external force to the paver.

(e) **Stationary Side Form Method** - Place the PCC between stationary side forms by means that will prevent segregation of constituents of the PCC, displacement or deformation of the forms or base, forming of piles, and unequal consolidation.

Spread and distribute the PCC with a mechanical concrete spreader which will fill all corners and spaces with PCC and leave it at such height that after consolidation and finishing it will be at specified grade and cross section. Spread and vibrate the PCC against and along the forms, and in the vicinity of joints comprising load transfer devices, with care to avoid displacement of the forms or devices.

Use shovels or muckrakes, not rakes, for hand spreading and distributing. Do not foul the PCC with foreign matter.

After being placed, strike-off, vibrate and consolidate the PCC with equipment conforming to the requirements of 00756.23. If more than one machine is required to properly handle production, the vibrating of PCC shall normally precede or accompany the first or leading machine only.

Perform the operations above within 15 minutes after the PCC is placed. The operations shall be continuous until the surface has been worked the equivalent of not less than 2 passes of a single screed machine. In each pass of the machine, maintain a roll of PCC ahead of the screed for the entire width of pavement being placed. The strike-off, vibrating and consolidating shall leave a surface of uniform texture, true to grade and cross section.

Equipment shall be in good mechanical condition at all times and be adjusted for wear at the direction of the Engineer. Keep forms and other controls of line and grade clean and true to line and grade.

(f) **Provision for Joints and Other Devices** - While placing concrete, make provision for constructing joints, placing dowels, tie bars, and other devices as shown and directed, and as provided in 00756.43 and 00756.48.

(g) **Reject Concrete Material** - Reject concrete if it:

- Is not in place within one hour after being mixed (90 minutes when delivered in ready mix truck).
- Has begun to take an initial set before placement.
- Has been retempered with water.
(h) **Protect Surface** - Equip supports of the slipform paver, and other equipment which ride on previously placed pavement to meet the requirements of 00756.60, to prevent marring, edge breaking, or chipping of the previously placed pavement.

(i) **Hand Operated Equipment** - Use shovels and muckrakes, not rakes, for hand spreading and distributing. Do not foul the concrete with foreign matter, nor disturb joint devices during such operations. Furnish hand operated mechanical vibrators satisfactory to the Engineer. Use these vibrators to consolidate the concrete pavement at least 6 feet on each side of construction and expansion joints and any other areas as directed.

(j) **Illumination** - During hours of darkness, adequately illuminate work areas at no additional cost to the City.

00756.47 **Test Strip** - At the beginning of paving operations, construct one initial test strip of concrete pavement at least 0.1 mile long at the specified paving width. Do not perform further paving until the test strip is evaluated according to 00756.55. An additional test strip will be required when:

- The Contractor proposes using different paving equipment.
- Any portion of a test strip fails to meet the smoothness requirements of 00756.55.

Change methods or equipment and construct additional test strips until a test strip meets smoothness requirements without grinding or other corrective work. Limit these additional test strips to 0.1 mile in length.

If 3 test strips fail to meet smoothness requirements before grinding, remove all 3 strips and construct additional test strips at no additional cost to the City.

00756.48 **Joints:**

(a) **General** - Construct joints of the kinds shown and where shown or directed. Joint types in the concrete pavement will be contraction, construction or expansion. They shall be transverse or longitudinal, as shown or directed. Extend all joints and joint filler to pavement edges or to each other.

Joints shall not vary from specified or indicated line by more than 1/4 inch. The tops of joint filler, when required, shall be slightly, but not more than 1/8 inch, below and paralleling finished pavement grade and cross section. Protect top edges of filler from damage by paving operations.

All joints which contain preformed filler are to be constructed before the final floating and surface finishing of the concrete, unless otherwise directed.

(b) **Longitudinal Joints** - If the Contractor elects to pour the entire width of pavement at one time, construct the longitudinal joint as shown. Longitudinal joints shall be the contact type or weakened plane type as shown:
(1) **Longitudinal Contact Joints** - Construct longitudinal contact joints when concrete is placed against hardened concrete regardless of age, between strips of pavement or between a strip of pavement and a concrete gutter.

(2) **Longitudinal Weakened Plane Joints** - Construct weakened plane joints by sawing to the depths and maximum width shown. Perform sawing as soon as the concrete has set enough to permit sawing without tearing or raveling. Saws may be single or tandem, as the Contractor elects, and be controlled by guides to true line. Restore curing agents broken or damaged by the sawing operations.

If the top width of sawed joints exceeds 1/4 inch, fill the joint with a poured joint filler.

(c) **Construction Joints** - Construct construction joints when there is an interruption of 20 minutes in the concrete placing operations.

The new concrete placed against the joint shall conform closely to the proportions and consistency of the previously placed concrete except vibrate and consolidate it to a greater degree and with more care than normal. Unless otherwise shown, do not construct construction joints within 10 feet of a transverse expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, remove the concrete back to the last joint and dispose of as directed.

(d) **Contraction Joints** - Construct all contraction joints by sawing. Create contraction joints at intervals shown on drawings. Vacuum the slurry from the saw cutting.

00756.49 **Surface Finishing** - After the concrete has been given a preliminary finish, check the surface of the fresh concrete in the longitudinal and transverse direction with a 12 foot straightedge. Correct surface deviations more than allowed by 00756.55(a). Check at intervals as required. This longitudinal checking and correction on areas to be graphically profiled will be waived if it is successfully demonstrated that required pavement profile surface is otherwise produced which conforms to 00756.55(b)(1)(a).

Following hand floating, use a 12 foot proof (grout) rod. Each pass of the proof rod in the longitudinal direction, over the entire surface of the pavement placement, shall overlap the previous pass by half of its width. Use of the proof rod in an obfuscating manner will not be allowed. Check the transverse direction as required. Use of a proof rod on areas to be profiled will be waived if it is successfully demonstrated that required pavement profile surface is otherwise produced which conforms to 00756.55(b)(1)(a).

(a) **Edge Slump** - Correct any edge slump of the concrete in excess of 1/4 inch before the concrete hardens.

(b) **Textured Finish** - Upon completion of the machine floating, straightedge testing, edge tooling and, if necessary, hand floating, and before initial set of the surface concrete, give the surface of the concrete a textured finish.
00756.53

Accomplish the textured finish with a broom or artificial turf drag. Markings shall be transverse to the roadway centerline and the full width of the pavement.

00756.51 **Modification of Strike-off, Consolidation, Final Floating and Surface Finishing Requirements** - Where the width of pavement is narrow, tapering or of irregular pattern, not lending itself to being constructed by prescribed machine methods, the Contractor will be allowed to perform the strike off, consolidation, final floating, and surface finishing with equipment, tools, means, labor and methods other than those specified, provided the work meets with the approval of the Engineer and the following requirements:

- Without causing segregation, vibrate throughout the concrete being placed until it is uniformly consolidated.
- Strike-off the concrete with templates or screeds designed and manipulated to shape the concrete to the specified cross section between the forms, carrying a slight excess of concrete in front of the leading edge of templates or screeds at all times.
- Following the vibrating and strike-off operations, float the concrete. Include transverse floating or other smoothing and finishing actions as necessary. Check and correct the surface according to 00756.49. Keep the surface free from laitance, soupy mortar, marks or irregularities.
- Finish the surface according to 00756.49.

00756.52 **Edge Tooling and Filling** - Tool edges at construction joints of new pavement and clean joints of previously placed concrete to remove laitance and mortar resulting from finishing operations, and to provide clean rounded edges without ridges on the surface. Perform tooling of edges at construction joints so that no more than a 1/8 inch radius is produced.

Fill any areas of minor honeycomb or other minor defect in composition of the concrete along the exposed sides of concrete with a stiff mortar of cement and fine aggregate, and apply to the moistened concrete to the satisfaction of the Engineer. Remove and replace areas showing serious defects in composition of the concrete with specified quality concrete for full panel width between longitudinal joints or edges, and for a length not less than 10 feet. Low spots exceeding 1/4 inch in depth, if in hardened concrete, may be filled with an Epoxy Grout from the CPL provided the area is prepared according to grout manufacturer’s directions and the filling is neat and blends inconspicuously with adjoining concrete.

00756.53 **Curing Concrete** - Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, cure the entire exposed surface of the newly placed concrete for at least 72 hours. If the Specifications require opening to traffic in less than 72 hours, curing may be removed just prior to opening. Use one of the following:
(a) **Liquid Membrane-Forming Compounds** - Apply liquid membrane-forming compound uniformly to the concrete by pressure-spray methods at a rate of at least 1 gallon per 150 square feet. Mix the liquid membrane-forming compound thoroughly before and during use.

(b) **Other Coverings** - Apply clear or white polyethylene film to damp concrete as soon as it can be placed without marring the surface. Place the membrane in contact with the surface, extend beyond the sides or edges of the slabs or forms, and weight down as required to hold it in position as a waterproof and moisture-proof covering. Laps shall be sufficient to maintain tightness.

00756.54  **Pavement Cracks** - Within 28 days after concrete placement and before opening the pavement to public traffic, the Engineer will perform a pavement crack survey. Clean the pavement before the crack survey. Pavement with uncontrolled longitudinal or transverse cracks which are visible without magnification will be considered unacceptable and will be repaired or removed as determined by the Engineer. **Perform all remedial work at no additional cost to the City.**

00756.55  **Surface Tolerance, Testing, and Correction** - Perform straightedge testing according to 00756.55(a). Except as specified, when the Project exceeds 0.6 mile of continuous pavement construction or when specified in the Special Provisions, conduct graphic profile testing according to 00756.55(b). Furnish and operate the equipment as soon as the hardness of the concrete permits.

(a) **Straightedge Testing and Tolerance** - Perform longitudinal and transverse smoothness testing of the pavement surface with a 12 foot straightedge. The extent of the testing will be as the Engineer determines necessary or expedient. The pavement surface shall not deviate from the straightedge at any point by more than 1/8 inch for all areas that are constructed by the prescribed machine methods and for all traffic lanes and ramps. Other areas shall not deviate by more than 1/4 inch. Longitudinal 12 foot straightedge testing will not be required for pavement accepted under 00756.55(b).

(b) **Graphic Profile Testing (GPT) and Tolerance:**

1) **General** - Test the longitudinal surface of all traffic lanes and bridges for smoothness by the graphic profile method according to ODOT TM 770. Before paving commences on the Project, demonstrate the profilometer operation by conducting a calibration test according to ODOT TM 770 and running the machine twice over a 0.1 mile section of pavement with repeating results.

   a. **Graphic Profile Tolerance** - The pavement shall have a profile index of 7.0 inches per mile or less for each wheel path in each 0.1 mile segment or partial segment, and shall have no individual deviation of 0.3 inch or more. On shoulders and auxiliary lanes the profile index shall be 12.0 inches per mile subject to the above criteria. Bonus payment for smoothness will be made according to 756.95.
b. **Daily GPT** - If the average profile index exceeds 7.0 inches per mile for all segments and partial segments of pavement constructed in any day's production, discontinue paving operations and construct one or more test strips as described in 00756.47. The test strip may be comprised of pavement placed during the shift that the shutdown is ordered, but in no case shall it be less than 0.1 mile in length.

(2) **Surface Test** - Run the profilograph or profilometer over the full length of the Project and 50 feet beyond the Project ends to provide a complete graphic profile. This includes all concrete traffic lanes and auxiliary lanes.

Obtain profiles on the pavement surface along lines parallel to and approximately 3 feet from each edge and longitudinal joint(s) for 12 foot wide lanes and 4 feet from each edge and longitudinal joint(s) for 14 foot wide lanes. The intent is to provide a profile in each vehicle wheel path. Take profile(s) on transition areas as close to the wheel path as practical.

Start the profiles that represent a day's production 50 feet before the beginning of that day's production and stop 50 feet before the end of that day's production.

Run the profiles for each day's production as soon as possible without damaging the surface. Analyze the daily GPT profiles according to 00756.55 (b)(3), and give the profiles and results to the Engineer within 24 hours of the conclusion of the day's production.

(3) **Determining Profile Index:**

a. **General** - Determine the profile index of pavement in 0.1 mile segments and partial segments. Segments shall begin 13 feet into the Project and run consecutively in either the direction of travel or the concrete placement, as determined by the Engineer. A segment will end as a partial segment and a new segment will begin when the segment sequence is interrupted by stage construction or by profiled areas excluded from the GPT smoothness requirements.

The following profiled areas of pavement are excluded from the GPT smoothness requirements:

- Profiles extending beyond the Project ends.
- Bridge decks and bridge panels.
- First and last 13 feet at the Project ends and bridge end panels.
- Pavement on horizontal curves with radii less than 1,000 feet.

Include and analyze separately those areas in the profile charts that are not subject to the GPT smoothness profile index requirements.
b. **Method of Analysis** - Determine the profile index and individual deviations of 0.3 inch or more by analyzing the profile charts according to ODOT TM 770 and provide the profile charts and results to the Engineer for review.

c. **Profile Index** - The profile index is the inches per mile in excess of the 0.2 inch blanking band. The formula for converting counts to profile index is:

\[
\text{Profile Index} = \frac{\text{Total Count} \times 0.10}{\text{Length of Full 0.10 Mile Segment or of Partial \_\_\_\_\_\_ Mile Segment}}
\]

* Report to the nearest 0.01 mile

(c) **Correcting Deficiencies** - Should testing described in 00756.49, 00756.51, and 00756.55 show the pavement does not conform to the prescribed limits of deviation, the following shall apply:

1. **Failure to Meet Straightedge Requirements:**
   a. **Plastic Concrete** - If the requirements of 00756.49 or 00756.51 are not met, stop the paving operations until revised methods, changes in equipment, or correction of procedures are made or proposed for trial, and are approved by the Engineer for trial. Also stop those revisions, changes and corrections if they do not produce a specified surface.
   
   b. **Hardened Concrete** - If the requirements of 00756.51 or 00756.55(a) are not met, correct according to 00756.55(c)(2)(a) or 00756.55(c)(2)(b) and retest.

2. **Failure To Meet Graphic Profile Requirements** - Correct any segment or partial segment that exceeds the requirements of 00756.55(b) in either wheel path by one of the methods listed below to the specified limits except correct deviations of 0.3 inch or more at least to the edge of the blanking band:
   a. Remove the non-specification concrete pavement as determined by the Engineer and replace with specification concrete pavement.
   
   b. Profile with abrasive grinder(s), equipped with a cutting head comprised of multiple diamond blades. The Engineer will determine and mark the areas to be profiled. For all areas corrected by grinding, restore the required surface texture as specified in 00756.49(b) by transverse sawing with diamond blade saws.

   Retest their entire length, according to 00756.55(b), all segments requiring corrective work with the profilograph or profilometer under the supervision of the Engineer. Perform all corrective work and graphic profiling, including traffic control, at no additional cost to the City.
00756.56 **Pavement Thickness** - Construct the pavement to the thickness shown. Pavement not so constructed will be subject to replacement according to 00756.57, or to payment at adjusted prices according to 00756.93.

(a) **Survey Method** - Determine conformance with minimum thickness requirements by random survey measurements of the concrete under the Engineer’s observation.

Divide the panel into units and partial units equivalent to a maximum of 200 lane feet. Normally, unit lengths will be 200 feet for 1 lane, 100 feet for 2 lanes, 70 feet for 3 lanes and as appropriate for transition areas. Take survey measurements within 10 feet longitudinally and 1 foot transversely from the calculated random location as determined by the Engineer in each unit and partial unit. Establish the horizontal location in such manner that it can be re-established in the same location to within 1 inch of the original location. Record vertical elevations to the nearest 0.1 inch. Take the measurements as follows:

- On the finished base course before paving and at the same location on the finished PCC pavement.
- No closer than 2 feet from the panel edges.
- With survey instruments capable of producing repeatable accuracy within the required survey limits.

Determine the pavement thickness by subtracting the elevation of the finished base course from the elevation of the finished PCC pavement. If surveyed depth is not obtained for a unit or partial unit, or is not available to represent the area of pavement remaining after the limits of pavement over 1 inch deficient is determined, the depth will be assumed to be the same as the preceding or following surveyed depth that is nearest in distance.

(b) **Thickness 0.5 Inch Deficient** - If a survey depth measurement indicates the pavement is 0.5 inch or more deficient in thickness, stop forward paving progress until appropriate adjustments are made or corrective action is taken.

(c) **Coring Requirements** - Perform required coring, or coring requested by the Engineer according to AASHTO T 24. Repair core holes as directed at no additional cost to the City. Cores will be measured by the Engineer according to AASHTO T 148 and the measurements reported to the nearest 0.1 inch. Core measurements will replace survey methods.

(1) **Corrective Grinding Areas** - If corrective grinding required by 00756.55(c) is performed at a 00756.56(a) depth measurement site, a core shall be obtained at the surveyed measurement site according to the following:
a. Profile Indexes 7.0 Inches Per Mile or Less - If the original profile indexes for a segment or partial segment determined by 00756.55 is 7.0 inches per mile or less in each wheel path, a core is not required after corrective grinding is performed at a depth measurement site within the segment or partial segment represented by the profile indexes.

b. Profile Index Greater Than 7.0 Inches Per Mile - If an original graphic profile index for a segment or partial segment determined by 00756.55 is more than 7.0 inches per mile for a wheel path, obtain a core, after corrective grading has been performed, at a depth measurement site within the segment or partial segment represented by the profile indexes if the depth measurement is the specified depth or less.

(2) Cores Requested By Contractor - If the Contractor believes that a depth measurement determined according to 00756.56(a), or a core obtained according to 00756.56(c), is not representative of the actual pavement thickness, the Contractor may take a replacement core. Take replacement cores at a location as directed, 10 feet from the depth measurement or core site in question and the same distance from centerline. The replacement core measurement will replace the original depth or core measurement.

(d) Thickness Over 1.0 Inch Deficient - If a depth measurement determined according to 00756.56(a) shows pavement over 1.0 inch deficient, obtain a core at the depth measurement site. If this core, or a core determined by 00756.56(c), shows pavement over 1.0 inch deficient, obtain additional cores. Take these additional cores at the same distance from the centerline and at 25 foot intervals each direction from the first core until a core in each direction shows pavement 1.0 inch deficient or less. These two core locations will be considered the limits of the pavement more than 1.0 inch deficient. The pavement panel between these two cores will represent the area of pavement subject to removal and replacement under 00756.57 or no payment under 00756.93.

When it is suspected by the Engineer that the pavement in the adjacent travel lane(s) in the panel may be more than 1.0 inch deficient for a greater distance than determined by the above procedure, core the pavement in the adjacent travel lane(s) in the nearest wheel track (3 feet) from the nearest edge) opposite both limit cores. If these cores are more than 1.0 inch deficient, the above procedure shall be followed to determine the limits.

00756.57 Deficient Pavement - Remove and replace pavement deficient in thickness by more than 1.0 inch as determined in 00756.56(d), at no additional cost to the City. If permitted by the Engineer, the pavement may be left in place without payment. Replacement pavement shall be of the specified design, quality and thickness as follows:
• Be the full width of the pavement panel involved.
• Extend far enough to replace at least a 20 foot length.
• Extend to the construction joint if closer than 20 feet to a construction joint.

**Maintenance**

**00756.60 Protection of Concrete** - Erect and maintain suitable barriers to protect the concrete from traffic or other detrimental trespass until the pavement is opened to traffic. If necessary provide watchmen. Repair or replace any part of the pavement damaged by traffic or damaged from any other cause before its official acceptance, according to 00170.80.

**00756.61 Opening to Construction Equipment or Traffic** - Do not operate construction equipment on newly placed concrete until the requirements of (a), (b), and (c) are met. Do not allow public traffic on newly placed concrete until all of the following requirements are met:

(a) The Contractor complies with 00150.60.

(b) The concrete attains a compressive strength of at least 70% of the specified 28-day strength as determined by at least 3 cylinders cured according to AASHTO T23 Section 9.2 (field cure) and tested according to AASHTO T22.

(c) The surface of the concrete is protected from scarring or abrasion and kept free of stones, loose mortar and other matter apt to be deleterious to the concrete in the paths of equipment.

(d) The pavement meets all of the requirements of 00756.55.

**Measurement**

**00756.80 Measurement** - The accepted quantities of concrete pavement will be measured by the square yard. The area will be determined by measuring the width and length of each separately constructed panel of pavement. The width is the design width or measured edge-to-edge width on the surface of the pavement whichever is less. The length is the horizontal measurement from end to end of pavement along the center line of the strip.

The measurement of extra thickness of pavement, as shown or as ordered, will be determined by conversion on a proportionate volume basis to an equivalent number of square yards of specified thickness pavement.

**Payment**

**00756.90 Payment** - The accepted quantities of plain concrete pavement will be paid for at the Contract unit price, per unit of measurement for the following items:
00756.92

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Plain Concrete Pavement, Undowell ed, ____ Inches Thick...</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(b) Plain Concrete Pavement, Dowelled, ____ Inches Thick........</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

The thickness of pavement will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for construction joint reinforcement bars, tie bars, dowel bars, curing materials, and sawcutting.

00756.92 Price Adjustment for Strength - For each lot of concrete for which a PF is determined, the following will apply:

- In no case will the actual payment exceed the Contract Unit Price.
- When the PF is less than 1.00, the price adjustment will be determined as follows:

  \[
  \text{Price Adjustment} = 0.3 \times (\text{PF} - 1) \times \text{Unit Price}
  \]

00756.93 Price Adjustment for Variation in Thickness - No additional payment over the Contract unit price will be made for pavement having a thickness greater than shown or ordered by the Engineer. When the pavement is found deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, as determined according to 00756.56, payment will be made at an adjusted price according to the following table:

<table>
<thead>
<tr>
<th>Deficiency in Thickness (inch)</th>
<th>Proportional Part of Contract Unit Price Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 to 0.20</td>
<td>100%</td>
</tr>
<tr>
<td>0.21 to 0.30</td>
<td>83%</td>
</tr>
<tr>
<td>0.31 to 0.40</td>
<td>76%</td>
</tr>
<tr>
<td>0.41 to 0.50</td>
<td>73%</td>
</tr>
<tr>
<td>0.51 to 0.75</td>
<td>63%</td>
</tr>
<tr>
<td>0.76 to 1.00</td>
<td>59%</td>
</tr>
</tbody>
</table>

No payment will be made for any area of pavement found deficient in thickness by more than 1.0 inch even though such pavement is allowed by the Engineer to remain in place under the provisions of 00756.57.

00756.95 Bonus Payment for Smoothness - If a profilograph or profilometer is used according to 00756.55 a bonus payment of up to 1.5% will be made to the Contractor for each 0.1 mile segment or partial segment of pavement except shoulders, as determined in 00756.55(b) if:
The profile index for each wheel path is 7.0 inches per mile or less.
No individual deviation is 0.3 inch or more.
The average of the 2 profile indexes is less than 5.0 inches per mile.
These requirements are met without any corrective action specified in 00756.55(c).

The bonus payment for each segment and partial segment meeting the above requirements will be computed as follows:

\[ \text{Bonus} = 0.006 \times (5.0 - \text{PI}) \times \text{Quantity} \times \text{Unit Price} \]

- \textbf{PI} = Average of the two profile indexes in the segment or partial segment (inches per mile).
- \textbf{Quantity} = The quantity (square yards) represented by the segment or partial segment.
- \textbf{Unit Price} = The unit price for the concrete pavement as shown in the Contract Schedule of Items.
00759 - Miscellaneous Portland Cement Concrete Structures

Description

Scope - This work consists of furnishing, placing and finishing commercial grade concrete curbs, monolithic curb and gutter, islands, traffic separators, driveways, monolithic curb and driveways, walks, monolithic curb and sidewalks, miscellaneous surfaces, and stairs with metal handrail in close conformity to the lines, grades and dimensions shown or established. These items in this Section will be collectively referred to as "structures".

Materials

- Furnish materials meeting the following requirements:
  - Bar Reinforcement ......................................................... 02510
  - Commercial Grade Concrete ......................................... 00440
  - Dowels ........................................................................... 02510.50
  - Epoxy Bonding Agent .................................................... 02070
  - Metal Pipe Handrail ...................................................... 02830
  - Poured Joint Fillers ....................................................... 02440.30
  - Preformed Expansion Joint Filler .................................... 02440.10
  - Sand ............................................................................. 00360.10
  - Welded Wire Fabric ...................................................... 02510.40

Aggregate Base - Furnish aggregate base materials for base, foundation courses, leveling courses or bedding meeting the requirements of Section 02630. If a designated size is not shown or given, furnish 1" - 0 or 3/4" - 0, as the Contractor elects.

Sidewalk Ramp Treatment - Furnish truncated dome detectable warning surfaces for sidewalk ramps and accessible route islands from the CPL. The truncated domes shall be thermoplastic, polymer composite or cementitious panels in the color yellow. Use one type of material throughout the Project and only adhesives recommended or supplied by the manufacturer.

Temporary Plating - Temporary plating shall conform to Section 00275.

Equipment

Concrete Extruding Machine - Concrete extruding machines shall operate under sufficient restraint to forward motion to produce a well consolidated mass of concrete.

Construction

Earthwork - Make excavations and backfills for the structures according to Section 00330 and to the depths, widths, and cross-sections shown, specified, or directed.
**00759.42 Foundations** - Construct foundations or other bedding using selected granular backfill material according to Section 00330 or using aggregate base when shown or directed.

For aggregate base, do one of the following:

- When existing aggregate base materials of the kind specified in 00759.11 are already in place, salvage and reuse.
- Use new aggregate base materials conforming to 00759.11.

**00759.43 Foundation Preparation** - Bring areas on which structures are to be constructed to established line, and make firm, dry and free of all unsuitable material before placing concrete. Existing concrete surfaces shall be clean and moist at the time of placing new concrete.

When placing concrete by the extrusion method, vertical dowel fastening to underlying concrete may be eliminated if the bond between surfaces is developed by applying epoxy bonding agent. Apply epoxy bonding agent according to the manufacturer's recommendations.

**00759.44 Joining New To Existing Concrete** - Construct suitable connections between new and existing concrete where existing driveways, walks, and other structures are cut back to permit the new construction or where the new construction abuts the existing concrete. Unless shown or directed otherwise, furnish and place minimum 1/2 inch thick preformed expansion joint filler between new and existing concrete.

**00759.45 Reinforcement, Dowels and Tie Bars** - Furnish and place reinforcement, dowels, and tie bars according to 00530.41 and as shown or directed.

Provide dowels with "slip sleeves" and place as load transfer devices where shown. Place dowels without "slip sleeves" as fastenings or ties between new and existing underlying concrete when shown.

**00759.46 Concrete** - Construct the structures between suitable forms or by the extrusion method. Place concrete according to Section 00440 subject to this Section.

**00759.48 Expansion Joints** - Construct expansion joints of the preformed filler type in concrete structures as shown and the following:

- Not less than 1/2 inch wide, except where abutting or underlying concrete joints are larger, then the width shall match those joints.
- At right angles to the structure alignment and normal to the structure surface.
- Which completely separate the concrete segments.
- Placed flush or no more than 1/8 inch below the concrete surface.
(a) **Curbs, Islands, and Traffic Separators** - Provide expansion joints:

- Opposite abutting expansion joints in abutting concrete.
- Over existing expansion joints in concrete underlying the new concrete structure.
- At each point of tangency in the structure alignment.
- Not over 200 foot spacing.

(b) **Driveways, Walks, Monolithic Curbs and Sidewalks, and Surfacings** - Provide expansion joints:

- Between driveways and concrete pavement
- Transversely in walks opposite expansion joints in adjoining curbs and elsewhere so the distance between joints does not exceed 45 feet.
- Transversely in walks at a distance of 6 feet to 8 feet from ends of walks which abut curbs.
- Around poles, posts, boxes, and other fixtures which protrude through or against the structures.

(c) **Stairs** - Provide expansion joints for stairs at the top and bottom landings as shown.

00759.49 **Contraction Joints** - Construct transverse contraction joints of the weakened plane or dummy type in the exposed surfaces of the concrete structures as shown and the following:

(a) **Locations** - Locate contraction joints:

- Over contraction joints in concrete underlying the new concrete structure.
- Opposite contraction joints in abutting concrete.
- At locations to confine joint spacing to a maximum of 15 feet.

(b) **Methods** - Construct contraction joints by:

- Inserting and removing plates, or other devices.
- Inserting and leaving in place preformed expansion joint filler even and flush with the concrete surface.
- Sawing as soon as practical after concrete placement but before any uncontrolled cracking occurs.
- Tooling
- Other approved methods
(c) **Requirements** - Contraction joints shall:

- Be not less than 1/8 inch nor more than 1/4 inch wide
- Be a depth of 1/3 the thickness of the concrete
- Have clean, unfilled grooves, (if preformed expansion joint filler is not used)

00759.50 **Surface Finishing:**

(a) **General** - Remove forms, if any, from structures after the concrete has taken its initial set and while the concrete is still green. Repair minor defects with mortar containing one part portland cement and two parts sand. Do not plaster exposed surfaces.

The top and face of structures shall be true and straight, free from humps, sags, or other irregularities. The surface shall not vary more than 1/4 inch from the edge of 12 foot long straightedge laid on the top or face of the structure, except in curves. Furnish the straightedge and operate it as directed. Unless otherwise shown or directed, tool edges to 1/4 inch radius.

(b) **Curbs, Islands, and Stairs** - While the concrete is still green, finish the exposed surfaces as required to produce a smooth surface and uniform texture.

(c) **Driveways, Walks, and Surfacings** - Finish concrete surfaces to smooth and uniform texture by troweling, floating and cross brooming. Lightly groove or mark surfaces into squares or other shapes to match markings on similar existing surfaces in the vicinity, as directed.

On all sidewalk ramps and accessible route islands, install truncated domes as shown. Place according to the manufacturer's recommendation.

(d) **Historic Dates and Names** - Historic dates and street names in existing sidewalk corners will be preserved or restamped into the new concrete. Stamp the dates or names in the curb as close to the original location as practical. Restamp the dates and names exactly as they existed in the sidewalk corner. This includes misspelled words and names that are no longer used for the street name. However for dates, the original date with a slash and the current date are required to be restamped into the new corner curb. Do not preserve or re-stamp Contractor names.

A set of stamping tools is available for loan through the Street Construction Office on a first-come, first-serve basis.

00759.51 **Curing** - Cure and protect concrete after placing and finishing according to Section 00440.

Keep the concrete structure free from contact, strain and public traffic for at least 7 calendar days or longer as directed. Do not apply curing compounds to the designated truncated dome areas of sidewalk ramps and accessible route islands.
Joint Filler - If curb is separately constructed next to sidewalks or driveways, pour joint filler in the joint between the curb and sidewalk or driveway.

Grout Pads - When replacing driveways, walks, islands, and similar surfaces reconstruct the grout pads under illumination and traffic signal equipment according to 00960.46(h)(1) and as directed.

Protection of Concrete - Erect and maintain suitable barriers to protect the concrete from traffic or other detrimental trespass until the driveway is open to traffic.

Opening to Traffic - Do not allow public traffic on newly placed concrete for driveways until the concrete attains a compressive strength of at least 70% of the specified 28-day strength as determined by at least 3 cylinders cured according to AASHTO T 23 (field cure) and tested according to AASHTO T 22.

Measurement - The quantities of structures will be measured on the following basis:

- Volume Basis - Measurement will be limited to the neat lines of the structure.
- Area Basis - Measurement will be limited to the neat lines of the structure.
- Length Basis - Measurement will be along the face of the structure, from end to end including curb tapers or depressed lengths at driveways and ramps.
- Each Basis - Measurement will be by actual count.

Payment - The accepted quantities of structures performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

City of Portland 2010 824
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Concrete Curbs, ....................................Foot or Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(b) Concrete Islands ........................................... Square Foot</td>
<td></td>
</tr>
<tr>
<td>(c) Concrete Driveways ............................................... Square Foot</td>
<td></td>
</tr>
<tr>
<td>(d) Concrete Driveways, Reinforced ................................ Square Foot</td>
<td></td>
</tr>
<tr>
<td>(e) Concrete Walks ........................................................ Square Foot</td>
<td></td>
</tr>
<tr>
<td>(f) Monolithic Curb and Sidewalks ..................................Square Foot or Foot</td>
<td></td>
</tr>
<tr>
<td>(g) Concrete Surfacing ................................................................. Square Foot</td>
<td></td>
</tr>
<tr>
<td>(h) Concrete Stairs .......................................................... Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(i) Concrete Driveway Connections .................................. Square Foot</td>
<td></td>
</tr>
<tr>
<td>(j) Concrete Bus Shelter Pads ............................................ Each</td>
<td></td>
</tr>
<tr>
<td>(k) Concrete Valley Gutter .................................................. Foot</td>
<td></td>
</tr>
<tr>
<td>(l) Detectable Warning Surface .................................................. Square Foot</td>
<td></td>
</tr>
</tbody>
</table>

In item (a) the type of curb will be inserted in the blank, if appropriate.

| Item (b) includes traffic separators. |
| Items (c) and (d) include monolithic curb at driveway locations. |
| Items (e) and (f) include sidewalk ramps. |
| Item (g) the specified thickness, or type, of concrete surfacings will be inserted in the blank, if appropriate. |
| Item (h) includes pipe handrail. |
| Payment for Item (l) is for existing ramps without a detectable warning surface. |

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separated pay items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90.
Section 00760 - Unit Pavers

Description

00760.00 Scope - This work consists of furnishing and installing standard or permeable segmental concrete pavers, clay segmental pavers or clay mortar set pavers at locations shown on the plans or as directed.

00760.02 Definitions:

Bedding Layer - a layer of clean crushed aggregate screeded smooth for bedding the pavers.

Bedding Sand - A layer of coarse, washed sand screeded smooth for bedding the pavers.

Brick Pavers - Clay paving units, rectangular or square capable of being placed with one hand into a laying pattern

Chamfer - A 45° beveled edge around the top of a paver unit to help prevent edge chipping.

Concrete Pavers - Concrete paving units, rectangular, square or dentated, capable of being placed with one hand into a laying pattern or with mechanical equipment.

Dentated Paver - A unit that is not rectangular or square in shape.

Edge Restraint - A curb, edging, building, or other stationary object that contains the sand and pavers so they do not spread or lose interlock.

Interlock - Frictional forces between paving units that prevent them from rotating or moving horizontally or vertically in relation to each other. Also defined as the inability of a paver to move independent of its neighbor.

Joint - The space between paving units typically filled with either sand or grout.

Joint Sand Stabilizer - Liquid penetrating or dry mix applied or materials that provide early stabilization of joint sand, reduces its permeability, sand loss and helps prevent weeds.

Permeable Concrete Pavers - Concrete interlocking pavers with wide joints from 3/8 inch to 1/2 inch or a shape that creates openings in which rainfall and runoff can infiltrate. The openings are typically filled with open-graded aggregate.

Segmental Pavement - A pavement whose surface consists of discrete units typical made of concrete, clay or stone.

Spacer Bars/Lugs, Spacers or Nibs - Small protrusions on each side of the paver that maintain a minimum space so sand can fill into the joints.
Materials

00760.10 Materials - Furnish materials meeting the following requirements:

Backer Rod ................................................................. 02440.14
Bedding sand ................................................................. 02620
Brick pavers ........................................... ASTM C 1272-04a, Type R, Application PX
Commercial Grade Concrete ........................................ 00440
Concrete pavers ................................................... ASTM C 936
Drainage blanket ......................................................... 00360
Joint sand ...................................................................... 02620
Joint sand stabilizers .............................................. 02440.23
Joint grout .................................................................... 02080.60
Geotextile ..................................................................... 02320
Mortar bed .................................................................... 02080.60
Poured Joint Filler ..................................................... 02440.30

00760.11 Aggregate Base - Provide aggregate base materials for base, foundation courses conforming to Section 02630. If a designated size is not shown or given, provide 1" - 0 or 3/4" - 0 as the Contractor elects.

00760.12 Unit Paver Type, Size and Color - Provide paver type, size and color as indicated in the Special Provisions.

00760.13 Temporary Plating - Temporary plating shall conform to Section 00275.

Construction

00760.40 Earthwork - Make excavations and backfills for the pavers according to Section 00330 and to the depths, widths, and cross-sections shown, specified, or directed. When pavers are used in tree wells, the compaction requirement in Section 00330 will be reduced to no more than 80%.

00760.41 Foundations:

(a) Aggregate Base - Construct bedding layer using aggregate base materials according to 00760.11.

(b) Sand Bedding - Construct foundations using sand conforming to 02620.

(c) Mortar Base - Construct foundations using mortar conforming to 02080.60

(d) Concrete Base - Construct foundations using commercial grade concrete according to 00440.

00760.42 Foundation Preparation:

(a) Aggregate Base - Bring areas on which structures are to be constructed to established line, and make firm, dry and free of all unsuitable material before placing concrete.
(b) **Sand Bedding** - Place a 1 1/2 inch leveling bed. Screed to grade and saturate with water to ensure a firm and smooth grade.

(c) **Mortar Base** - Install mortar setting bed on concrete base according to manufactures instructions.

(d) **Concrete Base** - Cure and clean concrete base before placing mortar bed. The surface shall not vary more than 3/8 inch from the edge of a 12 foot long straightedge laid on the top of the surface.

00760.43  **Paver Units** - Install pavers according to the manufacturer's instructions. Lay out rows so they are straight and parallel to the surrounding lines. Cut pavers with masonry saw where necessary to fit pattern to edges. The edge gap of the paver is to be no wider than 3/8 inch. The adhesion surface of the paver is to be clean of dust and foreign material. The texture of the pavers shall be a non-smooth standard finish (mission).

00760.44  **Joint Fill and Compaction** - After placing pavers, sweep joint sand into the joints. Use a vibrating mechanical tamper to compact.

00760.45  **Joint Grout** - Joints shall not exceed 1/2 inch in width and may be buttered or poured and tamped to provide 100% contact with all mating surfaces. The joint shall be thoroughly filled and finished flush with the surface of the concrete paver. The slurry or squeegee methods of filling the joints between the pavers shall not be used.

00760.46  **Joint Sand Stabilizer** - For pavers used for vehicle traffic, stabilize sand joints using a liquid stabilizer that is water or solvent based. The primary resin or bonding agent shall be an acrylic, epoxy or other polymer as solids by volume of 18 to 28%. Use of a dry stabilizer shall be allowed for pavers subjected only to pedestrian traffic.

00760.47  **Laying Pattern** - Use basket weave or running band pattern when shown or directed in areas for pedestrian traffic. Use 45° or 90° Herringbone pattern when shown or directed for pedestrian or vehicle traffic.

00760.48  **Expansion Joints** - Construct expansion joints according to 00759.48.

00760.49  **Contraction Joints** - Construct contraction joints according to 00759.49.

00760.50  **Paver Edge Restraints** - Use metal or plastic edge restraints as specified. The use of wood, either treated or untreated, is not allowed.

00760.51  **Surface Tolerance** - Do not deviate from the longitudinal and transverse surface grades by more than 1/4 inch in 12 feet.
Maintenance

00760.60 Refilling of Joints - One month after initial installation of pavers and at the completion of the Project, sweep additional sand into joints as needed.

00760.61 Paver Settlement - One month after initial installation of pavers and at the completion of the Project, check surface of pavers for settlement and re-set pavers as needed.

Finishing and Cleanup

00760.70 Clean Up - Remove excess sand, grout and broken paving material from the site when complete.

Measurement

00760.80 Measurement - The quantities of unit pavers will be measured on the area basis.

Payment

00760.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item                      Unit of Measurement
(a) Brick Pavers.......................... Square Foot
(b) Concrete Pavers........................ Square Foot
(c) Permeable Pavers...................... Square Foot

Item (a) includes the concrete pad, mortar bed and grouted joints. Aggregate base will be paid according to Section 00640.

Item (b) includes sand bedding. Aggregate base will be paid according to Section 00640.

Item (c) includes the sand material for the bedding and joints. Drainage blanket will be paid according to Section 00360.

Items (a), (b), and (c) includes the sidewalk ramps. It also includes all work associated with applying truncated domes.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

When earthwork is included as separate pay items, payment will be made according to Section 00330.
When earthwork is not included as separated pay items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to Section 00640.

Drainage blanket will be paid for according to 00360.90.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
 PART 00800 - PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES

Section 00810 - Metal Guardrail

Description

00810.00 Scope - This work consists of constructing metal guardrail and metal median barrier to the lines and grades shown or established and includes the assembly and erection of all components, parts and materials complete at the locations shown or directed.

Metal guardrail and metal median barrier will be referred to in this Section as "guardrail". The types of guardrail will be shown.

Materials

00810.10 Materials - Furnish materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guardrail</td>
<td>02820.40</td>
</tr>
<tr>
<td>Guardrail Hardware</td>
<td>02820.30</td>
</tr>
<tr>
<td>Metal Beam Rail</td>
<td>02820.10</td>
</tr>
<tr>
<td>Metal Posts</td>
<td>02820.20</td>
</tr>
<tr>
<td>Wood guardrail blocks</td>
<td>02110.20</td>
</tr>
<tr>
<td>Wood guardrail posts</td>
<td>02110.10</td>
</tr>
</tbody>
</table>

Use guardrail terminals from the CPL conforming to the National Cooperative Highway Research Program (NCHRP) Report 350.

00810.11 Posts - Posts, except as specified for use on bridges or otherwise shown or directed, may be of steel or wood, as the Contractor elects. Once a type has been selected, use it throughout the continuous run of guardrail except in the transitions and terminals.

00810.12 Median Barrier on Bridges - Metal median barrier on bridge decks shall be comprised of metal beam rail, metal posts and hardware, conforming to 00810.10.

At expansion joints on bridge decks, the slots in the rail member for post bolt and rail joint bolts shall be of special dimensions as shown.

00810.13 Guardrail Anchors - Guardrail anchors shall be steel.

00810.14 Condition of Materials - All materials will be subject to inspection of condition at the latest practical time available before or during incorporation of materials in the work.

00810.15 Salvaged Materials - Materials salvaged as part of removal work on the Project may be reused in new construction, if the Engineer determines the materials conform to current design, 00810.10 and the following:
(a) **Wood Posts** - Wood posts shall be structurally sound, treated and free from damage that would affect their strength and durability. Do not incorporate into the work any post damaged to the extent that untreated wood is exposed.

(b) **Metal Beam Rail Members** - Metal beam rail members shall be unpainted, straight and free of breaks, kinks, dents, damage to galvanized coating, or any other damage that would affect the integrity of the member. If paint is removed from metal beam rail members salvaged from the Project, remove the paint at a location outside of the highway right-of-way, and in a manner that will not damage the galvanizing. Repair minor damage to galvanizing according to 00810.43.

### Construction

**00810.40 Timing and Coordination of Work** - Time and coordinate construction of guardrail to hold disturbance of bases, surfacings and pavements to a minimum.

Place all salvaged metal guardrail or metal median barrier materials in continuous runs.

Do not leave posts installed for guardrail and median barrier exposed to traffic for more than 24 hours before installing the rail members, rail end pieces and anchors and tightening all bolts, except replacement rail shall be installed according to 00310.40(a).

**00810.41 Excavation and Backfill** - Subject to 00810.42, excavate to the lines, grades and depths shown or established. Make cuts through pavement by mechanical means, such as knife-edge cutters or rotary drills. Make cuts below the pavement by auger or other means that will prevent undue disturbance of abutting areas. Avoid fouling existing bases and pavements. Repair or replace, as directed, all materials that become fouled, at no additional cost to the City. Remove water and unsuitable material that would impair stability of the backfill, from areas to be backfilled.

In areas occupied by aggregates, bituminous material and pavements, backfill with like materials to the same thickness and density as the adjacent materials. In other areas, backfill with granular backfill materials meeting the requirements of 00330.14. Place all backfill in layers not exceeding 6 inches and compact each layer to a firm, dense condition.

Remove, replace, repair or restore, as directed, adjoining areas that become misshapen or disturbed during excavating and backfilling operations at no additional cost to the City. Dispose of excess materials according to 00330.41(a)(4).
00810.42  **Installation of Posts and Anchors** - Place posts and anchors as shown. If directed, install 8 foot guardrail posts. Set posts in excavated holes or drive them in place. If posts are driven through the bases, surfacings, or pavement, repair all damage as directed. Remove and replace posts, anchors or other components damaged during installation with sound components. Firmly set all posts at proper line, grade and spacing within a tolerance of 1/2 inch. Rigidly attach anchors, terminals and connections to other structures as shown.

When metal posts are required over box culverts, cattle passes, equipment passes or other concrete structures, place steel posts, base plates, or base plate concrete anchors as shown or directed.

00810.43  **Erection of Rails and Other Components** - Normally, all fabrication of metal beam rail members and other components shall be done in the shop or by the manufacturer. Limit field cutting, drilling and other field fabrication to the minimum and perform in a manner that will not impair the appearance or structural quality of the material. Burning new holes in metal beam rail members will not be allowed.

Restore to specified condition, surface finishes and protections that are damaged before or during erection. Repair the cut ends of galvanized bolts, rail elements and back-up plates, and any holes drilled or punched after galvanizing according to ASTM A 780. Minimum zinc content for Meth A2 is 94% on the dry film.

Toe nail blocks to post with two 10d, galvanized, flat head nails to prevent rotation.

Draw tight all bolts. Bolts shall be of sufficient length to extend slightly beyond the nuts.

00810.45  **Painted Guardrail** - Projects that include the removal and dismantling of painted metal guardrail require that environmental protection and worker safety precautions be established. If painted guardrail is reused in any application, comply with DEQ/EPA and OSHA regulations pertaining to paint removal.

**Measurement**

00810.80  **Measurement** - The quantities of guardrail items constructed under this Section will be determined as follows:

- **Length** - Measurement will be on the length basis measured by one of the following methods:
Count Method - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a "standard section" is defined as 12 1/2 feet of complete guardrail or median barrier, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post, and added to the total calculated length of the standard sections for each run.

Length Method - Measurement will be from center to center of end posts, or as otherwise shown, along the line and grade of each run of each type.

Unit - Measurement will be by actual count.

Payment

00810.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Guardrail, Type _______________________________</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Metal Median Barrier _____________________________</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Guardrail Anchors, Type _________________________</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Guardrail End Pieces, Type ______________________</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Guardrail Transition ____________________________</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Guardrail Connections __________________________</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Guardrail Terminals ______________________________</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Extra for ______ foot Posts ______________________</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Guardrail Posts ________________________________</td>
<td>Each</td>
</tr>
</tbody>
</table>

In item (a) the type of guardrail will be inserted in the blank. Item (a) includes all posts including steel, base plates, and base plate concrete anchors.

Items (a) and (b) include constructing the respective items except for:

- end pieces
- anchors
- transitions
- extra costs involved in constructing guardrail connections to existing bridges
- terminals

In item (c) the type of anchor will be inserted in the blank.

In item (d) the type of guardrail end piece will be inserted in the blank.

Item (e) includes preparing the bridge rail or concrete barrier for the transition and includes posts, rail elements, terminal connectors, connection plates, anchor bolts, and all necessary appurtenances and hardware.
Item (f) includes preparing the bridge rail or concrete barrier for the connection and installing the terminal connectors when there is no guardrail transition item and includes connection plates, anchor bolts, and all necessary appurtenances and hardware.

In item (g) the type of terminal will be inserted in the blank. Item (g) includes guardrail terminals, posts, anchors, rails, guards, end pieces, struts, soil tubes, and all necessary appurtenances and hardware.

In item (h) the length of post will be inserted in the blank. Item (h) includes installing 8 foot long or longer posts instead of standard 6 foot long posts. The extra costs for the longer posts are costs that are not covered and included in the unit price for one or more of the other listed pay items.

Item (i) includes only installing posts when upgrading or repairing existing guardrail installations.

Payment will be payment in full for furnishing and placing all materials, and furnishing all equipment, labor and incidentals necessary to complete the work, as specified.

No separate or additional payment will be made for excavation and backfill.
00811.00  

**Section 00811 - Cable Barrier**

**Description**

00811.00  **Scope** - This work consists of furnishing and installing cable barrier to the lines, grades, and at the locations shown or directed.

**Materials**

00811.10  **Cable Barrier** - Furnish cable barrier from the CPL. Provide all cable barriers on the Project from the same manufacturer regardless of the number of runs of cable barrier required and regardless of the types of cable barrier required.

Use precast or cast-in-place concrete docketed foundation line posts. Furnish and place concrete meeting the requirements of Section 00440.

00811.11  **Cable Barrier Terminals** - Use the following options as specified:

- **Option 1** - Use cable barrier terminals from the CPL that matches the system used.
- **Option 2A** - Tie the cable barrier to new guardrail as approved by the cable barrier manufacturer.
- **Option 2B** - Tie the cable barrier to existing guardrail as approved by the cable barrier manufacturer.

**Equipment**

00811.20  **Tension Measuring Device** - Measure the cable barrier tension with a manufacturer supplied measuring device. At the completion of the Project, the measuring device becomes the property of the City at no additional cost to the City.

**Labor**

00811.30  **Manufacturer's Representative** - If it is a requirement of the manufacturer to have a manufacturer's representative on site during installation, provide the services of a manufacturer's representative at no additional cost to the City.

**Construction**

00811.40  **Cable Barrier** - Install cable barrier according to the manufacturer's directions at the locations shown. Cable anchors and cable overlap as shown are approximate. Locate and overlap the actual anchor according to manufacturer's instructions.
Keep a tension log and give it to the Engineer upon completion of installation. The tension log shall show the time, date, location, ambient temperature, and the final tension readings, and be signed by the person performing the tension readings. Provide a copy of the manufacturer’s recommended tension chart along with the tension log.

Perform all tension checks or adjustments required by the manufacturer within a 30 day period of installation.

**00811.41 Cable Barrier Terminals** - Place terminals according to the manufacturer's directions, at locations shown, and as required by the cable barrier manufacturer to meet their minimum requirements. Ensure that there is compatibility between terminals and the cable barrier system installed.

**00811.42 Placement** - Place the concrete anchors and footings, and backfill them at least 2 weeks prior to tensioning the cables. Set the concrete anchors into the excavation as shown. Set the bottom of the anchor so it has full and even bearing in the surface under it. Excavate and backfill according to 00810.41.

### Maintenance

**00811.60 Training** - After installation, provide at least one 4 hour manufacturer presented training session to City maintenance personnel at no additional cost to the City.

### Measurement

**00811.80 Measurement** - The quantities of cable barrier will be measured on the length basis, from center of end post to center of end post along the line and grade of each separate run. Measurement will be made through the ends of the terminals and guardrail connections.

The quantities of cable barrier terminals and cable barrier guardrail connections will be measured on the unit basis.

### Payment

**00811.90 Payment** - The accepted quantities of cable barrier will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Cable Barrier, Test Level 3</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Cable Barrier, Test Level 4</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Cable Barrier Terminals</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Cable Barrier Guardrail Connections</td>
<td>Each</td>
</tr>
</tbody>
</table>

Items (c) and (d) include all special rail elements, brackets, posts, and all necessary appurtenances and hardware.

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Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00812 - Adjusting Guardrail

Description

00812.00 Scope - This work consists of adjusting existing guardrail by raising it to the proper height to conform to the applicable Standard Drawings.

Materials

00812.10 Materials - Replace rail members, posts or other materials that are damaged with material meeting the requirements of 00810.10. Replace materials damaged by the Contractor's operations at no additional cost to the City.

Construction

00812.40 General - Reinstall adjusted guardrail components during the same day they are removed. Repair minor damage to galvanizing according to ASTM A 780. Minimum zinc content for Method A2 is 94% on the dry film.

Adjust the existing guardrail by one or both of the following methods:

(a) Posts Remain in Place - Remove the existing rail members and blocks in a manner that will not damage galvanizing; drill new bolt holes in posts (if needed); treat existing and new holes with a preservative from the CPL; reinstall the rail members and blocks; and perform such other incidental work as may be required (see detail in the plans).

(b) Raise Posts - Remove and reinstall posts at the proper height, or raise posts to the proper height and set firmly by working grout or other materials under the post in a manner satisfactory to the Engineer.

Measurement

00812.80 Measurement - The quantities of adjusted guardrail will be the length, to the nearest yard, of existing guardrail adjusted according to these specifications. Measurement will be by one of the following methods:

- Count Method - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a "standard section" is defined 12 1/2 feet of complete guardrail, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post, to the nearest foot, and added to the total calculated length of the standard sections for each run.

- Length Method - Measurement will be from center to center of end posts, or as otherwise shown, along the line and grade of each run of each type to the nearest yard.
Payment

| 00812.90 | Payment | The accepted quantities of adjusted guardrail will be paid for at the Contract unit price per foot for the following item "Adjusting Guardrail". |

Payment will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work as specified.
Section 00815 - Bollards

Description

00815.00 Scope - This work consists of installing bollards at locations shown or as directed.

Materials

00815.10 Materials - Furnish materials meeting the following requirements:
- Commercial Grade Concrete .................................................. 00440
- Granular Drain Backfill ....................................................... 00430.11
- Reflective Sheeting (Type III and Type IV) ......................... from CPL

00815.11 Posts and Sleeves - Use Schedule 40 posts and sleeves conforming to ASTM A 53.

00815.12 Plates, Shapes, Fasteners and Hardware - Use plates and shapes conforming to ASTM A 36. Use fasteners and hardware conforming to ASTM A449.

00815.13 Galvanizing - Hot-dip galvanize all metal components after fabrication according to AASHTO M 111 (ASTM A 123) or AASHTO M 282 (ASTM A 153), as applicable.

00815.14 PVC Pipe - Use Schedule 40 PVC pipe.

Construction

00815.40 Bollards - Install bollards as shown or as directed.

Measurement

00815.80 Measurement - The quantities of bollards will be measured on a unit basis.

Payment

00815.90 Payment - The accepted quantities of bollards will be paid for at the Contract unit price per unit of measurement for the following item(s):
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Bollards</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Removable Bollards</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation work.
Section 00820 - Concrete Barrier

Description

00820.00 Scope - This work consists of constructing precast fixed form cast-in-place portland cement concrete barrier, to the lines and grades shown or established.

Materials

00820.10 Materials - Furnish materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Commercial Grade Concrete</th>
<th>00440, except as provided in this Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete coating</td>
<td>02210</td>
</tr>
<tr>
<td>Deformed bar reinforcement</td>
<td>02510.10</td>
</tr>
<tr>
<td>Portland cement grout</td>
<td>02080.40</td>
</tr>
<tr>
<td>Preformed joint filler</td>
<td>02440.10</td>
</tr>
</tbody>
</table>

00820.11 Other Materials:

(a) Concrete - Concrete shall meet the requirements of Section 00440, except that aggregates shall be modified as follows:

(1) Fine Aggregate - Fine aggregate shall meet the test requirements of 02690.30(d) and (e). Test results shall be no more than 1 year old.

(2) Coarse Aggregate - Coarse aggregate shall meet the test requirements of 02690.20(c) and (d). Test results shall be no more than 1 year old.

(b) Hardware - Pins, bolts, and dowels shall conform to ASTM A 449 and shall be hot-dip galvanized according to AASHTO M 232 (ASTM A 153).

(c) Loop Bars - Fabricate loop bars from ASTM A 36, hot-rolled round bar and hot-dip galvanize according to AASHTO M 232 (ASTM A 153) and ASTM A 143.

(d) C-shape Connectors - Furnish perforated C-shape connectors fabricated from ASTM A 36 channel, hot-dip galvanized after fabrication according to AASHTO M 232 (ASTM A153) and ASTM A143.

(e) Identification - Permanently cast into the top surface or into the side lower vertical face of each precast concrete barrier piece an identifying code consisting of the initials of the barrier manufacturer, the date of casting and the form number. Barrier pieces without identifying code will not be accepted.
00820.12 Re-use of Concrete Barriers - Used precast concrete barriers may be placed in permanent installations according to the following:

(a) New Barrier Used for Temporary Application - New precast concrete barriers used in temporary applications on the Project may be reused in permanent installations, provided they:

- Are in good condition, without visible cracks, chips or spalls
- Present a surface of uniform texture and appearance
- Are free of markings, except as required by 00820.11(e)
- Are given two coats of a water-based coating material meeting the requirements of 02210.30(c) after installation in final position

(b) Barrier Used on Previous Projects - Precast concrete barriers used on previous projects may be reused in permanent installations, provided they meet all the requirements of this Section and, prior to delivery to the Project Site:

- The Contractor furnishes documentation required by 00165.10(b).
- Barriers are restored to like-new condition, without visible cracks, chips, spalls or corroded loops.
- Barriers present a surface of uniform texture and appearance.
- Barriers are free of markings, except as required by 00820.11(e).

Apply 2 coats of a water-based coating material meeting the requirements of 02210.30(c) after installation in final position.

(c) Repair of Damage - If any concrete barrier segment is damaged by the Contractor during or after installation, immediately repair it to the Engineer's satisfaction or replace it with an undamaged section, at no additional cost to the City.

00820.15 Quality Control - Provide quality control according to Section 00165.

Labor

00820.30 Quality Control Personnel - Provide a certified Quality Control Technician (QCT).

Construction

00820.40 General - Construct cast-in-place barrier using fixed forms unless specifically directed otherwise. Use the same barrier design in any continuous run of barrier.
00820.41 Line and Grade - Place precast barrier sections on the pavement surface. New pavement surfaces placed as a part of this Project shall meet the appropriate smoothness requirement prior to placing the barrier. If corrective work is required for existing surfaces to receive concrete barrier, it will be paid for separately as Extra Work.

Place the barrier sections so that the joints offset no more than 1/4 inch transversely and no more than 1/2 inch vertically.

Construct the top and face of finished barriers true and straight. The top surface of the barriers shall be uniform width and free from humps, sags, or other irregularities. When a 12 foot straightedge is laid on the top or face of the barrier, the surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade breaks or curves. To compensate for variations in the roadway grade and cross slope, adjust the height of the barrier at no additional cost to the City.

00820.42 Concrete Construction - Construct concrete barrier according to Section 00440 except as provided in this Section.

00820.43 Curing - Cure barriers as follows:

(a) Cast-In-Place Barriers - Cure cast-in-place concrete surfaces by one of the following methods:

(1) Water Cure - Cover with burlap, canvas or other satisfactory material and keep moist for at least 7 calendar days.

(2) Latex Paint Cure - If approved, barrier may be cured with latex paint, using the following procedures:

- Allow free moisture to flash off, but only until the concrete surface does not glinten, and never for more than one hour.
- Apply latex paint from the CPL as follows:
  - Apply first coat at an application rate of 150 square feet per gallon.
  - Apply first coat to air dry for one hour.
  - Apply second coat of latex paint at same rate as above, with application direction transverse to the direction that the first coat was applied.

Barriers cured in this manner will be considered to have met the surface finishing requirements of 00820.45 except that additional coats may be necessary to provide uniform coverage and appearance to correct construction damage.
00820.44

(b) Precast Barriers - Cure precast concrete surfaces by one of the following methods:

(1) Water Cure - Water cure concrete surfaces by covering with burlap, canvas or other satisfactory material and keep moist for at least 7 calendar days.

(2) Steam Cure - Steam curing can be substituted for water curing if done under a suitable enclosure constructed to contain live steam and to minimize moisture and heat loss. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of cement. Do not apply the steam directly to the concrete.

Equip the steam supply line to the enclosure with a motor-operated, modulating steam control valve operated by a temperature-sensing element that measures the temperature within the enclosure. Distribute the steam within the enclosure through suitable ports located on each side of the enclosure at not more than 30 foot centers, or closer if necessary, to keep the units being cured completely and uniformly surrounded with live steam.

Equip the enclosure with a 24-hour recording thermometer, and record the temperature on a single chart for each 24-hour period.

Apply the steam after the initial set of the concrete as determined by ASTM C 403. Continue steam curing until the barrier concrete reaches a minimum compressive strength of 2,000 psi as determined by Contractor test cylinders or as approved.

00820.44 Joints for Cast-in-Place Concrete Barriers:

(a) Construction Joints - Make construction joints at an expansion or contraction joint location. If the placement of the barrier is stopped at a normal contraction joint location, construct an expansion joint at that location, before proceeding with the placement of the barrier, as shown.

(b) Contraction Joints - Score or saw contraction joints before initial set to the depth and width shown.

(c) Expansion Joints - Fill expansion joints with a preformed joint filler. Place the filler in correct position on one side of the joint before placing concrete on the other side.

00820.45 Surface Finishing - After stripping forms and while the concrete is still green, remove all fins and form marks, and repair all rock pockets and holes having a surface opening over 3/8 inch in diameter with portland cement grout conforming to 02080.40. Prevent grout from drying prematurely. Additional finishing after precast concrete barrier is set in its permanent position may be required to present a surface of uniform texture and appearance.
Coat the top and sides of all permanent barriers with a minimum of 2 coats of a water-based coating material conforming to 02210.30(c). Use additional coats as necessary to provide uniform coverage and appearance. Clean and thoroughly saturate with water the surfaces to be coated. Coat while damp. The second coat may be applied when the previous coat does not adhere to the fingers when touched lightly.

00820.47 Replacement or Price Reduction - Remove and replace barrier represented by cylinders that fail to meet the minimum strength requirement, at no additional cost to the City. If the Engineer determines the low-strength barrier is suitable for the purpose intended, the barrier may be accepted according to 00150.80.

00820.48 Inspection - Fabrication of barrier outside of the State of Oregon creates additional inspection expense to the City. The Contractor's payment for barrier will be reduced according to 00165.91.

Measurement

00820.80 Measurement - The quantities of concrete barrier will be measured on the length basis according to the following:

- Cast-In-Place Barriers - Cast-in-place barrier will be measured along the line and grade of each separate run, including terminal sections and transition sections.
- Precast Barriers - Precast barrier will be the laying length of a standard section, as shown on the applicable standard drawing, multiplied by the number of standard sections installed in each separate run. Non-standard sections, terminal sections and transition sections will be measured separately and added to the total length of standard sections.

Payment

00820.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement for the following items:

- **Concrete Barrier**............................................................... Foot
- **Concrete Barrier, Tall**....................................................... Foot

Payment will be payment in full for furnishing and placing all material, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate payment will be made for excavating and backfilling concrete barrier buried ends.
Section 00822 - Glare Shields

Description

**Scope** - This work consists of furnishing and installing glare shields on concrete median barrier.

Materials

**Materials** - The Contractor has the option of providing modular glare shields or individual glare shields as specified below:

- Furnish glare shields from the CPL.
- Furnish steel base plate brackets fabricated from ASTM A 304 stainless steel or merchant quality mild carbon steel. Mild carbon steel brackets shall be hot-dip galvanized after fabrication according to AASHTO M 111 (ASTM A 123).
- Furnish bolts, nuts, inserts, washers and other necessary assembly hardware made from ASTM A 304 stainless steel or mild carbon steel. Equip exposed hardware with vandal-resistant lock nuts or similar. Furnish mechanical inserts, if used, suitable for dynamic application. Galvanize carbon steel assembly hardware in accordance with AASHTO M 111 (ASTM A 123).

All base plate brackets and necessary assembly hardware installed in a continuous run shall be of the same material.

Construction

**Construction** - Install the glare shields according to the following:

- Recess inserts at least 1/4 inch below the concrete barrier surface.
- Install all glare shield blades vertical and true to line.
- Place glare shields according to the manufacturer’s recommendation.
- Install so that the angle of light coming through from the other side does not exceed 22°.
- Firmly attach the base plate anchor bolts to the concrete barrier to withstand a 1,000 pounds vertical pull and to prevent horizontal and rotational displacement. Do not exceed 30 inches spacing between anchor bolts on modular units.
- Modular or single element glare shields that are installed in a continuous run shall be of the same manufacture and of like appearance throughout the entire installation.

Measurement

**Measurement** - The quantities of glare shields will be measured on the length basis, along the line and grade of each run.
Payment

00822.90  Payment - The accepted quantities of glare shields will be paid for at the Contract unit price, per foot, for the item "___ inch Glare Shields."

The length of the blades will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Section 00830 - Impact Attenuators

Description

00830.00 Scope - This work consists of furnishing and installing impact attenuators for permanent installations.

00830.02 Required Submittals - If placement or method of installation of impact attenuators is different than the manufacturer’s recommendations, submit stamped shop drawings, including concrete components, according to 00150.35.

Materials

00830.10 Materials - Furnish impact attenuators from the CPL and as specified.

The following types of impact attenuators are allowed:

- **Type A**: Gating device, Test Level 3, for Shoulder use only, Narrow Width, Regular Maintenance
- **Type B**: Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance
- **Type C**: Non-Gating device, Test Level 2, for Shoulder, Gore and Median uses, Narrow Width, Regular Maintenance
- **Type D**: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance
- **Type E**: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance
- **Type F**: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance
- **Type G**: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance
- **Type H**: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Low Maintenance
- **Type J**: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance
- **Type K**: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Low Maintenance
Concrete shall meet the requirements of the manufacturer, or if the manufacturer makes no recommendations, concrete shall meet the requirements of Section 00440. Reinforcement shall conform to Section 00530.

All hardware, epoxy resin, and miscellaneous shall be according to the manufacturer's recommendations.

Construction

00830.40 General - Construct and surface finish concrete according to Section 00440.

Prepare surfaces, mix, and place epoxy grout for epoxy grout pad construction according to the manufacturer's recommendations.

Assemble and install impact attenuator systems according to the manufacturer's recommendations and approved shop drawings.

Measurement

00830.80 Measurement - The quantities of Impact attenuator will be measured on the unit basis per each by actual count at each location a system is installed.

Payment

00830.90 Payment - The accepted quantities of impact attenuator will be paid for at the Contract unit price, per each, for the item "Impact Attenuator, Type______".

The type of impact attenuator will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for transitions, concrete bases, and object markers.
Section 00840 - Delineators and Milepost Marker Posts

Description

00840.00 Scope - This work consists of furnishing and installing delineators and milepost marker posts at locations shown or established.

Materials

00840.10 Materials - Furnish materials meeting the following requirements:

| Barrier Markers .................................................................................................................. From CPL |
| Flexible delineators ............................................................................................................. From CPL |
| Galvanized support posts ....................................................................................................... From CPL |
| Delineator Reflective Sheeting (Type III and Type IV) ......................................................... From CPL |

00840.11 Target Members:

(a) General - The target members shall be of aluminum alloy conforming to the requirements of ASTM B 209, "3xxx" or "5xxx" series with "Hxx" approximately half-hard temper, suitable for enameling by continuous roller or other acceptable method. The aluminum sheet from which targets are fabricated shall have a nominal thickness of 0.050 inch, subject to standard manufacturer's tolerances. Provide well finished targets, free of burrs, irregularities and turned edges. When resting on a plane surface, the targets shall not show warp, twist or variation from the surface in excess of 1/4 inch.

(b) Surface Preparation and Enameling - Clean and prepare each surface of each target member for enameling according to one of the following procedures:

(1) Cleaning - Type A Solvent Cleaning or Type B, Method 1 Alkaline Cleaner Chemical Treatment, ASTM D 1730, with water rinsing. During rinsing, as evidence of proper cleaning, the cleaned surface shall retain a continuous film of water.

(2) Chemical Treating - Type B, or Methods 5, 6, or 7 chemical conversion coating, or Method 8 Acid-Bound Resinous Treatment, ASTM D 1730.

(3) Anodic Treating - Type C, Method 1 Sulfuric Acid Anodic or Method 2 Chromium Trioxide Anodic, ASTM D 1730.

(4) Enameling - Give each surface of each target member that has been cleaned and treated as specified above, and is ready for enameling either:

- 2 coats of enamel of the kind given in (c) below, each coat being properly baked and with the final coat baked to hard finish, or
A first coat of an inhibitive and compatible primer having a dry film thickness of about 0.3 mil, followed with 1 heavy coat of specified enamel baked to a hard finish. The baked enamel shall be uniform in color, commercially smooth and free from flow lines, streaks, blisters or other surface imperfections.

(c) **Enamel** - Enamel for the surface finish of the prepared aluminum target members shall be Class B baking enamel conforming to the requirements of Federal Specification TT-E-489, or equivalent.

The baked enamel finish is to be white or standard interstate yellow as applicable. The 3 1/2 inch x 13 3/4 inch target member may be furnished with a white finish on one side and a yellow finish on the other side, if the Contractor so elects.

(d) **Testing Baked Enamel:**

1. **Adhesion Test** - The adhesion test shall conform to ASTM D 3359, Method B. The enamel shall meet or exceed "4B" adhesion rating. One test is to be made on each face of each test specimen.

2. **Pencil Hardness Test** - The pencil hardness test shall conform to ASTM D 3363. The enamel shall have a gouge hardness rating of not less than "H". One test is to be made on each face of each test specimen.

(e) **Acceptance** - Acceptance of target members will be according to 00165.35 and the following:

1. **Pretested Stock** - A supplier may qualify an identified lot of target members for use by the City by complying with the requirements of 00840.11(a) through 00840.11(d). This lot may then be subdivided for shipment to several projects. The sublots may be accepted on the basis of certification by the supplier that the identified lot of target members had been qualified by the City’s Materials Laboratory.

2. **Target Members** - If target members are not from a qualified lot, furnish target members for testing as follows:

   - For acceptance testing, a lot shall consist of target members of the same color from a single production run.
   - Test specimens will be sampled at random by the Engineer as follows:
Lot Size | Number of Target Test Specimens
---|---
Up to 1,000 | 1 per 100 or fraction of 100
1,000 to 10,000 | 1 per 500 or fraction of 500
More than 10,000 plus | 1 per 1,000 or fraction of 1,000

- Allow the Engineer to sample the target members for test specimens, at no additional cost to the City for the specimens.
- If a test specimen fails any test, the lot will be resampled for the same number of test specimens and retested. If a specimen of the second sample fails any test, the lot will be rejected.
- Accompany each shipment of target members with a quality compliance certificate, as described in 00165.35, verifying that the materials furnished are represented by a lot that has been sampled and tested by ODOT and met the Contract requirements. The certification shall include the ODOT inspection report number.

**Construction**

00840.40 **Lines, Grades and Preparation Work:**

(a) **Delineator Posts** - Install delineator posts to the lines, grades and spacings shown and as established. To avoid difficult installation at any individual post site, the spacing may be varied 5% in either direction and may deviate from line by 6 inches in either direction. Remove vegetative growth, litter and debris from the post sites.

(b) **Milepost Marker Posts** - Locate and install milepost marker posts as shown.

00840.41 **Installation of Posts** - Set posts firmly into the ground and vertical. Remove and discard posts that become split, cracked, twisted, or bent, or whose tops become badly misshapen during installation.

(a) **Embedment Depth** - Field verify post length. Posts set in sandy, gravelly or other unconsolidated material may require an anchor system or need to be longer to provide adequate anchorage. Posts may be shortened to avoid unnecessary penetration in solid rock or in large rock fragments. If set in rock, drill a 9 inch deep hole, 1 inch greater in diameter than the large dimension of the post, and grout in place with a fine mortar grout.

(b) **Guardrail Locations** - At wood guardrail post installations, attach Type 4 delineators (alternate 1, plastic or alternate 2, steel) to the wood guardrail posts as shown on the standard drawings. At metal guardrail post installations, install full length Type 1, 1U, or 2 ground mounted delineators behind the rail, adjacent to metal guardrail posts.
(c) Concrete Barrier Locations - At concrete barrier installations, attach Type 5 delineators to the concrete barrier according to the manufacturer's recommendations and as shown on the standard drawings.

00840.42 Target Members for Delineator Posts- Assemble, fasten, set and align target members and reflective material appropriate to the type and color of delineators as shown. Attach reflective sheeting to the targets as recommended by the manufacturer.

00840.43 Signs For Milepost Marker Posts - Assemble, fasten, set, and align signs as shown.

Finishing and Clean Up

00840.70 General - Remove and dispose of excess excavated materials, litter, and debris resulting from the operations according to 00290.20. Finish the surface around the support to match the surrounding surface or as shown.

Measurement

00840.80 Measurement - The quantities of milepost marker posts will be measured on the unit basis.

Payment

00840.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Delineators, Type ___</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Milepost Marker Posts</td>
<td>Each</td>
</tr>
</tbody>
</table>

In item (a) the type of delineator will be inserted in the blank regardless of the color or number of reflectors and targets.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for preparation work, earthwork, grouting, backfilling and cleaning up.

Milepost marker signs will be paid for according to 00940.90.
Section 00850 - Common Provisions for Pavement Markings

Description

00850.00 Scope - This work consists of furnishing, preparing, and installing all forms of pavement markings.

Materials

00850.10 Materials - Furnish the following materials from the CPL:

- Adhesive for Pavement Markers
- High Performance Pavement Markings
- Pavement Markers
- Reflective Elements*
- Marking Paint
- Marking Tape
- Thermoplastic

*Reflective elements used with materials other than marking paint are not required to be from the CPL. Use reflective elements according to manufacturer's recommendations.

Equipment

00850.20 Equipment - Use equipment acceptable by the marking material manufacturer for the method specified and the following:

(a) Equipment for Pavement Legends and Bars - Use manual or automatic application equipment.

(b) Equipment for Longitudinal Lines - Use applicators, sprayers or extruders made specifically for applying the specified pavement marking material at a uniform width and thickness on the roadway surface.

Except for tape applications, use automatic bead applicators that place a uniform layer of beads on the line.

Provide equipment that can:

- Place 2 parallel lines simultaneously with 4 inch minimum to 12 inch maximum spacings between the 2 lines.
- Place the entire width of a line in one pass.
- Use a three-gun system for applying sprayed markings.
(c) **Equipment for Inlaid/Grooved Markings** - For thermoplastic and methyl methacrylate inlaid markings on dense graded asphalt concrete pavement, provide grinders with either diamond cutting heads that create smooth flat-bottomed cuts of uniform depth or carbide cutting heads that create smooth uniform depths and uniform patterned striations as the Contractor elects. For all other operations provide grinders with diamond cutting heads that create smooth, flat-bottomed cuts of uniform depth or sloped cuts as shown.

**Labor**

00850.30 **Manufacturer’s Representative** - For Sections referencing 00850.30, provide the services of a manufacturer’s representative on site during installation, authorized to sign a warranty on behalf of the manufacturer.

00850.31 **Manufacturer-Certified Installers** - For Sections referencing 00850.31, provide installers certified by the marking materials manufacturer for the specified marking material and method. Do not begin installation prior to receiving the Engineer's approval.

**Construction**

00850.40 **Projects Without Striping Plans** - For projects without striping Plan Sheets, replace striping to match existing pavement markings in kind. Document existing striping by survey. Submit survey documentation to the Engineer 7 calendar days prior to loss of existing pavement markings.

00850.41 **Projects With Striping Plans** - For projects with striping Plan Sheet, install striping as shown.

00850.42 **Pre-Striping Conference** - Meet with the Engineer and striping subcontractor, if striping is done by a subcontractor, 2 weeks prior to beginning striping work to discuss methods and practices of accomplishing all required striping work. Submit the following in writing 5 calendar days before the pre- striping conference for approval:

- A striping schedule showing areas and timing of work, and placing of material.
- A list of materials proposed for use and the application method.
- A copy of the manufacturer’s installation instructions and Material Safety Data Sheets (MSDS).
- Proof of installer’s certification for those Sections referencing 00850.31.
- Equipment specifications.
- A spill recovery plan including:
  - Name, address, and phone number of the Contractor’s contact with the DEQ.
  - Name, address, and phone number of the persons certified and on-call to do clean-up.
Prepare and Prime Pavement - Prepare pavement surfaces according to the following:

- **Existing Pavement Surfaces** - When required by the pavement marking manufacturer, remove pavement markings from existing pavement surfaces that will adversely affect the bond of new pavement marking material to the roadway surface according to Section 00851. Remove all other contaminants from existing pavement surfaces that may adversely affect the installation of new pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the pavement with a high-pressure system to remove extraneous or loose material.

- **New Asphalt Concrete Surfaces** - Remove contaminants from new AC surfaces that may adversely affect the installation of the pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to new asphalt concrete that is sufficiently cured according to the manufacturer's recommendations.

- **New Portland Cement Concrete Surfaces** - Remove curing compounds and laitance by an approved mechanical means. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to concrete that has reached a minimum compressive strength of 3,000 psi and that is sufficiently cured according to the manufacturer's recommendations.

After the pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

Striping Layout - Striping layout shall be the responsibility of the City. The Contractor provides support, which includes but is not limited to TCM, personnel, equipment and material. Do not proceed with installation until the layouts are approved by the Engineer.

Installation - Apply pavement marking materials to clean dry pavement surfaces and according the following:

- Place material according to the manufacturer’s recommendations.
- Place parallel double lines in one pass.
- Place the specified width of lines in one pass.
- The pavement surface shall not be visible in the striped areas.
- The top of pavement marking shall be smooth and uniform.
- Skip line ends shall be square and clean.
- Place pavement marking lines parallel and true to line.
- Place skip lines so that they are in cycle with at least one end of any adjacent project.
• Place markings in proper alignment with existing markings.
• Immediately clean up marking material dribbled beyond the cutoff.

For inlaid/grooved markings, grind the slot as shown. For each grinder operator and piece of equipment, obtain the Engineer’s and manufacturer representative’s approval of the slot within the first 150 feet for solid lines and within the first 300 feet for skip lines. Do not proceed with grinding until the slot is approved. Repeat this process for each new grinder operator or new piece of equipment used.

After grinding, obtain the Engineer’s and manufacturer representative’s approval before placing marking material. Clean the area with high pressure air immediately before placing the marking material.

00850.46 Placement Tolerance - Allowable tolerances for installation are:

- **Lateral location on roadway**: 1/2 inch on tangents; 1 inch on curves
- **40 foot skip cycle length**: ± 2 inches for skip length, ± 2 inches for gap length
- **24 foot skip cycle length**: ± 2 inches for skip length, ± 2 inches for gap length
- **12 foot skip cycle length**: ± 3/4 inch for skip length, ± 1 inches for gap length
- **8 foot skip cycle length**: ± 1/2 inch for skip length, ± 3/4 inches for gap length
- **Skip Cycle**: A tolerance of 1/10 of the skip line length on the first skip line of a run, but it shall be on cycle within one skip
- **Double lines**: Parallel, with a gap tolerance of ± 1/2 inch
- **Width of lines**: ± 3/8 inch, - 1/16 inch
- **Thickness of flat, surface applied lines**: ± 1/3 of the specified thickness, - 1/10 of the specified thickness
- **Divergence of parallel double lines**: ± 3/8 inch

00850.47 Quality Control - Record the following readings for each type and color of marking material and the locations where they were taken. Submit the results to the City within one day of taking the readings.

(a) Placement Tolerances - Measure the following at the time of installation or application:
• For inlaid/grooved markings, measure the depth of the slot every 300 feet.
• For surface applied markings, except paint and tape applications, measure the thickness of the lines, at 300 foot intervals. Thickness is measured from the top of the pavement marking to the top of the wearing surface. Marking material placed in a depression left by pavement line removal will not be included in measuring the thickness of the line.

(b) Curing of Material - Rate the line, markings, and pavement marker adhesive at the time of installation to determine if the material has properly cured. Note any soft spots, abnormally darkened areas, or other indications that the line has not properly cured.

(c) Retroreflectivity - Use a 100 FPPT geometry retroreflectometer to measure the retroreflectivity within 48 hours of curing, except for paint applications:

• At 300 foot intervals for longitudinal lines.
• At each pavement legend/bar. Take 10 individual readings per pavement legend/bar. If the Project has more than 10 pavement legend/bars, measure a minimum of 10 legends/bars or 10% of the total number of legends/bars, whichever is greater. The legends to be measured will be selected by the Engineer.
• Estimate the bead embedment depth for longitudinal lines and pavement legends/bars at the same location as the retroreflectivity reading.

Temporary

00850.50 General - Protect all applied markings from traffic until sufficiently cured so as not to be damaged or tracked by traffic movements.

Finishing and Clean-up

00850.70 Disposal of Waste - Waste material becomes the property of the Contractor at the point of origin. This includes grindings and all removed marking material. Dispose of waste according to 00290.20.

00850.75 Manufacturer's Warranty - For Sections referencing 00850.75, furnish a Warranty from the manufacture signed by the Manufacture's Representative

The Warranty period will start on the date the Engineer accepts the work and authorizes final payment.

The Warranty shall recite that the manufacturer is required to repair or replace, at the discretion of the Engineer and at no additional cost to the City, all markings that fail to bond, drop below the required minimum retroreflectivity, or show insufficient color stability, within 6 months of the City's request to do so.

City of Portland 2010 860
Perform Warranty repair work when weather permits. At the discretion of the City, temporary pavement markings may be required, at the Contractor’s expense, to protect traffic until repairs can be made.

When the City makes written request to the manufacturer for repair or replacement, the Warranty period will stop until the requested repair(s) or replacement(s) are made and accepted.
Section 00851 - Pavement Marking Removal

Description

00851.00 Scope - This work consists of removing markings from the pavement surface.

Construction

00851.40 General - Remove non-durable pavement markings by hydroblasting, steel shot blasting, or grinding so that the pavement surface is not damaged below a depth or 1/8 inch. Remove durable marking by steel shot blasting or grinding the pavement surface to a depth no greater than 1/8 inch, creating a smooth, flat slot of uniform depth.

Remove pavement markings the same day permanent markings are applied. Use vacuum shrouded equipment or other equally effective containment procedures. Dispose of all waste materials according to 00290.20.

Measurement

00851.80 Measurement - The quantities of pavement line removed will be measured on the length basis, to the nearest foot. Pavement line removed will be based on a nominal width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis.

The quantities of pavement bars removed will be measured in the area basis, to the nearest square foot, for each stop bar and crosswalk bar removed.

The quantities of pavement legends removed will be measured on the unit basis, by actual count. One legend is considered to include all letters, characters, and all markings associated with the particular pavement legend.

Payment

00851.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Line Removal</td>
<td>Foot</td>
</tr>
<tr>
<td>Pavement Bar Removal</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Pavement Legend Removal</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for removing existing pavement markings when directed by the pavement marking manufacturer, for the preparation of applying new pavement markings.

City of Portland 2010 862
Section 00855 - Pavement Markers

Description

00855.00 Scope - In addition to the requirements of Section 00850, install reflective and non-reflective pavement markers according to the following Specifications.

Construction

00855.40 Pavement Markers:

(a) General - Install reflective (Type I) and nonreflective (Type II) markers as shown.

(b) Surface Preparation - Remove contaminants from the wearing course surface which would adversely affect the bond of the adhesive.

Sandblast or steel shot blast the pavement surface to remove all surface contaminants. Use a blast of clean air to remove all loose particles from the surface.

(c) Installation - Apply pavement markers to a clean, dry surface.

Do not install markers spanning a pavement joint or crack. To avoid longitudinal cracks and joints, adjust pavement markers up to one half the width of the marker. To avoid transverse cracks and joints, adjust pavement markers ahead or back of line plus or minus 5 inches.

Place the adhesive uniformly on the prepared pavement surface or on the bottom of the marker in a quantity sufficient to result in a complete coverage of the area of contact of the marker with no voids present and a slight excess of material after the marker has been pressed in place.

Place the marker in position and apply pressure until firm contact is made with the pavement. Visually inspect the installation to ensure that a small bead approximately 1/8 inch thick forms around all edges and corners and the marker is fully supported on a pad of adhesive. Immediately remove excessive adhesive on the pavement, and adhesive on the exposed surfaces of the markers.

Completely remove adhesive from the surfaces of pavement markers using an approved adhesive remover.

00855.41 Recessed Pavement Markers:

(a) Surface Preparation - Construct grooves in the pavement to neat lines conforming to width, length and depth shown, and prepare the surface according to 00855.40(b).

(b) Installation - Install the pavement markers in the groove as shown and according to 00855.40(c).
### Measurement

**00855.80 Measurement** - The quantities of pavement markers and recessed pavement markers will be measured on the unit basis, for each type of marker.

### Payment

**00855.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the **Contract unit price**, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Mono-Directional White Type I Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Mono-Directional White Type IAR Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Bi-Directional Yellow Type I Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Bi-Directional Yellow Type IAR Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(e) White Type II Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Yellow Type II Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Mono-Directional White Type IAR Markers, Recessed</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Bi-Directional Yellow Type IAR Markers, Recessed</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for constructing pavement grooves, pavement preparation, adhesive, and clean-up.
Section 00856 - Surface Mounted Tubular Markers

Description

00856.00 Scope - This work consists of furnishing and installing permanent surface mounted tubular markers as shown or directed.

Materials

00856.10 Materials - Furnish surface mounted tubular markers from the CPL.

Construction

00856.40 General - Install surface mounted tubular markers straight and true to line at the spacings shown. In addition to bolting the base of the surface mounted tubular marker to the surface, bond the surface mounted tubular marker to the surface using an adhesive recommended by the manufacturer according to the manufacturer's recommendations.

Measurement

00856.80 Measurement - The quantities of permanent surface mounted tubular markers will be measured on the unit basis.

Payment

00856.90 Payment - The accepted quantities of permanent surface mounted tubular markers will be paid for at the Contract unit price, per each, for the item "Permanent Surface Mounted Tubular Markers".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00860 - Longitudinal Pavement Markings - Paint

Description

00860.00 Scope - In addition to the requirements of Section 00850, install painted longitudinal pavement markings according to the following Specifications.

Construction

00860.45 Installation - Apply painted longitudinal pavement markings as follows:

- Apply two separate applications of painted longitudinal pavement markings. Retrace the second application directly over the first application, within 1/16 inch as follows:
  - Apply the second application after 2 hours but within 48 hours of the first application.
  - For yellow colored markings that delineate two-way traffic, apply the second application in the opposite direction of the first application. For yellow colored markings on one-way roadways, apply the second application in the same direction of the first application. For white colored markings, apply the second application in the same direction of the first application.
- Apply each painted marking application at a thickness of 15 mils wet, equivalent to 17 gallons per mile for a 4 inch wide solid stripe.
- Apply reflective elements for each application at a minimum rate of 5 pounds per gallon of paint. Embed, by means of paint wicking, a minimum of 80% of the reflective elements in the paint to a minimum depth of 50% of their diameter.

Minimum initial retroreflectivity shall be the following:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Measurement

00860.80 Measurement - The quantities of painted longitudinal pavement markings will be measured on the length basis, to the nearest foot. Painted longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.
Payment

Payment - The accepted quantities of painted longitudinal pavement markings will be paid for at the Contract unit price, per foot, for the item "Longitudinal Pavement Markings - Paint".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00865 - Longitudinal Pavement Markings - Durable

Description

00865.00 Scope - In addition to the requirements of Section 00850, install durable longitudinal pavement markings according to the following Specifications.

Labor

00865.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

00865.31 Manufacturer-Certified Installers - Provide certified installer’s according to 00850.31.

Construction

00865.40 General - Before installing, and in the presence if the Engineer, conduct a performance test by applying a 150 foot test section on roofing felt. Do not place permanent material without the Engineer's approval of the performance test. Additional performance tests may be required. Conduct performance tests at no additional cost to the City.

00865.45 Installation - Place permanent markings only when the manufacture’s representative determines that the pavement is ready for the pavement marking material.

Apply reflective elements at a rate to obtain the following minimum initial reflectivity readings:

- White - 250 mcd/m2/lx
- Yellow - 200 mcd/m2/lx

Apply marking materials by one or more of the following methods:

- **Method A: Profiled Markings** - Place lines and bumps straight and square.
- **Method B: Non-Profiled Markings** - Apply with extrusion or ribbon type process. Sprayer applications will not be allowed.

00865.75 Manufacturer’s Warranty - Furnish a Warranty according to 00850.75 and the following:

- **Warranty Period** - The Warranty period shall be 3 years for surface mounted thermoplastic, and 4 years all other methods and materials in this Section.
- **Retroreflectivity** - Markings shall maintain a minimum retroreflectivity of 150 mcd/m2/lx for white and 125 mcd/m2/lx for yellow.
- **Color Stability** - Use Federal Color Chart PR-1 to determine color stability. Yellow markings shall meet 33538 Federal yellow. White markings shall have a minimum daylight reflectance of 84.

- **Adhesion** - A cumulative 5% or greater loss of line due to non-adhesion on any 300 foot segment of marking will constitute failure of the material in that segment.

### Measurement

00865.80  **Measurement** - The quantity of durable longitudinal pavement markings will be measured on the length basis, to the nearest foot. Durable longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

### Payment

00865.90  **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method A (Profile)</td>
<td></td>
</tr>
<tr>
<td>(a) Thermoplastic, Profile, 120 mils, Extruded</td>
<td>Foot</td>
</tr>
<tr>
<td>Method B (Non-Profile)</td>
<td></td>
</tr>
<tr>
<td>(b) Thermoplastic, Non-Profile, 120 mils, Extruded</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for work done under this Section will be limited to 75% of the amount due until the City has received the signed warranty.
Section 00867 - Transverse Pavement Markings - Legends and Bars

Description

00867.00 Scope - In addition to the requirements of Section 00850, install pavement markings for legends and bars according to the following Specifications.

Labor

00867.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

Construction

00867.40 General - Install staggered continental crosswalks and bike lane stencils, as shown, using Type B-HS or Type C-HS marking material only.

00867.45 Installation - Place permanent markings only when the manufacture’s representative determines that the pavement is ready for the pavement marking material. Transverse joints will be allowed with no overlap or gap allowed at the joint. Minimum initial retroreflectivity shall be 250 mcd/m2/lx.

Apply one or more of the following marking material types:

- **Type A: Liquid, Hot-Laid Thermoplastic Material** - For pavement bars, apply the thermoplastic material to the pavement by a spray or extrusion method, to the full width shown, in a single application. For pavement legends, apply the thermoplastic material to the pavement by a spray method, to the full width shown, in a single application. Pavement markings shall be 90 mils to 120 mils in thickness, exclusive of projecting surface-applied reflective elements, with a continuous and uniform cross sectional configuration, and with the upper surface slightly arched.

  Separately apply reflective elements to the material as it is placed at a sufficient rate to obtain an initial reflectivity reading of 250 mcd/m2/lx. Locate the dispenser behind the pavement marking extrusion die and uniformly distribute the reflective elements over the entire width of the thermoplastic material.

- **Type B: Preformed, Fused Thermoplastic Film** - Install preformed, fused thermoplastic film as shown. Install Type B - HS, preformed fused thermoplastic film high skid, that has intermixed reflective elements with factory installed crushed glass or aggregate on the surface.
• **Type C: Cold-Applied Plastic Film (Tape)** - On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

Apply Type C - HS, cold applied plastic film that has intermixed reflective elements with factory installed crushed glass or aggregate on the surface. On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

00867.75 **Manufacturer's Warranty** - Furnish a warranty according to the following:

- **Warranty Period** - The warranty shall be for 18 months.
- **Retroreflectivity** - Markings shall maintain a retroreflectivity of 100 mcd/m2/lx.
- **Color Stability** - White markings shall have a minimum daylight reflectance of 84.
- **Adhesion** - 5% or greater loss of marking due to non-adhesion will constitute failure.

00867.80 **Measurement** - The quantities of pavement legends will be measured on the unit basis, by actual count. The quantities of pavement bars will be measured on the area basis, to the nearest square foot, for each pavement legend, stop bar, and crosswalk bar.

00867.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pavement Legend, Type ____ : Arrows</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Pavement Legend, Type ____ : &quot;ONLY&quot;</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Pavement Legend, Type ____ : &quot;SCHOOL&quot;</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Pavement Legend, Type ____ : &quot;SCHOOL CROSSING&quot;</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Pavement Legend, Type ____ : &quot;SCHOOL XING&quot;</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Pavement Legend, Type ____ : Railroad Crossing Markings</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Pavement Legend, Type ____ : Bicycle Lane Symbols</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Pavement Legend, Type ____ : Diamonds</td>
<td>Each</td>
</tr>
<tr>
<td>(i) Pavement Legend, Type ____ : ____________</td>
<td>Each or Square Foot</td>
</tr>
<tr>
<td>(j) Pavement Bar, Type ____</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
In items (a) through (j), the type of pavement marking materials will be inserted in the first blank.

In item (i), the name of the legend will be inserted in the second blank.

Item (a) includes single or multiple headed arrows as required.

Item (f) includes a R x R Symbol and three 24 inch wide white pavement bars as shown.

Item (j) includes the pavement bars for stop bars and crosswalk bars.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for work under this Section will be limited to 75% of the amount due until the City has received the signed warranty.
Section 00905 - Removal and Reinstallation of Existing Signs

Description

00905.00 Scope - This work consists of one or both of the following:

- Removing existing signs, specific service signs and tourist-oriented directional signs (TODS) as shown or directed.
- Removing and moving existing signs, specific service signs and tourist-oriented directional signs (TODS) from their existing locations and reinstalling them at new locations as shown or directed.

Construction

00905.40 General - Do not remove signs from existing supports until new supports are in place, ready to receive the signs. Install the signs on the new supports immediately after removing from existing supports. Provide temporary supports as required. Provide permanent supports according to Sections 00920 and 00930 as required.

- Protect specific service signs (business logos) and TODS from damage, whether the signs are to remain in place or are placed on temporary supports, until reinstalled on permanent supports. Repair or replace damaged signs at no additional cost to the City.

- Install rigid, temporary vertical ties to the back of all extruded aluminum panel signs to prevent buckling of the sign panels or their legends during removal, moving and reinstallation of the signs. Repair any damage inflicted to the signs or their legends.

- Remove to 1 foot below the ground line those installations with concrete or steel footings set in the ground unless indicated otherwise. Fill the resultant hole and finish the surface to correspond with the surrounding area. Do not remove the existing appurtenances until ordered. Dispose of all existing appurtenances removed and not used in reinstallation, according to 00310.43.

Measurement

00905.80 Measurement - No measurement of quantities will be made for work performed under this Section.
Payment

- The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Remove Existing Signs</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Remove and Reinstall Existing Signs</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and Incidents necessary to complete the work as specified.
Section 00920 - Sign Support Footings

Description

00920.00 Scope - This work consists of constructing major and minor sign support footings of the dimensions and design shown and at the locations shown or directed.

Materials

00920.10 Materials - Furnish materials for constructing sign support footings meeting the following requirements:

| Anchor bolts | 02560.30 |
| Backfill (unless otherwise directed) | 00510.10 or 0510.11 |
| Commercial Grade Concrete | 00440 |
| Conduit | 02920.10 through 02920.12 |
| Reinforcement | 00530 |

00920.11 Breakaway Footings - For 2 inch diameter Schedule 40 pipe posts mounted in earth, provide 2 inch Schedule 40 pipe post break-away footings with 24 inch anchors complying with NCHRP350 testing having a "WZ" letter of approval from Federal Highway Administration.

For 2 inch diameter Schedule 40 pipe posts mounted in sidewalk, provide 2 inch Schedule 40 pipe post break-away dome bases designed to be bolted to the sidewalk complying with NCHRP350 testing and having "WZ" letter of approval from Federal Highway Administration.

Construction

00920.40 Excavation and Backfill - Excavate and backfill footings according to Section 00510.

Finish the surface of backfill to match the existing surface. Where required, reinstall curbs and pavement markings.

00920.41 Concrete - Construct concrete sign foundations according to Section 00440 and the applicable portions of 00540.48(a).

Pour concrete spread footings and concrete shaft footings against undisturbed material or backfill with selected granular backfill material according to 00510.11. Compact to 95% maximum density according to 00330.43 or as shown.

During concrete placement, accurately and securely hold in place all anchor bolts, post stubs or breakaway footings until the concrete has set.

Remove forms and place subsequent loading according to Table 00540-1 in 00540.52.
00920.42 Reinforcement - Fabricate and place steel reinforcement according to Section 00530.

00920.43 Conduit - Fabricate and install conduit according to Sections 00960, 00970 and 00990.

00920.44 Breakaway Footing Placement - Place breakaway footings so that when the pipe posts are inserted into the breakaway footing, the posts will be plumb with no more variance than a 1/4 inch in 12 feet.

Measurement

00920.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Estimated quantities of concrete for minor sign supports and estimated quantities of excavation, backfill, concrete reinforcement and miscellaneous metal for major sign supports will be listed in the Special Provisions. Miscellaneous metal includes anchor rods and associated hardware, templates, and anchor plates.

Payment

00920.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for item "Sign Support Footings":

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Sign Support Footings</td>
<td>.................................................. Lump Sum</td>
</tr>
<tr>
<td>(b) Sign Support Footings, Breakaway</td>
<td>.................................................. Lump Sum</td>
</tr>
</tbody>
</table>

Items (a) and (b) are for breakaway footings conforming to 00920.11.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Section 00930 - Metal Sign Supports

Description

00930.00 Scope - This work consists of furnishing, fabricating, galvanizing and erecting metal sign supports.

00930.01 Definitions:

90 Degree Rotational Sign Supports - The complete structure is composed of post stubs, base plates, posts, rotator connection, sign support members, and fastenings, but does not include the sign support footings.

Adjustable Sign Mounts - The complete support is adjustable horizontally and vertically to facilitate signal pole mast arm and pole mounting of flat sign sheets. The bracket consists of cast aluminum and galvanized steel elements, stainless steel straps, and fasteners.

Bridge Structure Mount - The W-shapes or special detailed attachments used for mounting signs to bridge structures, and includes all necessary support brackets, arms, and fasteners, but does not include sign illumination equipment and maintenance walkways.

Exit Number Sign Mounts - The S-shape, spacers, special mounting brackets, and fasteners, necessary to install the exit number signs.

Major Sign Supports - This group includes Truss Sign Bridges, Monotube Sign Bridges, Butterfly Sign Structures, and Monotube Cantilever Sign Structures.

Minor Sign Supports - This group includes Multi-Post Breakaway Sign Supports, Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, Square Tube Breakaway Sign Supports, 90 Degree Rotational Sign Supports, Pipe Sign Supports, and Square Tube Sign Supports.

Multi-Post Breakaway Sign Supports - The complete structure is composed of post stubs, base plates, posts, hinges, sign support members, and fastenings, but does not include the sign support footings.

Pipe Sign Supports and Square Tube Sign Supports - The complete structure is composed of metal post, sign support members and fasteners, but does not include the sign support footings.

Secondary Sign Mounts - This group includes tubes, S-shapes, channels, plates, and fasteners necessary to install secondary signs.

Signal Pole Mounts - The complete support including horizontal and vertical arms, supporting brackets, and fasteners.
Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, Sign Supports, and Square Tube Breakaway Sign Supports - The complete structure is composed of post stub, base plates, metal post, sign support members, and fasteners, but does not include the sign support footings.

Truss Sign Bridge, Monotube Sign Bridges, Butterfly Sign Structures and Monotube Cantilever Sign Structures - The complete structure is composed of base plates, support columns, cantilever arms, trusses, horizontal beam, sign support arms, supporting brackets, and fasteners, but does not include the sign illumination equipment, maintenance walkways and sign support footings.

Vertical Sign Mounts on Existing Structures - The additional or replacement vertical members and fasteners necessary to install a new sign onto an existing major sign support.

00930.02 Working Drawings - Submit 6 copies of unstamped working drawings, according to 00150.35(m)(1) for all structural metal work. Submit 6 copies of stamped designs, details, plans, and calculations according to 00150.35 for all engineered details and drawings that are not prepared by the City but are required by the Contract Documents and Specifications for the Project prior to fabrication. Include the Field Verification of Post Lengths form for Major Sign Supports, available from the Engineer. Material ordered for work done before the Engineer finishes and returns the documents will be at the Contractor's risk.

In addition to the working drawings, submit 6 copies of all available data including manufacturer's pamphlets and brochures, technical bulletins, working drawings and other technical information relative to products used on the Project. After installation, submit corrected working drawings that represent the material as installed and in operation. Include sufficient information to enable the City's maintenance forces to replace all or part of the commercially manufactured sign structures, under routine or emergency maintenance, by direct reference to the information furnished by the Contractor.

Working drawings are not required for the following types of steel supports:

- Multi-Post Breakaway Sign Supports
- Triangular Base Breakaway Sign Supports
- Signal Pole Mounts
- Exit Number Sign Mounts
- Secondary Sign Supports
- Route Marker Frames
- Pipe Sign Supports

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Working drawings for these supports will be provided by the City's Engineer of Record. Use the Field Verification of Post Lengths form, available from the Engineer, to provide the necessary site data to the Engineer of Record for use in producing working drawings. All work done, or materials ordered, before receiving working drawings from the Engineer of Record will be at no additional cost to the City.

00930.09 Identifying Tags - Overhead and butterfly sign support structures, except structure mounts, shall have stainless steel or brass identifying tags attached to all posts, arms, and truss sections. The tags shall be at least 1/16 inch thick. Tag lettering shall be at least 1/4 inch in height, and shall be stamped into the tag. Tags shall be attached with stainless steel pop rivets of at least 3/16 inch nominal body diameter. Do not locate pop rivet holes within 6 inches of welds. Post tag shall be located approximately 5 feet above the baseplate. Holes for pop rivets shall be drilled prior to hot-dip galvanizing. Remove excess hot-dip galvanizing from holes and repair according to ASTM A780.

Tags shall include the following information:

- Structure number
- Manufacturer
- Month and year of manufacture

Materials

00930.10 Materials - Furnish structural steel materials and pipe sign posts meeting the applicable portions of Section 02530, with weights and sizes as shown or specified.

Furnish galvanized bolts, nuts, hardened washers, and direct tension indicators meeting the requirements of Section 02560, except the Rotational Capacity Test of 02560.60(a) need not be repeated at the job site for minor sign supports.

All components of steel sign structures shall be galvanized after fabrication and before assembly. Except for square tube sign supports, galvanizing shall conform to the requirements of Section 02530. Galvanize square tube sign supports according to ASTM A653 G 140.

00930.11 Commercially Manufactured Products - For Street Name Signs, use the following hardware:

- Single street name sign mounting hardware designed to be mounted on a 2 inch Schedule 40 steel pipe post with a 5.25 inch flat blade receiver designed to support a 0.125 inch thick flat sign blank.
- Double street name sign mounting hardware with 90° crosspiece 5.25 inch flat blade receivers designed to be mounted on a 0.125 inch thick sign blank and to support an additional 0.125 inch thick flat sign blank.
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**Labor**

- Single street name sign cantilever mounting hardware with high-strength 3/4-inch banding designed to be mounted on a round post or pole and to support a 0.125 inch thick by 36 inch maximum width flat sign blank.
- Single street name sign cantilever extension hardware designed to be used in conjunction with cantilever mounting hardware to support a 0.125 inch thick blank that is greater than 36 inches wide.

00930.30  Fabricators - Fabricators of metal sign supports shall have either a current AISC Simple Steel Bridge Structures (Sbr) certification or a current AISC Major Steel Bridges (Cbr) certification.

00930.40  Construction

**Fabrication and Erection** - Fabricate and erect according to the applicable portions of Section 00560, except where in conflict with the following:

(a) **General** - Erect breakaway sign posts, pipe sign posts and pipe support columns at a true vertical.

Where two or more posts are required to support a sign, orient and position both posts so that no twist or warp will be imparted to the sign panels.

(b) **Assembly of Metal** - Accurately assemble the parts as shown on the plans and follow any match marks. Handle the material carefully so that no parts will be bent, broken or otherwise damaged. Clean bearing surfaces and surfaces to be in permanent contact before the members are assembled. Roughen faying surfaces of slip-critical structural connections utilizing high strength bolts by means of hand wire brushing after galvanizing. Power wire brushing is not allowed.

(c) **Welding** - Weld steel sign structures according to AWS D1.1. The fabricator shall inspect welds according to details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 5.15 WELDING CONNECTIONS in AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Submit all testing procedures for Engineer's review prior to starting inspection. Submit certified copies of inspection reports to the Engineer for review.

If requested by the Engineer, additional weld inspection may be required upon arrival of the material at the job site. If defects are found by this additional inspection, the Contractor shall be responsible for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.
(d) **Bolt Installation** - Do not reuse galvanized high strength bolts. Other high strength bolts may be reused, if approved, but not more than once. Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts will not be considered a reuse.

Provide all high strength bolts with hardened washers under the element (nut or bolt head) turned in tightening. If a high strength bolt is installed in an oversize or short slotted hole in an outer ply, use a hardened washer. If a high strength bolt is installed in a long slotted hole in an outer ply, use a plate washer or a continuous bar made of structural grade steel at least 5/16 inch thick with standard holes. Make the washer or bar sufficiently large to completely cover the slot after installation.

Protect fasteners from dirt and moisture at the jobsite. Do not remove the lubricant that is present in as-delivered condition. Clean and relubricate fasteners that accumulate dirt according to 02560.70.

1. **Bolt Installation for Slip Bases (Breakaway)** - Furnish, at no additional cost to the City, a calibrated torque wrench of a capacity appropriate to the size of the high-strength bolts installed and tightened. Confirm the accuracy of the calibrated torque wrench through calibration by an approved testing agency at least once a year.

Remove any dirt and moisture from the lubricated fasteners, and recoat the lubricated fasteners with a fresh, second coat of lubricant immediately before tightening. Tighten the bolts, in the presence of the Engineer, to the minimum torque or tension shown to seat the bolts in the base plate slots. After all the bolts in the slip base are tightened, loosen each bolt and retighten to the prescribed torque or tension shown in the same order as the initial tightening.

2. **Bolt Installation for Slip-Critical Connections** - Tighten high strength bolts by direct tension indicator method unless noted otherwise. The calibrated torque wrench method of final tightening is not acceptable. Use of direct tension indicators is not allowed with Type 3 high-strength bolts in AASHTO M 270 Grade 50W ASTM A 709, Grade 50W, ASTM A 588 unpainted weathering steel connections.

   a. **Direct Tension Indicator Tightening** - Install new and unused direct tension indicator washers that meet the requirements of 02560.20(d) and 02560.40(b) at each bolt. Do not permit the surfaces contacting the protrusions of the direct tension indicator washers to turn during tightening. Bring each bolt to a snug tight condition, as indicated by partial compression of the direct tension indicator protrusions. Then tighten all fasteners in the connection, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening before final tightening to deform the protrusion to nil gap or as specified.
A "nil gap" is defined as the condition that exists when at least half of the spaces between the direct tension indicator protrusions refuse entry to a 0.005 inch feeler gauge, and a visible gap exists in at least one space.

b. Turn-of-Nut Tightening - During all turn-of-nut tightening, proceed systematically from the most rigid part of the connection to the free edges. Tighten all bolts until they are simultaneously snug tight and the connection is fully compacted. Snug tight is defined as the tightness that exists when all plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a worker using a 12 inch long wrench. Following this initial operation, further tighten all bolts in the connection by the amount of rotation specified in Table 00560-3 of Section 00560. During the tightening operation do not permit rotation of the part not turned by the wrench.

(e) Bolt Inspection:

(1) General - The Engineer will observe the installation and tightening of bolts to determine that the selected tightening procedure is properly used and that all bolts are tightened, and in the case of direct tension indicators that the correct indication of tension has been achieved. Bolts may reach tensions substantially above the value given in Table 00560-1 in Section 00560, but this will not be cause for rejection.

(2) Direct Tension Indicator Method - Provide the Engineer full opportunity to witness installation of bolted connections. The Engineer will periodically observe the installation and tightening operations to ensure that proper procedures are being adhered to.

Upon completion of a bolted joint, the Engineer will determine that all bolts have been tightened. A minimum of 10%, but not less than 2 bolts in each joint, will be inspected. If all gaps checked are nil or as shown, the joint will be accepted as properly tightened. If gaps checked are in excess of the above, reinspect all bolts and retighten bolts in the joint, as required, then resubmit the joint for inspection.

Apply the feeler gauge to all of the openings between protrusions around the indicator circumference. To satisfy the nil gap requirement, the feeler gauge shall be refused by at least 1/2 of the applied places.

(3) Turn-of-Nut Method - When all turn-of-nut tightening activities have been witnessed and found acceptable by the inspector, no additional bolt tightening inspection is required. If turn-of-nut tightening has been performed without being witnessed by the inspector, use the following inspection procedure:
• In the presence of the Engineer, use an inspection wrench, which may be a calibrated torque wrench.

• Place three bolts of the same grade, diameter and condition as those under inspection individually in a calibration device capable of indicating bolt tension. Use a hardened washer under the part turned in tightening each bolt.

• Tighten each bolt specified in the paragraph above in the calibration device by any convenient means to an initial condition equal to 20% of the required tension, and then to a tension not less than 5% greater than specified for its size in Table 00560-1 in Section 00560. Tightening beyond the initial condition shall not produce greater nut rotation than 1.5 times that allowed in Table 00560-3 in Section 00560. Then apply the inspecting wrench to the tightened bolt and determine the torque necessary to turn the nut or head 5°, approximately 1 inch at 12 inches radius, in the tightening direction. Take the average torque measured in the tests of three bolts as the job inspecting torque to be used in the manner specified in the next paragraph.

• Test bolts that have been tightened in the structure and are represented by the sample prescribed above with the inspecting wrench. Apply the job inspecting torque to 10% of the bolts, but not less than 2 bolts selected at random. If no nut or bolt head is turned by this application of the job inspecting torque, the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspecting torque, test all bolts in the connections. Retighten all bolts whose nut or head is turned by the job inspecting torque, and re-inspect. Retighten all of the bolts in the connection and then resubmit the connection for the specified inspection.

00930.41 Adjustable Sign Mounts - The mount shall allow vertical adjustment for positioning the sign and shall rotate to plumb the sign. Use galvanized or stainless steel nuts, bolts and washers for fasteners.

Measurement

00930.80 Measurement - No measurement of quantities will be made for metal sign

Estimated quantities of structural steel will be listed in the Special Provisions. If field-verified post lengths increase or decrease by more than 25% of the length specified, adjustments to the Contract lump sum amount will be made according 00190.10(h).

Payment

00930.90 Payment - The accepted quantities of metal sign supports will be paid for at the Contract unit price, per unit of measurement for the following items:
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Sign Supports</strong></td>
<td></td>
</tr>
<tr>
<td>(a) Truss Sign Bridge</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Monotube Sign Bridge</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Butterfly Sign Structures</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Monotube Cantilever Sign Structures</td>
<td>Lump Sum</td>
</tr>
<tr>
<td><strong>Mounts</strong></td>
<td></td>
</tr>
<tr>
<td>(e) Bridge Structure Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) Exit Number Sign Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(g) Signal Pole Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(h) Adjustable Sign Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(i) Vertical Sign Mounts on Existing Structures</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(j) Secondary Sign Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td><strong>Minor Sign Supports</strong></td>
<td></td>
</tr>
<tr>
<td>(k) Multi-Post Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(l) Triangular Base Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(m) Pipe Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(n) Square Tube Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(o) 90 Degree Rotational Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(p) Pipe Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(q) Square Tube Sign Supports</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for route marker frames, wind bracing, pole clamps, stainless steel clamps, mast arm street name sign mounts, or special sign brackets.
Section 00940 - Signs

Description

00940.00  Scope - This work consists of furnishing, fabricating and erecting traffic signs of the types shown.

00940.02  Types of Signs - Traffic signs are classified by sign type according to the descriptions in 02910.02. Use either retroreflective, reflective, or nonreflective sign sheeting as shown and according to 02910.02.

Use sign sheeting colors conforming to the Federal Highway Administration "Color Specifications for Retroreflective Sign and Pavement Marking Materials". In addition, specified color coordinates shall be subject to visual matching by the Engineer to determine that all panels in any one sign match.

00940.03  Drawings - Copies of working drawings for non-standard signs will be made available to the Contractor by the Engineer. Standard signs called for in the Contract Documents shall be constructed using drawings available in FHWA's "Standard Highway Signs" (FHWA English Version) or ODOT's "Sign Policy and Guidelines for the State Highway System". The ODOT sign policy is available for purchase from the ODOT Procurement Office, Salem.

Materials

00940.10  Materials - Furnish materials for signs meeting the requirements of Section 02910.

Construction

00940.40  General - Finished signs shall conform to the designs shown or specified.

Choose the substrate material from the following table:

<table>
<thead>
<tr>
<th>Sign Size</th>
<th>Acceptable Substrate Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4' x 5'</td>
<td>Sheet aluminum</td>
</tr>
<tr>
<td></td>
<td>Extruded aluminum panels</td>
</tr>
<tr>
<td>From 4' x 8'</td>
<td>Extruded aluminum panels</td>
</tr>
<tr>
<td>Over 4' x 8'</td>
<td>Extruded aluminum panels</td>
</tr>
<tr>
<td>Over 8' in any dimension</td>
<td>Extruded aluminum panels</td>
</tr>
</tbody>
</table>

Street name signs mounted on signal pole mast-arms may exceed the width limit of 4 feet for sheet aluminum substrate.

See Table 02910-1 in Section 2910 for sheet aluminum thicknesses for various sizes of signs.

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Fabricate all components of each individual sign with sheeting from the same supplier, to ensure that all components are compatible, and are warrantable by the manufacturer. Removable legend does not have to be fabricated with sheeting from the same supplier as the background sheeting on the sign panels.

Construct standard signs as shown in the FHWA "Standard Highway Signs" manual or in ODOT's "Sign Policy and Guidelines for the State Highway System" or in the City Standard Drawings.

**00940.41 Aluminum Panel Sign Fabrication:**

(a) **General** - Fabricate aluminum panel signs as shown or specified. Do not round corners of panels outside the border. Reinforced sheet aluminum signs will not be allowed. All aluminum used for sign panels shall be new material.

(b) **Extruded Aluminum** - Each panel of extruded aluminum panel signs shall be a continuous section. Apply the sign sheeting to the extrusion a sufficient distance around the edge to ensure that no aluminum surface is visible on the face of the sign.

(c) **Sheeting** - The sign sheeting applied to the extrusions shall be the background color of the sign.

(d) **Legend** - Signs consisting of only one extrusion may use permanent legend.

(e) **Transparent Paste** - Do not use transparent paste background on extruded aluminum signs.

**00940.42 Sheet Aluminum Sign Fabrication:**

(a) **General** - Cut the sheet aluminum sign to size and shape as shown or specified. The sign shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication.

Before application of retroreflective, reflective or nonreflective sheeting, treat the entire surface of the sign with a conversion film according to the sheeting manufacturer’s recommendations.

(b) **Mounting Holes:**

(1) **On Posts** - Signs having a vertical dimension of less than 48 inches and mounted on wood or metal posts shall have at least 2 mounting holes. Signs having a vertical dimension of 48 inches or greater shall have 3 mounting holes. Place the third mounting hole near the center of the sign. Locate mounting holes so the mounting hardware will not cover any portion of the legend unless otherwise shown.

(2) **On Extruded Aluminum Signs** - Provide a minimum of 8 mounting holes for sheet aluminum signs mounted on extruded aluminum signs.
00940.44 Retroreflective, Reflective, or Nonreflective Sheeting Application - Apply the sheeting according to the sheeting manufacturer’s recommendations on extruded aluminum panel signs. Up to 25% of the extruded aluminum panel signs required in the plans will be allowed one manufacturer's splice for each sign. One patch will be allowed for each 50 square feet of sign to a maximum of 3 patches for each sign. Patches shall be between 3/4 inch and 3 3/8 inches in diameter. No Contractor splices will be allowed.

On all other signs, manufacturer's splices will not be allowed except as noted on approved shop drawings, or when sign dimensions exceed the sheeting manufacturer's capabilities. Make these splices horizontal with the upper section of sheeting overlapping the lower by a minimum of 3/8 inch on encapsulated lens sheeting, and butt splice prismatic lens sheeting with no appreciable substrate visible. The use of overlaid transparent paste or electronic cuttable film will not be allowed on overlapped splices. No Contractor splices will be allowed.

00940.45 Legend Installation:

(a) General - The word "legend" means the entire message and border for a sign. A group of words, numbers or symbols constitute the "message" for a sign. Install the type of legend for each traffic sign as shown and according to 00940.02.

Spacing between letters or numbers shall conform to the FHWA "Standard Alphabets for Highway Signs" manual.

Spacing between words for Series "E" (modified) or equivalent legend shall be 1.5 times the upper case letter height. Spacing between words for other Highway Series or equivalent fonts shall be as tabulated below unless otherwise shown:

<table>
<thead>
<tr>
<th>Legend</th>
<th>Series Word Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>(0.531) H</td>
</tr>
<tr>
<td>C</td>
<td>(0.625) H</td>
</tr>
<tr>
<td>D</td>
<td>(0.836) H</td>
</tr>
<tr>
<td>E</td>
<td>(1.000) H</td>
</tr>
</tbody>
</table>

H = height of upper case letter

Spacing between symbols shall conform to FHWA "Standard Highway Signs" unless otherwise shown.

Space all lines equally between side borders unless otherwise shown. Space the legend vertically as shown. For diamond shaped signs, space between lines in the legend a minimum of one half the average letter height and space between the message and the borders equally so the message is centered on the sign.
(b) Attachment - Attach removable legend to aluminum panels using aluminum, domed head, 1/8 inch diameter, self-plugging blind rivets. Remove aluminum shavings from the sign face before attaching the legend. The entire sign will be rejected if any shavings are left beneath the legend. Drill 0.128 inch diameter holes in the removable legend and sign panel as shown on the "Mounting Details for Removable Legend" standard drawings.

Apply screened legend according to the sheeting manufacturer's recommendations. Apply cut-out legend according to 00940.44.

Attach 1 inch retroreflective removable border sections by placing 2 rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inches apart, centered in the section. Corner border sections shall be attached with a minimum of 5 rivets, 2 rivets 1/2 inch from each end, and the remaining rivet centered in the middle of the section.

Attach 2 inch retroreflective removable border sections by placing 2 rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inch apart, along the top and bottom edge of the section. Corner border sections shall be attached with a minimum of 5 rivets, 2 rivets 1/2 inch from each end, and the remaining rivet centered in the section.

(c) Border Sizes - Unless otherwise shown, the width of the sign borders shall be according to the following:

<table>
<thead>
<tr>
<th>Maximum Letter Size</th>
<th>Border Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 inch capital or upper case</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>8 inch or 10 2/3 inch upper case</td>
<td>1 inch</td>
</tr>
<tr>
<td>10 inch or 12 inch capital</td>
<td>1 inch</td>
</tr>
<tr>
<td>13 1/3 inch or 16 inch upper case</td>
<td>2 inches</td>
</tr>
<tr>
<td>15 inch or 16 inch capital</td>
<td>2 inches</td>
</tr>
</tbody>
</table>

The corner radii shall be approximately 1/8 of the least dimension of the sign. Determine the corner radii by rounding this approximate value to the nearest 1 1/2 inches, 3 inches, 6 inches, 9 inches or 12 inches.

Except for the corners, mount the border flush with the edge of the sign. Do not round the corners of the aluminum panels.

(d) Overhead Street Name Sign (OSN) - Overhead street names signs shall be a standard guide sign with a green background and white letters. The sign shall be fabricated on white prismatic lens reflective sheeting ASTM Type IX on 0.125 inch thick aluminum sheeting. The sign shall utilize a reverse cut green translucent background (3M-1177 Electro-cut film or equivalent). The sign face shall display the sign legend, which consists of the prefix, street name (primary copy), primary copy suffix, and street name suffix as described below.
The City’s “Rose” logo may be required by the engineer. When used, it shall be aligned with the primary copy on the left side of the sign face and oriented with one leaf in the top left corner and two leaves in the bottom right corner. The height and width of the logo shall not exceed the letter height of the sign. The “Rose” logo design shall be obtained from the City of Portland or from an approved outside source. If obtained from an outside source, it must be submitted and approved prior to incorporation into the sign fabrication.

The length of the sign will be dependent upon the name length plus the prefix, suffix and City’s “Rose” logo as required, in multiples of 6 inches. The OSN sign shall not be less than 36 inches or exceed 84 inches. The sign height shall be 16 inches for one line of copy or 32 inches for 2 lines of copy with a 1 inch dividing line between street names.

Legends shall be composed of a combination of lower-case letters with initial upper-case letters using Clearview Hwy Alphabet 2-W letters for all copy. 1-W letters may be used for the primary copy when the maximum length of the sign would otherwise be violated. When this occurs, the Engineer shall be notified to determine and approve an alternative design. Conventional abbreviations may be used except for the street name itself.

The primary copy (name message) letters shall be 8 inches using mixed case letters. The direction prefix (1 or 2 letters) shall be upper case, 2/3 the primary copy letter height and aligned with the bottom of the primary copy capital letters. The primary copy suffix shall be lowercase superscript, 1/2 the primary copy letter height and aligned with the top of the primary copy letters. The suffix copy shall be mixed case, 2/3 the primary copy letter height and aligned with the bottom of the primary copy capital letters. Block numbers shall be used on non-numbered streets. When block numbers are used, they shall be 1/2 the primary copy letter height and the suffix copy shall be 1/2 the primary copy letter height. See City Standard Drawings for placement of the prefix, primary copy, copy suffix, suffix and block number.

(e) Side-mount Street Name (SSN) Sign – Side-mount street name signs should be installed at all street intersections unless overhead street name signs are present. SSN signs shall be a standard guide sign with a green background and white letters. The sign shall be fabricated on white prismatic lens reflective sheeting ASTM Type III on 0.125 inch thick aluminum sheeting. The sign shall utilize a reverse cut green translucent background (3M-1177 Electro-cut film or equivalent.) The sign face shall display the sign legend, which consists of the prefix, street name (primary copy), primary copy suffix, and street name suffix as described below.

On multi-lane streets posted at more than 40 MPH the primary copy (name message) shall be composed of 6 inch mixed-case letters. For all other roads the primary copy shall be composed of 4 inch mixed-case letters. The direction prefix (1 or 2 letters) shall be upper case, 2/3 the primary copy letter height and aligned with the bottom of the primary copy capital letters. The suffix of the primary copy shall be lowercase superscript 1/2 the primary copy letter height and aligned with the top of the primary copy letters. The suffix copy shall be mixed case, 2/3 the primary copy letter height and aligned with the bottom of the primary copy capital letters. Block numbers shall be used on non-numbered streets.
streets. When block numbers are used, they shall be 1/2 the primary copy letter height and the suffix copy shall be 1/2 the primary copy letter height. See City Standard Drawings for placement of the prefix, primary copy, copy suffix, suffix and block number.

The length of the sign will be dependent upon the name length plus the prefix and suffix as required, in multiples of 6 inches. The 4 inch primary copy SSN sign shall not be less than 24 inches or exceed 48 inches. The 6 inch primary copy SSN sign shall not be less than 24 inches or exceed 60 inches. The sign height shall be 2 times the primary copy letter height.

Legends shall be fabricated using ClearviewHwy Alphabet 2-W for all copy. If the primary copy is long, ClearviewHwy Alphabet 1-W may be used to minimize sign length. When this occurs, the Engineer shall be notified to approve an alternative design. Conventional abbreviations may be used except for the street name itself.

00940.46 Inspection - The Engineer will inspect signs at the fabrication shop or at the jobsite. Inspection will be for conformance to plans and Specifications, and for conformance to nighttime visibility. Testing for nighttime visibility will be according to ODOT TM 804. The Contractor's expense for sign inspection will be according to 00165.91.

00940.47 Sign Erecting - Erect all signs at the locations staked and as shown or directed. Do not erect individual signs until the sign is complete with legend. Signs not mounted as shown or directed will not be accepted.

Erect the signs so the sign face is vertical, unless otherwise directed.

When signs are installed on supports 10 feet or less from the edge of guardrail, curb, or shoulder, set them to reflect 3° away from traffic. When signs are installed on supports more than 10 feet from the edge of guardrail, curb or shoulder, set them to reflect 3° toward traffic.

The closest edge of any column or overhead sign structures shall be as shown.

Where signs are mounted to supports by bolting through the sign, a sheeting manufacturer-approved lubricant may be used on the nylon and metal washers to prevent sign sheeting deformation. Replace damaged signs, or signs with sheet deformation, with new signs at no additional cost to the City.

If a sign installation is a replacement for an existing sign, install the new sign immediately after removal of the existing sign unless otherwise directed.
Overhead street name signs shall be attached to the mast arm using a stainless steel adjustable banded bracket system, such as Band-It Brack-It D004 or approved equal, sufficient to provide a stable, flat and level sign installation with a minimum of three banded brackets on each sign. The banding shall be cut to length after tightened according to manufacturer specifications. The bands shall be spaced equally and not more than 24 inches apart. The edge of holes drilled in the sign face shall be at least 3/4 inch from the edge of the sign. The overhang of the right and left edges of the signs shall not exceed 15 inches from the outside bands.

The sign shall be placed on the mast arm centered between the inside signal head and the mast arm pole (riser). If no space is available, they shall be placed as directed.

Measurement

**00940.80 Measurement** - The quantity of signs measured on the area basis by multiplying the height by width, using the dimensions shown. No deductions will be made for irregular shapes cut from the rectangle.

Route markers and other signs fastened to the face of larger signs will be measured as separate signs.

Payment

**00940.90 Payment** - The accepted quantities of signs will be paid for at the Contract unit price per square foot, for the item "Type ______ Signs In Place".

The type of sign will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for work done under this Section will be limited to 75% of the amount due until the City has received the signed warranties required by 02910.75.
Section 00941 - Sign Covers

Description

00941.00 Scope - This work consists of covering sign faces as shown, specified or directed.

Materials

00941.10 Materials - For permanent signs, use sign covers from the CPL or porous cloth covers pre-approved by the sign sheeting manufacturer. Do not use plywood.

For temporary signs comply with Section 00225.

Construction

00941.40 Fabrication - Fabricate sign covers in one piece, unless otherwise directed. Make them large enough to completely cover the sign, and capable of easy attachment to the sign without damaging the sign face.

00941.41 Installation - Lap covers over all sign edges and secure to the sign or support as recommended by the sign sheeting manufacturer.

00941.42 Alternate - The Contractor may elect one or more of the following as alternate methods subject to approval:

- Install signs in conjunction with the movement of the traffic flow.
- Remove demountable legend from signs and reinstall legend as directed.
- Remove entire sign and store in a vertical position for future reinstallation.

Measurement

00941.80 Measurement - No measurement will be made for sign covers.

Payment

00941.90 Payment - No separate or additional payment will be made for sign covers or for the alternate methods listed in 00941.42. Payment will be included in payment made for the appropriate items under which this work is required.
Section 00950 - Removal of Electrical Systems

Description

00950.00 Scope - This work consists of removing of electrical systems as shown or specified.

00950.02 Definitions:

Electrical Systems - Electrical systems will be described in the Special Provisions.

Materials

00950.10 Materials - The materials covered under this Section are those materials shown, specified and required to properly repair and refurbish salvaged materials that are to be reinstalled.

Construction

00950.40 General - Remove existing electrical systems in the order directed.

- Keep existing electrical systems to be removed in operation until the new electrical systems are ready to be turned on or as directed. Keep authorized downtime to a minimum. Perform the changeover with a minimum disruption to traffic.

- Remove existing materials, as specified or approved, which interfere with or which are incompatible with new construction, before completion of the new construction. Notify the Engineer at least 4 calendar days in advance of removal.

- The method to keep existing traffic signals in operation shall be safe and effective and will be subject to approval on an intersection by intersection basis. The Engineer will assist the Contractor to determine appropriate methods to keep the existing traffic signals operational.

00950.41 Removal and Abandonment - Remove from the right-of-way underground conduit, conductors and foundations. Dispose of materials according to 00290.20. Abandon conduit by removing all wiring, elbows, and risers.

- If a foundation is abandoned, remove the top of the foundation, anchor bolts, and conduits to a depth not less than 2 feet below the adjacent finished ground line. Backfill resulting holes with material equivalent to the surrounding material. Finish and blend the surface area to the adjacent surface area.

- Repair all holes or damage to existing surfacing caused by removal of existing installations as directed at no additional cost to the City.

- Wood poles shall be completely removed from the ground.
00950.42 Stockpiling Existing Materials - Remove, deliver and stockpile all materials specified to be stockpiled at the locations specified in the Special Provisions or directed.

00950.43 Reinstalling - If shown or specified, utilize existing material in the construction of new installations. Thoroughly clean, repair and refurbish salvaged material to be reinstalled to a like new condition before reinstallation. Replace damaged parts as directed.

Furnish and install all miscellaneous materials including anchor bolts, nuts, washers and concrete required to complete the reinstallation according to Sections 00960, 00961, 00970, and 00990.

Relamp all roadway luminaires, traffic signals and interior illuminated signs to be reinstalled with new lamps of the size and type required for new installations, according to Sections 00970 and 00990, except where such lamp appurtenances as sockets, et cetera, do not permit the installation of the specified lamps. In such instances, furnish and install a new lamp of the same manufacture as is currently installed in the unit.

If it is determined that there are conditions existing within the proposed project scope that do not meet the current applicable electrical codes or variances, obtain approval to furnish and install all necessary materials to meet the applicable electrical codes.

Measurement

00950.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00950.90 Payment - Payment for work performed under this Section will be made either method "A" or method "B" as follows:

Method "A" - Method "A" will be used when existing electrical systems are removed and replaced with new electrical systems. Under method "A" no separate payment will be made for removal of electrical systems.

Payment for removal of existing electrical systems will be included in payment made for the appropriate new electrical system.

Method "B" - Method "B" will be used when existing electrical systems are removed and are not replaced with new electrical systems. Under method "B" payment will be made at the Contract lump sum amount for the item "Removal of Electrical Systems."

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Items shown or specified as work to be done to bring existing installations into conformance with current electrical codes, will be considered incidental to the work and no separate or additional payment will be made.

Items not shown or specified, but necessary to bring existing installations into conformance with current electrical codes, will be paid for according to Section 00196.

00950.91 Incidental Basis - When neither the Special Provisions nor Schedule of Items indicate separate payment for the traffic signal work under this section, perform work as incidental to and included in the contract lump sum amount bid for the item "Traffic Signal Installation, Complete".
Section 00959 - Fiber Optics for Telecommunications to Traffic Signals

Description

00959.00 Scope - This work consists of furnishing and installing fiber optic cable for traffic interconnect and camera surveillance as shown. Material and installation shall meet all applicable portions of Sections 00961, 00990 and 02921.

00959.01 Abbreviations:

- CFR - Code of Federal Regulations
- dB - Decibel
- dBm - Decibel referenced to one milli-watt
- EIA - Electronics Industries Association
- FDP - Fiber Distribution Panel
- FO - Fiber Optic
- FOIP - Fiber Optic Inside Plant
- FOOP - Fiber Optic Outside Plant
- FOTP - Fiber Optic Test Procedure as defined by TINEIA standards.
- Hz - Hertz, cycles per second
- Nm - nanometer
- OD - Outside Diameter
- OTDR - Optical Time Domain Reflectometer
- OSHA - Occupational Safety and Health Administration
- p-p - Peak to Peak
- REA - United States Rural Electrification Administration
- Rms - root mean square
- SM - Single Mode
- SMFO - Single Mode Fiber Optic
- SC - Type of Fiber Optic Connector
- ST - Type of Fiber Optic Connector
- TIA - Telecommunications Industries Association

00959.02 Definitions:

- Connector - A mechanical device used to align and join two fibers together to provide a means for attaching to and decoupling from equipment or another fiber.
- Couplers - A device that mates fiber optic connectors.
End to End Loss - The maximum permissible end to end system attenuation (total loss) in a given link. This loss could be the actual measured loss, or calculated loss using typical (specified) values. This number will determine the amount of optical power (in dB) needed to meet the system performance margin.

Fiber Distribution Panel (FDP) - A rack or wall mounted unit containing both a patch panel with couplers and splice trays.

Handhole - An underground container used to provide an access point to the fiber cable for conduit routing purposes. This container is typically smaller than a Splice Vault and provides less cable coiling (slack) as well.

Jumper - A short fiber optic cable with connectors installed on both ends.

Light Source - Portable fiber optic test equipment that, when coupled with a power meters, is used to perform end to end attenuation testing. It contains a stabilized light source operating at the wavelength of the system under test.

Link - A passive section of the system, the ends of which are to be connected to active components that may include splices and couplers.

Loose Tube Cable - A type of cable construction in which fibers are placed in buffer tubes to isolate them from outside forces (stress). A flooding compound or material is applied to the interstitial cable core to prevent water migration and penetration.

Mid-span Access Method - A procedure in which fibers from a single buffer tube are accessed and spliced to an adjoining cable without cutting the unused fibers in the buffer tube, or disturbing the remaining buffer tubes in the cable.

Optical Attenuator - An optical element that reduces the intensity of a signal passing through it.

Patchcord - A term used interchangeably with jumper.

Pigtail - A short optical fiber with a connector on a single end.

Power Meter - A portable fiber optic test equipment that, when coupled with a light source, is used to perform an end to end attenuation test. It contains a detector that is sensitive to light at the designed wavelength of the system under test. It displays the amount of optical power being received at the end of the link.

Segment - A section of fiber optic cable that is not connected to any active device and may/or may not have splices per the design.

Splice - The permanent joining of two fiber ends using a fusion splicer.

Splice Closure - An environmentally sealed container used to organize and protect splice trays. The container allows splitting or routing of fiber cables from multiple locations. Normally installed in a splice vault or a handhole.
**Splice Tray** - A container used to organize and protect spliced fibers.

**Splice Vault** - An underground container used to house excess cable and splice closures.

**00959.03 Required Submittals for Approval** - Within 30 days after the contract is awarded, submit to the Engineer a complete listing of all major components of the system. Include the manufacturer's name, model numbers, catalog sheets, or other descriptive literature of proposed materials. The catalog cuts and literature shall include technical data, physical properties and operational description in sufficient detail to demonstrate that the equipment meets these specifications.

**00959.05 Regulations, Standards, and Codes** - The following documents and others referenced therein form part of the Contract to the extent designated in this Specification.

**Code of Federal Regulations (CFR)**

Title 7 Agriculture

Part 1755 Telecommunications Program standards and specifications -material, equipment, and construction

**Electronics Industry Association (EIA)**

EIA-455-3A (FOTP 3) Fiber Optic Test Procedures
EIA-455-21A (FOTP 21) Mating Durability for Fiber Optic Interconnecting Devices
EIA-455-25B (FOTP 25) Impact Testing of Fiber Optic Cables and Cable Assembly
EIA-455-33 (FOTP 33) Fiber Optic Cable Tensile Loading and Bending Test
EIA-455-41 (FOTP 41) Compressive Loading Resistance of Fiber Optic Cables
EIA-455-81A (FOTP 81) Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA-455-82 (FOTP 82) Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
EIA-455-104 (FOTP 104) Fiber Optic Cable Cyclic Flexing Test
Fiber Optic Cable - Furnish single mode fiber optic (SMFO) cables for video and traffic interconnects. SMFO fibers shall contain single mode dual window (1310 nm and 1550 nm) fibers. The cable shall be qualified as compliant with RUS Federal Rule 7CFR1755.900.

(a) Optical Fiber - All fibers in buffer tubes shall be usable fibers, meeting optical, mechanical, and environmental requirements of these special provisions,

(b) Fiber Characteristics and Tests - Single mode fibers shall meet the requirements in the following table:
## Fiber Characteristic Table

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Single Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Step Indes</td>
</tr>
<tr>
<td>Core diameter</td>
<td>8.3 µm (nominal)</td>
</tr>
<tr>
<td>Cladding diameter:</td>
<td>125 µm ± 1.0 µm</td>
</tr>
<tr>
<td>Core to cladding offset:</td>
<td>≤ 1.0 µm</td>
</tr>
<tr>
<td>Coating:</td>
<td>dual layer, UV-cured acrylate strippable mechanically or chemically without damaging fibers</td>
</tr>
<tr>
<td>Optical fibers</td>
<td>doped silica core with concentric silica</td>
</tr>
<tr>
<td>Coating diameter:</td>
<td>250 µm ± 15 µm</td>
</tr>
<tr>
<td>Cladding non-circularity defined as:</td>
<td>≤2.0% [1-(min. cladding dia/max. cladding dia.)]x100</td>
</tr>
<tr>
<td>FOP cable:</td>
<td>all dielectric, gel-filled, duct-type</td>
</tr>
<tr>
<td>Proof/Tensile Test:</td>
<td>345 MPa, min</td>
</tr>
<tr>
<td>Attenuation at 1310 nm and at 1550 nm:</td>
<td>≤ 0.4 db/km</td>
</tr>
<tr>
<td>Test cable in accordance with:</td>
<td>EIA-455-25 (FOTP-25)</td>
</tr>
<tr>
<td></td>
<td>EIA-455-33 (FOTP-33 Condition II)</td>
</tr>
<tr>
<td></td>
<td>EIA-455-41 (FOTP-41)</td>
</tr>
<tr>
<td></td>
<td>EIA-455-81 (FOTP-81)</td>
</tr>
<tr>
<td></td>
<td>EIA-455-82 (FOTP-82)</td>
</tr>
<tr>
<td></td>
<td>EIA-455-104 (FOTP-104 Conditions I and II)</td>
</tr>
<tr>
<td>Test optical fiber in accordance with:</td>
<td>EIA-455-3A (FOTP-3)</td>
</tr>
<tr>
<td>Attenuation at the Water Peak:</td>
<td>≤2.1 dB/km @ 1383 ± 3 nm</td>
</tr>
<tr>
<td>Chromatic Dispersion</td>
<td></td>
</tr>
<tr>
<td>Zero Dispersion Wavelength:</td>
<td>1301.5 to 1321.5 nm</td>
</tr>
<tr>
<td>Zero Dispersion Slope</td>
<td>≤0.092 ps/(nm^2 *km)</td>
</tr>
</tbody>
</table>
Fiber Characteristic Table

Maximum Dispersion: \( \leq 3.3 \text{ ps/(nm}^2 \text{ *km)} \) for 1285 - 1330 nm  
\( \leq 0.092 \text{ ps/(nm}^2 \text{ *km)} \) for 1550 nm

Cut-Off Wavelength: \(<1250 \text{ nm}\)

Mode Field Diameter  
Petermann II \(9.3 \pm 0.5 \mu\text{m at 1310 nm}\)  
\(10.5 \pm 1.0 \mu\text{m at 1550 nm}\)

(c) Color Coding - In buffer tubes containing multiple fibers, each fiber shall be distinguishable from others in the same tube by means of color coding according to the following:

1. Blue (BL)  
2. Orange (OR)  
3. Green (GR)  
4. Brown (BR)  
5. Slate (SL)  
6. White (WT)  
7. Red (RD)  
8. Black (BK)  
9. Yellow (YL)  
10. Violet (VL)  
11. Rose (RS)  
12. Aqua (AQ)

Buffer tubes shall also be color coded with distinct and recognizable colors according to the same table listed above for fibers. These colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598.

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade, smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause the fibers to stick together.

(d) Cable Construction - The fiber optic cable shall consist of, but not limited to, the following components:

(1) Buffer Tubes - Clearance shall be provided in the loose buffer tubes in fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes. The fibers shall not adhere to the inside of the buffer tube. Each buffer tube shall not exceed a maximum of 12 fibers. Provide the number of fibers per cable as shown on the plans:

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.
Buffer tube filling compound shall be a homogenous hydrocarbon based gel with ant-oxidant additives used to prevent water intrusion and migration. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member by a method, such as reverse oscillation stranding process, which will prevent stress on the fibers when the cable jacket is placed under strain.

(2) **Central Member** - The central member which functions as an anti-buckling element shall be a glass reinforced plastic rod with similar expansion and contraction characteristic as the optical fibers and buffer tubes. To ensure the proper spacing between buffer tubes during stranding, a symmetrical linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

(3) **Filler Rods** - Fillers may be included in the cable to maintain the symmetry of the cable cross section. Filler rods shall be solid medium or high-density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

(4) **Stranding** - Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage.

(5) **Core and Cable Flooding** - The cable core interstices shall contain a water blocking material, to prevent water ingress and migration. The water blocking material shall be either a polyolefin based compound which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block the ingress of water. The flooding compound or material shall be homogeneous, non-hygroscopic, non-conductive, and non-nutritive to fungus. The compound or material shall also be nontoxic, dermatologically safe and compatible with other cable components.

(6) **Tensile Strength Member** - Tensile strength shall be provided by high tensile strength aramid yarns or fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

(7) **Ripcord** - The cable shall contain at least one ripcord under the jacket for easy sheath removal.
(8) **Outerjacket** - The jacket shall be free of holes, splits, and blisters and shall be medium or high density polyethylene, or medium density cross linked polyethylene with minimum nominal jacket thickness of 1/32 inches plus or minus 0.003 inches. Jacketing material shall be applied directly over the tensile strength members and water blocking materials and shall not adhere to the aramid strength material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings every meter. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 3/32 inches.

(e) **Packaging and Shipping Requirements** - Pack completed cable on reels for shipment. Wrap cable in weather and temperature resistant covering. Seal both ends of cable to prevent ingress of moisture. Secure each cable end to the reel to prevent the cable from coming loose during transit. Have at least 72 inches of cable length accessible for testing purposes.

Label each cable reel with a durable, weatherproof label showing manufacturer's name, cable type, actual length of cable on the reel, Contractor's name, contract number, and reel number. Include a shipping record in a weatherproof envelope showing the above information and also include the date of manufacturer, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and any other pertinent information.

Minimum hub diameter of reel shall be at least thirty times the cable diameter. Fiber optic cable shall be continuous length on each reel. Mark reel indicating direction reel should be rolled to prevent loosening of cable.

Furnish installation procedures and technical support information at delivery.

(f) **Labeling** - Label all fiber optic cabling in a permanent and consistent manner. All tags shall be of a long life material and shall be marked with permanent ink on non-metal types, or embossed lettering on metals tags. Metal tags shall be constructed of stainless steel. Labels shall be affixed to the cable per the manufacturer's recommendations and shall not be affixed in a manner which will cause damage to the fiber. Handwritten labels shall not be allowed.

00959.11 **Fiber Optic Cable Assemblies and Pigtails:**

(a) **General** - Cable assemblies (pigtails and jumpers) shall be products from the same manufacturer. The fiber optic cable used for cable assemblies shall be made of fiber meeting the performance specifications of Section 00959.11.
(b) **Pigtails** - Pigtails shall be of simplex (one fiber) construction, in 900 µm tight buffer form, surrounded by aramid for strength, with a PVC jacket with manufacturer identification information, and a nominal outer jacket diameter of 1/8 inch. Simplex cable jackets shall be yellow in color. All pigtails shall be factory terminated and tested and at least 6 feet in length.

(c) **Jumpers** - Jumpers may be of simplex or duplex design. Duplex jumpers shall be of duplex round cable construction. All jumpers shall be at least 6 feet in length, sufficient to avoid stress and allow orderly routing. The outer jacket of duplex jumpers shall be yellow in color. The two inner simplex jackets shall be contrasting colors to provide easy visual identification of polarity.

(d) **Connectors** - Connectors shall be of the ceramic ferrule SC type for single mode fiber. Connector body housing shall be glass reinforced polymer. The associated coupler shall be of the same material as the connector housing. Each connector shall not exceed 0.75 dB loss as specified by EIA/TIA-568-B.3.

(e) **Fiber Distribution Unit (FDU)** - The fiber distribution unit shall consist of an EIA 482.6 mm rack, a compartment for termination and distribution cable tray and a compartment for a splice drawer. The termination and distribution cable trays shall accommodate 48 singlemode optical fiber cables. The termination and distribution cable trays shall have sufficient tray areas for excess optical fiber storage with provisions to assure that the optical fibers do not exceed a 2 inch bend radius. The termination and distribution cable trays shall include a designation strip for identification of the 48 optical singlemode optical fibers. Each splice drawer shall include 2 splice trays with each splice tray capable of accommodating 48 fusion-type splices. Each splice drawer shall allow for storage of excess lengths of the optical fibers of fiber optic cables. Each fiber distribution unit shall be provided with cable clamps to secure fiber optic cables to the chassis.

### Labor

00959.30 **Licensed Electricians** - Electrical work shall be in accordance with 00960.30. In addition to submitting electrician's license, those individuals performing fiber terminations and splices must possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association. Submit a copy of certification prior to performing any work.

### Construction

00959.40 **Installation and Setup:**

(a) **Cable Installation** - Submit manufacturer's recommended procedures for pulling fiber optic cable for review 20 days prior to beginning installation. Mechanical aids may be used in cable installation. Place tension measuring device or breakaway swivel between ends of cable grip and pull rope to ensure tension does not exceed 80% of recommended tension or 2225 N, whichever is less. Use cable grips with a ball bearing swivel for installing fiber optic cable to prevent cable from twisting during installation.

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During installation, maintain a minimum bend radius of 20 times the outside diameter of the cable. Do not stress the cable beyond the minimum bend radius. Install fiber optic cable using cable pulling lubricant as recommended by the manufacturer. Use a non-abrasive pull tape. Station personnel at each splice vault and hand hole to lubricate the cable and prevent kinking or other damage. Install fiber optic cable without splices, except as specifically allowed for on the plans, as described herein, or as directed. Divide slack equally on each side of splice closures. Following installation of cable in conduit, seal all entrances in cabinets, junction boxes and vaults with duct sealing compound to keep out moisture, foreign materials, and rodents.

(b) Splicing - Optical fibers shall be spliced using the fusion-type and shall not exceed 0.07 dB loss per splice. Place splice tray in a splice closure unless using a splice enclosure. Protect all splices with a thermal shrink sleeve.

The completed splices shall be placed in a splice tray. The splice tray shall then be placed in the splice closure. All splices shall be protected with a thermal shrink sleeve. All fibers shall be labeled in the splice tray with permanent vinyl markers. Pigtail ends shall also be labeled to identify the destination of the fiber.

(c) Splice Closures - The fiber optic field splices shall be enclosed in splice closures which shall be complete with splice organizer trays, brackets, clips, cable ties, seals and sealant, as needed. The splice closure shall be suitable for a direct burial or pull box application. Manufacturer's installation instructions shall be supplied to the Engineer prior to the installation of any splice closures. The splice closure shall meet the following requirements:

- Non-filled thermoplastic case
- Rodent proof, water proof, re-enterable and moisture proof
- Expandable from 2 cables per end to 8 cables per end by using adapter plates
- Cable entry ports shall accommodate 7/16 inch to 1 inch diameter cables
- Multiple grounding straps
- Accommodate up to 8 splice trays
- Suitable for "butt" or "through" cable entry configurations
- Place no stress on finished splices within the splice trays

The splice closure shall be attached to the inside wall of the vault or handhole. The splice closure shall be 3M 2178-L/S series, Coyote Closure series, Tyco Raychem series or approved equal.

(d) Splice Trays - Splice trays must accommodate a minimum of 12 fusion splices and must allow for a minimum bend radius of 1-3/4 inches. Individual fibers must be looped one full turn within the splice tray to allow for future splicing. No stress is to be applied on the fiber when it is located in its final position. Buffer tubes must be secured near the entrance of the splice tray. Buffer tubes shall be securable with channel straps.
Splice trays shall be of the same manufacturer as the splice closure.

(e) **Cable Terminations** - At the FDP, the cable jacket of the SMFO cable, shall be removed exposing the aramid yarn, filler rods, and buffer tubes. The exposed length of the buffer tubes shall be at least the length recommended by the FDU manufacturer which allows the tubes to be secured to the splice trays. Each buffer tube shall be secured to the splice tray in which it is to be spliced. The remainder of the tubes shall be removed to expose sufficient length of the fibers in order to properly install on the splice tray.

The cable shall then be spliced and secured with tie warps and routed to its appropriate fiber distribution unit location.

When applicable, the moisture blocking gel shall be removed from the exposed buffer tubes and fibers. The transition from the buffer tube to the bundle of jacketed fibers shall be treated by an accepted procedure for sleeve tubing, shrink tube and silicone blocking of the transition to prevent future gel leak. Manufacturer directions shall be followed to ensure that throughout the specified temperature range gel will not flow from the end of the buffer tube. The individual fibers shall be stripped and prepared for splicing.

Factory terminated pigtails shall then be spliced and placed in the splice tray.

All fibers entering the FDP shall be terminated and labeled.

A transition shall then be made, with flexible tubing, to isolate each fiber to protect the individual coated fibers. The final transition from bundle to individual fiber tube shall be secured with an adhesive heat shrink sleeve.

(f) **Distribution Breakout** - Terminate distribution breakout in a fiber distribution panel. Remove cable jacket, aramid yarn and filler rods, and expose buffer tubes. Expose buffer tubes as recommended by manufacturer. Secure buffer tubes to splice tray. Remove remainder of tubes and expose individual fibers for routing on splice tray as described in 00959.30(b). Remove moisture blocking gel from exposed buffer tubes and fibers following manufacturer's directions to ensure gel will not flow from end of buffer tube. Strip and prepare individual fibers for splicing onto factory prepared pigtails. Connect pigtails to the distribution panel's couplers. Use factory prepared jumpers to connect between the FDP couplers to individual components.

(g) **Fiber Distribution Panel Installation** - At traffic controller cabinet locations, provide a single-height rack mount type fiber distribution panel with a drop cable, equivalent to the Gator Patch ITS Drop Cable (GP2 G12 FNB-GP).
Finishing and Testing

00959.70 Testing:

(a) Test Plan - Prior to beginning testing, submit for approval 5 copies of installation and test plan detailing methods of installation and testing for all materials, equipment, and systems. At the same time, submit the associated schedule of activities. Notification of approval or rejection will be made within 4 weeks. If the test plan is rejected, submit a revised test plan within 20 working days. Do not begin testing until receiving approval of the test plan by the Engineer. Submit all test results, including results of failed tests or retests to the Engineer. The Contractor shall supply all test equipment.

Provide 48 hours notice of intent to proceed prior to commencing each functional or subsystem test. In the notice, provide location(s) of test(s). Conduct environmental tests of field equipment as part of the functional tests. Subsystem testing and inspections shall include visual inspection from damaged or incorrect installation, adjustments, alignments, and measurement of parameters and operating conditions.

(b) Factory Testing - Documentation of compliance with the fiber specifications as listed herein shall be supplied by the original equipment manufacturer. Before shipment, but while on the shipping reel, 100% of all fibers shall be tested for attenuation. Copies of the results shall be maintained on file by the manufacturer with a file identification number, attached to the cable reel in a waterproof envelope, and submitted to the Contractor and Engineer.

(c) Arrival On-Site Testing - Each cable and reel shall be physically inspected upon delivery and 100% of the fibers shall be attenuation tested to confirm that the cable meets the requirements. The failure of any single fiber in the cable to comply with these specifications is cause for rejection of the entire reel. Test results shall be recorded on the Cable Verification Worksheet, dated, compared, and filed with the copy accompanying the shipping reel in a waterproof envelope. The cable shall not be installed until completion of this test sequence and the Engineer provides written approval. Copies of traces and test results shall be submitted to the Engineer. If the tests are unsatisfactory, the reel of cable shall be considered unacceptable and all records corresponding to that reel shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at no additional cost to the City. The new reels of cable shall be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

(d) Fiber Optic Cable Testing - Testing shall include the tests on elements of the passive FO components. (1) at the factory, (2) after delivery to the project site, but prior to installation, (3) after installation, but prior to connection to any other portion of the system. Provide all personnel, equipment, instrumentation, and materials necessary to perform all on-site testing.
Provide documentation of all test results to the Engineer at most 2 working days after the test is completed. At least 15 working days prior to the arrival of cable, provide detailed field testing procedures. In the procedures include the test involved and method by which tests are to be conducted. Include in the notification the model, manufacturer, configuration, calibration, and alignment procedures for all proposed test equipment.

(e) **Outdoor Splices** - Verify insertion loss quality of each splice prior to sealing splice closure.

(f) **Cable Verification:**

1. **OTDR Testing** - Once the cabling system has been installed and is ready for activation, test all fiber links with the OTDR test equipment for attenuation at wavelengths of both 1310 nm and 1550 nm. Index matching gel shall not be allowed in connectors during testing. Record, date and compare test results and file with previous copies. Submit hard copy printout of traces and test results to the Engineer. The OTDR shall be capable of recording and displaying anomalies of at least 0.02 dB.

2. **Power Meter and Light Source Testing** - At the conclusion of the OTDR testing, 100% of the fiber links shall be tested end to end with a power meter and light source, in accordance with FOTP-171 and in the same wavelength specified for the OTDR tests. These tests shall be conducted in one direction. The insertion loss shall be calculated. Test results shall be recorded, compared, and filed with the other recordings of the same links. Test results shall be submitted to the Engineer. Record the values in the Cable Verification Worksheet. The power meter shall be calibrated with traceability to the National Institute of Standards and Technology (NIST).

3. **Cable Verification Worksheet** - Complete the Cable Verification Worksheet shown at the end of this section. Include the completed worksheets as part of the system documentation.

4. **Test Failures** - If the link loss measured from the power meter and light source exceeds the calculated link loss, or the actual location of the fiber ends does not agree with the expected location of the fiber ends (as would occur with a broken fiber), the FO Link will be rejected. Replace the unsatisfactory segments of cable, or splices with a new segment of cable or splice at the Contractor's expense. Complete the OTDR Testing, Power Meter and Light Source Testing, and Cable Verification Worksheet for the repair to determine acceptability. Submit copies of the test results to the Engineer. The removal and replacement of a segment of cable shall be interpreted as the removal and replacement of a single continuous length of cable connecting two splices, two connectors. The removal of only the small section containing the failure and therefore introducing new unplanned splices will not be allowed.
Measurement

00959.80 Measurement - There will be no separate measurement of work done under this Section.

Payment

00959.90 Payment - Installing fiber optic cable will be paid for at the Contract lump sum amount for the item "Fiber Optic Cable". Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Cable Verification Worksheet

End to End Attenuation Testing with a Power Meter, Light Source, and an OTDR

Contract No.: ____________________  Contractor: ________________
Operator: ______________________  Date: ___________________
Link Number: ________________  Fiber Number: ____________
Test Wavelength (Circle one):  1310 _______________ 1550
Expected location of fiber ends:  End 1: _______  End 2: _________

Power Meter and Light Source Test Results:
  Power In:  __________ dB m  1A
  Output Power:  __________ dB m  1B
  Insertion Loss (1A –1B):  __________ dB m  1C

OTDR Test Results:
  Forward Loss:  __________ dB m  2A
  Reverse Loss:  __________ dB m  2B
  Average Loss [(2A + 2B)/2]:  __________ dB m  2C

To be completed by City of Portland:
Engineer’s Signature:    Cable Link Accepted:

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Fiber System Performance Margin Calculations Worksheet

A. Calculate the Passive Cable Attenuation

1. Determine the Fiber Loss at Operating Wavelength: ___nm
   
   Cable Distance x Individual Fiber Loss:
   ___ km x ___ dB/km = ____ dB
   at 1310 nm (0.4 dB/km)
   at 1550 nm (0.25 dB/km)

B. Calculate the Total Connector/Splice Loss

2. Determine Maximum Allowable Connectors Loss:
   (Excluding transmitter and receiver connectors)
   Individual connector loss x number of connector pairs along one fiber path
   0.75 dB x ____ = ____ dB
   Provide documentation demonstrating installation does not exceed the above number.

3. Calculate Splice Loss:
   Individual splice loss x number of splices along one fiber path
   0.1 dB x ____ = ____ dB
   Provide documentation demonstrating installation does not exceed the above number.

4. Determine Other Components Power:
   Provide documentation of output power of each fiber optic modem and video transmitter.

5. Calculate Total Losses:
   Video: B.4 - A.1 - B.2 - B.3 = ____________________ dB
   Traffic Controller: B.4 - A.1 - B.2 - B.3 = ____________________ dB

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Scope - This work consists of furnishing and installing materials for electrical systems and for modifying existing systems. The location of material shown is approximate, with exact locations established in the field.

Regulations, Standards, and Code - All electrical materials and workmanship shall conform to the following standards where applicable:

- American National Standards Institute (ANSI)
- International Municipal Signal Association (IMSA)
- Underwriter's Laboratories, Inc. (UL)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Electrical Code, Oregon Amended (NEC)
- Standards of the American Society for Testing and Materials (ASTM)
- Local laws

Wherever reference is made to any of the standards mentioned above, the reference means the code, order, or standard in effect on the date the Project is advertised unless otherwise shown or specified in the Special Provisions.

Do not begin installations until all permits are obtained and copies are given to the Engineer.

Equipment List and Drawings - Within 30 calendar days after execution of the Contract, submit at least 3 copies of:

- Cut sheets for materials that the Contractor proposes to install, unless otherwise permitted in writing. List all material shown or specified by manufacturer’s name, size, and identity number of each item, if it is necessary or customary in the trade to identify such materials. Supplement the list with other data, including but not limited to, detailed scale drawings.
- Wiring diagrams for all circuits and any nonstandard or special equipment.
- Brochures, technical bulletins, parts lists, service instructions, working drawings and other technical information relative to products proposed for use on the Project.
- Submittals shall be in orderly bound form with specific items for installation clearly marked. Partial submittals will not be accepted.
  - Use Materials from the current list of acceptable signal and street lighting materials. The updated list is available from the Engineer. Mark the list according to the instructions on it. The list eliminates the need for most cut sheets.
All engineered details and drawings, which are not prepared by the City, but are required in the Contract Documents, shall be submitted for review prior to fabrication. Submit stamped designs, details, plans and calculations according to 00150.35(m)(1).

Upon completion of the installation, submit two copies of any data required to show in detail all changes made from the original plans. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

Materials

00960.10 Materials - Furnish electrical materials meeting the requirements of Section 02920.

Furnish concrete meeting the requirements of Section 00440.

00960.11 Temporary Plating - Temporary plating shall conform to Section 00275.

Labor

00960.30 Licensed Electricians - According to the Oregon Administrative Rule 918-282-0120(1), every person engaged in the installation of electrical equipment and wiring systems shall possess a valid Oregon Electrical Supervising or Journeyman’s License, or be registered as an Electrical Apprentice. Every person who installs electrical systems on the Project shall submit a copy of his/her electrical license or apprentice registration to the Engineer prior to performing any work. Contractor employees who are not licensed electricians or registered apprentices will not be allowed to perform electrical work.

Construction

00960.40 General - The City will continue operation and maintenance of existing systems including the furnishing of electrical energy.

Maintain new signal equipment until notification by the Engineer. The Owner will continue to furnish electrical energy.

00960.41 Excavation:

(a) General - Remove and replace sidewalks, paved surfaces, and other materials as needed. Place conduit under curbs without disturbing curbs. Replace and finish all surfaces to correspond with the existing surfaces. Restore all disturbed landscaping and underground systems to original condition. Use hand excavation if directed. Protect all existing pipes that become a part of a foundation as directed by the Engineer.
Excavate trenches to lines, grades and cross sections established or approved. Furnish, place, and remove any shoring required to prevent caving of walls.

When excavating in paved areas, cut through to the base material and along a T cut of the area with a 6 inches overlap along the neat boundaries of the area to be removed. Cut sharp and well-defined pavement edges with no evidence of cracking, delaminating, or stressing.

(b) Excavation for Pedestal Foundations - Make all excavations to the neat lines of the foundations. Hand excavation may be required. Place the concrete directly against the sides of the excavation in undisturbed or well-compacted material.

(c) Excavation for Conduit - All underground conduit runs shall be placed with a minimum of 36 inches and a maximum of 42 inches of cover below the surround surface. Stub conduits for detector loop pockets shall be placed as close as possible to the bottom of the curb. Stub conduits extend 6 inches past the face of the curb and gutter.

Special precautions should be taken when installing conduits in the vicinity of NW Natural gas mains. These mains are protected by cathodic protection system. Any contact with electrically ground conduits will interfere with cathodic protection systems. Maintain 12 inches of separation from gas mains where practical. If this is not possible, notify NW Natural so that they can insulate the conduit from the main while the trench is open.

Place the conduit under curbs without disturbing curbs.

If the trench is not backfilled the same day the rigid nonmetallic conduit is placed:

- Cap or plug all conduit ends,
- Leave one end of conduit run free until backfill is started, or
- Install a rigid, nonmetallic conduit expansion joint in the run

(d) Conduit under Paved Surfaces - Install conduit under all paved surfaces by horizontal directional drilling or the open trench method.

(1) Horizontal Directional Drilling - Drilling shall not "hump" or deform the pavement and shall be guided. Pneumatic hammers are not allowed. Keep drilling pits at least 2 feet from the edge of pavement unless otherwise authorized in writing. Do not use water to the extent that the pavement might be undermined or subgrade softened. Sand bedding and marking tape are not required with this method. When the work must be left overnight, cover the drilling pit with adequate planking.
(2) **Open Trench** - If the open trench method is used, do the following:

a. **Width** - Hold trench width to a practical minimum.

b. **Pavement Cuts** - Cut the existing pavement as required in 00960.41(a).

(e) **Conduit under Railroad Tracks** - Install conduit inside a galvanized, rigid metal conduit at the depth required by the governing railroad company. Construct so that conduit ends are at least 12 feet beyond the centerline of every track or other distance as required by the railroad. When the work must be left overnight, cover the drilling pit with adequate planking.

(f) **Disposition of Waste Materials** - On completion of the work, or as directed, dispose of all waste materials according to 00330.41(a)(6) or as directed.

(g) **Backfill** - Use an approved sand blanket, selected general backfill meeting the requirements of 00330.13, selected granular backfill meeting the requirements of 00330.14, or concrete meeting the requirements of Section 00440 as follows:

1. **Rigid Nonmetallic Conduit:**
   a. **Bedding** - Place 2 inches of sand blanket in trench bottom before placing conduit.
   b. **Cover** - Cover conduit with 2 inches of additional sand blanket.
   c. **Backfill** - Backfill according to the following:
      1. **New Roadway and Shoulder** - Place selected granular backfill material in layers not greater than 6 inches thick. Compact the selected granular backfill material according to 00405.46(c)(2).
      2. **Existing Roadway and Shoulder** - Backfill all conduit trenches with CLSM backfill according to Section 00442. Place to an elevation 6 inches below the surface of the existing pavement or to the bottom of the existing pavement, whichever is lower. When this method is used the sand blanket may be omitted.
      3. **Unpaved Areas** - Place selected granular backfill material in layers not greater than 6 inches thick. Compact the selected granular backfill material according to 00405.46(c)(2) to the top of trench, surrounding ground level or upper limit of excavation as directed. The sand blanket requirement of a. and b. above may be deleted as approved when excavated material does not contain large, angular stones that could fracture or dent conduit.
d. Pavement - Place and compact AC and PCC according to Section 007-44, 007-45, 007-55, and 007-56 as applicable and the following:

1. Existing Non-roadway, Non-shoulder Pavement - Match surfacing thickness.

2. Existing Roadway and Shoulder - Match existing surfacing thicknesses or provide a minimum thickness of 6 inches, whichever is greater.

e. Finish - Finish to a smooth riding surface.

(2) Rigid Metal Conduit - For rigid metal conduit provide backfill according to 00960.41(g)(1)(c) and 00960.41(g)(1)(d) except the sand blanket is not required.

00960.42 Conduit:

(a) General - Conduit runs shown on the plans are for bidding purposes only. Locations may be changed to avoid obstructions, if approved. Larger size conduit than specified may be used at the option and cost of the Contractor. Use the same size conduit for the entire length, from outlet to outlet. Reducer couplings will not be permitted. Install all underground conduit runs and conduit risers on poles as needed, even if not shown.

All conduit shall be rigid PVC Schedule 80 unless otherwise indicated on the plans and details. Where shown on plans, galvanized rigid metal conduit in conformance with 2920.10(a) shall be used.

Use rigid metal conduit elbow when converting from an underground, rigid, nonmetallic conduit to an aboveground run or extension. Bond all metallic lids for junction boxes containing 120+ VAC regardless of the elbow material type, riser material type, or bushing material type.

Install a yellow #12 THWN stranded copper wire as a locate wire in each conduit. Extend the wire 2 feet beyond conduit ends and install a wire nut. Do no join multiple locate wires under a common wire nut.

Install a polyester line with a break strength of at least 1250 pounds and 40 inches of slack, tied off at each end of every conduit run. Any pull lines utilized by the Contractor shall be replaced with a new polyester pull line.

If corrosive soil conditions exist and if shown or specified, coat metallic conduit with a non-metallic coating or wrap with corrosion protection tape.

(b) Conduit on Wood Poles - Mount conduit on City-owned wood poles with two-hole, galvanized, steel conduit straps spaced no more than 3 feet apart. Mount conduit on utility-owned wood poles according to local utility regulations. Use stand-off brackets if required.
(c) Conduit on Metal Poles - Mount conduit on metal poles with 3/4 inch, stainless steel straps or a single-hole, galvanized metal strap, drilled and tapped with galvanized bolts. Place straps no more than 3 feet apart. After tightly drawing steel bands, cut and fold under the ends to eliminate protruding edges.

(d) Conduit in Foundations - Use rigid metal conduit and extend conduit 2 inches to 3 inches above the top of the cabinet foundations. Install conduit within 6 inches of the hand hole for illumination and traffic signal poles. Extend the conduit beyond the face of curb and gutter, or as shown on the detail drawings. Conduit for service equipment ground rod conductors shall be 1/2 inch PVC Schedule 40.

Ground rods shall be installed diagonally into the foundations as described under 00960.50(b).

Group conduits in foundations so that, with the pole in place, it is possible to place an insulated bushing on each conduit end. On breakaway poles, do not extend the conduit above the slip plane of the base.

Place all conduit in the foundation. Surface-mounted conduit will not be accepted.

When a new conduit is required in an existing foundation, install the conduit by cutting a slot in the foundation, without cutting reinforcing steel, or by core drilling, as directed. Install the conduit and patch the opening with grout. Extend the new conduit far enough into the base of the pole to allow attachment of a ground clamp or bonding bushing. Bond the new conduit to the ground lug inside the pole with a No. 6 AWG copper bonding jumper. Do not damage the surrounding foundation or reinforcement during these operations. Do not use pavement-breaking equipment.

Install the conduit into an existing controller using an "LB" fitting and conduit hub through the controller riser frame.

(e) Underground Conduit Installation - Make conduit runs continuous between any pole, junction box, or cabinet. Do not cover conduit runs until inspected. Permanently mark all underground conduit runs by installing an underground marking tape directly over the conduit.

The underground marking tape shall be:

- A red polyethylene film, 6 inches wide, and at least 4 mils thick
- Imprinted with the following or similar legend: CAUTION CAUTION CAUTION BURIED ELECTRIC LINE
- Placed 6 inches ± 1 inch below the surface
- Continuous between pole bases, junction boxes and cabinet locations

Installation of HDPE conduit may be by drilling or open trench methods, or by plowing if approved. Minimum cover shall be 3 feet.
(f) **Elbows** - Use a standard factory bend where a conduit bend is required unless factory conduit bend sizes are not commercially available, or a special bend is required. Bends performed on the job or in the shop shall:

- Have a radius of at least 6 times the inside diameter of the conduit.
- Be bent without crimping or flattening.
- Be rigid metal conduit conforming to 02920.10(a), or 02920.10(b) if the bend is 45° or more, unless otherwise specifically permitted.

(g) **Conduit Ends and Couplings** - Ream the ends of all conduits whether cut in the shop or field, to remove burrs and rough edges. Make cuts square and true so the ends will fit together for their full circumference. Slip joints or running threads will not be allowed for coupling conduit. Use an approved threaded union coupling when a standard coupling cannot be used. Plug or cap all conduit ends until wiring is installed. After wiring is installed install duct seal compound or precut closed cell polyethylene foam that will prevent debris from entering the conduit system.

1. **Metallic Conduit** - Paint the following with rust-preventative coating:
   - Threads on all metal conduit
   - Areas where the coating has been damaged so underlying metal is exposed
   - Exposed, ungalvanized threads resulting from field cuts

   Tighten all couplings until the conduit ends are brought together throughout the entire length of the run.

2. **Nonmetallic Conduit** - Connect nonmetallic conduit with solvent welds. Use a nonmetallic female threaded connector to connect nonmetallic conduit to metallic conduit.

3. **Riser** - Provide and install conduit risers within junction boxes according to the following:

   Use PVC bell end fittings on all PVC conduit ends. Use insulated metallic bushings on all metal conduit ends. Ground bushings where metal conduit contains AC circuits; bushing on conduits containing only DC circuits need not be grounded. Bond conduit end bushings to the equipment ground wire, and connect the grounding bushings in the metal pole to the pole grounding lug with a jumper. Install insulated bushings on all metal conduits. For ground rod conduits, use push-on nylon/PVC bushings.

(h) **Conduit in Junction Boxes**:  

1. **General** - Install conduit in junction boxes according to the following:
   - Enter through the bottom of boxes where possible.
   - Enter the box from the direction of the run.
• Terminate conduit 1 inch inside the box wall when entering through the side walls.
• Use factory 90° galvanized rigid metallic bends.

(2) **Cast Iron Junction Boxes** - Conduit entrances into new or existing cast iron junction boxes shall:

• Use a watertight malleable iron hub for metal conduit entrances.
• Use a watertight malleable iron hub when NEMA 3R or NEMA 4 junction boxes are specified.
• Be cut with a hole saw.
• Repair damage to galvanizing of existing cast iron junction boxes as directed.

(3) **Concrete Junction Boxes** - Install conduit entrances into concrete junction boxes according to the following:

• Locate conduits near the end walls to leave the major portion of the box clear.
• Orient conduit ends towards the top of the box so that conductors may be pulled out of the conduit from the top of the box without touching the side of the box or other conduits.

(i) **Conduit Installed for Future Use** - If conduit is noted on the plans for future use, with no conductors installed, insert a yellow #12 AWG conductor and a coated polyester pull tape with at least 1250 pounds break strength. The pull line is to be replaced when new conductors are installed.

Include 3 feet of slack in the polyethylene line **within the conduit and 3 feet outside the conduit.**

(j) **Existing Conduit** - Use existing conduit only where shown. Clean existing conduit, without conductors, with a mandrel or cylindrical wire brush, and blow out with compressed air before incorporating into a new system. Where new junction boxes are placed in existing conduit runs, fit the conduit as specified in (h) above. Install bushings as specified in (g) above.

(k) **Conduit In or On Structures** - Install conduit in or on structures according as shown. Use expansion **fitting**s at all expansion joints in or on a structure.

(l) **Installation by Horizontal Directional Drilling** - If jointed conduit is used, verify the joints have not separated by pulling a mandrel through after installation.
00960.43 Foundations:

(a) General - Construct foundations for pedestals, posts and cabinets according to Section 00440 and the applicable portions of 00540(a). Place concrete:

- With a continuous pour.
- To the elevation shown or directed.
- With conduit ends and anchor rods held securely in proper vertical position, to proper height, with a manufacturer's recommended template until the concrete sets.
- Maintain rebar clearances during concrete pour.

Make no adjustment of anchor rods after concrete has set. Any adjustment made may be cause for rejection of the foundation.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until the concrete has set.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

00960.44 Junction Boxes:

(a) General - Install junction boxes at the approximate locations shown on the plans, or no more than 300 feet apart. The Contractor may, at no additional cost to the City, install additional junction boxes to facilitate the work.

The tops of junction boxes installed in the ground or in sidewalk areas shall be flush with the surrounding grade or top of curb. Where practical, place pull boxes shown behind curbs against the back of the curb. If installed in the roadway or shoulder, leave the top of junction box 1/2 inch below the pavement surface. If installed outside roadways or shoulders, install a Portland cement concrete apron around the junction box.

In boxes having an open bottom, construct a sump of reasonably well graded 3/4 inch - 0 crushed gravel, 4 inches deep covering the approximate area of the box. Do not install conductors until the sump has been constructed. All conduits shall have 10 inch clearance to the lid after the junction box is installed.

Bond all metal junction boxes and covers to form a continuous system with metallic conduit, grounding wire, metal standards and controller cabinets. Leave enough slack in the bond wire to the cover to allow complete removal of the cover.
(b) Junction Box Locations - Mark the location of all flush-mounted junction boxes installed in unsurfaced areas with a Type 1 delineator, placed 3 feet behind the box, or as directed. Use white targets with black, 3 inch, series “B” letters reading “JCT.BOX”. Reflectors are not required.

If junction boxes are installed in unpaved areas, install a Portland cement concrete apron even if not shown.

00960.45 Cable and Wire:

Arrange wiring neatly within cabinets and junction boxes. Use approved lubricants when inserting conductors in conduit. Before pulling wires through underground conduit runs, blow the conduit out with 120 cubic feet per second compressed air.

Before cable installation, clean all existing and new conduit with an approved cylindrical mandrel of the proper size for that conduit and blow out with compressed air. Mechanical pulling methods may be used for conduit cleaning.

Do not use tapes, straps, ties or other binding materials to bundle single conductors or cables together inside conduits or poles. Bundling of conductors or cables will be permitted at the terminating end points for pulling only.

Install pre-wired factory equipment according to the manufacturer's instructions.

Pull all wire by hand and on a straight line with the conduit opening to prevent damage to insulation. If pulls are made with poles or controller cabinet in place, use a pulley device to achieve a straight pull.

Use spade-type pressure connectors to connect all traffic signal conductors to terminal screws in cabinets.

Clearly label all conductors with associated circuits in sidewalk boxes, panels, and all splice points.

00960.46 Wiring Practices:

(a) General - Install electrical system and electrical system components in a neat and workmanlike manner;

(b) In-Line Fuse Holder - Insulate terminal ends using either heat shrink tubing or electrical insulating rubber tape over wrapped with electrical vinyl plastic tape as specified.

00960.48 Coating - Coatings shall conform to all applicable portions of Section 00594. Do not paint equipment fabricated of aluminum, stainless steel, or hot-dipped galvanized material, except as shown or specified.
00960.49 Electrical Services:

(a) General - Service points shown on the plans are approximate only. The exact location will be determined in the field. If service equipment is to be installed on utility-owned poles, position and attach the service equipment as required by the serving utility. Wiring connections to the terminal screws on the circuit breakers and contactors shall make full contact under the screw head. Install conduit and weather heads on the service pole as required by the local utility or as shown. Size and depth of power service conduit shall be as specified by the supplying power company responsible for maintaining the conduit.

Equip each service cabinet with a solid copper neutral bus and the number and size of switches or circuit breakers shown or specified. Install all overcurrent protection and relays as shown and according to the applicable portions of the NEC. Notify the local serving utility before making any contacts to utility poles.

Meter bases shall not be installed.

(b) Circuit Breakers - Provide circuit breakers of the rating shown or specified.

00960.50 Grounding and Bonding:

(a) General - Make all conduit, metal poles, grounding wire, metallic junction boxes, metallic junction box covers and cabinets mechanically and electrically secure to form a continuous, effectively grounded system. Bond together all rigid steel conduit ends that terminate at the same location. Bond the copper grounding electrode conductor between the metal poles to the grounding rod at each foundation. Use stranded conductors for all ground and bond wires.

Ground Rods shall be driven diagonally in all pole and controller foundations.

(b) Ground Rods - Construct accessible grounding conditions with electrodes of at least 5/8 inch x 8 foot nonrusting, copper covered, steel ground rods with bronze grounding wire clamps. Drive ground rods into the ground with the top about 6 inches below the finished grade at the ground rod locations. Install a separate ground rod for each electrical system that originates from a separate power source.

If approved, grounding rods may be driven diagonally. Where rock prevents full length driving, if approved, a buried galvanized iron or copper plate may be installed at the bottom of the concrete foundation hole. The plate shall be at least 2 foot square and 1/4 inch thick.

If resistance to ground is greater than 25 Ω, furnish and install a second ground rod, at no additional cost to the City. Place electrodes at least 6 feet apart.

If resistance to ground is greater than 25 Ω after a second rod is driven, additional grounding methods, as approved, will be paid as Extra Work according to 00196.

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Use No. 6 AWG copper wire to connect the ground rod to the electrical system.

(c) **Services and Cabinets** - Bond the neutral conductor, the control cabinets, and the metal base to the grounding electrode system. The ground rod for the service shall be in addition to the ground rod for a metal pole.

(d) **Structure Mounted Poles and Cabinets** - Bond all poles and cabinets mounted on structures or walls to a common ground rod at the end of the structure. Ground the system at the first convenient acceptable location off the structure.

For standard 4-bolt anchor base poles, provide a 1/2 inch, Type 308, 309 or 310 stainless steel stud on the inside of the shaft. Locate the stud directly opposite and level with the handhole in the pole. Attach grounding electrode conductors and bonding conductors to the stud with a grounding wire clamp, "acorn style", similar to what is used with ground rods in (b) above.

(f) **Wood Poles** - Bond all metallic conduit, messenger cable, terminal cabinet, and other metallic parts within 10 feet of the ground line.

(g) **Nonmetallic Conduit** - In all nonmetallic-type conduits, run a bond/ground wire continuously between all poles, pedestals, posts, and cabinets. Bond/ground wire shall be a green No. 8 XHHW copper wire or as required by NEC, or as shown. Bond wires are not required in conduit that only contains circuits that operate at less than 25 volts.

**00960.70 Electrical Energy** - Obtain the required permits and have the power service inspected by the City. Notify the Engineer to arrange for the utility to make the electrical hookup. Power consumption for traffic signals and illumination shall be flat-rated.

Electrical energy costs to operate traffic signals or illumination will be billed to the City or those named in the construction agreement. Do not use for construction purposes electrical energy billed to the City or other agencies.
00962.00 Scope - This work consists of furnishing, fabricating, galvanizing, and installing materials for illumination and traffic signal supports and foundations. The location of illumination/signal material shown is approximate, with exact locations established in the field.

00962.01 Regulations, Standards, and Codes - All designs and workmanship shall conform to the following standards where applicable:

- AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- AWS D1.1

Wherever reference is made to any of the standards mentioned above, the reference means the code, order, or standard in effect on the date the Project is advertised unless otherwise shown or specified in the Specials Provisions.

Do not begin installations until all permits are obtained and copies are given to the Engineer.

00962.02 Calculations and Drawings - Within 30 calendar days after execution of the Contract, submit at least 3 copies of:

- Pre-approved manufacturing shop drawings
- Calculations and shop drawings of all nonstandard poles
- Calculations and installation drawing of all nonstandard pole foundations

All engineered details and drawings which are not prepared by the City, but are required in the Contract Documents, shall be submitted for review prior to fabrication. Designs, details, plans, and calculations shall be stamped and submitted according to 00150.35.

Upon completion of the installation, submit one copy of all changes made from the original plans. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

00962.05 Design - Design all traffic signal and illumination poles according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

<table>
<thead>
<tr>
<th>Basic wind speed (3 second gust)</th>
<th>100 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gust factor (G)</td>
<td>1.14</td>
</tr>
<tr>
<td>Importance Factor (Ir)</td>
<td>1.0 (50 year recurrence interval)</td>
</tr>
<tr>
<td>Fatigue Category</td>
<td>II</td>
</tr>
<tr>
<td>No Galloping, Truck Speed</td>
<td>50 mph</td>
</tr>
</tbody>
</table>

### (b) Traffic Signal Strain Pole Supports

<table>
<thead>
<tr>
<th>Basic wind speed (3 second gust)</th>
<th>100 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gust factor (G)</td>
<td>1.14</td>
</tr>
<tr>
<td>Importance Factor (Ir)</td>
<td>1.0 (50 year recurrence interval)</td>
</tr>
</tbody>
</table>

Fatigue design is not required.

### (c) Illumination Supports
- Design non-standard Luminaire slip base, and fixed base poles and foundations according to the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 1994". Design factors include:

| Basic wind speed (fastest mile per hour) | 100 mph |

### Materials

<table>
<thead>
<tr>
<th>00962.10 Materials</th>
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</thead>
<tbody>
<tr>
<td>Furnish materials meeting the following requirements:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anchor Rods</th>
<th>02560.30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Grade Concrete</td>
<td>00440</td>
</tr>
</tbody>
</table>

Furnish steel pole materials meeting the requirements of Section 02530 modified as follows:

- Provide steel sheet for pole and arms meeting the requirements of ASTM A 595 Grade A or B or ASTM A 572, or approved equal.
- Provide all other steel sheet and plate meeting the requirements of ASTM A 36 or ASTM A 572, or approved equal.
- Supplementary Requirement S18 (ASTM A 6), maximum tensile strength, is required.

### Construction

<table>
<thead>
<tr>
<th>00962.41 Excavation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect all existing pipes that become a part of a foundation as directed by the Engineer or local utility company.</td>
</tr>
</tbody>
</table>

Do all excavation, backfilling and resurfacing work necessary to complete the work. This includes removal and replacement of curbs, sidewalks, paved surfaces and other materials. On completion of the work, replace and finish all surfaces to correspond with the existing surfaces.
Furnish, place, and remove any shoring required to prevent caving of walls.

When excavating in paved areas, cut with an approved pavement cutting saw to a depth of at least 2 inches along the neat boundaries of the area to be removed. Cut sharp and well-defined pavement edges with no evidence of cracking, delaminating, or stressing.

Restore all disturbed landscaping and underground systems to original condition upon completion of the work at no additional cost to the Agency. Use hand excavation if directed.

(a) **Excavation for Poles Foundations** - Make all excavations for pole foundations to the neat lines of the foundations. Hand excavation may be required. Place the concrete directly against the sides of the excavation in undisturbed or well-compacted material.

(b) **Disposition of Waste Materials** - On completion of the work, dispose of all waste materials according to 00330.41(a)(5).

**00962.43 Foundations** - Construct foundations according to Section 00440 and the applicable portions of 00540.48(a). Place concrete as follows:

- With a continuous pour.
- To the elevation shown or directed.
- With conduit ends and anchor rods held securely in proper vertical position and height with the manufacturer’s recommended template until the concrete sets.

Make no adjustment of anchor rods after concrete has set. Any adjustment made may be cause for rejection of the foundation.

Maintain rebar clearances during concrete pour.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until removed. Use a steel template to accurately locate the anchor rods and hold them plumb and in proper alignment. Out-of-position anchor rods and anchor rods installed more than 40V:1H out of plumb is cause for rejection of the foundation. Field bending of anchor rods and field modification of the base plate are not allowed.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

Where obstructions prevent the construction of planned foundations, construct the foundations in the location directed. Any extra cost due to the site change will be paid according to Section 00196.
If it is determined that foundations will extend deeper than shown, the extra foundation depth will be paid according to Section 00196.

(a) Treatment for Aluminum-Concrete Contact - If aluminum poles are used, furnish anchor rods, nuts, and washers as specified for steel poles.

Separate the aluminum from the concrete with 1 layer of 30 pound non-perforated, asphalt-saturated felt. Neatly trim the felt pad to the size and shape of the base contact surfaces.

00962.46 Metal Illumination and Signal Poles - Metal poles include vertical posts, signal mast arm, luminaire arms, connection hardware, and anchor rods. Do not erect poles until the Engineer has made a visual inspection of pole welding.

Fabricate entrance openings in metal poles and arms, including handholes, before galvanizing, except as shown for mounting traffic signal material.

Four standard anchor rods each fitted with hex nuts and washers shall be furnished with each pole.

Galvanize steel illumination and traffic signal poles, mast arms, luminaire arms, fittings, hardware, assemblies and appurtenances after fabrication.

City of Portland Signals and Street Lighting staff will mark traffic signal pole locations in the field.

(a) Metal Illumination Poles - Design all metal poles with self-supporting upsweep arms similar to the details shown.

(1) General - Identify all poles, arms and anchor rods by pole number, catalog number, and contract number. Before poles are ordered, submit to the Engineer, catalog cuts of approved drawings of poles, including anchor rod and bolt circle information.

All illumination poles with a resulting mounting height of 24 feet or more shall have a reinforced hand hole with a minimum overall dimension of 4 inches x 6 inches. All illumination poles with a resulting mounting height of less than 24 feet shall have a hand hole with a minimum overall dimension of 3 inches x 5 inches. The bottom of the hand hole shall be approximately 18 inches above the bottom of the pole base. The hand hole shall be positioned 90° to the bracket arm, faced away from approaching traffic in the adjacent roadway lane. A cover that matches the pole shall be provided for the hand hole. The cover shall be secured to the pole with stainless steel allen-head screws.

The interior of the pole at the top of the shaft shall have an open-on-top hook attached at 90° to the mast arm opening.

Each pole shall be equipped with a removable metal ornamental pole cap secured to the shaft with stainless steel screws, and nut covers or full base covers finished to match the pole shaft. Cover shall be attached to the shaft with stainless steel allen-head screws.
Each pole shaft shall have an internal lug nut, or 5/8 inch hole for the purpose of attaching a grounding conductor.

All nuts, bolts, and washers shall be made from passivated stainless steel except for anchorage hardware.

(2) Aluminum Illumination Poles:

a. General - Fabricate aluminum poles from one piece of seamless aluminum alloy tapered tubing conforming to ASTM B 241M, Alloy 6061-T6 or 6063-T6 with a minimum wall thickness of 0.156 inch.

The base flange for the attachment of the shaft to the foundation shall be one-piece cast socket of aluminum Alloy 356-T6. The flange shall be joined to the shaft by means of complete circumferential welds, externally at the top of the flange, and internally at the bottom of the shaft tube. Anchor rod covers shall be made of aluminum Alloy 43.

The surface finish shall be natural "satin" or anodized (Dark Bronze) aluminum, as specified.

b. Aluminum-Concrete Contact - Felt used between aluminum and concrete contact surfaces shall conform to ASTM D 226, except that testing shall be limited to weight requirements (minimum 26 pounds per 100 square feet) only. Acceptance of felt will be according to 00165.35.

(3) Steel Illumination Poles – All poles shall be round unless otherwise specified by the Engineer. All poles and arm entrance fittings shall be of the type shown on plans or specified and shall be welded into the pole or arm. Fabricate all pole and arm entrance fittings, including handholes, before galvanizing. Grind all exposed butt-welds flush with the base metal before poles are galvanized.

Pole assembly dimensions and thickness shall be as shown in the plans. All tube thicknesses shall consist of a single ply of steel, no multi-ply shafts shall be utilized. No alternate sizes will be accepted. All pole assemblies shall be galvanized. Prior to galvanizing, the pole manufacturers shall submit mill certificates verifying silica content to the Engineer and the galvanizer.

Submit detail drawings of poles for approval prior to fabrications.

(4) Ornamental Poles - Ornamental poles and castings shall conform to the "City of Portland Specifications and Standard Drawings for Ornamental Light Poles". Materials which are received that do not conform to these specifications will be rejected.

(5) South Waterfront Steel Combination Poles – All poles and mast arms shall be fabricated from coil or plate conforming to ASTM A 595 Grade A or ASTM A 572 Grade 65.
The pole shall be round in cross section and have a constant linear taper of 0.14 inch/foot. The shaft shall be one piece, and contain no circumferential welded butt splices. The longitudinal weld seam shall be ground flush with the pole shaft after fabrication. Laminated tubes are not permitted. All pole shafts up to 50 feet in length shall be manufactured and shipped in one piece. The pole shall have a reinforced handhole with cover located 2 1/2 feet above the pole base.

At mast arm connections, the pole diameter/thickness ratio (D/t) shall not exceed 52 for A 595 Grade A tubes or 66 for A 572 Grade 65 tubes. Each pole shall be provided with a steel pole top cap secured in place with set screws. The pole top cap shall have a 0.75 inch half coupling welded into the top plate of the cap. The pole shall be hot dip galvanized to the requirements of either ASTM A 123 (fabricated products) or ASTM A 153 (hardware items).

The mast arm shall be round in cross section and have a constant linear taper of 0.14 inch/foot. The longitudinal weld seam shall be ground flush with the mast arm shaft after fabrication. All mast arm shafts up to 50 feet in length shall be manufactured and shipped in one piece. Circumferential welded tube butt splices and laminated tubes are not permitted. Each arm shall be provided with a zinc die cast end cap secured in place with set screws. The mast arm shall be hot dip galvanized per the requirements of this specification.

Base plates shall conform to ASTM A 36 with a minimum yield strength of 36 ksi or ASTM A 572 Grade 50 with a minimum yield strength of 50 ksi. Plates shall be integrally welded to the tubes with a full penetration butt welded joint with an internal back-up ring.

(b) Steel Traffic Signal Poles:

(1) General - All poles shall be 8-sided in cross section unless otherwise specified by the Engineer. Alternative cross section shapes shall be considered special design poles and require submission of pole design calculations per the above criteria. All poles shall have a hand hole with a minimum overall dimension of 4 inches x 6 1/2 inches. The reinforcing frame shall be as shown on the base plate detail drawings. The bottom of the hand hole shall be not more than 7 inches above the bottom of the pole base.

Poles, as indicated on the plans shall have a recessed terminal cabinet with a minimum overall dimension of 7 inches x 30 inches. The reinforcing frame shall be as shown on the base plate detail drawing. The bottom of the recessed terminal cabinet shall be 48 inches above the bottom of the pole base.

Pole assembly dimensions and thickness shall be as shown in the plans. All tube thicknesses shall consist of a single ply of steel, no multi-ply shafts shall be utilized. No alternate sizes will be accepted. The height of strain poles and mast arm poles and the length of mast arms shall be as indicated on the plans.
All steel used in the pole assemblies including base plates, flange plates and gusset plates shall have a yield strength of at least 50 ksi.

All pole assemblies shall be galvanized. Prior to galvanizing, the pole manufacturers shall submit mill certificates verifying silica content to the Engineer and the galvanizer.

Submit detail drawings of poles for approval prior to fabrications.

(2) Design:

<table>
<thead>
<tr>
<th>Strain Poles</th>
<th>All strain poles shall be furnished with pole tops.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type 1 Strain Poles</strong></td>
<td>Type 1 strain poles shall be tapered 8 or 12 sided faceted and shall, as a minimum, be fabricated of 5/16 inch weldable plate or coil steel. The pole diameter shall not be less than 12 1/2 inches and shall be tapered at 0.14 in/ft. The pole base plate shall be 2 inches thick and 18 1/2 inches square.</td>
</tr>
<tr>
<td></td>
<td>Type 1 strain poles shall be mounted on the footing shown on Standard Drawing P-606. This footing utilizes four 2 1/4 inches x 48 inches ASTM F1554 Grade 36 anchor rods on a 18 inches bolt circle. The base plate on the Type 1 strain pole shall be able to accommodate this bolt pattern as well as the &quot;old standard,&quot; 1 3/4 inches diameter bolts on a 16 1/2 inches bolt circle. See Standard Drawing P-604 for base plate detail.</td>
</tr>
<tr>
<td><strong>Type 2 Strain Poles</strong></td>
<td>Type 2 strain poles shall be tapered 8 or 12 sided faceted and shall, as a minimum, be fabricated of 3/8 inch weldable plate or coil steel. Pole diameter at the base shall not be less than 14 inches and shall be tapered at 0.14 in/ft. The pole base plate shall be 2 1/2 inches thick and 21 1/2 inches square.</td>
</tr>
<tr>
<td></td>
<td>Type 2 strain poles shall be mounted on the footing shown on Standard Drawing P-607. This footing utilizes four 2 3/4 inches x 60 inches ASTM F1554 Grade 36 anchor rods on a 20 inches bolt circle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mast Arm Poles</th>
<th>Mast arm poles shall be tapered 8 sided faceted unless otherwise indicated on the plans and shall be fabricated of weldable plate or coil steel of the minimum size shown on the drawings.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The length of the mast arm pole shaft from the base plate to the center of the mast arm shall be indicated as the dimension (RISER) on the mast arm clearance calculations shown on the plans.</td>
</tr>
<tr>
<td></td>
<td>There are three types of mast arm poles: Type 1, Type 2 and Type 3. Each pole type may have a single street light luminaire arm.</td>
</tr>
</tbody>
</table>
• Type 1 mast arm poles shall be mounted on the footing shown on Standard Drawing P-606. This footing utilizes four 2 1/4 inches x 48 inches ASTM F1554 Grade 55 anchor rods on a 18 inches bolt circle. See Standard Drawing P-604 for base plate detail.

• Type 2 mast arm poles shall be mounted on the footing shown on Standard Drawing P-607. This footing utilizes four 2 3/4 inches x 60 inches ASTM F1554 Grade 55 anchor rods on a 20 inches bolt circle.

• Type 3 mast arm poles shall be mounted on the footing shown on Standard Drawing P-607. This footing utilizes four 2 3/4 inches x 60 inches ASTM F1554 Grade 55 anchor rods on a 22 1/2 inches bolt circle.

All mast arms up to 40 feet in length shall attach to the pole riser shaft using a flange plate connection as shown in detail on Standard Drawing P-604. All mast arms greater than 40 feet in length shall attach to the pole riser shaft using a flange plate connection with reinforcing rings as shown in detail on Standard Drawing P-604. The mast arm shall be inserted into the mast arm flange plate and shall be circumferentially welded inside and outside. The mast arm flange plate shall be perpendicular to the centerline of the mast arm. The pole flange plate shall be welded to the pole at the designated angle using 5/16 inches thick gusset plates. The gusset plates shall form a water tight “box” after welding is completed. Vent holes shall be cut into the pole inside the gusset “box” to allow proper ventilation for galvanizing. A 3 inch STD pipe wire guide shall be welded into the center of the pole flange and shall protrude into the pole.

All mast arms greater than 45 feet in length shall have an arm taper of 0.16 inch per foot in order to limit pole vibration.

(3) Mast Arm - Mast arm shall match the pole style. When attached to the mast arm riser pole at the flange plate joint, the mast arm and the straight stub tube will form a geometric figure composed of three segments. Starting from the mast arm riser pole, the first segment will be an angled straight section. The second section is a curved section of constant radius tangent to the first and third sections. The third section is a straight section that is a maximum of 4° above horizontal when the mast arm is unloaded and a minimum of 1° above horizontal when fully loaded.

When the mast arm assemblies are installed and all the cabling, signals and signs are in place, the elevation difference between the top of the foundation and the end of the arm will be at a minimum the value shown on the plans in the mast arm clearance calculations. This value may be higher by up to 3% of the mast arm length but not less than the value given.
A pipe tenon shall be installed by the manufacturer for each signal and sign, as shown on the plans. The placement of the tenon on the arm shall be on the side of the arm facing the approaching traffic as described in the pole schedule. Holes installed in the tenons for the required through bolts shall be field drilled.

Field installed pipe tenons shall be Pelco AB-3008 Clamp Kits or approved equals. The placement of the tenon shall be on the side of the arm facing the approaching traffic as shown on the plans. Field drill and tap a 1 inch hole for the wiring entrance and install a short nipple and bushing prior to installing the tenon clamp kit. Field drill holes in the tenon for through bolts that connect the plumbizer.

(c) Pole Height - Before poles are ordered, the Engineer will check the pole heights in the field and verify that the specified luminaire mounting heights above pavement are provided. Provide upsweep bracket arms of lengths shown in the Metal Light Pole Table or shown on the plans. Provide traffic signal poles of heights as shown or specified. Height of poles requiring slip plate bases is the length of shaft above the slip plate.

(d) Mast Arm Installation - Install mast arms for traffic signals and signs according to details provided by the manufacturer. Use proper type and size of mounting appurtenances that correctly fit the pole furnished, or as shown. All mast arms shall allow wiring entrances directly into the pole from inside the mast arm.

(e) Luminaire Arm Installation - The luminaire end of the arm shall be level when loaded to design weight. Use a bolted, flange-type connection to join the upsweep arm to the pole. The connection shall be raintight and shall develop the strength of the arm. Arms shall be self-supporting without tie rods, or braces. Provide tapered arms that are round, similar in design shown on plans. All arms shall allow for wiring entrances directly into the pole from inside the arm.

All pole bracket attachments for mounting upsweep arms shall have reamed, smooth ends.

The nominal mounting height (MH) shown on the plans is the distance between the roadway at the edge of the pavement and the luminaire. This height may vary plus or minus 1 foot.

(f) Deflection - The horizontal dead load deflection at the top of the poles shall not exceed 1% of the pole length (2% for strain poles).

(g) Deviation from Straightness - After the poles are delivered to the jobsite, and before they are erected on the foundations, the Contractor may be required to check any or all poles for deviation from straightness according to the following:
(1) Deviation in One Plane and One Direction Only - A straight line joining the surface of the pole at the base and the same surface of the pole at the top shall not be more than 1/2 inch from the surface of the pole for each 10 feet of length from the closest of these points. The opposite surface shall meet the same requirement.

(2) Deviation in Any Plane - A straight line connecting the midpoint of the pole at the base, with the midpoint at the top, shall not pass through the surface of the pole at any intermediate point.

Any pole not meeting these requirements will be rejected. If more than 25% of the poles fail to meet these requirements, sufficient cause exists to reject the entire shipment of poles for the Project.

(h) Welding - Weld illumination and signal poles according to AWS D1.1. The fabricator shall inspect welds according to details and requirements called out in the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 5.15 Welding Connections in AASHTO “Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals”. Submit all testing procedures for Engineer’s review prior to starting inspection. Submit certified copies of inspection reports to the Engineer for review.

If requested, additional weld inspection may be required upon arrival of the material at the job site. If defects are found by this additional inspection, the fabricator shall be responsible for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.

(i) Welding Steel After Galvanizing - No field welding of galvanized steel will be allowed. The effected piece shall have the existing galvanizing removed from the heat effected area before welding. Perform the weld, remove the galvanizing totally from the entire piece and hot-dip galvanize it. Submit the following data, stamped according to 00150.35 for review:

- Explanation for the modification
- Name of shop performing the work
- Welding procedure
- Description of the work that will be performed
- Name of the shop performing the hot dip galvanizing

(j) Erecting Metal Poles - Erect metal poles on concrete foundations and according to the recommendations of the pole manufacturer and as shown. Exercise reasonable care to prevent marking the finish and damaging poles.

Install all joint traffic signal and illumination poles so the distance from the pavement to the light center is as shown or specified. Use the same tapered design for traffic signal and street light arms.
Bolt protrusion on slip base poles shall not interfere with the breakaway action of pole. File sharp edges smooth and repair according to ASTM A 780.

Mast Arm Poles shall be raked away from the resultant load before loading. After all appurtenances have been attached, the pole will be plumb or slightly raked away from the load. A 1 inch wide weep channel shall be provided on the lowest face of the grout pad.

Pipe Post and Frangible Base Pedestals shall be provided with a 1 inch wide weep channel on the lowest face of the grouted pad.

Street light poles shall be provided with a short section of 1/2 inch diameter plastic pipe as a weep channel on the lowest face of the grout pad.

Dry-pack non-shrink mortar shall be placed as grout material under the pole base plates to be completely fill the space the base plate, castings (where applicable), and around the conduits and ground rod. Dry-pack non-shrink mortar shall consist of 1:3 mixture of cement

Furnish steel or aluminum poles as shown or specified. Luminaire poles may be of different material and design than traffic signal poles, but poles for similar use must be of same material and design.

1. Repair Damaged Finish - Repair damaged galvanizing according to ASTM A 780. Minor scratches less than 3 inches long by 3/16 inch wide or an area of 1/2 square inch can be repaired with the sprayed zinc method.

2. Assembly of Supports and Bolt Tightening - Nuts shall have full thread engagement.

   a. Anchor Rods for Signal Supports and Fixed Base Luminaire Supports - After foundation concrete strength and curing requirements are satisfied and after inspection of the foundation, pole installation may begin.

      Lubricate anchor rods and nuts according to 02560.70. Estimate the required rake, if any, and set the lubricated leveling nuts accordingly, so that when pole installation is complete and all appurtenances are installed on the pole, the top of the pole is plumb with the base of the pole.

      Lift the pole into position on the leveling nuts and washers. Make sure all leveling nuts and washers are in full contact with the base plate.

      Install washers and lubricated top nuts, and bring to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Several passes may be required to obtain uniform snug tightness.
When all anchor rods are snug tight, proceed with installation of arms and other appurtenances, if not previously installed. When installation of arms and appurtenances is complete, and the pole is plumb as defined above, final anchor rod tightening may begin. If the pole is not plumb, adjust as required and repeat snug tightening as described above. As a safety measure, provide crane support of the pole until anchor rods tightening is completed.

Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate each top nut past snug tight by the amount shown in “a.” below. Several passes may be required to obtain uniform final tightness. “Cheater” bars or slugging wrenches are allowed if required for large diameter anchor rods.

b. High-Strength Bolts in Mast Arm-to-Pole Connections and Luminaire Arm-to-Pole Connections - Lubricate high-strength bolts according to 02560.70. Provide all high-strength bolts with hardened flat washers under the element turned during tightening.

If arms or appurtenances are attached after pole erection, support them until bolts are snug tight. Install high-strength 4-bolt connections to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate the top nut of each anchor rod past snug tight by the amount indicated in paragraph “b” below. Several passes may be required to obtain uniform snug tightness.

Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate each top nut past snug tight by the amount shown in “c.” below. Several passes may be required to obtain uniform final tightness.

c. Final Tightening - Required final tightening of anchor rods and high-strength bolts are shown in the following Table:

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Rotation Past Snug Tight</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F 1554 Gr. 55 Anchor rods</td>
<td>30° (1/12 turn)</td>
</tr>
<tr>
<td>ASTM A 449 Anchor rods</td>
<td>60° (1/6 turn)</td>
</tr>
<tr>
<td>ASTM F 1554 Gr. 55 Anchor rods</td>
<td>60° (1/6 turn)</td>
</tr>
<tr>
<td>ASTM A 325 4-bolt connection</td>
<td>60° (1/6 turn)</td>
</tr>
</tbody>
</table>

(3) Bolt Inspection - The Engineer will observe the installation and tightening operations to ensure that proper procedures are followed. All inspections will be visual and no testing will be conducted.

Top surface of bolts or rods that are not flush or extend passed the top of the nut requires the rejection of the installation.
Coating: Coatings shall conform to all applicable portions of Section 00594. Do not paint equipment fabricated of aluminum, stainless steel, or hot-dipped galvanized material, except as shown or specified.

Galvanized and Aluminum poles and castings shall be cleaned with a solvent (xylene or MC thinner to remove any oils and contaminants, wiped dry, and sanded to abrade the surface prior to applying primer. The poles and castings shall be primed by the pole manufacturer with 3 mil DFT (dry film thickness) on all exterior surfaces with one coat of Wasser MC-Ferrox B, and allowed to cure for a minimum of 6 hours prior to applying the top coat.

The poles and castings shall have a field applied top coat with 3 mil DFT of Wasser paint in accordance with the manufacturer’s recommendations and Steel Structure Painting Council SSPCPA-1 Good Painting practices. The top coat color shall be as indicated on the plan set. Current paint colors include:

- Transit Blue MC-Luster (W21.0233)
- Historic Black MC-Luster (W21.79)
- Portland Green MC-Luster (W21.0227)
- Gold MC-Luster (W21.0226)
- Cascade Green MC-Luster (W21.0225)
- Chinatown Red MC-Luster (W21.0261)
- Silver MC-Luster (W21.82)
- Transit Mall Dark Silver MC-Luster (W21.8002)

Post “WET PAINT” signs near each pole.

Spray application will not be permitted at any time.

Grounding and Bonding:

Metal Poles - Install a ground rod at each pole. At each pole location, supply and install a grounding electrode conductor from a lug inside the pole to the ground rod clamp at the ground rod. Bond all conduit within the pole together and to the ground rod. Use No. 6 AWG copper bond wire.

Each metal pole shall be bonded to all attached messenger cable by means of a bond wire from a pressure clamp on the cable to a grounding bushing outside of and on the bottom of the terminal cabinet or attached to the pole if there is no terminal can. Do not take the bond wire inside the cabinet.
In sidewalk or other areas where the ground rod cannot be made accessible, the ground rod may be driven diagonally through the foundations of fixed anchor base poles. If this method is used, drive the ground rod at least 4 feet into earth and leave at least 3 inches exposed through the top of the foundation. Bend the rod so that the exposed end is vertical and near the center of the pole. Connect the steel reinforcing cage to the ground rod using a No. 6 AWG copper wire. Securely clamp the wire to the reinforcing steel, through the ground rod clamp, and to the pole grounding lug. Do not use this method on slip base poles.
Section 00970 - Illumination

Description

00970.00  **Scope** - In addition to requirements of Section 00960 and Section 00962, install illumination according to the following Specifications.

00970.03  **Luminaire Submittal** - Provide a sample luminaire for inspection and photometric testing if required. Sample luminaires may be considered as part of the shipment furnished for installation.

Construction

00970.41  **Metal Light Pole** - The metal light poles for the Project are shown on the illumination plans.

00970.42  **Cable and Wire** - Use type XHHW stranded copper wire in all current-carrying conductors in raceways. Support the conductors at the top of the pole using a flexible metal cable support grip to prevent insulation damage at the upsweep arm opening. When splicing into a new or existing circuit at a pole base (minimum wire length: 18 inches outside handhole), install a watertight, in-line fuseholder in the pole base for each ungrounded wire going up the pole. This fuseholder shall conform to the requirements of 02920.26 and be constructed so the wire to the ballast can be disconnected without cutting or disconnecting wiring at the ballast.

Use No. 10 AWG Type XHHW wire from the control cabinet to the photoelectric relay.

Use 3 conductors No. 10 Type TC cable from the pole base to luminaire ballast. Use 2 conductors for luminaire ballast connection and 1 conductor for circuit grounding the luminaire. Extend and securely connect electrical circuit grounding for each circuit connected to the luminaire end.

Wires from the ballast to the lamp holders shall conform to the manufacturer’s recommendations.

00970.43  **Photocontrol Electronic Relay** - Equip the photocontrol electronic relay for either luminaire, wood pole or metal pole mounting as shown or specified.

Use a pole-top mounted, photocontrol electronic relay with twistlock plug where shown or specified. Furnish and install a pole-top, slip-fit adaptor with terminal board. Securely fasten the pole-top adaptor to the pole top with setscrew studs, and follow EEI-NEMA specifications for mounting tubeless control units.

Use 3 conductors No. 10 Type TC cable from the pole base to luminaire ballast. Use 2 conductors for luminaire ballast connection and 1 conductor for circuit grounding the luminaire. Extend and securely connect electrical circuit grounding for each circuit connected to the luminaire end.
Wires from the ballast to the lamp holders shall conform to the manufacturer’s recommendations.

00970.44 Luminaires - Level luminaires on the upsweep arms in both the transverse and the longitudinal direction, as recommended by the manufacturer.

On roadway grades greater than 4%, orient luminaires on the upsweep arm so that the light beams strike the pavement equidistant from the luminaire.

(a) Mounting Height - Mount luminaires at heights shown. Measure the nominal mounting height from the top of the nearest edge of pavement to be lighted to the center of the luminaire.

(b) Lamp Marking - Mark the month and year the lamp is installed on the lamp base dating system with a sharp instrument.

(c) Lamp Size and Identification Decals:

(1) Identification Decals for High-Intensity Discharge Lamps - Indicate the lamp size and type with a NEMA-approved decal on each luminaire as specified below. Apply decals on clean and prepared surfaces. Use decals that provide a durable, legible surface for the life of the luminaire, and:

- Are at least 3 inches square
- Are made of noncorrosive, pressure sensitive material
- Have a colored background with black numbers as shown in Table 00970-1

For pole-mounted cobrahead and shoebox style luminaires, install the decals on the bottom side of the luminaire so as to be readily visible from the ground.

For wall-mounted luminaires, install the decals vertically on the luminaire housing or adjacent to the luminaire on the wall, as directed.

For pendant-mounted luminaires, install the decals horizontally on the ballast housing or externally at the top portion of the reflector if a remote ballast installation.

(2) Lamp Size and Identification Decal Code - Use the lamp size and color codes that conform to the following:
Tables 00970-1 A and B - Lamp Decal Code
High Intensity Discharge Lamps

TABLE 00970-1 A

<table>
<thead>
<tr>
<th>Lamp Wattage</th>
<th>Identifying Number</th>
<th>Lamp Type</th>
<th>Background Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>5</td>
<td>Clear Mercury</td>
<td>Blue (Light)</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
<td>Phosphor-Coated Mercury</td>
<td>White</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
<td>High Pressure Sodium</td>
<td>Gold - Yellow</td>
</tr>
<tr>
<td>150</td>
<td>15</td>
<td>Clear Metal Halide (^1)</td>
<td>Red</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
<td>Phosphor-Coated Metal Halide (^1)</td>
<td>Green</td>
</tr>
<tr>
<td>250</td>
<td>25</td>
<td>Induction Lamp</td>
<td>Orange</td>
</tr>
<tr>
<td>400</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) In addition, metal halide lamp targets shall include a 1/2 inch wide by 3 inch long strip of pressure sensitive, flat top, wide angle reflective tape to show lamp burning position requirements. Apply tape 1/2 inch from the lamp size target as follows:

Lamp Burning Position | Target Color
---|---
Any Position | None
Base up to horizontal | None
Base down to horizontal | Gold
Position-oriented-mogul socket (POM) | Red

Maintenance

**00970.60** Maintaining Existing and Temporary Illumination Systems - Protect existing illumination systems and approved temporary replacements. Shutdown of a system may be allowed for alterations or final removal, as approved. Lighting system shutdowns shall not interfere with the regular lighting schedule unless otherwise permitted. Notify the Engineer before performing any work on existing systems.

Determine the exact location of existing conduit runs and pull boxes before using equipment that may damage such facilities or interfere with any system.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, keep the existing systems in operation until the final connection to the modified circuit is made. The modified circuit is to be complete and operating by nightfall of the same day the existing system is disconnected.

Finishing and Testing

**00970.70** Field Test - After the lighting systems has been installed and energized, and prior to final acceptance, operate the system for 7 days under normal conditions (off during the day, on at night). Notify Street Lighting Inspector 48 hours in advance of start of the 7 day test.
Measurement

00970.80 Measurement - No measurement of quantities will be made for work performed under this Section.

The estimated quantities of lighting poles and arms will be listed in the Special Provisions. If plan changes by more than 3 feet are made to pole lengths or arm lengths or if field verified pole lengths or arm lengths increase or decrease by more than 3 feet, adjustments will be made according to 00970.10. Adjustments will be made only for the increased or decreased length greater than 3 feet.

Payment

00970.90 Payment - The accepted quantities of work performed under the Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pole Foundations</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Lighting Poles, Fixed Base</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Lighting Poles, Slip Base</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Lighting Pole Arms</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(e) Luminaires, Lamps and Ballasts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) Switching, Conduit, and Wiring</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(g) Refurbishing and Reinstalling Existing Illumination Systems</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Item (a) includes all concrete foundations for lighting poles.

Item (f) includes all switches, conduit, cabinets, wiring, delineators and other items required to construct the lighting system as specified.

Item (g) includes all refurbishing, reinstalling, and other work as specified and not included in the removal of existing illumination.

Payment will be payment in full for furnishing and placing all materials, and furnishing all equipment, tools, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for labeling the lights or poles.

If shown or specified as part of the work for concrete bridges or retaining walls, all conduit, junction boxes, cabinets and other items permanently encased within concrete bridges and retaining walls, as well as pole foundations incorporated in a bridge or wall, will be included in payment made for the appropriate bridge and wall items.

00970.92 Electrical Energy Costs - All electrical energy costs for the lighting systems or subsystems will be paid for by the City.
Scope - In addition to requirements of Section 00960 and Section 00962, install traffic signals according to the following Specifications.

Cable and Wire:

(a) General - Install wire and cable according to 00960.45 and the following:

Install wire between pole or pedestal bases and terminating points without splicing. Install control cable from signal spans to terminal cabinets without splicing. Do not use junction boxes for splicing, except for loop wire splicing of loop wires to loop feeder cables.

Leave slack in each wire and cable at each pull box, pole, and controller cabinet as follows:

- 2 feet in pull boxes and poles
- 6 feet in controller cabinets
- 6 feet in the first pull box nearest the controller

Control cable shall be No. 14 stranded copper conductors and shall be used for all intersection wiring inside poles and conduits. Individual wires shall not be used except for power service.

Tape the ends of extra conductors with insulating vinyl plastic tape.

(b) Control Cable Attachment - Use self-locking plastic straps to attach control cables to the messenger cable. Tighten to remove gaps between the control cable and the messenger cable. After tightening, trim all excess material neatly.

(c) Messenger Cable - Attach messenger cable at least 6 inches below the top of the pole, unless otherwise shown or specified.

Use an eyebolt and StrandVise® to attach messenger cable to City-owned wood poles. Install a 2 inch x 2 inch washer between the eye and the pole.

Make attachments to utility-owned poles according to the local utility company’s regulations and under its supervision.

Do not weld eyebolts to poles. Install the eyebolts through the entire pole. Pull the shoulder of the eye tight against the front face of the pole.

(d) Tether and Stabilizer Cable - Tighten cables to limit signal and sign movement. Install City-furnished S-hooks between the eyebolt and turnbuckle.
(e) Interconnect Cable:

(1) **Labels** - Label all interconnect cable with approved bronze or plastic labels, permanently and ruggedly attached. The labels shall be embossed with the cable identification number if shown. Additionally, labels used on utility facilities shall bear the legend “TRAFFIC SIGNAL”. Label all ends of cables. Label all overhead cable in each direction away from the point of attachment, 2 feet from utility poles. Do not install labels until the Engineer approves the labels and attachment mechanism. Label all cables in the interconnect terminal cabinets and at terminal panel locations.

Splices or breaks in the interconnect cable and shield will not be permitted except as shown.

Use terminal cabinets for aerial pole entrance of interconnect cable.

(2) **Interconnect Cable Installation:**

Use approved cable guides, feeders, shoes and bushings to prevent damage to the cable during installation. Do not pull cable over edges or corners, over or around obstructions or through unnecessary curves or bends. Cable shall enter the box or cabinet directly from the reel or storage stack. Pull directly out of the next downstream box or cabinet.

(3) **Aerial Cable** - Use terminal cabinets for aerial pole entrance of interconnect cable.

Match the sag as closely as possible with wires already on poles to minimize movement in windstorms and conflict with adjacent wires.

Use a cable grip on the jacketed messenger when pulling and tensioning. Pull and tension cable without damaging the jacket. When separating the messenger on figure-8 cable from the jacketed conductor assembly for dead-ending or splicing, split the web using approved tools designed for this task.

At corners and run ends, dead-end the messenger strand with approved automatic dead end connectors. Cut the strand and remove the jacket, exposing enough strand so that the ends of the strands coming through the chucks of both vises can be overlapped and bonded together to form a continuous ground. Use a one-bolt guy clamp to bond the strand ends together. Where figure-8 cable is used, remove existing unused messenger cable.

(4) **Underground** - In transition areas from overhead to underground, continue the aerial cable underground to the nearest termination panel. If figure-8 type cable is used for overhead locations, strip the messenger wire from the cable, using approved tools, where the cable is within a conduit, pole or cabinet.
Pull the necessary length of cable to be installed from one junction box, handhole, controller cabinet, or terminal cabinet to the immediate next downstream box, handhole, or cabinet. Carefully store the remaining length of cable to be installed in the next conduit in a manner that is not hazardous to pedestrian or vehicular traffic, and protects the cable from damage. Store the cable so that it can be safely pulled into the next conduit. Obtain the Engineer’s approval of the storage methods to be used.

Protect existing cables or equipment from damage as required by 00150.50(c) and 00170.80. Should existing cables or equipment be damaged by the Contractor’s operations, immediately notify the Engineer and the affected owner. The cost to repair damages caused by the Contractor’s actions may be withheld according to 00195.50(m).

| (5) Testing | Test interconnect cable according to 00990.70(i). |

00990.41 | Cabinet:

(a) Signal Circuit Overhead Terminal Cabinets:

(1) General - All wires or cables, which begin or terminate in a terminal cabinet, shall be made up using double pressure type, terminal blocks utilizing a pressure spring. The terminal blocks shall have 6 or 12 feed through terminals and shall be of unit construction, not modular. The wiring channel and clamp pieces of the connector shall be copper.

Where a terminal cabinet or pole base is detailed in a terminal cabinet or pole base wiring diagram, use the exact number of 6 or 12 terminal strips shown. Where a straight through connection of a cable is shown as a dot, provide and install terminal strips of adequate size to accommodate the number of wires in the cable.

Individual wires shall be stripped to between 1/2 inch to 3/4 inch. The strands shall be reformed into a tight bundle before insertion into the block. Where two or three wires enter a block on the same side, the bare strands of wire shall be twisted together before insertion. The wires shall be inserted to the stop. No more than three wires shall be inserted into one side of any one terminal. The terminal screw shall be tightened to a torque of between 30 and 35 inch pounds.

The terminal strips shall not be attached to the cabinet and there shall be enough slack left in the cables or wires to allow the terminal strips to be completely removed without disconnecting any conductors.

All wires and cables shall be connected in accordance with the color code specified on the plans.

All spare wires shall have their ends taped and shall not be used as extra neutral conductors.
Splicing of wires or cables will not be permitted in conduits or outside of terminal cabinets, condulets, steel poles, pole bases, signal heads or pull boxes.

(2) **Existing Terminal Cabinet** - If it is determined that existing terminal cabinets need to be replaced, and this work is not covered by the Contract Documents, furnish and install the cabinet with the required number of sectional double terminals on an Extra Work basis according to Section 00196.

(3) **Mast Arm Pole Recessed Terminal Cabinet** - Terminate only one wire in each termination point. If additional terminals are required, use a factory jumper between terminals. Enter on the marking strip the wire number and or letter as coded at the terminal strips in the controlled cabinets. Use only mechanically printed labels.

(b) **Flasher Cabinet** - The cabinet shall be 14 inches high x 10 inches wide x 7 inches deep. The cabinet shall have brackets which extend 1 1/2 inches above and below the cabinet to allow the cabinet to be mounted with lag bolts or steel banding. Furnish a Best Co. padlock 21B722-L-606 with a "Green" core for the cabinet. The cabinet shall be equipped with a securely mounted Model 204 flasher. The cabinet shall contain double barrier type screw terminals with marker strips connected as follows:

<table>
<thead>
<tr>
<th>Model 204 Flasher</th>
<th>Terminal Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Number</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>AC+</td>
</tr>
<tr>
<td>10</td>
<td>AC-</td>
</tr>
<tr>
<td>7</td>
<td>LD Cut #1</td>
</tr>
<tr>
<td>8</td>
<td>LD Cut #2 Common</td>
</tr>
<tr>
<td>9</td>
<td>EQ GND</td>
</tr>
</tbody>
</table>

(c) **Power Service Cabinet** - A combination enclosed meter socket and main disconnect will not be required. Power consumption meters will not be required and shall not be installed on this project.

Furnish a Best Co. padlock 21B722-L-606 with a "Green" core for the service.

(d) **Cabinet Protection** - Keep interiors of all cabinets clean and free of dust, dirt, moisture, and other foreign matter. In inclement weather, use tents to cover cabinets when doors are open. Vacuum and dry out all cabinets immediately before installing equipment unless otherwise directed. Correct any damage caused by dust, dirt, moisture or foreign matter at no cost to the City.
00990.42  Indication Equipment:

(a) **Standard Vehicle Signal Heads** - Standard traffic signal heads shall be one-way, three-section heads, adjustable through 360° about a vertical axis, and designed for the method of mounting shown or specified. Furnish heads complete, including lamps, lenses, LEDs modules, visors, reflectors, sockets, backboards and mounting appurtenances.

Vehicular signal heads shall be:

- Designed so they can be suspended from mast arms or span wires, or mounted on brackets or pedestals as required
- Equipped with positive lock rings and fittings designed to prevent the heads from turning due to external forces
- Equipped with all necessary appurtenances for the type of mounting required

Tighten all backboards and visors securely against the signal head.

(b) **LED Traffic Signal Head Retrofit Kits** - Retrofit kits in new or existing heads shall fit into all types of 12 inch traffic signal heads without the need to modify the head.

(c) **Optically Programmed Vehicle Signals** - Conform to all applicable portions of 00990.42(a). A complete vehicle signal includes the required number of signal sections with optical components, individual intensity control, cutaway visor, backboard and mounting hardware.

Optically programmed vehicle signals shall:

- Use lamps of the type and wattage recommended by the signal manufacturer
- Permit selective programming of the visibility zone of the projected indication anywhere within 15° of the optical axis of each signal section

*When mounted on span wires, install washers on the hanger to shoe attachment pin to limit the lateral movement of the hanger.*

(d) **Pedestrian Signal Heads** - All relevant portions of 00990.42(a) and 02920.65 apply to pedestrian signal heads.

(e) **Flashing Beacon Signal Heads** - Flashing beacons shall:

- Conform to all applicable portions of this subsection
- Be of single-section construction
- Be equipped for the type of mounting shown
Use the size of lamps specified in 02925.51.

Mount single-section heads on span wires as shown for three-section heads.

**(f) Suspension of Signal Heads** - Vehicle signals, interior illuminated signs, and reflective signs shall be mounted such that the bottom of the signal backboards and signs shall be not less than 18 feet above the horizontal projection of crown of the roadway, or as directed by the Project Manager. All heads on any one span shall be mounted such that the bottom of all signals will be at substantially the same elevation. The tops of the signals shall be level with the tops of the adjacent signal backboards. The maximum length of the stem between the plumbizer and the signal head shall be 18 inches unless otherwise directed. All signals and signs shall be substantially plumb.

All signals and signs mounted on span wires shall be tethered as shown. Signals and signs mounted with plumbizers shall utilize plumbizers with 6 leveling screws.

All bolts, nuts, washers, lock washers and set screws utilized for the suspension of signals and signs shall be Type 316 stainless steel. This particular alloy is non-magnetic and will be tested in the field for this property.

Signals shall be suspended using a tri-stud adapter assembly. On signal suspension assemblies where adjacent parts can be rotated, install a cotter pin to secure the parts as shown on the details. When setscrews are incorporated into the suspension fittings, drill and tap a hole of sufficient size to allow the setscrew to extend into the adjacent part. Where the top bracket enters the signal housing, place a non-hardening silicon caulking compound around the bracket to make a watertight seal.

Nylon insert lock nuts shall be used on bolts and hangers that extend through and are secured inside the signal head housing.

Pedestrian signals shall be mounted on poles using "clamshell" type mounting hardware. The clamshell shall consist of a two piece cast aluminum alloy assembly. The two separate castings shall be joined in the final assembly by the use of stainless steel pins. The pole half of the assembly shall be designed to adapt to a wide range of pole configurations. The pole mating surface shall be configured much like terminal compartments used for conventional bracket mounting.

The clamshell shall be mounted by bolting directly to a tapped metal pole or lag screwing directly to a wood pole. When mounting is on a wood pole the pole half of the clamshell shall have 1/2 inch threaded holes on each side for external conduit attachment. Plugs shall be furnished and installed in those holes that do not require conduit connections.

The bolt hole shall be elongated from side to side and the recessed shoulder shall be curved to allow rotation of the installed assembly 15° in either direction from center for a total of 30° when mounted on a 4 inch pole.
The clamshell assembly shall provide a "pole to pedestrian head" clearance of approximately 3 inches.

Two 3/16 inch drain holes shall be drilled in the bottom of the clamshell assembly.

The head half of the assembly shall be secured to the pedestrian signal with four 5/16 inch bolts.

The pole mounting half of the clamshell assembly shall be equipped with a conventional terminal compartment type 12-position molded terminal block with each position consisting of a pair of terminals, one on the line side and one on the load side of the block.

Electrical connection of the pedestrian head section of the clamshell mounting assembly shall be through a three conductor cable permanently attached to the pedestrian head section and connected to an appropriate load side position of the terminal block in the pole mounting half of the clamshell assembly. A rainshield shall be provided in the upper third of the pole half to prevent water entrenchment onto the terminal block. A neoprene gasket shall be provided on the mating surface of the two halves of the assembly to provide raintight protection.

Connections to field wiring may be made by conventional screw-type terminals or by quick disconnects.

(g) Vehicular Signal Head Covers - Cover mounted vehicle signal heads and pedestrian heads at all times until the signal installation is ready for continuous operation.

00990.43 Traffic Signal Detection Devices:

(a) Pedestrian Push Buttons - Mount pedestrian push buttons on a pole, pedestal or post whose foundation directly abuts an asphalt concrete or Portland cement concrete landing or walkway. Equip push buttons with an instruction sign having an arrow pointing to the crosswalk for which it is intended.

(b) Inductive Loop Detectors:

(1) Sawcut - Make cuts compatible with construction and in the most practical, direct line between loops and junction boxes, except where parallel to, or nearly parallel to, a lane line; then locate cuts under the lane lines.

Make sawcuts at least 1/2 inch wide for loop wire.

Sawcuts shall have smooth bottoms, with no edges due to differences in cut depth.

Limit sawcut angles to 90° or less to limit the bend in loop wire. Cuts shall not create islands of pavement less than 2 1/2 square feet in area.
Flush cuts thoroughly with a high-pressure water stream immediately after sawing, and before the cuttings dry. Blow free of water, debris, rock, and grit with high-volume or high-pressure air. Slots may also be cleaned by means of a high-pressure water injection/vacuum extraction system. Remove all cuttings from the Project.

Dry before placing wire. Remove rocks or other material that may be wedged in the cut.

Two sets of twisted pair loop wires may be installed in a single sawcut, as long as the minimum cover shown is provided and adequate pavement depth is available. The Engineer may limit the allowable sawcut depth and width to avoid damage to the pavement.

On new open-graded AC wearing courses install loops in the base lift, or in the existing surfacing if it is to be overlaid, and after milling has been completed.

In an existing open-graded AC surface, the sawcut installation shall be as shown.

(2) Wire - Place a permanent plastic label on each loop feeder cable with the loop numbers, in indelible ink, as shown on the Loop Detector Wiring Diagram. Place labels within 4 inches of the end of the jacket at each end of the loop feeder cables.

Do not remove the outside jacket and shield of loop feeder cables more than 6 inches from the end, inside the controller cabinet. Solder all loop feeder conductor terminations from field wiring in signal controller cabinets after crimp lugs have been installed. Crimp lugs used for loop wire field terminals may be insulated or non-insulated. Terminate loop feeder shield drain wire to the cabinet input panel grounding bus nearest the feet wire termination points.

(3) Installation - The Engineer will mark or approve the center point location of all loops to be installed. Do not place wire in sawcuts until the Engineer has inspected the cuts.

After the sawcut is cleaned of debris, place the loop wire by pushing it into the slot with a blunt, nonmetallic object. Use care to avoid damaging the insulation.

Use one continuous, unbroken length of loop wire to form a loop of the number of turns required and to reach the loop feeder cable splice point shown or specified. Twist the loop wire pair together from the exit point of the loop to the splice point of the loop feeder cable or termination point in the controller cabinet as shown. Use one continuous, unbroken length of loop feeder cable from the loop wire splice point to the cabinet. The loop leads shall have minimum of 6 twists per foot.
After loop wire is placed and before the saw slot is sealed, install loop wire hold-downs (backer rods) made of closed-cell polyurethane. Place 1 inch lengths of the hold-down material along the loop perimeter and all other saw slots containing loop wire 6 inches from loop corners and at maximum centers 12 inch. Hold-downs shall fit snugly in saw slots.

After placing the wire, perform loop resistance testing before filling the slots with hot-melt sealant. Install the sealant in slots according to the manufacturer’s instructions and recommendations using an approved pressure feed wand system. Furnish a copy of the manufacturer’s specifications including application procedures. The Engineer may order a test run of any application method or material before filling sawcuts.

Sealant shall not protrude above the pavement, nor be more than 1/8 inch below the pavement level after curing. Where cuts are made on a slope and sealant runs or puddles, start at the low end, pour the sealant, and hold it in place with 2-inch duct tape placed on the roadway surface over the cut. If duct tape or other device is used to contain the sealant in the sawcut, remove it on the same day, after the sealant is fully cured.

In order to prevent heat damage to the insulation, do not allow the temperature of the sealant to exceed 410 °F during application. Install hot-melt sealant in layers to prevent damage to wire insulation. Allow each layer to cool before the next layer is installed. Do not use water to accelerate cooling. Do not seal street boxes with sealant that remains soft after setting or cooling. See Standard Drawings.

Sealants that crack or pull away from the sawcuts after curing will be rejected.

(4) Splice - Splice loop wires to feeder cable in junction boxes. Connect loop wires to loop feeder cable with a screw on silicon grease filled wire connector. Remove 4 inches to 6 inches of feeder cable outer jacket, drain wire and shield. Do not damage the conductor insulation. Offset splices to ensure they do not make contact with each other. Strip feeder and loop conductors back about 1/2 inch. Cover the splice with a two piece plastic enclosure flooded with silicon grease.

(5) Resistance Testing - The resistance to ground of the loop and loop feeder combinations, tested with a 200 V Megger tester, shall be 500 MΩ or greater when checked both before placing the sealant and after the sealant has set.

Upon the request of the Engineer, furnish a report identifying the resistance for each:

- Before splicing and sealing
- Before splicing and after sealing
- After splicing and sealing
(6) **Loop Sensitivity** - Loops shall be sensitive to bicycles. After installation is complete the Engineer will test each loop with a lightweight bicycle or other approved device. If the bicycle is not detected on the highest amplifier sensitivity setting, replace the detector at no additional cost to the City, and repeat the procedure.

(7) **Preformed Vehicle Detection Loops in Existing Pavement** - They shall be Never-Fail loop systems model F-38 or approved equal.

To be an approved equal, loops shall be pre-manufactured and designed for routed or sawcut pavement installation. The loops shall have an integral home run that is protected and sealed to the splice point. This “protected” home run shall reach from the loop into the specified splice box.

Loops shall consist of 4 turns of twenty gauge stranded Teflon coated wire. The wire shall meet or exceed Military-MIL-W-16878/4 Type E, 200°C, 600 V specifications. The wire shall be encased in 3/8 inch hydraulic flexible hose that can withstand 1400 psi and the conduit shall be injected full of soft asphalt rubber sealant. To ensure long-term performance, the loops shall contain sealed expansion-contraction joints at the tee junctions protected with 80 CVPC.

Slots in existing pavement shall have residual moisture dried using compressed air. After the loops and home runs are installed, the slot will be completely filled and sealed in 3 lifts. There shall be a minimum of 2 1/2 inches ultimate cover over the loops and home runs in existing pavement and 1 inch cover in base lift pavement.

(7) **Microwave Detector for Activation of Pedestrian Signals** – They shall be MS Sedco Model 1400 bi-directional microwave motion sensors equipped with DIP switch adjustable delay timer, sensitivity and range settings or approved equal. A separate 24 volt transformer (SOLA/HEVI-DUTY Model SDN5-24-100P or approved equal) shall be mounted on DIN rail in the rear of the controller cabinet with an eight position terminal strip mounted adjacent to the transformer on the same DIN rail to power the field devices. The device shall be mounted at eleven feet above the pedestrian landing and pointed directly at the appropriate landing area.

(8) **Microwave Detector for Crosswalk Occupancy Detection** – They shall be MS Sedco Model 1800 bi-directional microwave motion sensors equipped with DIP switch adjustable approach only or bi-directional, sensitivity and range settings or approved equal. A separate 24 volt transformer (SOLA/HEVI-DUTY Model SDN5-24-100P or approved equal) shall be mounted on DIN rail in the rear of the controller cabinet with an eight position terminal strip mounted adjacent to the transformer on the same DIN rail to power the field devices. The device shall be mounted at twelve feet above the adjacent pedestrian landing and pointed to provide coverage of the near half of the appropriate crosswalk.
00990.44 **Traffic Control Signs** - The type of sign and method of mounting will be as shown or specified. Provide a hanger with span wire mounted signs that will permit both vertical and horizontal adjustments.

00990.46 **Fire Preemption** - Fire preemption systems shall:

- Include all required control modules, detector units, detector feeder cable, wiring harness, interface circuitry and miscellaneous hardware.
- Have detector feeder cable of the type and size recommended by the supplier of the preemption equipment.
- Have cable that runs continuously without splices from the detector unit to the controller cabinet.
- Include City-approved rack-mounted control modules with all Model 170 signal controllers.
- Not include emitter units.

00990.47 **Railroad Interconnect** - Run the circuit conductors in underground electrical conduit of the size shown. Terminate the conduit at the railroad cabinet at the location and in the manner directed by the railroad company. Extend the ends of the wire at least 3 feet beyond the end fitting of the supplied conduit. All other work inside the railroad cabinet is the responsibility of the railroad.

Do not work in the immediate vicinity of the railroad cabinet without first notifying the Engineer and receiving permission. The City will obtain supervisory personnel from the railroad company.

Do not place any materials or equipment in the vicinity of the tracks without observing proper clearance. When applicable, clearances will be listed in the Special Provisions under 00170.01(a)(5).

**Finishing**

00990.70 **Testing and Turn-on** - This work consists of testing traffic signal control equipment, testing traffic signal installations, and turning on completed traffic signal installations. Do not conduct turn-ons on Fridays unless approved.

(a) **Delivery of Control Equipment** - Provide manuals, diagrams and other documents as required by the City. Deliver all traffic signal control equipment, including wiring diagrams and operation manuals, in one shipment. Partial shipments will not be accepted and will be returned, at Contractor’s expense, to the Contractor. Include the following information with equipment shipments:

- Contractor
- Supplier
- Manufacturer
- Location
- Contract number
- City for which the equipment is to be tested. Include a complete set of plans and specifications to which the equipment is to be tested.

Deliver the traffic signal control equipment and information for testing to:

Oregon Department of Transportation
Traffic Signal Services Unit
2445 Liberty St. NE
Salem, Oregon 97303-6738

(b) Control Equipment Testing - The following traffic signal control equipment will be tested by the ODOT Traffic Signal Services Unit for conformance with the Contract Documents before being installed:

- Controller unit
- Controller cabinet
- Power supplies
- Input devices
- Output devices
- Conflict monitors
- Flasher units
- Relays
- Preemption devices
- Auxiliary equipment in the cabinet
- Other equipment required for the operation of the installation

Control equipment will be tested at the expense of the Contractor.

The control equipment will be tested in three categories: physical, functional and environmental as specified by the ODOT Standard Specification for Microcomputer Serial Controller. ODOT will require 6 weeks for completion and evaluation of the testing.

(c) Control Equipment Installation - The Contractor shall be responsible for picking up the signal equipment after testing, installing the signal equipment and checking the field wiring and control equipment operation prior to turn on of the equipment.

The control equipment shall be kept in a warm and dry location from the time it leaves the State Test Lab. until it arrives at the intersection. The controller cabinet shall not be installed until power is available at the service switch. Immediately after installing the controller cabinet, a 100 watt lamp shall be installed and energized to provide a heat source until the intersection is placed into operation.
(d) **Field Testing** - Field testing of traffic signal installations will be performed by City electrical crews. Notify the Engineer one week in advance of the anticipated signal completion date. The Engineer will notify the City’s Traffic Signal Section and the City’s electrical crew of the anticipated completion date. Field testing will be performed within one week following the date of completion. The Engineer will notify the Contractor of the test results. If an intermediate Contract Time is specified for signal work, the Engineer may suspend that portion of the work so that time may be excluded according to 00180.80(d)(1)(e) after the final corrections have been completed, or the signal is turned on.

Information on City testing procedures is available from the Engineer.

(e) **Traffic Signal Turn-on** - The Engineer will establish the date and time the installation is to be turned on. The City will turn on the signal within one week after completion of corrections.

Be present at the Project Site to assist as necessary.

After traffic signals are turned on and operating as designed, the agency ultimately responsible for maintenance will assume operation and maintenance of the signal. Turn-on does not constitute final approval. The Contractor is still obligated to finish any incomplete portion of the installation and correct problems with workmanship or replace material that does not meet Specifications. After turn-on, damage to the traffic signal installation caused by conditions beyond the Contractor’s control will be the responsibility of the City.

(f) **Interconnect Cable Testing:**

Test each interconnect cable circuit installed in the system. Test the complete system only when all terminations for each cable circuit are completed from the interconnect or controller cabinet at the beginning of the new cable run to the controller or interconnect cabinet at the end of the new cable run. If any test is failed, repair the circuit and repeat the entire test series for that cable circuit.

Perform all tests in the presence of the Engineer. Document the test results. When the tests are completed, whether successful or not, furnish the test results and the test data to the Engineer. Conduct tests, as described below, for all cable conductors, including spares, the cable shield, and all field terminations.

In addition to testing the complete system, perform the following tests for each cable circuit:

(1) **Continuity** - Perform a continuity measurement for each conductor and the cable shield in the system. Conductor resistance shall not be more than 10 Ω per 1,000 feet for each cable pair and shield of the communications cable. Measure the resistance with an ohmmeter having a minimum input impedance of 10 MΩ/V. Record the resistance of each pair and furnish to the Engineer as described above.
(2) **Isolation** - Perform an isolation measurement for each conductor and cable shield in the system. Measure the insulation resistance with all connections to the conductor or shield under test removed and all other conductors in the cable grounded. Make the measurement with a DC potential of not less than 360 V nor more than 550 V, continuously applied for one minute. Insulation resistance of each cable conductor and the shield shall exceed 1,000 MΩ per mile. Use a Megger tester with a meter scale for measurements, marked with a range from 100 KΩ to 100 GΩ, and with zero and infinity also marked.

**Measurement**

| 00990.80 | **Measurement** | No measurement of quantities will be made for work performed under this Section. |

**Payment**

<p>| 00990.90 | <strong>Payment</strong> | The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items: |</p>
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Traffic Signal Installation</td>
<td>lump sum</td>
</tr>
<tr>
<td>(b) Traffic Signal Modifications</td>
<td>lump sum</td>
</tr>
<tr>
<td>(c) Loop Detectors Installation</td>
<td>lump sum</td>
</tr>
<tr>
<td>(d) Interconnect System</td>
<td>lump sum</td>
</tr>
<tr>
<td>(e) Flashing Beacon Installation</td>
<td>lump sum</td>
</tr>
</tbody>
</table>

Items (a) through (e) include payment for replacement of disturbed earthwork, base and surfacing, when applicable.

Item (a) includes furnishing and installing all items of the traffic signal system, including the fire preemption system, the controller, controller cabinet equipment and programs as applicable, and detection system, and includes removing, salvaging, and stockpiling traffic signal equipment as specified.

Item (b) includes furnishing and replacing or installing items for an existing traffic signal installation as specified and includes removing, salvaging, and stockpiling traffic signal equipment as specified.

Item (c) includes furnishing and installing a complete traffic loop detector installation, including incidental controller equipment for existing traffic signal installations.

Item (d) includes furnishing all items of the interconnect system as specified.

**Item (e) includes furnishing and installing all items of the flashing beacon system.**
Payment for replacement of solid conductor ground wire with THWN wire according to 00990.40(e)(2)(d) will be considered incidental to the work of this Section, and no extra payment will be made.

Payment for providing railroad company personnel to supervise interconnection with railroad cabinets will be considered incidental to the work of this Section, and no extra payment will be made.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and Incidentals necessary to complete the work as specified.

No separate of additional payment will be made for replacement of disturbed earthwork, base, and surfacing.

00990.91  Incidental Basis - Where neither the Special Provisions nor bid schedule indicates separate payment for street name, regulatory and other signs installed on traffic signals, perform work as incidental work for which no separate payment will be made.
Section 00996 - Traffic Camera Systems

Description

00996.00 Scope - This work consists of one or both of the following:

- Furnishing and installing new traffic cameras, including field equipment such as the camera assembly, pan/tilt units, camera poles, camera power supply, Fiber Distribution Units (including splice trays and coupler plates, Fiber Optic Video/Data Multiplexers, Fiber Optic Data Transceivers, Fiber Optic Communications Node, and all miscellaneous video, data and power cables to equipment between the fiber distribution unit and the camera.
- Furnishing and installing new web-based wireless PTZ cameras that allows up to 10 simultaneous users to view the live feed from the camera.

00996.01 Abbreviations:

- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- ATMS - Advanced Traffic Management System
- AWG - American Wire Gauge
- BNC - Bayonet Neill Concelman
- bps - Bits per second
- CCD - Charge-Coupled Device
- CCTV - Closed Circuit Television
- CFR - Code of Federal Regulations
- dB - Decibel
- EIA - Electronics Industries Association
- EPA - Effective Projected Area
- FCC - Federal Communications Commission
- FDU - Fiber Distribution Unit
- FO - Fiber Optic
- FOP - Fiber optic outside plant cable
- Hz - Hertz
- MHz - Megahertz
- NEC - National Electrical Code
- NEMA - National Electrical Manufacturers Association
- nm - nanometer
- NTSC - National Television Standards Committee
- ODOT - Oregon Department of Transportation
- OFNP - Nonconductive Optical Fiber Plenum Cable
- OFNR - Nonconductive Optical Fiber Riser Cable

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Definitions:

Camera Pole - A one-piece pole, tenon, anchor bolts and base plate.

Closed Circuit Television Assembly (CCTV) – Camera, lens, environmental enclosure (housing), and necessary connectors and cables.

Connector - A mechanical device used to provide a means for attaching to and decoupling from a transmitter, receiver, or another fiber (such as on a patch panel).

Connector Module Housing (CMH) - Patch panel used in the FDF to terminate single-mode fibers with most common connector types and may include jumper storage shelf and hinged door.

Couplers - Device that mates two fiber optic connectors to facilitate transition of optical light signals from one connector into another. Couplers may also be referred to as: adapters, feed-thrus and barrels and are normally located within FDFs mounted in panels. May also be used un-mounted to join two simplex fiber runs.
Fiber Distribution Frame (FDF) - A rack-mounted system usually installed in the TMOC, or communications Hub consisting of a standard equipment rack, fiber-routing guides, horizontal jumper troughs, FDUs, CMHs, and SMHs. The FDF serves as “home” for passive fiber optic components from cable breakout for connection by jumpers to the electronics.

Fiber Distribution Unit (FDU) - Enclosure containing both a CMH and SMH.

Integrated System Testing - Testing associated with the functional performance of the system with all subsystems composing the system properly interconnected and powered; testing of the complete system with all elements working together.

Link - A passive section of the systems, the ends of which are to be connected to active components that may include splices and couplers.

Pan/Tilt Unit (PT) - Unit for moving CCTV camera via remote control to view a particular scene.

Patch-cord - A short fiber optic cable with a connector installed on both ends; typically used for connection within an FDF. Patch-cords may also be referred to as jumpers.

Pigtail - Relatively short length of fiber optic cable with a connector on a single end and typically installed in a splice tray of a fiber optic distribution unit.

Power Meter - Portable piece of fiber optic test equipment that, in conjunction with a light source, is used to perform end-to-end attenuation testing. Contains a detector sensitive to light at a designed wavelength of system under test. The display indicates amount of power injected by light source that arrives at receiving end of link.

Video Control System - Interface to system software allowing user input through check boxes, icons, and radio buttons in a graphical manner in a Windows NT format.

00996.03 Required Submittals - Within 30 days after the contract is awarded, submit to the Engineer a complete listing of all major components of the system and operational description for approval. Include the manufacturer’s name, model numbers, catalog sheets or other descriptive literature of proposed materials. The catalog sheets and literature shall include technical data, physical properties and operational description in sufficient detail to demonstrate the equipment meets these specifications. Submit installation details for the camera cabinet and schematic drawings showing all proposed materials, dimensions, part make, model, and quantity.

00996.04 Quality Assurance - Except as provided below, each electrical product shall be listed for intended use in one of the following:

- Underwriters Laboratory Electrical Appliance and Utilization Equipment Directory
- Underwriters Laboratory Construction Materials Directory

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Each product shall bear the listing organization’s label. In the absence of a label, provide documentation verifying product listing.

For products not listed in the above directories, provide evidence that the product has been tested and certified by a nationally recognized laboratory, in accordance with 29 CFR 1910.7. The following are acceptable evidence:

- OSHA documentation that demonstrates recognition
- Laboratory documentation that verifies testing in accordance with a recognized national code or standard

00996.05 Regulations, Standards, and Codes - The following documents and others referenced therein form part of the Contract to the extent designated in this Specification.

Code of Federal Regulations (CFR)

Title 29, Part 1910.7 OSHA Recognition Process for Nationally Recognized Testing Laboratories

Institute of Electrical and Electronics Engineers, Inc. (IEEE)
C62.41 – 1991 Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits

National Fire Protection Association (NFPA)
70 – 2002 National Electric Code

Underwriters Laboratories (UL)

Electrical Appliance and Utilization Equipment Directory – 1998

Electrical Construction Equipment Directory – 1998

50 – 1996 Enclosures for Electrical Equipment
489 – 2002 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
1059 – 1993 Terminal Blocks
1449 – 1996 Transient Voltage Surge Suppressors
1778 – 1994 Uninterruptible Power Supply Equipment

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Materials

00996.10 General - Furnish materials meeting the following requirements:

00996.11 Video Cable - Video cable is used between the camera housing and the camera enclosure for the NTSC signal. Provide RG-6 coaxial cable, 75 Ω with 18 AWG solid, bare copper center conductor with 95% or greater bare copper braided shield. Video cable shall be suitable for wet locations. See Section 00959 for the specifications of the fiber optic cabling and connectors used for the transmission of video over fiber.

00996.12 Camera Power Cable - Furnish one pair of 14 AWG THHN/THWN, copper stranded conductors.

00996.13 Camera Grounding and Bonding - Furnish one 8 AWG bonding conductor.

00996.14 Camera, Lens, Housing and Pan/Tilt - The camera, lens, housing, and pan/tilt assembly shall integrate to form a complete functioning system. The minimum performance specifications for the camera and lens are:

(a) CCTV Camera Performance - The performance specifications for the camera are:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Device</td>
<td>High resolution color/black-white CCD</td>
</tr>
<tr>
<td>Image Sensor</td>
<td>0.25 inch CCD</td>
</tr>
<tr>
<td>Pixels</td>
<td>724H x 494V (NTSC)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 °F to 122 °F</td>
</tr>
<tr>
<td>Sensitivity at 35 IRE</td>
<td>F/1.6: 0.08 Lux at 1/2 sec shutter speed (color); 0.013 Lux 1/2 sec shutter speed (black-white)</td>
</tr>
<tr>
<td>Digital Zoom</td>
<td>4x minimum</td>
</tr>
<tr>
<td>Focus</td>
<td>Auto w/manual override, Focus locked automatically during preset recall.</td>
</tr>
<tr>
<td>Camera Power</td>
<td>24 VAC nominal (18 to 30 VAC range)</td>
</tr>
<tr>
<td>Signal to Noise Ratio</td>
<td>&gt;50 dB</td>
</tr>
<tr>
<td>Synchronization System</td>
<td>Internal/AC line lock, phase adjustable via remote control, V-Sync</td>
</tr>
<tr>
<td>Video Output Level</td>
<td>1.0 V p-p (75 Ω composite)</td>
</tr>
<tr>
<td>Iris Control</td>
<td>Automatic with manual override</td>
</tr>
<tr>
<td>Gain Control</td>
<td>Automatic/Off</td>
</tr>
<tr>
<td>White Balance</td>
<td>Automatic with manual override</td>
</tr>
</tbody>
</table>
**b) Dome Drive** - The variable speed/high speed pan and tilt drive shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Pan Speed</td>
<td>0.1° to 80° per second</td>
</tr>
<tr>
<td>Manual Tilt Speed</td>
<td>0.1° to 40° per second</td>
</tr>
<tr>
<td>Preset Pan Speed</td>
<td>360° per second</td>
</tr>
<tr>
<td>Preset Tilt Speed</td>
<td>200° per second</td>
</tr>
<tr>
<td>Vertical Tilt</td>
<td>Unobstructed tilt of +2° to -92°</td>
</tr>
<tr>
<td>Presets</td>
<td>Minimum 80 programmable preset positions,</td>
</tr>
<tr>
<td></td>
<td>with 20-character labels</td>
</tr>
<tr>
<td>Preset Accuracy</td>
<td>+/- 0.1°</td>
</tr>
<tr>
<td>Motor</td>
<td>Variable speed. Operated at 24VAC nominal</td>
</tr>
<tr>
<td>Patterns</td>
<td>Minimum 4 user defined programmable</td>
</tr>
<tr>
<td></td>
<td>patterns including pan, tilt, zoom and</td>
</tr>
<tr>
<td></td>
<td>preset functions</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Maximum 75 VA (with heater)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>122 °F ti -50 °F (sustained operation)</td>
</tr>
</tbody>
</table>

The Camera Housing and Pan/Tilt assembly shall be Pressurized Pelco’s Spectra IV® series or Honeywell HD6CE4NJ (or approved equal) and UTP transceiver.

**00996.15 Web-based Wireless Camera, Lens, Housing and Pan/Tilt** - The web-based cameras shall be used to remotely monitor traffic using a web-based interface. The minimum performance specifications for the web-based cameras are:

**a) Wireless PTZ Web-based Camera Performance** - The performance specifications for the camera are:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Protocols</td>
<td>TCP/IP</td>
</tr>
<tr>
<td></td>
<td>UPnP</td>
</tr>
<tr>
<td></td>
<td>HTTP</td>
</tr>
<tr>
<td></td>
<td>FTP®</td>
</tr>
<tr>
<td>Wireless Security</td>
<td>WPA™ PSK</td>
</tr>
<tr>
<td></td>
<td>TKIP</td>
</tr>
<tr>
<td></td>
<td>128-bit WEP Encryption</td>
</tr>
<tr>
<td>Video Resolution</td>
<td>Up to 10fps at 704 x 480</td>
</tr>
<tr>
<td>Wireless Standard</td>
<td>802.11g</td>
</tr>
<tr>
<td>Device Ports</td>
<td>10/100Mbps Fast Ethernet</td>
</tr>
<tr>
<td>External Power Supply</td>
<td>+12V DC 1.5A</td>
</tr>
<tr>
<td>Motorized Pan/Tilt/Zoom</td>
<td>10X Optical Zoom</td>
</tr>
<tr>
<td></td>
<td>10X Digital Soom</td>
</tr>
<tr>
<td></td>
<td>Pan 270°</td>
</tr>
<tr>
<td></td>
<td>Tilt 90°</td>
</tr>
</tbody>
</table>
The Web-based wireless camera shall be DCS-70 or approved equal.

All system components with printed circuit boards (PCBs) will have conformal coating on the PCBs, with the exception of those inside the pressurized dome.

Equipment to be installed includes:

- CCTV Cameras including dome housing, lens and pan/tilt assembly
- CCTV wiring (video/data/power)
- CCTV Camera Power supplies
- Miscellaneous Fiber Optic Cabling (including splicing, pigtails, patch chords and testing)
- Fiber distribution Units (including splice trays and coupler plates)
- Fiber optic Video/Data Multiplexers
- Fiber Optic Transceivers
- Fiber Optic Communications Node
- All miscellaneous video, data and power cables to equipment between fiber distribution units and the camera

All equipment supplied shall interface with existing equipment including IFS Orion Fiber Optic Communication System.

(b) **Cable Components** - FO cable shall consist of, but not be limited to, the following:

1. **Buffer Tubes** - Provide sufficient clearance between fibers and inside of buffer tube to allow for unconstrained expansion of fiber. Fibers shall be loose or suspended within tubes; not adhering to inside of tube. Each buffer tube shall contain 1, 2, 6 or 12 fibers.

Extrude loose buffer tubes from material having a coefficient of friction allowing free movement of fibers. Material shall be tough, abrasion-resistant and provide mechanical and environmental protection of fibers, yet permit safe, intentional “scoring” and breakout, without damaging or degrading the internal fibers.
Buffer tube filling compound shall be homogenous, hydrocarbon-based gel with anti-oxidant additives used to prevent water intrusion and migration. Filling compound shall be non-toxic and safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. Filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional, nontoxic solvents.

Strand buffer tubes around a central member such that strain on cable jacket does not produce stress on fibers.

Color-code each buffer tube according to Munsell color shades meeting EIA/TIA standards.

(2) **Central Member** - The central member, which functions as an anti-buckling element, shall be a glass-reinforced, plastic rod with expansion and contraction characteristics similar to optical fibers and buffer tubes. To ensure proper spacing between buffer tubes during stranding, a symmetrical, linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

(3) **Filler rods** - Use solid, medium- or high-density polyethylene for filler rods. Filler rod diameter shall be same as outer diameter of buffer tubes.

(4) **Stranding** - Strand completed buffer tubes around over-coated central member using stranding methods, lay lengths and positioning so that cable meets mechanical, environmental and performance specifications. Use polyester binding to hold buffer tubes in place. Apply binding with sufficient tension to secure buffer tubes to central member without crushing. Binding shall be non-hygroscopic, non-wicking, or rendered so by the flooding compound, and dielectric with low shrinkage.

(5) **Core and Cable Flooding** - Fill cable core interstices with a polyolefin-based compound to prevent water ingress and migration. Use a flooding compound that is homogeneous, non-hygroscopic, electrically nonconductive, and non-nutritive to fungus. Compound shall also be nontoxic, safe to exposed skin, and compatible with all other cable components.

(6) **Tensile Strength Member** - Strand high-tensile strength aramid yarns or fiberglass helically around cable core.

(7) **Ripcord** - Cable shall contain at least one ripcord under jacket for easy sheath removal.

(8) **Outer jacket** - Outer jacket shall be free of holes, splits, and blisters and shall be medium- or high-density polyethylene with a minimum jacket thickness of 1/32 inch. Apply jacketing material directly over tensile-strength members and flooding compound. Material shall not adhere to aramid strength material. Use polyethylene containing carbon black to provide ultraviolet light protection and discourage fungal growth.
Mark jacket or sheath with manufacturer’s name, the words “Optical Cable”, number of fibers, year of manufacture, and sequential measurement markings every meter. Actual length shall be within ± 1% of the length marking. Use a color that contrasts with cable jacket for the marking. Print height of marking shall be approximately 7/64 inch.

**00996.16 Camera Power Supply** - Provide a power supply for the PTZ and camera. The power supply shall provide surge protection for the camera power, video and PTZ control connections. The supply shall convert the incoming 120V AC, 60 Hz to 24V AC output. The entire assembly shall be housed in a NEMA Type 4 rated enclosure and mounted within the camera cabinet.

**00996.17 Video Encoder and Ethernet Switch** - Each camera cabinet shall come equipped with a MPEG-2 fiber optic video encoder for transmitting video over IP/Ethernet networks. The encoder shall also be capable of transmitting serial data, such as pan-tilt-zoom, over the same network. Built into the same housing shall be a Fast Ethernet network switch.

The encoder/switch shall meet the following minimum requirements:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Input</td>
<td>1V peak to peak (75 ohms), NTSC</td>
</tr>
<tr>
<td>Number of Video Inputs</td>
<td>1</td>
</tr>
<tr>
<td>Video Connector</td>
<td>BNC</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>30 fps</td>
</tr>
<tr>
<td>Encoding</td>
<td>MPEG-2</td>
</tr>
<tr>
<td>Resolution</td>
<td>H: 720, V: 480</td>
</tr>
<tr>
<td>Bit Rate: Variable, up to 10 Mb/s</td>
<td></td>
</tr>
<tr>
<td>Video Output</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>100Base-FX</td>
</tr>
<tr>
<td>Connector</td>
<td>LC</td>
</tr>
<tr>
<td>Wavelength</td>
<td>1310 angstroms</td>
</tr>
<tr>
<td>Ethernet Switch</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>10/100 Base-FX</td>
</tr>
<tr>
<td>Number of Switch Ports</td>
<td>8</td>
</tr>
<tr>
<td>Wavelength</td>
<td>1310 angstroms</td>
</tr>
<tr>
<td>Port Types</td>
<td>LC</td>
</tr>
<tr>
<td>Mean Launch Power</td>
<td>-5 to 0 dBm</td>
</tr>
<tr>
<td>Networking Protocols</td>
<td>Multicast filtering, IEEE 802.1p, IEEE 802.1d, SNMP, HTTP, TCP/IP</td>
</tr>
<tr>
<td>Distance</td>
<td>19.9 miles minimum over single mode fiber</td>
</tr>
<tr>
<td>Terminal Server</td>
<td></td>
</tr>
<tr>
<td>Data Types</td>
<td>RS-232, RS-422, RS-485</td>
</tr>
<tr>
<td>Number of Ports</td>
<td>3</td>
</tr>
<tr>
<td>Data Connector</td>
<td>RJ-45 or DB9</td>
</tr>
<tr>
<td>Bit Rate</td>
<td>Up to 115 kbps</td>
</tr>
</tbody>
</table>
The video encoder shall be Teleste EASI IP Series IPE or approved equivalent.

**00996.18 Video Decoder** - Provide one rack assembly and four video receivers designed to work with the video encoder specified. Provide covers on all unused rack slots. Provide the video decoders and associated rack equipment to the Project Manager to be installed by others.

The video decoder shall meet the following specifications:

- **Video Output**: 1V peak to peak (75 Ω), NTSC
- **Bandwidth**: 5 Hz – 6.5 MHz
- **Differential Gain**: Less than 3%
- **Differential Phase**: Less than 3°
- **Signal to Noise Ratio**: 60 dB minimum at maximum optical loss budget
- **Receiver Sensitivity**: -30 dB
- **Data Interface**: RS-232, RS-422, 2 wire RS-485
- **Data Format**: NRZ, NRZI, Manchester, Bi-phase
- **Data Rate**: DC-100 kbps (NRZ)
- **Operating Mode**: Simplex or full duplex
- **Fiber Wavelength**: 1310/1550 angstroms, single mode
- **Optical Emitter**: Laser diode
- **Optical Detector**: PIN
- **Indication**: Input sync presence, Transmitted data, Received data, Optical carrier detect, Power
- **Optical Connector**: ST
- **Power Connector**: Provided by rack assembly
- **Data Connector**: Terminal block
- **Video Connector**: Gold plated BNC
- **Mounting**: Rack
- **Mean Time Between Failure**: Greater than 100,000 hours
- **Operating Temp Range**: -40 °F to 165 °F
- **Storage Temp Range**: -40 °F to 185 °F
- **Relative Humidity**: 0 to 95% non-condensing
- **Listing**: UL

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00996.19 Uninterruptible Power Supply - A UPS shall be provided for temporary backup, protection against temporary outage (brownouts), voltage regulation, and surge protection of the incoming power.

The UPS shall meet the following specifications:

- Line Transient Protection: UL 1449
- Safety Compliance: UL 1778
- Waveshape: True sine wave
- EMC Compliance: FCC Class B
- Voltage (nominal): 120 VAC, 60 Hz
- Battery Type: Sealed, maintenance free
- Runtime (full load): 30 minutes
- Maximum load: 1300 Watts (minimum)
- Backup Receptacles: 5-15R (minimum)
- Mounting: Rack mounted, 19 inches

00996.20 Camera Cabinet - Furnish and install a 334 cabinet shell with fan and CCTV PDA (Power Distribution Assembly) pole mount with a Standard 19 in rack. The cabinet shall be UL 50 Type 3R listed. The cabinet shall consist of Housing #1 and Mounting #1 Cage assemblies as defined in ODOT’s Standard Specification for Microcomputer Signal Controller. Provide the housing requirements listed in Section 2 with the exception of the police panel. The cabinet shall house the video transmitter, UPS, Fiber Distribution Panel (see Section 00959) and associated camera equipment. The camera cabinet assembly shall be assembled and listed by a certified UL 508A panel shop or have the final assembly certified by an approved National Recognized Testing Laboratory.

The cabinet shall have dataline surge protection meeting IEEE C62.41 for the Pan/Tilt/Zoom data signals.

All incoming 120V circuits shall terminate on terminal blocks. All terminal blocks shall be UL 1059 listed. For No. 10 AWG conductors or smaller, use sectional, double-terminal, barrier-type terminal blocks with binder screw terminals. Terminal ampacities shall be equal to or greater than conductor ampacities. For No. 8 AWG conductors or larger, use either one-piece for factory assembled, sectional, barrier-type terminal blocks with box lug terminals having a pressure plate between screw and conductor. Use terminals of the correct size for the conductor to be connected.

Bus bars shall be sized to accommodate required connections and shall be amperage rated for use.

Incoming power shall be protected by circuit breakers sized appropriately. All circuit breakers shall be UL 489 listed. All equipment shall be protected by branch circuit breakers.

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00996.40 Installation - Install materials and equipment as shown on the plans, according to these specifications, and in accordance with the manufacturer's instructions.

All cables and wires associated with the camera shall be continuous between the cabinet and the camera unit. No splices shall occur outside the cabinet.

00996.45 Identification and Marking - All cables and wiring between subsystems shall be clearly and permanently labeled. All conductors shall be marked by means of imprinted tubular white or yellow plastic wire markers at termination points within 2 inches of wire terminations. Marker nomenclature shall be visible without moving wires or markers.

00996.46 Nameplates - All major components within the cabinet assemblies shall be identified by a nameplate. The nameplates shall be 5/64 inch thick laminated plastic stock with white surface and black core. Letter height of the inscription shall be 15/64 inch minimum.

00996.47 Covers and Guarding - Provide covers or guarding for live parts of terminations on circuits of 50 V or more to ground.

Finishing and Testing

00996.70 Site Acceptance Testing - Demonstrate the Pan/Tilt/Zoom functionality, camera lowering functionality, and video quality performance for each camera site. Present an acceptance test to the Engineer for approval at least 30 days prior to scheduling the test.

00996.75 Warranty - The warranty of 00170.85(b) applies to work under this Section. Provide manufacturer's warranties or guaranties on all equipment before installing equipment on the project. Such warranties shall recite that they are enforceable by either the Contractor or City. In addition, warrant all work performed by the Contractor under this Section for a period of one year, beginning on the date of final acceptance of such work. This warranty requires repair or replacement of equipment warranted, as necessary to correct any defects or failures, and includes all materials, equipment, tools, labor, and incidentals necessary to complete such repair or replacement.

Measurement

00996.80 Measurement - No measurement of quantities will be made for work performed under this Section.
Payment

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Traffic Camera Installations</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Camera Cabinet Installations</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Item (a) includes all cameras, PTZ units, cabling, and associated wiring.

Item (b) includes the camera cabinets, and associated video equipment.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
01030.00 **Scope** - This work consists of seeding and associated tasks to develop plant growth for erosion control, environmental mitigation, and roadside development.

01030.02 **Definitions:**

**Certified Seed** - A grass or legume seed named variety that has been reviewed and accepted into the Oregon Certified Seed program. Currently certified seed is individually sold in bags with a blue-colored Oregon Certification Tag, thus the name commonly used for such seed is "blue tag stock".

**Establishment Period** - A period when planting work has been performed and initially accepted, and there is a Contract requirement to care for the planted areas in some way until the period ends.

**Native Plant (existing)** - A variety of plant species that occurring in its natural habitat without direct or indirect human actions.

**Noxious Weed** - All weed designated by the Oregon State Weed Board as injurious to public health, agriculture, recreation, wildlife, or all public or private property. The Oregon Department of Agriculture (ODA) will be the authority in determination of noxious weed species.

**Pure Live Seed (PLS)** - The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is excluded.

**Riparian** - Related to the bank, shore, or water-influenced areas of a watercourse or water body.

**Sensitive Areas** - Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.

**Specified Weeds** - All noxious weeds as defined above, and all plant species identified in the Special Provisions or on the plans as a species to be removed.

**Waters of the State** - See ORS 468B.005 for "Waters of the State" definition.

**Weed** - A plant that is undesirable where it is growing.
**Weed Free** - For these Specifications, "Weed Free" is defined as the following maximum amount of living weeds per square yard:

- Zero "Type A" or "Type T" Noxious Weeds
- One "Type B" Noxious Weed
- One of each non-noxious weed listed in the Special Provisions

The ODA Noxious Weed Policy and Classification System lists Type "A", "B", and "T" Noxious Weeds.

**Weed Management Area (WMA)** - A defined project area with Specified Weeds to remove, including areas where weeds begin growing because of project-associated ground disturbance. A WMA may be the entire project site or any portion, including material source and disposal sites as shown.

**Materials**

- **01030.11 Topsoil** - Furnish topsoil meeting the requirements of 01040.14.

- **01030.12 Soil Conditioners, Amendments, and Bio-Amendments** - Furnish soil modifiers meeting the requirements of 01040.15, 01040.16, and 01040.17.

- **01030.13 Seed** - Furnish seed meeting the following requirements:

  **(a) Label** - Deliver all seed in standard, sealed containers meeting the requirements of the Oregon Seed law. See ORS 633.520 and OAR 630-56 for specific labeling requirements.

  - The kind and variety of each seed of 3% or more in a mixture, by weight. Be sure that seed mix labels include the words "mixture" or "mixed seed" when the seed is a mixture
  - The country or state where the seed is grown
  - The lot number or other lot identification
  - The total percentage, by weight, of other crop seed
  - The total percentage, by weight, of weed seed
  - The total percentage, by weight, of inert matter
  - Statement of "No Noxious (weed) Found"
  - For each named seed:
    - Percentage of germination
    - Percentage of hard (non-living) seed, if more than 1%
    - Percent of PLS for each kind of seed
    - Percent and kind of other crop
    - Month and year of seed test
    - Net weight of contents
    - Name and address of seed labeler or seller
• Origin for each seed (state or foreign country)
• If seed inoculant is used, the claimed date that inoculant effectiveness ends
• For treated seeds (if any):
  • Statement that the seeds have been treated
  • Name of all chemical used in the treatment
  • Description process used in the treatment
  • Warning statement for all residual chemicals used
• Net weight of each container
• For seeds listed as native, date and location of collection of source (first generation) seed
• For native seeds specified to be collected for direct use on a project, label containers with the date and location of collection sites for each seed species

Alternate label requirements may be identified in the Special Provisions for certain native plant seeds.

In addition to the labeling requirements of the Oregon Seed Law, label all native seed containers with the date and location of where the original stock seed originated. Seed whose origin cannot be traced may not meet the definition of "native." For native seed collected for direct use on a Project, label containers with the date and field location of collection of each seed type.

(b) Quality - Furnish seed meeting the following requirements:

• The seed and labeling complies with Oregon Seed Law and Federal Seed Act.
• The seed has been tested within 18 months of the planting date.
• The seed is not sprouted, moldy, or showing evidence of having been wet or otherwise damaged.
• The seed is labeled as "Oregon Certified Seed" or the equivalent from another state when identified in the Special Provisions. Information about certified seed is available from County Extension Offices, Oregon State University, and the Oregon Department of Agriculture.

(c) Pure Live Seed - Obtain the amount of seed to apply by using the purity and germination percentages from the label on actual bag of seed to be used on the Project.

To calculate the amount of seed to be applied:

• Obtain the PLS factor by multiplying the seed label germination percentage times the seed label purity percentage
• Divide the specified PLS rate by the PLS factor
Example

A PLS seeding rate of 10 pounds per acre is specified. The seed label shows a purity of 80% and germination is 90%. After converting percentages to decimals, 0.80 x 0.90 equals a factor of 0.72. The specified PLS rate, 10 pounds per acre, divided by the factor of 0.72 equals 13.88. About 14 pounds per acre of total seed needs to be applied in order to meet a PLS seeding rate of 10 pounds per acre. For a seed mix, make this calculation for every seed to obtain the total amount to be applied.

(d) Inspection - Each lot of seed is subject to inspection upon delivery to the Project. Seed that is not labeled or that does not conform to the Specifications will be rejected and replaced at no additional cost to the City.

(e) Mixes - Furnish seed mixes that meet the labeling, quality and inspection requirements stated above. Submit any other proposed seed or seed mixes for consideration and receive written approval before seeding work begins. Replace rejected seed before planting.

(f) Types of Seed Mixes - Seed mixes, quantities, standards, and other information will be included in the Special Provisions for each type of seed mix.

The following are the functional categories of seed mixes that may be included on projects (a category may have multiple functions on a project site):

- **Temporary Seeding** - To provide short-term control of soil erosion until permanent seeding is performed or all potential for erosion is removed.

- **Permanent Seeding** - The final seeding or only seeding performed for erosion control.

- **Lawn Seeding** - Seeding for areas where finished turf appearance is desired.

- **Wildflower Seeding** - Seeding to develop growth of wildflowers. The seed mix will typically contain grass or other plant seed to provide erosion control.

- **Plant Seeding** - Seeding which typically includes more than just grass species, such as seeds of woody or herbaceous plants.

- **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.

- **Wetland Seeding** - To vegetate existing or constructed wetlands with native plant species.

- **Native Plant Seeding** - Seeding to restore native vegetation.

(g) Availability - Provide a list of seed sources for all specified seeds within 60 calendar days after execution of the Contract. Verify that all specified seed has been located and will be available for use on the Project.
01030.14 **Fertilizer** - Furnish standard, commercial grade fertilizer meeting the following requirements:

(a) **General** - Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate that includes the container weight, the percentage of each ingredient, and the source of each component in the mixture. Ensure that each container is labeled with a Quality Compliance Certificate that meets the applicable requirements of Section 00165.

Furnish fertilizer according to State and Federal regulations. Fertilizer is subject to testing by the State Department of Agriculture.

(b) **Type of Fertilizer** - Provide the following fertilizer:

1. **West of the Cascades** - Furnish 22-16-8 inorganic fertilizer, analyzing 22% nitrogen, 16% phosphoric acid, 8% soluble potash, and including a minimum of 2% sulfur. Furnish fertilizer containing not less than 50% available water-insoluble, controlled-release nitrogen derived from one of the following sources:
   - Urea formaldehyde (Nitroform)
   - Isobutyliidene Diurea (IBDU)
   - Polymer coated urea (no sulfur)

2. **Near Water** - For application within 50 feet of open water, furnish 22-2-11 low-phosphorus fertilizer, analyzing 22% nitrogen, 2% phosphorus, and 11% potassium which releases slowly over an 8 to 9 month period. Furnish fertilizer containing a minimum of 60% available water-insoluble, controlled-release nitrogen derived from one of the three sources stated above. Furnish phosphorus and potassium that is coated to allow a minimum of 95% controlled-release.

01030.15 **Mulch** - Furnish mulch materials free of all weed or plant seeds containing no substances detrimental to plant life. The kind of mulch material(s) acceptable for use will be shown on the plans listed in the Special Provisions, or will be as approved.

Furnish mulch for seeding according to the following:

Furnish straw mulch for all roadside erosion control seeding except hydromulch may be used under the following conditions:

- Spring planting between March 1 and May 15
- Slopes are steeper than IV to 1.5H and longer than 16 feet
- Residential or commercial sites with low erosion potential such as sidewalk, median, or parking lot planter strips
Projects that have variable slopes may include straw mulch and hydromulch when approved.

(a) **Hydromulch from Cellulose, Wood, or Straw Fiber** - Furnish cellulose fiber produced from virgin wood, straw, or paper fiber product from the CPL.

Furnish wood or straw mulch processed so the fibers remain uniformly suspended under agitation in water and the fibers have moisture-absorption and percolation properties.

Ship hydromulch in packages of uniform weight, plus or minus 5%, that are labeled with the manufacturer's name and air-dry weight.

(b) **Straw** - Unless otherwise specified, furnish straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass singly or in combination. Cereal grain straw from barley, oat or wheat may be allowed upon approval of the City. Provide straw that is not moldy, caked, decayed or of otherwise low quality. Submit certification from the supplier that the straw is free of noxious weed seeds or plant parts. Acceptable documentation is any one of the following:

- The straw source is an "Oregon Certified Seed" field.
- The straw is certified by a recognized program accepted by the Oregon Department of Agriculture as being weed free.
- Seed lab test results of seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content.

(c) **Tracer** - For hydromulch application, include enough green dye so applied mulch is easily visible.

01030.16 **Tackifier** - Furnish a commercial quality tackifier containing no agent toxic to plant life. Furnish tackifier of either a liquid stabilizing emulsion or a dry powder tackifier meeting the following requirements:

(a) **Liquid Stabilizer Emulsion** - Tackifier with a base material of liquid, polyvinyl acetate polymers, using emulsion resins and containing not less than 55% total solids by weight. Furnish tackifier containing no polyacrylates or polyvinyl acrylics. The emulsion shall, when diluted with water and upon drying, allow exchange of air and moisture to the seeds and have an effective life of 1 year or more.

(b) **Dry Powder Tackifier** - Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable, and consisting of a processed organic adhesive derivative of one of the following:
- Gumbinder derived from guar (Cyamopsis tetragonoloba)
- Gumbinder derived from plantain (Plantago insularis)

01030.17 **Pesticides** - Submit proposed pesticides and receive approval before using. Submit a copy of the manufacturer’s federal registered label and, if requested, a Material Safety Data Sheet. The City reserves the right to restrict chemicals from being used on Sensitive Areas.

**Labor**

01030.30 **General:**

(a) **Weed Control Coordinator** - Submit certification at the preconstruction conference that the weed control coordinator meets the following minimum requirements:

- Demonstrates ability to identify noxious and other weed species commonly seen in Oregon. Some examples of potentially acceptable credentials are at least one year conducting weed surveys in Oregon or Washington State or a degree in botany or horticulture from an accredited institution.
- Has successful weed control experience, with similar duties to those stated under typical duties below, on at least 3 construction or vegetation management projects. Two examples of acceptable certification are an Oregon Pesticide Consultant License or Oregon Landscape Contractor’s License held in the individual’s name.

Typical duties of the weed control coordinator include the following:

- Identify Specified Weeds.
- Prepare and update the Weed Control Work Plan (WCWP).
- Coordinate Contractor’s weed removal work and records.
- Resolve weed control issues as the Contractor’s representative.
- Determine when Specified Weed content exists in disposable materials and ensures the materials are disposed of at an approved off-site facility.

(b) **Pesticide Applicator** - Submit certification before application of pesticide work begins, that when chemical weed control is used, that each applicator possesses an Oregon Commercial Pesticide Applicator’s License held in the individual’s name. Submit a certification each time a new applicator begins application work on the Project.
Construction

01030.40 General - Notify the City not less than 24 hours in advance of seeding operations. Do not begin seeding until prepared slopes in an area have been approved for seeding. Do not perform seeding during windy weather or when the ground is frozen, excessively wet, or otherwise not tillable.

Do not disturb or damage existing desirable vegetation that is to be left in place. Do not disturb areas previously seeded and mulched, with the exception of disturbances caused by stage construction. If previously seeded areas are disturbed, rework and reseed as directed, at no additional cost to the City.

Remove all non-approved plants resulting from the seed mixes provided for the Project at no additional cost to the City, including erosion protection required during reseeding.

01030.41 Area Preparation - Refer to 01040.48 for area preparation for the following kinds of seeding:

- Temporary Seeding - Method E
- Permanent Seeding - Method D
- Wildflower Seeding - Method B
- Plant Seeding - Method B
- Water Quality Seeding - Method B
- Wetland Seeding - Method B
- Lawn Seeding - Method C
- Native Plant Seeding - Method B

01030.42 Weed Control - When the Contract Schedule of Items includes an item for "Weed Control", remove and prevent regrowth of Specified Weeds, weed plant parts, and weed seeds from areas within the Project limits.

Do not harm or disturb existing native or ornamental vegetation, unless directed to do so. Do not compact soil with heavy equipment in areas where soil will not be disturbed for roadway or other construction.

If a pesticide has been approved for use, apply according to Federal and State laws, including conditions and requirements of the Federally registered pesticide label.

(a) Weed Control Work Plan - Depending on project conditions such as location, sensitive environments, permit requirements, jurisdictional regulations, or other items, there may be limits on the use of chemicals or other weed control methods. Before submitting the initial WCWP, determine if there are restrictions or all potential for restrictions on weed control methods on project sites. At the preconstruction conference, submit a WCWP with the following:
- Name and contact information for the approved weed control coordinator.
- WMAs with existing Specified Weeds mapped on project plan sheets where possible.
- Botanical and common name of each species of weed to be removed.
- The proposed methods of weed removal and continuing control for each weed species listed.
- Schedule of weed control measures.
- Request to use wheeled or tracked construction equipment in sensitive areas.

If changes of the WCWP are necessary, resubmit a revised WCWP for approval before proceeding.

(b) Weed Control Inspections - Inspect the project for new growth of specified weeds at least monthly and apply weed control measures as appropriate. This requirement may be waived by the Engineer during the period that weeds are fully dormant. To ensure satisfactory weed removal, the last WMA inspection will occur at least 30 days after growing season has begun or as directed.

At a minimum, schedule weed control inspection with the City at the following times:

- After approval of WCWP and prior to beginning weed control within a WMA.
- Monthly.
- Upon request by the City to discuss non-compliant weed control work.
- After completing weed control at material sources and disposal sites.

(c) Remove and Control of Weeds - Remove and control weeds according to the following:

(1) All areas:

- At least 3 calendar days prior to beginning weed control activities, walk through each WMA with the Engineer and confirm the identity, location, type, and approximate number of Specified Weeds. Verify that control methods in the WCWP are acceptable as planned for each WMA before proceeding with weed control activities.
- Remove Specified Weeds and receive approval prior to beginning construction or equipment mobilization in that area. As much as practicable, ensure that weed seeds or reproducing plant parts such as vines, runners, or rhizomes don’t remain or become dispersed during control activities.
01030.43

- As soon as practicable, place weeds and related materials in an approved container and transport to an approved offsite disposal facility according to applicable laws and regulations. During transport, ensure that materials are fully enclosed at all times to prevent escape.
- Keep a record of all weed material loads transported off the Project and submit documentation from the approved disposal facilities that a corresponding number of weed material loads were disposed of at that facility.
- Keep WMAs Weed Free including weeds not initially present in the walk through.

(2) Sensitive Areas:

- Unless otherwise approved in writing, use only hand or light mechanical weed control methods within 50 feet of Sensitive Areas. Hand methods include the use of hand tools. Light mechanical methods include the use of hand carried, motorized machinery.
- Inside Sensitive Areas, obtain approval before using wheeled or tracked construction equipment. Requests will be approved only when all vegetation in the area will be cleared, such as under new roadways or slopes.
- The Engineer will be the authority in the determination of Sensitive Areas.

(d) Weed Control Corrective Work - If corrective work for areas identified as deficient by the Engineer is not completed within a 15 calendar day period, the Engineer may suspend the work according to 00180.70. If the Contactor’s weed control work is determined to be unsatisfactory, the City reserves the right to do the work at the Contractor’s expense.

01030.43 Temporary and Permanent Seeding:

(a) Temporary Seeding - Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again. Provide fertilizer, mulch, water, and other amendments necessary to ensure establishment. Ensure that temporary seeding work achieves the coverage of live plants required by 01030.60 by the end of the next permanent seeding date stated in 01030.43(b). If this coverage is not achieved, or if the City determines that it is not effective in stabilizing the soil from erosion, stabilize the area with other temporary stabilization methods as described in 00280.42 at no additional cost to the City.

(b) Permanent Seeding - Perform this seeding during the permanent seeding dates shown below. If work done within the seeding dates does not provide coverage according to 01030.60, re-seed according to 01030.48 and as directed. The dates for permanent, wildflower, plant, water quality, wetland, lawn, and native plant seeding are as follows:
- **West of the Cascades** - March 1 through May 15 and September 1 through October 31. If new lawn areas are regularly watered, they can be seeded from March 1 through November 15.

- **Wetland (Statewide)** - September 1 through October 31 and March 1 through April 30.

Permanent seeding outside these dates requires written authorization from the City. Approval to seed outside these dates will only be given when physical completion of Project work is imminent and environmental conditions are conducive to satisfactory growth. For permanent seeding done outside the seeding dates, ensure that the coverage of live plants required by 01030.60 is achieved no later than 3 weeks into the next permanent seeding period. If this coverage is not achieved, re-seed and refertilize areas of insufficient coverage according to the permanent seeding requirements, at no additional cost to the City.

**01030.44 Fertilizer:**

(a) **Inorganic** - Apply 22-16-8 or 22-10-5 at the rate of 400 pounds per acre.

(b) **Low-phosphorous** - Apply 22-2-11 polymer coated urea low-phosphorus fertilizer at the rate of 200 pounds per acre.

Use low-phosphorous fertilizer within 50 feet of water.

**01030.45 Soil Testing** - Test soil according to 01040.13.

**01030.46 Topsoil and Wetland Topsoil** - Construct topsoil according to 01040.43 or 01040.44 as appropriate.

**01030.47 Soil Amendments and Bio-Amendments** - Incorporate soil amendments and bio-amendments into the seeding operation according to 01040.45 and 01040.46, as appropriate.

**01030.48 Application** - The following application methods are acceptable for both temporary and permanent seeding:

(a) **Hydroseeding, Fertilizing, Hydromulching, and Tacking** - Apply seed, fertilizer, mulch, and tackifier as follows:

Use hydraulic equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the equipment and application method provides a uniform distribution of the slurry. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.
(1) **Hydroseeding operation** - Perform hydroseeding according to the following:

a. **One-step operation** - Apply materials in one step only for the following situations:
   
   - When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.
   - When treating small areas according to 01030.48(e). Double the amount of seed to compensate for seed suspended above soil by the mulch.

b. **Two-step operation** - Except for the one-step method situations in 01030.48(a)(1)(a), use the two-step method for all hydroseeding operations:
   
   - **Step 1** - Apply seed, fertilizer, and tracer. The seed and fertilizer may be applied separately or together. If hydromulch is used as tracer, apply it at a rate of 500 pounds per acre.
   
   - **Step 2** - Apply mulch and tackifier. Hydromulch, if used as a tracer in Step 1, will be included as part of the specified hydromulch rate specified in 01030.48(a)(3)

(2) **Seed** - Thoroughly mix seeds when more than one kind is to be used.

(3) **Mulch** - Apply hydromulch at the following rates based on dry fiber weight:

   a. **Slopes Flatter Than 1V:2H** - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

   b. **Slopes 1V:2H or Steeper** - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.

(4) **Tackifier for Cellulose Fiber Applications** - Use one of the following:

   a. **Liquid Stabilizer Emulsions** - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at a rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.

   b. **Dry Powder Tackifier** - Apply at the following rates unless the manufacturer recommends a greater rate of application:
• **Slopes Flatter Than 1V:2H** - 60 pounds per acre mixed with hydromulch fibers at the rate specified.

• **Slopes of 1V:2H or Steeper** - 100 pounds per acre mixed with hydromulch fibers at the rate specified.

(b) **Seeding, Fertilizing, Dry Mulching, and Tacking** - Apply seed and fertilizer separately or together as the first step. Apply dry mulch as the second step. Tackify the mulch as the third step.

(1) **Seed and Fertilizer** - Apply seed and fertilizer at the specified rates. When fertilizer and seed are to be applied in dry condition, apply them separately. When applied from separate compartments, the application may be done in one operation. Apply seed and fertilizer by one of the following methods:

a. **Blower** - Blower equipment using air pressure and an adjustable spout that uniformly applies dry fertilizer and dry seed in separate and successive applications at constant measured rates.

b. **Helicopter** - Helicopter equipped with hoppers and adjustable disseminating mechanisms that separately and successively apply fertilizer and seed in uniform and prescribed quantities.

c. **Mechanical Spreaders** - Hand or machine operated mechanical spreaders that uniformly apply dry fertilizer and dry seed separately and successively in the prescribed quantities.

d. **Hydroseeding** - Uniformly apply at the rate specified. Add 500 pounds per acre of hydromulch fiber to the seed and fertilizer mixture to visibly aid uniform application at the Contractor's expense.

(2) **Dry Mulch** - Evenly apply straw mulch material according to these Specifications within 24 hours after seeding and fertilizing. In areas not accessible to heavy equipment or hose, mulch by hand or by other approved methods.

Place straw mulch approximately 2 inches deep, in loose condition, which requires roughly 2 1/2 tons per acre of dry mulch, depending on moisture content. Do not use straw mulch on slopes of 1V:1.5H or steeper.

(3) **Tacking** - Anchor mulch using one of the following methods:

a. **Dry Powder Tackifier** - Unless the manufacturer recommends a greater rate, apply dry powder tackifier at the rate of 80 pounds per acre mixed with 800 pounds per acre of hydromulch.

b. **Mechanical Crimping** - Mechanically incorporate the straw into the top 2 inches of the soil forming uniform erosion control surface cover.

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c. **Crimping Disc** - A heavy disk with flat scalloped discs approximately 61/4 inch thick, having dull edges and spaced no more than 9 inches apart.

d. **Sheep's-Foot Roller** - Modified sheep's foot roller equipped with straight studs, made of approximately 3/4 inch steel plate, placed approximately 8 inches apart and staggered. Ensure that the studs are not less than 6 inches long, nor more than 6 inches wide, and are rounded to prevent withdrawing the straw from the soil. Use a roller with enough weight to incorporate the straw sufficiently into the soil providing a uniform surface cover.

(c) **Drill Seeder** - Apply seed and fertilizer with a grass seed drill that works fertilizer into the soil and places seed under about a 1/4 inch soil cover.

(d) **Seeding Over Mulched Areas** - If an area has been previously mulched for erosion control or temporary seed and mulch is present on the soil surface, double the pound rate for each seed type used. Apply seed and fertilizer hydraulically and add a green dye to the mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

- Mulch is punched into the soil by mechanized means.
- It is necessary to hold down mulch with netting or like material.
- The slope is 1V:1.5H or steeper and a slurry mixture would tend to run down the slope.
- Mulch is removed prior to seeding.

(e) **Optional Temporary or Permanent Seeding** - Upon approval, the following may be used to stabilize disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:

1. **Seed** - Seed the disturbed area with the seed mix at the rate of 2 pounds per 1,000 square feet. Seed may be spread by mechanical spreader according to 01030.48 (b)(1)(c).

2. **Cover** - Cover seeded areas with one of the following:

   - Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly and apply commercial tackifier or netting to hold in place.
   - Bark mulch spread uniformly at an approximate depth of 1/2 inch. Use well-decomposed mulch for seed mulching.
   - Suitable open-weave, biodegradable erosion control matting installed according to manufacturer's instructions.
   - Hydromulch applied in one step according to 01030.48(a).

3. **Fertilizer** - Fertilize according to 01030.44.
01030.49  Work Quality:

(a) Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used. Use protective covering on structures and objects where coverage and stains would be objectionable and when tacking agents are used with mulch. Protect vehicles and people from drifting spray. If equipment and methods of application result in wasting material, make corrections to prevent waste.

(b) Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto areas occupied by rock base, rock shoulders, plant beds, or other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.

(c) Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

01030.60  General - Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the establishment period. The minimum living plant coverage standards for acceptance of seeding in a planted area are as follows:

- Temporary Seeding - 70% coverage of ground surface.
- Permanent Seeding - 90% coverage of ground surface.
- Wildflower and Wetland Seeding - 70% coverage of ground surface.
- Water Quality and Lawn Seeding - 100% of ground surface.
- Woody or Other Plant Seeding - See Special Provisions for minimum living plant coverage.

01030.61  Establishment Period - The seeding establishment period is as follows:

(a) Erosion Control Seeding - For temporary and permanent seeding done solely for erosion control, the establishment period begins upon acceptance of the initial seeding work and ends upon satisfactory plant growth and coverage of the seeded areas according to 01030.42 and 01030.60.

(b) All Other Seeding - Establishment periods for wildflower, plant, water quality, lawn, wetland, and permanent seeding begins upon acceptance of the initial seeding work and ends as follows:

- The seeding establishment period will end 45 days after the beginning of the establishment period, if the area was seeded during the seeding season and all establishment responsibilities have been met.
If the original seeding construction is completed and accepted outside the permanent seeding dates, the establishment period will end 45 calendar days after any necessary reseeding is completed and accepted during the following seeding season.

**01030.62 Establishment Work:**

(a) **Erosion Control Seeding** - Select and provide establishment work for erosion control seeding from 01030.62(b) necessary to provide performance described in 01030.60.

(b) **All Other Seeding** - Ensure the establishment of wildflower, lawn, plant, water quality, wetland, native plant, and permanent seeding by the following:

1. **Protection** - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at no additional cost to the City. Obtain approval of any protective methods used.

2. **Fertilizing and Watering** - Apply fertilizer according to 01030.44. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the City.

3. **Weed Control** - Remove Specified Weeds prior to plants going to seed and keep WMAs and seeded areas "Weed Free" throughout the establishment period.

4. **Mowing** - Mowing is required for lawn seeding and water quality seeding. Do the first mowing of grass when soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1 1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval. The approval may be granted if:
   - Mowing is done with a mulching blade.
   - There are no weed seeds in the mulch.
   - Mulch is not detrimental to the growth of grass.

5. **Repair and Restore** - Repair and restore soil grades and re-seed any damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the City.

**Finishing and Clean Up**

6. **Cleanup** - Remove weeds, trash, debris, stones, and all other extraneous matter from seeded areas as directed and dispose of according to 00290.20.
01030.90

01030.71 Waste Disposal - Protective coverings used on structures and all waste materials associated with seeding, fertilizing, mulching, and associated activities become the property of the Contractor at the point of origin. Dispose of these waste materials according to 00290.20.

Measurement

01030.80 Measurement - The quantities of seeding and associated work performed under this Section will be measured according to the following:

- Unit Basis - Unit basis items will be measured by actual count.
- Area Basis - Area basis items will be measured on the ground surface.

Payment

01030.90 Payment - The accepted quantities of seeding and associated work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Weed Control</td>
<td>Acre</td>
</tr>
<tr>
<td>(b) Seeding Mobilization</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Temporary Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(d) Permanent Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(e) Wetland Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(f) Water Quality Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(g) Plant Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(h) Native Plant Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(i) Wildflower Seeding</td>
<td>Acre</td>
</tr>
<tr>
<td>(j) Lawn Seeding</td>
<td>Acre or Square Yard</td>
</tr>
<tr>
<td>(k) Fertilizing</td>
<td>Acre</td>
</tr>
<tr>
<td>(l) Mulching</td>
<td>Acre</td>
</tr>
</tbody>
</table>

Item (a) includes all work associated with the WCWP.

Item (b) includes all labor and transportation of materials and equipment, each time the Contractor mobilizes as required for all hydraulically or airborne applied seeding, fertilizing, and mulching.

Items (c) through (j) include preparing the seed bed, soil preparation, seeding, fertilizing, mulching, applying tacking agent, and all establishment work.

When temporary seeding, applied according to 01030.43(a), is later accepted as permanent seeding according to 01030.43(b), payment will be made only one time under the permanent seeding pay item. No separate payment will be made for the initial seeding.
01030.90

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

**No separate or additional payment will be made for:**

- mobilization for application by blowers, mechanical spreaders, or hand spreading
- inspections or maintenance
- seeding mobilization if it is not included in the Contract Schedule of Items

The amount paid for permanent seeding items will be as follows:

- At completion of seeding ............................................................ 70%
- At completion of the establishment period ................................. 30%
Section 01040 - Planting

Description

01040.00 Scope - This work consists of planting and associated work as shown or directed.

01040.02 Definitions:

Arborist - A specialist in the care and maintenance of trees.

Caliper - The diameter of a tree measured at a point 6 inches above the ground. If the measurement is over 4 inches, a new measurement is taken at a point 12 inches above the ground.

Certified Arborist - An Arborist certified by the International Society of Arboriculture (ISA).

Consulting Arborist - An Arborist registered with the American Society of Consulting Arborists (ASCA).

Dripline - The area directly under the branch and leaf canopy of trees and large shrubs. This area typically contains the most important of a plant's roots and is sometimes used as an approximate guide to estimate a root protection zone.

Licensed Nursery - Commercial nursery licensed by the Oregon Department of Agriculture to operate as a grower, dealer or agent, or to transport or store nursery stock grown or held for sale.

Native Plant (existing) - See 01030.02 for native plant definition.

Noxious Weed - See 01030.02 for noxious weed definition.

Ornamental Plant - A desirable plant species that is not native, or a plant propagated in such a way that it does not carry genetic characteristics of the species that are native to the area where it is planted.

Permanent Wilting Point - The level of soil wetness at which a plant wilts and can no longer recover its sustainable turgidity when placed in a saturated atmosphere for 12 hours.

Plant Establishment Period - A period of time, that is part of the planting work, that ensures satisfactory growth and establishment of plants.

Root Protection Zone - A generally circular area around an existing plant to be protected from disturbance or compaction by the use of temporary fencing or other means. The zone as actually staked may exceed the current root area to allow for future growth of the plant. Root Protection Zones will be shown on the plans or staked before construction activities begin.

Weed - See 01030.02 for weed definition.
01040.03  General - Ensure that work meets the following requirements:

(a) Existing Vegetation - Do not disturb existing desirable vegetation that is to remain or is designated for protection, unless approved by the City prior to construction.

(b) Pesticide Applicators License and Chemical Registration - Furnish evidence to the City that each applicator is licensed for the specific class of chemical being applied. Also, furnish evidence that any chemical is registered for the proposed use by the Oregon Department of Agriculture according to ORS Chapters 452, 561, 570, and 634.

(c) Weather Conditions - Planting work will not be allowed during the following conditions, unless otherwise approved:

- **Cold weather** - When air or ground temperatures are expected to be below 32 °F.
- **Hot weather** - When air or ground temperatures are expected to be above 88 °F.
- **Wet weather** - When the ground reaches saturation, except as approved when planting wetland plants.
- **Windy weather** - When wind velocity exceeds 25 mph.

(d) Work Performed During Unacceptable Conditions - If any work occurs during unacceptable weather conditions, the Contractor may be required to provide the following services at no additional cost to the City:

1. **Expert Consultation** - Consultation with a certified Arborist (for trees) or other expert as approved (for other plants) to determine what plant care measures are required to maintain the plants installed during the unacceptable weather conditions in a healthy and vigorous condition.

2. **Replacement** - Replacement of all work performed during unacceptable weather conditions.

3. **Watering and Maintenance** - Watering and maintenance of all plant materials installed during the unacceptable weather conditions and responsibility for all extra costs incurred.

01040.04  Coordination - Coordinate the following elements with the City prior to construction:

(a) Planting Work Plan (PWP) - Within 90 calendar days of award of the Contract, submit a PWP for approval. Include or describe the proposed methods for the following:
• Work progress schedule according to 00180.41
• Material submittals according to 01040.10
• Contract Growing Plan according to 01040.19(g)
• Topsoil or Wetland Topsoil approvals according to 01040.14
• Plant installation and establishment
• Weed Control Work Plan (WCWP) according to 01030.42(a)
• Emergency contact person, including the name, telephone and pager numbers, and voice mail or email address information

The following are included as part of the PWP, but are required only before the related planting work begins:

• Soil Fertility Test and Soil Amendment Report according to 01040.13
• Soil Testing and Soil Bio-amendment Report according to 01040.13

Proceed according to the approved PWP once written approval is received from the City. If any part of the PWP become unworkable at any time during construction, notify the City, then submit a revised plan. Do not proceed with the planting work until approved by the City.

(b) Notice for Inspections - Notify the City a minimum of 24 hours prior to each required inspection.

(c) Site Conditions - Ensure that the area is properly prepared prior to the start of the planting operation.

(d) Utility Locate - Coordinate all existing utility locations according to Section 00150.

(e) Utility Use - Provide required water and electricity for planting and plant establishment at no additional cost to the City unless an approved City source is available.

(f) Verification - Verify actual ground dimensions prior to construction. Notify the City of any discrepancies before beginning work.

Materials

01040.10 General - Submit a list of Project materials for approval according to 01040.04(a) before arranging for procurement of any materials. For materials not approved, submit a list of alternate materials for approval. Materials installed without approval will be subject to removal and replacement with acceptable material at no additional cost to the City.

Substitute materials may be allowed if proof of equivalent quality, suitable product specifications, manufacturer's literature and other detailed information is furnished to the City according to 00140.70.
01040.12 **Product Delivery, Storage, and Handling** - Deliver manufactured products in original, unopened containers, each bearing the manufacturer's guaranteed analysis, name, trade name, and conformance with governing regulations and laws. Protect products against damage or dehydration. Remove unacceptable products as soon as possible from the Project site. If required or requested, provide any manufacturer's literature to the City.

01040.13 **Soil Testing** - Furnish the following kinds of soil testing and reports:

(a) **Soil Fertility Test and Soil Amendment Report** - Prior to planting, furnish a soil fertility analysis of existing soils performed by a certified testing lab. Prior to planting, adjust soil amendment and fertilizer applications as recommended by the soil amendment report and as approved by the City.

1. **Sampling** - Take 5 samples per hectare of each soil type. Mix the 5 samples into one test sample for each soil type. Furnish soil fertility test results that provide information on available nutrient content and fertility status of the soil. Conduct sampling procedures according to the Oregon State University Extension Service handout EC 628, "How to Take a Soil Sample... and Why".

2. **Testing** - The test may be performed by any qualified soils testing laboratory. A list of qualified soils testing laboratories is available from the Oregon State University Extension Service. Include testing for levels of acidity (pH), salinity, nitrates, ammonium, phosphates, potassium, calcium, magnesium, and any other tests necessary to determine appropriate fertilization and amendment needs for the type of plants being planted.

3. **Soil Amendment Report** - Provide a report from the testing laboratory summarizing sampling locations and procedures with printed results, and which makes recommendations for fertilizers and soil amendments to effectively develop productive soil.

(b) **Testing and Soil Bio-Amendment Report** - Have soils tested prior to planting by an approved soil ecology lab. Provide information on soil foodweb structure and function, and include total and active bacterial biomass, total and active fungal biomass, protozoan numbers, nematodes, microarthropods, and mycorrhizal colonization. Adjust the kind and amount of soil conditioners, soil amendments, soil bio-amendments, and fertilizers (if any) as recommended by the soil bio-amendment report, and as approved by the City prior to construction.

1. **Sampling** - Take 5 samples per acre of each soil type. Mix the 5 samples into one test sample for each soil type. Conduct sampling according to the standard procedures for soil organism assessment as recommended by the soil ecology lab.

2. **Testing** - Perform the following soil ecology tests and furnish soil meeting these minimum soil organism biomass requirements:
### Test Minimum Requirements

<table>
<thead>
<tr>
<th>Test</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent active bacterial and fungal biomass</td>
<td>between 5% and 25% activity</td>
</tr>
<tr>
<td>Total bacterial biomass</td>
<td>$6 \times 10^8$ per gram of dry soil</td>
</tr>
<tr>
<td>Total fungal biomass</td>
<td>$100 \mu g$ for grasslands</td>
</tr>
<tr>
<td></td>
<td>$200 \mu g$ for shrubs or perennials</td>
</tr>
<tr>
<td></td>
<td>$300 \mu g$ for forested areas</td>
</tr>
<tr>
<td>Protozoa</td>
<td>$5000$ per gram of soil</td>
</tr>
<tr>
<td>Beneficial nematodes</td>
<td>$20$ per gram of soil</td>
</tr>
<tr>
<td></td>
<td>(No root-feeding nematodes)</td>
</tr>
</tbody>
</table>

Determine if anaerobic or compacted conditions are present, based on the assessment of total bacterial biomass, percent bacterial activity, and protozoan biomass.

If the soil contains biomass numbers lower than these levels, apply amendments and inoculates according to the soil ecology lab recommendations in the soil bio-amendment report in 01040.13(b)(3).

### (3) Soil Bio-amendment Report
- Provide a report summarizing sampling locations and procedures. Include the soil ecology lab report of the soil organism assessment and the recommendations for:
  - Inoculation of missing organisms groups to the soil
  - Amendment with food resources for organism groups with too low of a biomass
  - Reduction of undesirable groups, or groups with the biomass too high for the optimal growth of the desired plants
  - Any adjustments to the bio-amendments required for the types of plants being planted

### 01040.14 Topsoil
- Furnish topsoil containing no substance detrimental to the growth of plants and that is free of plants designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds. Unsuitable topsoil, or topsoil placed by the Contractor without approval in areas to be planted, may be required to be replaced at no additional cost to the City.

20 days before furnishing any type of topsoil, do the following:
  - Give the City notice of intent to use the source
  - Provide access to the source for City inspection
  - Provide one 20 pound representative soil sample of each topsoil type for testing of particle size range and organic matter by the City, unless otherwise specified
  - Obtain approval of the source before excavation of topsoil begins
(a) **Selected Topsoil** - Furnish native topsoil from the required excavations according to 00330.10 or from other City-controlled lands. The general limits of topsoil materials will be indicated on the plans. The City will make the final determination of the areas where the most suitable materials exist. Furnish topsoil that is the fertile part of a soil profile commonly referred to as the "A" horizon, typically ranging in depth from 3 inches to 12 inches. Do not take material for topsoil from a depth greater than 12 inches below existing ground, unless approved.

Select only sources that are well-drained and, before stripping, have a healthy crop of vegetative growth. Remove and dispose of all heavy grass or other vegetation before taking materials from the source.

(b) **Imported Topsoil** - Furnish imported topsoil from non-City controlled lands that, when tested according to AASHTO T 88, conforms to the following limits:

<table>
<thead>
<tr>
<th>Standard Sieve Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size Range</td>
</tr>
<tr>
<td>Larger than 2&quot;</td>
</tr>
<tr>
<td>2&quot; - 3/4&quot;</td>
</tr>
<tr>
<td>3/4&quot; - No. 4</td>
</tr>
<tr>
<td>No. 4 or less</td>
</tr>
</tbody>
</table>

Of the fraction passing the No. 4 sieve, excluding organic material, furnish topsoil that conforms to the following limits:

<table>
<thead>
<tr>
<th>Hydrometer Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size Range</td>
</tr>
<tr>
<td>No. 4 - No. 200</td>
</tr>
<tr>
<td>No. 200 - 2 µm</td>
</tr>
<tr>
<td>Less than 2 µm</td>
</tr>
</tbody>
</table>

In addition, furnish topsoil that analyzes at least 2% organic matter according to ASTM D 2974.

(c) **Wetland Topsoil** - Furnish a native, naturally hydric wetland topsoil consisting of silts, clays, and organic matter in combination that is free from substances detrimental to plant growth, such as noxious weeds, undesirable plant roots, refuse, sticks, or lumps. Provide wetland topsoil that is from a wetland with an existing, well established, healthy growth of the desired wetland plants. Obtain approval of the source before excavation of wetland topsoil begins.

Excavate, at a minimum, the top 24 inch depth of existing wetland soils using standard construction equipment.
(d) Stormwater Facility Topsoil - Furnish imported topsoil for vegetated stormwater facilities conforming to the following:

1. Standard Blend for Public and Private Facilities - Use this blend for all vegetated stormwater management facilities, except those in the right-of-way where compaction from foot traffic is a concern as specified in Section 01040.14(d)(2) "Infiltration Blend for the Right-of-Way".

a. General Composition - The material shall be any blend of loamy soil, sand, and compost that is 30-40% compost (by volume) and meets the other criteria in this specification.

b. Analysis Requirements for the Blended Material:

1. Particle Gradation - A particle gradation analysis of the blended material, including compost, shall be conducted in conformance with ASTM C117/C136 (AASHTO T11/T27). The analysis shall include the following sieve sizes: 1 inch, 3/8 inch, #4, #10, #20, #40, #60, #100, #200. The gradation of the blend shall meet the following gradation criteria.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
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<tr>
<td># 4</td>
<td>75 -100</td>
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<td># 10</td>
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<td># 40</td>
<td>15-50</td>
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<td># 100</td>
<td>5-25</td>
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<tr>
<td># 200</td>
<td>5-15</td>
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</tbody>
</table>

The blend shall have a Coefficient of Uniformity (D60/D10) equal to or greater than 6 to ensure it is well graded (has a broad range of particle sizes). The coefficient is the ratio of two particle diameters on a grain-size distribution curve; it is the particle diameter at 60% passing divided by the particle diameter at 10% passing.

2. Acidity - The pH (Power of Hydrogen) of the blended material shall be tested and be between 6 to 8.

c. General Requirements for the Blended Material:

1. The material shall be loose and friable.

2. It shall be well mixed and homogenous.

3. It shall be free of wood pieces, plastic, and other foreign matter.

4. It shall have no visible free water.

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d. Compost - The compost shall be derived from plant material and provided by a member of the US Composting Council Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers.

The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet provided by the vendor.

- 100% of the material must pass through a 1/2 inch screen.
- The pH of the material shall be between 6 and 8.
- Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight.
- The organic matter content shall be between 30 and 70% (dry weight basis).
- Soluble salt content shall be less than 6.0 mmhos/cm.
- Maturity Indicator shall be greater than 80% for Germination and Vigor.
- Stability shall be 'Stable' to 'Very Stable'.
- Carbon/Nitrogen (C/N) ratio shall be less than 25:1.
- Trace metals test result = “Pass.”

e. Submittals - At least 14 working days in advance of construction, submit the following:

1. Documentation for the two analyses described in section 01040.14(d)(1)(b) of this specification (particle gradation with calculated coefficient of uniformity; and pH) shall be performed by an accredited laboratory with certification maintained current. The date of the analyses shall be no more than 90 calendar days prior to the date of the submittal. The report shall include the following information:

- Name and address of the laboratory.
- Phone contact and e-mail address for the laboratory.
- Test data, including the date and name of the test procedure.
2. A compost technical data sheet from the compost vendor. The analysis and report must conform to the sampling and reporting requirements of the US Composting Council Seal of Testing Assurance (STA) program. The analysis shall be performed and reported by an approved independent STA program laboratory and be no more than 90 calendar days prior to the date of the submittal.

3. Two 5-gallon buckets of the blended material.

4. A description of the location, equipment, and method proposed to mix the material.

f. Stormwater Facility Topsoil Installation - See 01040.43(c).

(2) Infiltration Blend for the Right-of-Way - Use this blend for facilities in the right-of-way where compaction from foot traffic is a concern. Approval is required.

a. General Composition - The material shall be a mix of sand and compost, blended by volume consisting of 60-70% sand and 30-40% compost (by volume).

b. Analysis Requirements - The requirements are the same as those specified in section 01040.14(d)(1)b for the “Standard Blend for Public and Private Facilities.” The single difference is the particle gradation criteria, which are as follows.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
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<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
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<tr>
<td># 4</td>
<td>60-100</td>
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<td># 40</td>
<td>15-50</td>
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<tr>
<td># 100</td>
<td>5-20</td>
</tr>
<tr>
<td># 200</td>
<td>1-5</td>
</tr>
</tbody>
</table>

c. General Requirements for the Blended Material - See 01040.14(d)(1)c.

d. Compost - See 01040.14(d)(1)d.

e. Submittals - See 01040.14(d)(1)e.

f. Stormwater Facility Topsoil Installation - See 01040.43(e).
01040.15 Soil Conditioners - Soil conditioners are for modifying soil structure and improving soil aeration characteristics, as distinguished from plant foods, mulch, and soil organism amendments. Furnish soil conditioners free of noxious weeds, living plants and rhizomes, and substances detrimental to plant life. Submit a 15 pound sample for approval by the City prior to construction. Provide soil conditioners that are free of weed seeds, excessive salts, chemicals detrimental to plant growth, and pest organisms. Soil conditioners proposed for use are subject to testing at any time or place the City deems appropriate.

Furnish one or more of the following soil conditioners:

(a) Mushroom Compost - The used bedding material from commercial mushroom production.

(b) Composted Yard Debris - Commercially manufactured material, made from dead plant material such as grass clippings, weeds, green and dead dry leaves, garden and vegetable material, and ground branches of trees and shrubs. Furnish a product that is composted under controlled aerobic decomposition, with the internal temperature reaching 135 °F for 15 days, without exceeding 155 °F. Ensure that it contains a maximum of 10% bacteria and 10% fungus. Additional certification may be required in areas having a certification program.

(c) Peat Moss - Horticultural grade, natural peat moss in air-dry condition, free from woody substances, in bales or bags labeled for content and volume. Only peat moss used in combination with one of the above composts is acceptable.

01040.16 Soil Amendments - Soil amendments are intended to improve soil nutrition. Furnish soil amendments that are free of materials detrimental to plant life. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. Obtain approval for use before beginning work. Soil amendments may include the following:

- Lime
- Dolomite Lime
- Gypsum
- Rock, Diammonia, or other Phosphate
- Calcium or Potassium Nitrate
- Iron Sulfate
**01040.17 Soil Bio-amendments** - Soil bio-amendments are intended to increase beneficial soil organism numbers or soil organic nutrient content. Furnish bio-amendment products or materials that are free of substances or lifeforms detrimental to plant life and receive approval prior to use on the Project. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. The following are typical soil bio-amendments that may be identified in the soil bio-amendment report:

(a) **Bacterial Food Amendments:**
- Simple sugars such as brown sugar, brown syrups, or molasses
- Plant extracts of Yucca or Nettle, usually containing sap of the plant comprised of a combination of simple sugars, proteins, and carbohydrates
- Fulvic acids
- Yeast, including baker's yeast, brewer's yeast, and champagne yeast
- Kelp meal
- Rock dust

(b) **Fungal Food Amendments:**
- Cellulose
- Lignin
- Humic acids - brown to dark brown products (black is not acceptable)

(c) **Protozoa Food Amendments:**
- Bacteria
- Hay infusions - A method of growing protozoa for soil inoculation by using hay in water

(d) **Nematode Food Resources** - Nematodes come as four types: bacterial-feeders, fungal-feeders, root-feeders and predatory nematodes. Predatory nematodes eat other nematodes, while the name of the other groups indicate what organisms they eat.

The primary source of material containing a wide diversity of beneficial nematodes is good compost. Provide certification that the compost contains beneficial nematodes and does not contain root-feeding or other detrimental nematodes.

(e) **Mycorrhizal Inoculates** - Commercially produced ectomycorrhizal and endomycorrhizal fungi that improve plant root absorption of soil nutrients.
(f) **Microbes** - Commercially produced product designed to enhance microbiological activity in the soil by the addition of beneficial and essential microbes. Commercial products may also contain vitamins, amino acids, plant growth hormones, micronutrients, and plant stress relievers.

(g) **Earthworms** - Common earthworms that are either "Red Wigglers" or "Night Crawlers" delivered in peat moss or other damp medium.

**01040.18 Fertilizer** - The soil amendment and bio-amendment reports will recommend fertilizer types and application rates. When identified in the report furnish commercial fertilizer meeting the requirements of 01030.14 and the following:

(a) **Organic** - Organic fertilizer 5-4-3, analyzing 5% nitrogen, 4% available phosphoric acid, and 3% soluble potash.

(b) **Plant Bags and Tablets** - Plant bags or tablets containing 20-10-5, or approved equal, may be used instead of granular fertilizer in pit planting.

Furnish plant bags or tablets that are controlled-release with a minimum 1 year release period. Chemical formulation, rates and use will be approved by the City.

**01040.19 Plants:**

(a) **Nomenclature** - Botanical identification and nomenclature of plant materials shall be according to the most current edition of "Hortus Third", by Bailey. The City may authorize use of other references such as the "Sunset Western Garden Book", the "Flora of the Pacific Northwest", by Hitchcock, or the "Manual of California Plants", by Jepson.

Furnish plants that conform to the applicable requirements of the current issue of the "American Standard for Nursery Stock", published by the American Association of Nurserymen. When a conflict exists between this publication and the Specifications, the Specifications will prevail.

(b) **Quality** - Provide plants that are healthy, first-class representatives of their species or variety, free from disease and insect pests, with top growth that is well developed and free of disfiguring knots, sun scalds, bark abrasions, wind or frost injury or any other objectionable features.

Furnish plants that are acclimated to the specific project environmental site conditions prior to planting. Store all container-grown and balled and burlapped (B & B) plant materials acquired for fall planting a minimum of 3 months before planting, at a location north of the 42nd Latitude (Oregon - California border).

Furnish plants that possess top growth and root systems typical to their variety. Provide trees with central leaders that have a symmetrical, well-branched, straight trunk. Trees with a damaged or missing leader, multiple leaders or Y-crotches will be rejected, as will sheared conifer trees.
Protect plants at all times during handling, shipping, storage and planting against such detrimental effects as windburn, extreme weather conditions and drying of roots, root balls and foliage.

(c) Certification - Furnish a State inspection certificate and shipping certificate for each load or lot of plant material that includes the following information:

- Date of shipment
- Name of nursery where grown
- Name of plants (Including all names as specified in the Contract)
- Number of plants
- Grade or classification of plants (Verifying conformance with the Specifications)
- Size (Including height, spread, runner length, caliper and other measurements as required)
- Identify at least one plant (botanical and common name) within each group of like species
- Identify one plant (botanical and common name) within each different size category

(d) Inspection - Plants will be subject to inspection by the City, at any time and place. The City will make no plant material inspection at the source, except as it may elect. Notify the City of each delivery of plants to the Project site no less than 24 hours ahead of delivery. Do no planting until the plants have been inspected and approved for use. Any planting done without prior approval of the plants will be considered in violation of these Specifications. The presence of noxious weeds in the soil accompanying plants or at the nursery source will be cause for rejection of any or all plants from that source.

(e) Availability - Furnish a list of nursery sources for all specified plants within 90 calendar days after execution of the Contract. Verify, by this list, that all specified plant material has been located and will be available for use on the Project. If applicable, see 01040.19(g) for alternate requirements.

(f) Plant Substitution - No substitution of plant materials will be allowed unless written evidence is submitted that a specified plant or material cannot be obtained and has been unobtainable since the execution of the Contract. If substitution is allowed, it will be by written approval from the City for the nearest acceptable variety, size and grade. Make any request for substitution in writing to the City with ample time for approval without delaying the work.

(g) Contract Grown Plant Materials - When required by the Special Provisions, include a contract growing agreement between the Contractor and a nursery supplier in order to ensure plant availability or suitability.
If a contract growing agreement is part of the Project, submit a Contract Growing Plan that describes plant material size at delivery, growth environment, name and location of nursery, and the source for each plant (native seed, indigenous cuttings, or commercially grown). Submit this required information as part of the PWP outlined in 01040.04.

(h) Definition of Plants and Descriptive Terms - The following definitions describe the distinctive habit and characteristics of the most common plant materials:

1. **Conifer Trees** - Trees with needle or scale-like leaves that maintain live-leaf foliage throughout the year, and that usually bear seed from a woody cone.

2. **Deciduous Trees** - Trees with leaves that are shed at the end of the growing season, and which remain leafless throughout dormancy.

3. **Transplanted Specimen Plants** - Unique or large plants typically used in low numbers on projects. See the plans for specimen type, size, and location. Deliver trees to the site that are dormant and with buds that have not yet swelled. Furnish plants that have an unbroken root ball sufficient to sustain continued growth. Ensure that the root ball size conforms to the current edition of the "American Standard for Nursery Stock". Provide plants with no broken limbs or bark abrasions, and cleanly cut off any frayed roots or damaged limbs. Deliver trees that are balled and burlapped, boxed or moved by commercial tree spade.

4. **Balled and Burlapped (B & B) Plants** - Plants excavated with soil around the root system whose root ball is wrapped for shipping and handling. B & B materials are generally trees or shrubs, such as evergreens, that require a large ball of earth to sustain them after the transplant. Furnish plants that are balled and burlapped in conformance with the latest edition of the "American Standard for Nursery Stock", including minimum size of root balls.

Furnish plants with root balls securely wrapped in burlap or similar mesh fabrics not harmful to plants, and bound with removable twine or wire. Provide root balls that are firm, intact and held solidly together by a fibrous root system consisting of only the earth in which the plant was growing. "Made" balls will be rejected.

5. **Collected Plants** - Plant material that is harvested from existing on- or off-site plant populations. Furnish collected plants that conform to all appropriate quality, grade and class requirements of the current issue of the "American Standard for Nursery Stock".

6. **Container Grown Plants** - Plants that are grown and delivered in containers which possess well-formed top growth and whose root growth is typical to the variety.
Furnish plants that are resident in their delivery containers long enough to have established new fibrous roots, have a root mass that will retain its shape, and hold 90% (visual estimate) of the root ball material when removed from their containers. Some root growth should be visible along the outer edges of the container. Root-bound container grown plants and “made” container plants will be rejected.

(7) Seedling Trees - Plants that are grown from seed in a nursery and brought to the site in a bare root condition. Provide seedlings labeled with age and certification (class number) which shows the number of seasons grown in a nursery seedbed, followed by the number of seasons grown in a transplant bed. Furnish seedling trees that are a minimum 2 years old.

Furnish seedling trees that are Oregon Department of Forestry "zoned" (grown) within approximately 500 vertical feet of the Project site elevation. Submit seedling zone information for the proposed plants to the City prior to construction.

(8) Bare-root Plants - Small deciduous plant material that is excavated for transplant with exposed roots. Furnish only bare-root plant materials that have dormant buds at the time of planting. Take great care to protect bare-root plants against dehydration and sunburn.

(9) Plant Cuttings - Living, freshly cut branches from certain woody shrub or tree species that readily propagate when embedded in damp soil. Furnish plant cuttings of regionally native species and dimensions as shown on the plans. Obtain written approval of the cutting stock sources before taking any cuttings and furnish a brief, written description of the cutting site(s) and the date and time the cuttings were taken to the City. Take cuttings in such a manner so as to leave no long-term damage to the source population. If willow species are called for, select the local native shrub variety.

(10) Fascine - Bound, cylindrical bundles of live plant cuttings that are placed in shallow trenches, partially covered with soil, and staked in place, typically used to stabilize stream banks against erosion. Furnish only fascines of regionally native materials having the dimensions shown on the plans.

(11) Brush Mattress - A combination of plant cuttings and fascines installed to cover and protect stream banks and shorelines. Brush mattress dimensions and any material requirements will be shown on the plans.

(12) Tubeling Plants - Plants grown in containers that encourage deep root growth.

(13) Vines - Plants with growth primarily along stems, often having climbing characteristics, and typically attaching to walls by tendrils or other means.

(14) Groundcovers - Low growing or spreading plants.

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(15) **Wetland Plants** - Plants that meet the definition of hydrophyte, which is any macrophyte that grows in water, or on a substrate, that is at least periodically deficient in oxygen as a result of excessive water content.

(16) **Bulbs** - For the purposes of this section, these will typically include the forms known as bulbs, corms, culms, plantlets, rhizomes, runners, small offsets, stolons and tubers. These plants will be collectively referred to as "Bulbs". The appropriate propagule (plant part that can be separated and used to grow another plant) will vary depending on the plant species.

(17) **Sod Lawn** - Grass sod grown on agricultural land that is commercially cultivated specifically for turf sod. Furnish sod that is free of weeds, diseases, harmful nematodes and insects. Provide sod that is mature, not less than 10 months old, and machine cut to a uniform thickness of 5/8 inch or more, excluding top growth and thatch. Broken pieces and torn or uneven ends will not be accepted. Plant sod within 36 hours of harvest.

**01040.20 Mulch** - Furnish plant bed mulch materials free of noxious weed seeds or plants and which contain no substance detrimental to plant life. Mulches are subject to inspection at any time and place at the discretion of the City. The following are some types of materials that fall under the category of "mulch", and may be used on projects:

(a) **Bark Mulch** - Ground, shredded or broken particles from the bark of fir, pine or hemlock trees which is free of non-bark debris, harmful bacteria, disease spores, pests and substances toxic to plant growth. Provide mulch that is the standard trade size known as "medium fine mulch".

(b) **Cinder Mulch** - Crushed lava cinders, screened to an approximate size between 3/16 inch to 5/8 inch. Furnish cinders free of fines and other non-cinder material.

(c) **Straw Mulch** - Provide straw mulch according to 01030.15.

(d) **Environmental Zone Grass Straw Mulch** - If shown in the Special Provisions, use grass straw mulch from native species. Submit documentation showing seed lab test for species type and certify that no Type "A" or "B" weed seeds are present in the straw.

(e) **Rock Mulch** - Round 3/8" - No. 4 pea gravel or round 2" - 3/8" rock. Provide material that is free of fines and other non-gravel material. Rock colors may vary.

(f) **Wood Chip Mulch** - Mulch that is chipped from cleared site vegetation. Ensure that chipped material is free of any noxious weeds or invasive vegetation. Allowable size range or other qualities may be listed in the Special Provisions.
01040.21 Herbicides - The use of herbicide chemicals will be permitted only upon approval of the City. Select and apply chemical herbicides according to all applicable Federal, State and local laws, as well as the Weed Control Plan requirements of the PWP outlined in 01040.04. The following are standard herbicide functional categories:

(a) Soil Sterilant - Chemical herbicide that is used to kill all new emergent vegetation, often including seeds or other plant parts.

(b) Pre-emergent - Chemical herbicide that is used to stop the germination of seeds before they grow above the soil level.

(c) Post-emergent - Chemical herbicide that is used to selectively or non-selectively kill vegetation after germination and emergence above ground.

01040.22 Water - When required by the Special Provisions, furnish the following:

(a) Pressure Moisture Stress (PMS) Instrument - A pressure chamber instrument capable of applying up to 40 Bars or 600 psi to a small leaf or shoot in order to determine its water potential. Instrument is to include all accessories necessary to perform a plant moisture stress test.

(b) Timed-Release Water - Containerized moisture retention chemical in the form of a solid gel that is delivered in biodegradable cartons. Typical ingredients are 97.85% water, 2% cellulose and 0.15% aluminum sulfate.

(c) Moisture Retention Chemicals - Granular chemical that are typically cross-linked potassium based polyacrylate or polyacrylamide copolymers. Provide commercial quality product from the CPL.

01040.23 Miscellaneous Items - Furnish miscellaneous items meeting the following requirements or provide commercial-quality products from the CPL. Obtain approval from the City prior to use.

(a) Anti-transpirant - Apply liquid anti-transpirant spray to all appropriate deliverable plant materials, prior to transport.

(b) Boulders - Furnish boulders of indigenous materials, with source, dimensions, and other characteristics as shown.

(c) Browsing Protectors - Flexible, semi-rigid plastic or metal mesh, brown or light green in color, with stake supports.

(d) Game Repellent - A commercial nontoxic spray that makes vegetation unpalatable for animal forage.

(e) Root Barrier - A root barrier designed to contain and control root intrusion into unwanted areas.
(f) **Tree Grates** - Tree grates complete with frames, all required attachment hardware, and at least one issue of any specialty key or tool that is required to open or move the item for maintenance.

(g) **Tree Stakes and Ties** - Rough sawn tree stakes of 1 1/2 inch x 1 1/2 inch douglas fir or pine, construction grade or better. Use stakes 6 foot long for trees less than 8 feet tall, and stakes 8 foot long for trees 8 feet or taller. Stain all tree stakes with an approved, dark green penetrating oil stain. Provide tree trunk protection of guying material of either a commercially available tree tie or a section of garden hose. Furnish tree guying material of a commercial product manufactured for this use, such as plastic chain, or stainless steel woven-wire with clamp fasteners. Size the guying material appropriate to the size of the tree and the wind factors of the area.

(h) **Trunk Wrap** - Typically manufactured of waterproof, crinkled paper and is designed to protect tree trunks against sunscald, loss of moisture and insect attack.

(i) **Weed Control Geotextile** - Weed control geotextile is typically manufactured of permeable, fibrous synthetic material and is generally for use under material such as mulch or gravel.

(j) **Woody Course Debris** - Logs or root-wads salvaged from on-site deciduous tree clearing and grubbing activity.

**Construction**

01040.40 **General** - Planting areas and plant locations shown on the plans are approximate unless shown with dimensions. Be responsible for layout and staking for plant placement, subject to approval by the City before planting. The City will make only field measurements necessary to calculate and verify quantities for payment.

Adjust tree locations to avoid possible conflicts with vehicle recovery clear zones, utilities, structures, miscellaneous appurtenances, and signing, as directed. In mowable grass areas, locate trees at least 10 feet from the edge of plant beds, other trees, fences, and ditch bottoms, unless otherwise specified.

01040.41 **Planting Season** - Perform all plant installation work from September 1 to May 15, unless otherwise specified. Container-grown materials located within irrigated areas may be planted at other times, depending upon written City approval.

Do not place lawn sod before March 15 or after September 30 without written City approval.

01040.43 **Topsoil:**

(a) **Excavation** - Prevent fouling of suitable material with subsoil or other detrimental matter. Form stockpiled soil into windrows at least 6 feet high, not to exceed 13 feet high, to maintain and preserve soil organism vitality.
(b) **Subsoil Preparation** - Grade and finish areas that are to receive topsoil, allowing for the specified amounts of topsoil. Scarify or till subsoil that is not loose and friable to a depth of 6 inches and obtain approval from the City before placing topsoil.

(c) **Hauling and Spreading** - Haul and spread material without compacting the topsoil or areas where it is placed. Protect from damage any surrounding objects, pavement, structures and areas that must be traveled, crossed or mounted by equipment.

Smoothly spread the topsoil over the specified areas to the thickness, grades, and slopes shown or directed. Avoid wasting topsoil and do not place material during wet conditions. Do not work saturated soils in any manner. Material placed contrary to City instructions or in undesignated places will not be paid for and removal may be required at the discretion of the City.

(d) **Finishing and Cleaning Up** - Finish areas covered with topsoil to proper grade, contour and cross section. Cultivate all topsoil not in a loose and friable condition to a depth of at least 4 inches. Bring the surface to a condition ready for planting operations.

(e) **Stormwater Facility Topsoil Installation:**

1. **Protection of the Topsoil** - The material shall be protected from all sources of contamination, including weed seeds, while at the supplier, in conveyance, and at the project site.

2. **Placement of the Topsoil** - The material shall be placed in loose lifts, not to exceed 8 inches each and each lift shall be compacted with a water-filled landscape roller. The material shall not otherwise be mechanically compacted.

3. **Timing of Plant Installation** - Weather permitting and as approved, plants shall be installed as soon as possible after placing and grading the topsoil in order to minimize erosion and further compaction.

4. **Erosion Control** - Temporary erosion control measures are required until permanent stabilization measures are functional.

5. **Protection of the Installed Topsoil** - In all cases, the installed material must be protected from foot or equipment traffic and surface water runoff. Temporary fencing or walkways should be installed as needed to keep workers, pedestrians, and equipment out of the area. Under no circumstances should materials and equipment be stored on top of the installation area.

6. **Wet and Winter Conditions** - Placement of the topsoil will not be allowed when the ground is frozen or saturated or when the weather is too wet as determined by the Owners Representative.
Select Wetland Topsoil:

(a) **Excavation** - Stage construction so that excavated soils may be moved directly to the wetland mitigation location. If that is not possible, stockpile the material for not more than 28 days. Water stockpiled material twice weekly and keep moist until used. Form stockpiled soil into windrows at least 6 feet high, not to exceed 13 feet high, to maintain and preserve soil organism vitality.

(b) **Subsoil Preparation** - Excavate or grade areas to receive selected wetland topsoil as shown and finish as smooth as practicable through one pass of standard construction equipment. Have subsoil preparation inspected and approved by the City prior to spreading the selected wetland topsoil.

(c) **Hauling and Spreading** - Transport select wetland topsoil to the site by any means which meets all applicable regulations related to hauling potentially wet or moist materials. Spread the topsoil to a depth of 6 inches minimum to 24 inches maximum, or to meet the finished elevations as indicated. Make as smooth as practicable without excessive soil compaction. After spreading, have the area inspected and approved by the City prior to planting.

**01040.45 Soil Amendments** - Incorporate soil amendments into the topsoil when required by the soil fertility test and soil amendment report. The application rate will be verified by checking settings on the spreading or application equipment.

**01040.46 Soil Bio-Amendments** - Incorporate the following soil bio-amendments into the topsoil of areas to be planted, according to the recommendations of the soil bio-amendment report, the supplier, or the following:

- Bacterial Food Amendments
- Fungal Food Amendments
- Protozoa Food Amendments
- Nematode Food Amendments
- Microbes and Biostimulants
- Earthworms - Add 9 worms per cubic yard of topsoil (this roughly equates to 3 worms per surface) 10 square feet of topsoil at 12 inches depth.
- Mycorrhizal inoculation - Incorporate into the planting hole quantities of mycorrhizia sufficient to correct the soil for the type of plants or grasses being grown.
- Mycorrhizal Inoculation (Injection) - Provide pre-measured packets containing live endo- and ecto-mycorrhizal fungi.
- Mycorrhizal Inoculation (Root Dip) - Apply root dip material containing live endo- and ecto-mycorrhizal fungi.
The application rate will be verified by visual inspection of application rates. A one-time application should be adequate, as long as pesticides, fertilizers or other toxic materials are not used at the same time. If it becomes necessary to apply pesticides that have non-target organism effects, or to apply fertilizer at rates greater than 13 pounds per acre, re-inoculate the organisms about one month after the pesticide or fertilizer was applied.

**01040.47 Fertilizers** - Incorporate fertilizer based upon recommendations of the soil amendment and soil bio-amendment reports or, with City approval, at the type and rate as follows:

<table>
<thead>
<tr>
<th>Plant Bags/Tablets</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Rate</td>
</tr>
<tr>
<td>Tree</td>
<td>3 per tree</td>
</tr>
<tr>
<td>Shrub</td>
<td>2 per shrub</td>
</tr>
<tr>
<td>Vine/Ground Cover</td>
<td>1 per plant</td>
</tr>
</tbody>
</table>

**Granular Fertilizer Rate**

- 1 pound per tree per application
- 1/2 pound per shrub per application
- 1/8 pound per vine/ground cover per application

Evenly space planting bags or tablets around plants after planting pits are 2/3 filled with backfill. Mix granular fertilizer into the upper 1/2 of plant backfill.

The application rate will be verified by visual inspection. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material.

Do not allow the fertilizer application to conflict with the soil bio-amendments. In case of questions, provide the soil bio-amendment supplier’s written recommendations to the City.

**01040.48 Planting Area Preparation** - All planting areas are to be Weed Free before planting or seeding operations begin. Identify, kill, and remove plants according to 01030.62(b)(3).

Prepare planting areas according to the following methods, or as otherwise specified:

(a) **Method "A" (Cultivated Planting Areas, Non-lawn)** - Cultivate plant beds to a depth of 2 inches. Thoroughly mix 2 inches of soil conditioners into the top 12 inches of plant beds. In addition, add soil amendments, soil bio-amendments and fertilizers, as shown or specified, according to the soil amendment and soil bio-amendment reports recommendations, into the top 12 inches of topsoil.
Finish grades by raking to a grade tolerance of plus or minus 1 inch, with a smooth and firm condition, and an even grade that is free of undulations or low areas that could create standing water. Match existing grades at the perimeter. Finish to the proposed grades shown or specified.

On slopes that the City determines are too steep to cultivate, plants may be planted in individual planting holes prepared using method "B".

**(b) Method "B" (Non-Cultivated Planting Areas)** - Spray existing weeds and non-desirable vegetation with herbicide to kill all top growth and roots in areas not requiring cultivation. Use herbicides that have limited residual toxicity to permit safe planting as required under the Contract. Do not spray or otherwise harm plants to be saved. After inspection and approval, remove the dead top growth of plant material within 2 inches of the surface and dispose of according to Section 00320. Replace plants to be saved that are damaged by herbicide application at no additional cost to the City.

Add any soil conditioners, soil amendments, soil bio-amendments or fertilizers with the backfill at each plant pit or to the seeding operation.

Finish wetland mitigation planting areas to specified finish elevations, blending to existing ground smoothly, as required and directed. Except for projects that are less than one year in duration and unless otherwise approved, review the seasonal hydrology of the area to be planted for one full winter season (November 15 to February 28) prior to planting any wetland plants. Adjust plant types and planting locations as required or directed, based on the review of site hydrology.

When planting seedling plants, completely scalp vegetation from a 12 inch diameter area around each planting hole. Clear all debris such as wood and rocks from the planting spots, provided debris is not deeper than 12 inches. When debris is deeper, move the planting location. Use herbicides around seedlings only upon written approval of the City.

**(c) Method "C" (Sod Lawn and Seeded Lawn Areas)** - Cultivate existing ground to a depth of 6 inches, achieving a loose and friable condition suitable for fine grading. Remove all vegetation, rocks larger than 2 inch diameter, clods, roots, sticks, debris, and other matter detrimental to the growth of sod.

Uniformly spread soil conditioners, soil amendments, soil bio-amendments, and fertilizer evenly over the area and thoroughly rototill into the soil to a depth of 4 inches. Apply at rates recommended by soil testing, or as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate (per 100 square yards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil conditioner</td>
<td>1/2 cubic yard</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>10 pounds</td>
</tr>
<tr>
<td>Lime (Western Oregon Only)</td>
<td>40 pounds</td>
</tr>
</tbody>
</table>
Fine-grade and roll planting areas with a water-filled roller to provide a fine-textured, smooth, firm surface, free of undulations, irregularities or low areas that could create standing water. Grade areas receiving sod to within 1/2 inch of the designed grades, and 1 inch below adjacent walks, curbs and pavement. Since sod thickness varies, adjust initial grades so the final sod soil level is slightly below adjacent hard surface grades. Ensure that final sod grade does not create a pedestrian tripping hazard.

Furnish the City with sod mixture information and a quality compliance certificate from the sod grower, certifying sod compliance with mixture requirements, according to 01040.10.

Prior to completion of any sodding and seeding, re-grade ruts, footprints, washouts, or any other irregularities, and re-seed or re-sod repaired areas as originally specified.

(d) Method "D" (Rough Areas Seeded for Revegetation or Erosion Control) - Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks or debris. On slopes 1V:3H or flatter, remove all debris larger than 2 inches in any dimension. On cut slopes 1V:1.5H or flatter, roughen the surface with furrows parallel with slope contours and loosen the soil to a depth between 3 inches and 6 inches.

(e) Method "E" (Temporary Seeding Areas) - If grading is required or directed, make equipment passes at right angles to the slope in order to form seed-holding tracks in the soil.

01040.49 General Planting - Plant trees, shrubs, groundcover, vines, and bulbs using the following practices:

- Inspect plants after arrival at the Project and before planting. Do not install plant materials until each required inspection by the City is complete. Replace plants not meeting the requirement of the Specifications with plants as specified or otherwise directed, at no additional cost to the City. Initial approval of plant materials for planting by the City will not constitute final acceptance.
- Protect all plants during shipping, handling, storage, and planting from windburn or exposure to harmful weather conditions, and root or root ball drying.
- When excavating planting holes, stockpile excavated topsoil separately from subsoil. Do not include alkali soil, subsoil, gravel, debris or rocks in the topsoil. Dispose of any substandard excavated materials in a manner not harmful to plants or planting work. Scarify planting pit sides and bottoms to eliminate glazed surfaces. Dispose of excess soil in a manner that is not harmful to plants or planting work.
- Do not plant in standing water unless approved by the City. If standing water is present within a plant pit, notify the City prior to planting to determine what corrective measures are required. Perform corrective measures on an Extra Work basis according to Section 00196.
• Excavate tree plant pits a minimum of twice the diameter of the plant root ball or 2 feet greater than the ball, whichever is larger. Dig shrub plant pits a minimum of one foot greater than diameter of root ball. Dig pits to the same depth as the root ball, root mass or container. Spread root systems of bare root plants and plant stock as necessary to keep plants from being root bound.

• Cleanly cut off broken or frayed roots of bare-root plants before planting. Spread out roots in their natural position within the pit and trim only damaged roots as approved by the City. Remove all labels, tags and attachment materials from the plants before final inspection.

• Set upright growing plants straight and plumb, and prostrate growing plants level to the ground surface. Set all plants so that, after settlement, they are at the same level as when growing in the nursery or container.

• Place the backfill then add soil amendments, soil bio-amendments, and fertilizers as recommended by the soil amendment and bio-amendment reports. Moisten backfill completely after placing to eliminate air pockets and minimize settlement of the backfill. Form a shallow 2 inch high water-holding saucer in the soil around the plant unless directed otherwise.

• Balled and burlapped plants may be placed with the root ball wrapping removed or, if all materials are untreated and fully biodegradable, left in place. If the root ball wrapping (burlap) is left around the plant, completely remove all tie wire, string or twine and fold down the burlap from the top half of the root ball.

• Perform any required pruning using good horticultural practice appropriate to the type of plant. Prune to remove all dead, damaged, crossed or rubbing twigs and branches, and to compensate for loss of roots during planting. Make cuts close to the parent stem, but not flush or through the bark "knob" at the branch joint. Do not prune terminal ends of tree leaders without approval of the City.

• Apply bark or wood chip mulch of the type and depth as shown. Correct any contamination of new mulch due to the Contractor’s operations at no additional cost to the City. Feather mulch into plant material trunks, stems, canes or root collars, and leave 1 inch below the top of junction and valve boxes, curbs and pavement edges. Any mulch placed to a thickness greater than specified will be at no additional cost to the City.

• Do not disturb protected existing vegetation unless approved by the City prior to construction.

• Dig pits of street streets that have hard surfaces around them so the crown of the rootball will be 3 inches below the finish surface of the surrounding grade.

• Water deciduous trees 1 1/2 inches or larger, conifer trees over 4 feet in height, and all shrubs at a minimum frequency identified in the Special Provisions.
01040.50 Special Planting Requirements:

(a) Transplanted Specimen Plants - Use the following methods for transplanting specimen plants, unless otherwise specified:

(1) Mechanical Digging - Use a "Vermeer" type of tree spade or approved equal. Move only during the season that the tree is dormant. Treat deciduous plants with anti-transpirant prior to excavation. Confirm with the City that the size of the spade is appropriate to the size and type of tree prior to beginning work. Dig the receiving hole prior to digging the tree to be transplanted. Take care not to damage the tree bark. Refill the original hole after transplanting. Do not move Oregon White Oak (Quercus garryana) by this method.

(2) Hand Digging - Before digging, obtain approval from the City for the size of container or root ball to be used for each plant. Begin digging at a diameter greater than the expected size of the root ball and remove dirt toward the plant until the surface roots show. When completely dug, secure the root ball with burlap and twine, wire basket or in a wooden box. Take special care to dig deep enough so that the taproot is not cut until it is smaller than 3/8 inch. Take care not to damage the tree bark. Refill the original hole and compact the soil after transplanting.

Install perforated plastic drainpipe as shown. Add fertilizer, soil amendments or bio-amendments to backfill topsoil mixture. Stake or guy the tree as specified.

Provide one application of anti-transpirant before transplanting, and one application of Vitamin B1 growth hormone after planting to each specimen plant according to the manufacturer’s recommendations.

Perform all replanting of specimen plants according to 01040.41 and 01040.42.

(b) Staking and Guying Trees - Stake and guy planted trees as shown or directed.

(c) Seedling Trees - Plant seedling trees using one of the following three methods:

- Planting hoe capable of opening a vertical hole broken out on 3 sides, with a minimum blade length of 12 inches and width of 3 inches
- Planting shovel capable of opening a vertical hole broken out on 3 sides and at least 10 inches deep
- Normal bare-root planting method

No pre-staking of planting locations will be required. The City will be present as planting begins and will approve the spacing, planting method, and areas to be planted before work can begin. Vary plant spacing in order to allow seedlings to be planted in suitable soil. During the planting process, remove one tree at a time from the planting bag or other container to prevent drying of roots.

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Place the roots of each seedling in the ground so that they assume a natural arrangement and do not twist, angle, bunch together or turn up at the ends. Plant seedlings so that the root collar is at or above the ground plane by no more than 1/2 inch. During planting, tamp soil around the roots in the lower half of the hole. Then fill the hole to the surrounding soil level and firmly pack so that no air pockets remain around the roots.

Ensure that seedlings do not pull loose with a tug strong enough to detach a small group of needles or small branch ends as applicable. Place a stake at the edge of each planting pit and install browsing protection and browsing repellant.

(d) Tubeling Plants - Place the tubeling into the planting pit without breaking the root mass. Set the top of the root collar 1/2 inch above finish grade, and gently tamp soil around the plant to compact the backfill. Place a stake at the edge of the plant pit and attach a browsing protector around each plant.

(e) Collected Plants - After plants become dormant, excavate collected plants by hand, protecting the root mass against drying, freezing or breaking. If possible, plant all collected stock the same day as gathered, or transport to a local nursery for temporary storage until final planting.

If immediate planting is not possible, place collected plants in heavy paper or plastic with slightly damp peat moss or sterile potting soil. Store dormant plants at 32°F to 37°F until planting. Examine stored material frequently for signs of stress or disease and correct storage conditions as necessary. Plant collected plants before dormant bud development.

(f) Bulbs - Plant dormant bulbs at a depth of 1 inch to 2 inches or to the grade they grew naturally. Compact the soil firmly around the bulbs to prevent float-out and ensure good establishment. Dig holes large enough to naturally space bulbs within the planting area.

(g) Plant Cuttings - Collect and plant the cuttings while in winter dormancy, generally between October and March. Notify the City if conflicts exist with permit requirements. Store all cut material in ventilated plastic containers that allow free flow of water. Protect root systems from excessive drying at all times. Do not store plants in airtight containers.

Plant stock within 4 hours of harvest. If plants are a willow species, plant in the riparian zone on that portion of the slope where the plant stem ends will be in contact with year-round moist soil as determined by the City. Make planting holes by forcing a steel bar or similar tool into the ground about 12 inches deep. Place the cuttings into the holes and tamp soil firmly around the stems, leaving a minimum of 6 inches showing. Vary these dimensions as required for larger plant cuttings.
01040.51 **Planting Wetland Plants** - When planting wetland plants, do not use soil amendments, mulch, or fertilizer. Plant rhizomes, tubers and plugs within the upper 2 inches to 3 inches in exposed muddy or moist soils. When the water depth reaches or exceeds 1 inch notify the City of the potential need for adjustment to the planting.

01040.52 **Placing Sod Lawn** - Place sod only after approval of the City. Immediately before placing sod, water the soil bed to prevent drying of grass roots. Lay the first sod row in a straight line, then place subsequent rows parallel to and tightly against each other, staggering lateral joints. Do not stretch or overlap the sod. Tightly butt all joints. Do not use sod segments containing less than 2 square feet of surface area.

After placement, diagonally roll and thoroughly water the sod. Apply a second application of fertilizer (22-16-8) at the rate of 10 pounds per 100 square yards and thoroughly water.

01040.53 **Mulch** - Apply mulch according to the following:

(a) **Ornamental Plant Bed Areas** - Submit a 15 pound sample of bark mulch to the City for visual inspection and approval. The approved sample will be the standard of acceptability for all mulch used on the Project.

Apply bark mulch after beds are made free of weeds and debris, the surface is brought to a smooth finished grade, and all planting work, except for vines and groundcovers, is complete. Uniformly bark mulch planted areas to a nominal depth of 2 inches with bark mulch. Apply bark mulch so that it presents a smooth and even appearance as approved by the City. Raking may be required.

Keep bark mulch off plants, structures, roadways, shoulders, walks, and lawns. Uncover all plants covered by mulch material as soon as possible and leave the site in a neat, clean and finished appearance. When planting vines or groundcover, rake bark mulch away from planting pits so that the bark is not contaminated. After planting, evenly spread excess soil and rake bark mulch back into place.

Replace bark mulch that is displaced or blown away, and correct to the specified depth any bark mulch placed to a greater than specified depth, at no additional cost to the City.

Spread rock or cinder mulch to a depth of 2 inches after planting trees and shrubs.

(b) **Non-Ornamental Plant Bed Areas** - Apply mulch according to one of the following methods:

1. **Straw Mulch** - Spread grass straw mulch to a nominal 2 inch depth and tackify, after planting of tubeling plants and seeding as required.

2. **Wood Chips** - Spread wood chips to a nominal depth of 2 inches. Add 15 pounds of Ammonium Nitrate/1000SF to neutralize nitrogen loss.
**01040.54 Water** - Water all plants at intervals as required to maintain and promote healthy growth. Avoid excessive watering of shrub bed areas that may leach herbicide and damage adjacent lawns or desirable or protected vegetation. Repair all lawn vegetation damage at no additional cost to the City.

(a) **Pressure Moisture Stress Sensor** - When a pressure moisture stress sensor is specified, the City will test a 1% to 5% representative sample to ensure that the moisture stress level is below 20 bars of pressure and inform the Contractor if any material exceeds this limit. Any plant material found to have greater than 25 bars of pressure will be considered to be under extreme moisture stress. Provide sufficient water within 24 hours to bring the plant into normal range. The City will retest to determine the new representative pressure. Plant material that have 30 bars or greater will be considered to have reached its permanent wilting point. Replace all such material during the next planting period. Testing will occur at mid-day at the following times until the end of the establishment period(s):

- After plant delivery, during temporary storage, and before planting
- At 1 month intervals throughout the summer season, up to the first fall rain or snow
- At weekly intervals during extremely hot or dry summer periods
- Any time the City believes the plant material may be under stress

(b) **Timed-Release Water** - Apply timed-release water containers when specified. Cut the bottom from the carton, dig a hole next to the plant and place so the contents touches the root ball or root area approximately 4 inches beneath finish grade, or according to the manufacturer’s directions. Fill soil back around the carton to hold it firmly in place. Apply 1 carton for seedlings and tubelings, 2 cartons for No. 1 containers, and 4 cartons for larger plant material.

Water deciduous trees 1 1/2 inches or larger and conifer trees over 4 feet in height as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Frequency</th>
<th>Gallons/Tree (Minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May - June</td>
<td>weekly</td>
<td>15</td>
</tr>
<tr>
<td>July - August</td>
<td>weekly</td>
<td>20</td>
</tr>
<tr>
<td>September - October</td>
<td>weekly</td>
<td>15</td>
</tr>
</tbody>
</table>

Water shrubs as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Frequency</th>
<th>Gallons/Shrub</th>
</tr>
</thead>
<tbody>
<tr>
<td>May - June</td>
<td>weekly</td>
<td>5 - 10</td>
</tr>
<tr>
<td>July - August</td>
<td>weekly</td>
<td>15 - 20</td>
</tr>
<tr>
<td>September - October</td>
<td>weekly</td>
<td>10 - 15</td>
</tr>
</tbody>
</table>

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(c) **Moisture Retention Chemicals** - Utilize moisture retention chemicals according to the manufacturer’s recommendation, depending upon specific application.

**01040.55 Miscellaneous Items** - Place or install miscellaneous items as follows:

(a) **Boulders** - Place boulders in locations as shown. Do not scar or break boulders with equipment. Ensure that 1/3 to 1/2 of each rock is buried beneath finish grade. Verify all rock placement with the City prior to installation.

(b) **Tree Grates** - Install grates, frames, and appurtenances as shown and according to the manufacturer's recommendations. Place frames flush at sidewalks and place guards plumb according to the manufactures recommendations.

(c) **Weed Control Geotextile** - Place weed control geotextile at finish soil grade when planting is complete but before mulch placement begins. Place weed control geotextile with a minimum 4 inch overlap between rolls, turned under edges, and attached to the ground as recommended by the manufacturer.

(d) **Woody Course Debris** - Place woody course debris within the stream channel, facing upstream at approximately 45° from the stream bank, or as shown or as directed. Anchor woody course debris to the stream channel bottom as shown.

(e) **Anti-transpirant** - Apply anti-transpirant according to the manufacturer's directions to all exposed foliage surfaces immediately before materials are delivered to the Project, or as otherwise specified. Provide certification of compliance.

(f) **Game Repellent** - Apply a game repellent to all exposed foliage surfaces immediately after materials are planted, or as otherwise specified. Re-apply to each plant every 120 days, or according to the manufacturer's printed instructions, until the end of the plant establishment period.

(g) **Browsing Protectors** - Install browsing protectors according to the manufacturer’s recommendations.

(h) **Root Barrier** - Install root barrier according to the manufacturer’s recommendation.

(i) **Tree Stakes and Ties** - Place tree stakes parallel with the prevailing winds and drive vertically into the ground at least 12 inches below the planting hole depth, or as shown. Do not drive stakes through the rootball.

(j) **Trunk Wraps** - Wrap tree trunks with the specified wrap, covering all exposed trunk between finish ground and the first whorl of tree branches.
01040.56 Cleanup During Construction - Maintain the Project in a neat, orderly condition. Remove unsightly construction materials at the end of each working shift. Clean all pavement surfaces of mud, debris, or other materials that may, in the opinion of the City, cause problems. If material is not removed, the City reserves the right to have the cleanup work performed and deduct the value of this work from the monies otherwise due the Contractor.

Plant Establishment

01040.70 General - The Contractor is responsible for the survival of all plant material until the end of a plant establishment period of 1 calendar year. The plant establishment period work will begin when all the original planting is completed. The original planting is considered complete when all the plant material has been planted to the satisfaction of the City.

Establishment period work includes removing all plants that have reached their permanent wilting point, are dead, dying, or which do not meet Specifications, and replacing them with healthy plants. All plants in place after this replacement will be recognized as the "original planting" and will be subject to the establishment specifications. Repair, restore, and replace all plantings that have been damaged by vehicles, vandalized and stolen according to 00170.80.

01040.71 Plant Care and Success Criteria - During establishment, maintain plants in a vigorous growing condition by regularly:

- Watering, and fertilizing sufficiently to promote growth
- Weeding, cultivating, pruning, and repairing
- Adjusting tree stakes and guys
- Controlling weeds before they seed according to 01040.48
- Controlling pests and noxious weeds before the reproductive cycle
- Removing dead or non-vigorous plants
- Replacing missing plants
- Re-mulching of plant bed areas

The determination of a successful plant establishment period will be made at periodic plant establishment inspections. A successful planting establishment for each inspection is defined as follows:

- All plants are surviving and have vigorous growth.
- Plants are free of insects and disease.
- Plants show signs of continuing health.
- Plants have not reached permanent wilting point.
At the discretion of the City, certain types of regularly spaced plantings such as groundcovers may be measured using an area sampling method. To determine the rate of survival, set out (delineate) representative plots measuring 100 square feet at the completion of the original planting at random locations in each general planting area. The representative plots will be mutually agreed upon between the Contractor and the City. Mark the plot corners with permanent markers such as re-bar, including date and identification. Delineate a minimum of 3 plots per acre of new planting area.

The use of representative plots is intended to simplify the measurement of planting establishment work. If work within the representative plots does not accurately reflect the condition of the entire planting area(s), the City reserves the right to reject all establishment work.

**01040.72 Periodic Inspections** - During each establishment period, the City will make three inspections jointly with the Contractor at the following times:

- Spring, early May
- Summer, mid July
- Fall, late September

Depending on when the establishment period begins, one of the above inspections will be the final inspection.

During each plant establishment inspection, the City may determine, based upon the specified success criteria, that supplemental corrective work is required. If so, the City will provide the Contractor with a written notice of required corrective work sent by hand-delivery or mail.

**01040.73 Corrective Work** - Complete all corrective work within 15 calendar days after written notification is received by the Contractor, except for such work as plant replacement during the appropriate planting season, unless otherwise specified. The 15 day requirement excludes those days the City determines to be impractical for working.

When the corrective work has been re-inspected and is completed to the satisfaction of the City, the appropriate proportional payment due the Contractor will be made.

The Contractor will be allowed to replace plants outside the Planting Season to perform corrective work after each periodic inspection.

Provide plant replacements of the same variety, size and quality as specified for the original plants, unless otherwise approved.

Notify the City when the corrective work complete. When the corrective work has been re-inspected and is completed to the satisfaction of the City, the appropriate partial payment due the Contractor will be made.
If the Contractor does not perform the corrective work within the 15 day period after written notification, excluding those days the City determines to be impractical for working, the City may have the corrective work done by others and deduct the entire cost of the corrective work from monies due or to become due the Contractor under the Contract.

**01040.75 Weed Control** - Provide weed control according to 01030.42.

**01040.77 Plant Establishment (Ornamental Areas)** - In addition to these plant establishment requirements, perform the following:

(a) **Watering, Fertilizing, and Mulching** - Water all plants at the required intervals using the installed permanent or temporary irrigation systems, or such means as has been established for the Project. Avoid excessive watering of shrub areas adjacent to lawns that may leach herbicide and damage the lawn. Repair damaged lawns at no additional cost to the City.

If specified for the original planting, re-fertilize plants to promote vigorous growth.

Maintain the plant bed mulch at a 2 inch depth during establishment, unless otherwise specified. Rake to a smooth and even finish grade.

Remove all timed-release water cartons that have not bio-degraded by the end of the establishment period.

Water all plants during establishment as shown in 01040.54.

(b) **Trimming and Pruning** - Prune in order to enhance the natural growth of plants, eliminate dead growth and crossing branches, maintain growth within available space, minimize overgrowth onto walks and walls, and minimize tree canopy damage from winds.

Prune during the dormant season unless otherwise specified. Remove and dispose of all dead and critically damaged plant material to maintain the overall appearance of the Project.

(c) **Transplanted Specimen Plants** - Care for transplanted specimen plants immediately after the planting work is completed. Water, fertilize, and protect specimen plants against disease and infestation as required to ensure the plants remain healthy and vigorous. Final acceptance of transplanted specimen plants will depend on plant health and condition.

(d) **Seeded Lawn and Sod** - Mow, cut and fertilize turf as required to maintain a healthy and vigorous condition. A schedule of feeding, mowing, and general treatment, including thatching and aeration will be listed in the Special Provisions. If directed in the Special Provisions, final acceptance of sod lawn areas may be 45 days, depending on its health and condition. Keep sod mowed to a height between 1 1/2 to 2 inches.
Do not perform the first mowing until the sod is firmly rooted and secure in place. Remove no more than 1/3 of the grass leaf during initial or subsequent cuttings.

**01040.78 Plant Establishment (Mitigation or Other Non-Ornamental Areas):**

(a) **Watering and Mulching** - Water all plants as necessary to promote and maintain growth using temporary irrigation methods. Keep planted areas raked to a smooth and even finish grade. Maintain mulch within plant saucers at a 2 inch depth, unless otherwise specified.

(b) **Weeding** - Perform weed control activities according to 01030.42.

(c) **Soil Testing and Corrective Soil Amendments** - If specified for the original planting, have a soil test performed by a soil ecology lab between the second and third periodic inspection. Present the recommendations to the City at the third inspection. Apply the amendments as recommended by the soil test report and as directed by the City.

**01040.79 Final Inspection** - After plant replacement work and any other required work has been completed, the City will make a final inspection. Ensure that all plant materials, planting beds and other facilities are according to the Specifications as a prerequisite for acceptance.

**Measurement**

**01040.80 Measurement** - The quantities of plantings and associated work performed under this Section will be measured according to the following:

(a) **Soil Testing** - Soil testing will be measured on the unit basis for each test that is completed and accepted. Soil testing includes the required sampling, testing, analyses, and reports for one or more of the following:

- Soil particle size range test
- Soil fertility test and soil amendment report (including chemical analysis, acidity, salinity)
- Soil ecology analysis and soil bio-amendment report

(b) **Topsoil and Wetland Topsoil** - Topsoil and wetland topsoil will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

Topsoil taken from the required excavations according to 00330.10 will be measured according to 00330.82.

(c) **Soil Conditioners** - Soil conditioners will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

(d) **Plant Materials** - Plant materials will be measured according to one of the following:
• **Unit Basis** - Under this method, plant materials will be measured on a unit basis.

• **Average Area Method** - This method may be used when a plant bed area is greater than or equal to 3,000 square yards and will be measured as follows:

  - The total plant bed area will be measured along the ground surface by the foot and calculated to the nearest square yard and will be measured as follows:
    - 1% to 5% of the plant bed area will be selected and staked as 30 square yard representative plots
    - All the plants in each staked representative plot will be counted. Unless otherwise approved, if the number of plants in a plot exceeds the number of required plants of the representative plot, the number of required plants will be used to represent the plot.
    - Based on the results of the plant count, the average number of plants per plot will be calculated
    - The quantities of each item will be based on the calculated average number of plants per plot multiplied by the number of plots in the total plant bed area.

**e** Sod Lawn - Sod lawn will be measured on an area basis on the ground surface and calculated to the nearest square yard.

**f** Mulches - Mulch will be measured on the volume basis in the hauling vehicle.

**g** Miscellaneous - Miscellaneous items will be measured as follows:

  - **Tree Grates** - Tree grates will be measured on a unit basis. One grate includes two half grates, frame, hardware, tree guards and appurtenances.
  
  - **Woody Course Debris** - Woody course debris will be measure on a unit basis.
  
  - **Boulders** - Boulders will be measured on a unit basis on the weight basis.
  
  - **Root Barrier** - Root barrier will be measured on the length basis.
  
  - **Weed Control Geotextile** - Weed control geotextile will be measured on the area basis on the ground surface and calculated to the nearest square foot.

If not listed in the Schedule of Items, these items are considered Incidental to planting and no separate measurement will be made.
Payment

01040.90 Payment - The accepted qualities of plantings and associated work performed under this Section will be paid for according to the following:

(a) Soil Testing - Soil tests will be paid for at the Contract unit price, per each, for the item "Soil Testing". Payment includes mobilization, soil sampling, testing, analyses, and preparation of the soil amendment and bio-amendment reports.

(b) Topsoil and Wetland Topsoil - Topsoil not taken from required excavations, will be paid for at the Contract unit price, per cubic yard, for the item "Topsoil". Wetland topsoil, taken from either the Project excavations or imported from other sites, will be paid for at the Contract unit price, per cubic yard, for the item "Wetland Topsoil". Topsoil taken from required excavation according to 00330.10 will be paid for according to 00330.94. No payment will be made for topsoil or wetland topsoil that is placed in non-designated areas or which is contrary to the City's instructions.

(c) Soil Conditioners - Soil conditioners will be paid for at the Contract unit price, per cubic yard, for the item "Soil Conditioner".

(d) Plant Materials - Plants will be paid for at the Contract unit price per each, for the appropriate items listed in the Schedule of Items. Plant materials will be listed by caliper size, size of container, or other size, or condition shown. Transplanted plants will be paid for at the Contract unit price, per each, for the item "Transplanted Specimen Plants". Partial payments for plant materials will be made as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the time of the original planting</td>
<td>30%</td>
</tr>
<tr>
<td>After the first plant establishment inspection</td>
<td>10%</td>
</tr>
<tr>
<td>After the second plant establishment inspection</td>
<td>10%</td>
</tr>
<tr>
<td>After the third plant establishment inspection</td>
<td>10%</td>
</tr>
<tr>
<td>At completion of the establishment period</td>
<td>40%</td>
</tr>
</tbody>
</table>

Partial payments made throughout the establishment period will be made for all surviving and replaced plants. Upon completion of the establishment period, full payment will be made for all surviving and replaced plants, except for corrective work performed by other according to 1040.73. The City will pay the Contract unit price only once for the specified quantity, whether or not plants are replaced.

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If the Contractor requests partial payment for plant materials on hand, payment will be made according to 00195.60.

(e) Sod Lawn - The accepted quantities of sod lawn will be paid for at the Contract unit price, per square yard, for the item "Sod Lawn".

(f) Mulch - The accepted quantities of mulch will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Bark Mulch</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(b) Cinder Mulch</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(c) Wood Chip Mulch</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(d) Grass Straw Mulch</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(e) Rock Mulch</td>
<td>Ton</td>
</tr>
</tbody>
</table>

(g) Miscellaneous - The accepted quantities of miscellaneous items will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Tree Grates</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Woody Course Debris</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Boulders</td>
<td>Each or Ton</td>
</tr>
<tr>
<td>(d) Root Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>(e) Weed Control Geotextile</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing the materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be paid for:

- soil amendments
- lime, gypsum, or trace minerals
- soil bio-amendments
- fertilizer
- herbicides
- anti-transpirants
- game repellant
- browsing protectors
- pesticides
- trunk wraps
- tree stakes and ties
- water
- timed-released water
- pressure moisture stress sensors
- mulch materials required as part of replacement planting
- corrective work during the plant establishment period
Section 01050 - Fences

Description

01050.00 Scope - This work consists of constructing:

- Fences, gates, and gateways of barbed wire, woven wire fabric, chain link fabric, or combinations, to the lines and grades shown or directed
- Protective fences, on and off structure as shown or directed

All dimensions shown on the plans are horizontal and vertical measurement. Actual quantities required for the installation may be greater depending on the slope of the terrain.

01050.01 Definitions:

(a) Fences - Fence, gates, gateways, and appurtenances, regardless of kinds and types.

(b) Gates - Swinging units to provide an opening in the fence line.
  (1) Single Gate - A unit of 16 feet or less.
  (2) Double Gate - Two single gate units used together for an opening of more than 16 feet.

(c) Gateway - Supported fence wire or fabric stretched between gate posts and fastened by bars, wire hinges and locking devices.

(d) Panel - That portion of fence between adjacent posts.

(e) Run - As used in this specification, run is defined as follows:
  - Fences, gates, and gateways - The length of fence between end posts, intermediate end posts, corner posts, and gate posts.
  - Bridge protective fence - A section of fence 150 feet or less in length.

Materials

01050.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement ..........................................................02510.10
Barbed Wire ....................................................................03010.10
Chain Link Fabric ............................................................03010.30
Commercial Grade Concrete ...............................................00440
Fence Gates ...................................................................03010.60
Fence Grounding .........................................................03010.50(e) and (f)
Fence Posts, Braces, and Appurtenances.....02110.30, 03010.50
Guardrail Elements .......................................................02820.10
Pickets ............................................................................03010.31
Construction

01050.40 General - Construct the several kinds and types of fences including the assembly and erection of all component parts and materials complete in place at the locations shown or directed. Confine activities and operations to the area immediately adjacent to the right-of-way line and within the highway right-of-way. Arrange for permits required from adjacent property owners to perform the work.

Restrain animals to lands on which they are confined using temporary fences or other adequate means. Provide adequate temporary fences or other protection around excavations to prevent animals or unauthorized persons from entering. Schedule the installation of fencing or provide temporary fencing or other adequate means to prevent animals from entering the Project right-of-way, easements or adjoining properties.

At bridges, animal passes and culverts, if shown or directed, connect the new fence to the structure in a manner that permits free passage of animals under or through the structure.

01050.41 Lines, Grades and Preparation Work - Unless otherwise directed, set fences so the fence fabric and wires are on right-of-way lines or City property lines, with posts set on City property. If directed, center concrete footings and fence posts 1 foot from the right-of-way or property line on City property.

Clear, grub and prepare the fence line area. Remove all shrubs, brush, snags, down timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with fence construction. If directed, preserve trees and geographic features on fence lines by varying the fence alignment to miss them.

Fill or excavate ground surface irregularities which interfere with maintaining specified clearance above ground surface of the bottom wire of the fence. Limit the width as necessary to provide a clear way for the fence.

Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil, or not less than 18 inches deep in rock. Prevent disturbance of original ground at the sides and bottom of the excavation.

Clear and grade gate openings to permit the gate to swing in a horizontal plane according to 01050.48.

Dispose of materials removed under these provisions, including excess excavation, in a satisfactory manner.
Optional Posts - Use steel or wood posts in barbed, or barbed and woven wire fence construction according to one of the following options, and once an option has been selected, use that option throughout the Project:

Option 1: Steel posts entirely in all types of fence.

Option 2: Treated wood posts entirely in:
- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on median areas exceeding 16 feet in width

Option 3: Steel line post in combination with treated wood end posts, intermediate end posts, corner posts and gate posts in:
- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on median areas exceeding 16 feet in width

Installing Posts and Braces:

(a) General - Set all metal end posts, intermediate end posts, corner posts, gate posts, chain link fence posts in concrete footings. Set all other posts firmly in the ground or in concrete footings as the Contractor elects.

Set posts to the depths shown. Reasonable variation in depths will be allowed and posts may be appropriately shortened or left slightly high, as approved by the Engineer, to:
- Avoid unnecessary penetration or excavation in rock or other unusually firm material
- Obtain desired grades along the fence

Set all posts vertical, except on curved alignment set posts slightly off vertical, as directed, to offset the pull of the fence fabric and wires.

(1) Driven Posts - Posts which are set by driving shall be free of damage when set. Remove and replace any driven posts which are split, twisted or bent, or have badly misshapen tops.

(2) Dug Holes - Where rock is encountered, set the posts to depths of not less than 18 inches and backfill with fine granular material. Do not exceed the post height shown by more than 3 inches.

When posts are set in dug holes, backfill in 6 inch layers with each layer separately and thoroughly tamped and compacted.
Concrete Footings - Dimensions of footings shall not be less than shown and shall fill the excavated areas. Place the concrete with contact against firm soil at the sides and bottom and tamp around the posts and brace ends after the posts and braces have been brought to and firmly held in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water. Allow to cure for at least 5 calendar days before subjecting the posts and braces to strain.

(b) End Posts - Set end posts:
- At the beginning and end of new fence construction that is not terminating at gate posts
- At the end of the intersecting line of existing fences just outside the line of the new fence

(c) Intermediate End Posts - Set intermediate end posts in the line of the new fence:
- At each summit and at each valley in the grade of the fence where the algebraic difference in the grades of adjoining panels of fence exceeds 30%
- At other points located along the new fence line to break the fence construction into approximately equal runs not exceeding the applicable lengths of runs shown

(d) Corner Posts - Set corner posts as follows:
1. Barbed and Woven Wire Fences - At angle of deflection exceeding 5° for fences with steel line posts or 15° for fences with wood line posts. Changes in line where the angle of deflection does not exceed the above limitations will be considered alignment angles. The adjacent line posts at alignment angles shall be made fast to the angle post by means of diagonal tension wires.
2. Chain Link Fences - At angle points in fence alignment where the alignment of adjoining panels of fence changes direction by 20° or more.

(e) Gate Posts - Set gate posts at the beginning or end of runs of fence to provide openings for gates or gateways.

(f) Line Posts - Set line posts along the line of fence, between end, intermediate end, corner, and gate posts, and at the spacings shown. Line posts may be set at spacings not exceeding 25% greater than specified or at closer spacings if approved. Set a line post in the new fence line at a point in alignment with each intersecting fence line approximately 1 foot from the end post of the intersecting fence line.

It is intended that the actual number of line posts will average to the number required for normal spacing.
(g) Braces - Construct braces before placing of fence fabric and wires on the posts.

(1) Metal Braces - Provide corner posts and intermediate end posts with two braces, one each direction from the post in the main fence lines. Provide end posts and gate posts with one brace in the line of the fence as shown.

Attach metal braces to the metal end, intermediate end, corner and gate posts and set in concrete footings.

(2) Wood Braces - Assemble and construct treated wood braces in conjunction with treated wood end posts, intermediate end posts, corner posts and gate posts to form units as shown. Fasten the wire brace guys to posts with three staples in each post. By means of a wood lever, twist together the four strands of wire between the posts until the entire assembly is taut and firm. Leave the lever in place. Drive the staples to provide contact with the wires without indentation of the posts.

01050.44 Barbed and Woven Wire Fence:

(a) Placing Fabric and Wire - Place fabric and wire on the face of the post which is away from the highway or as shown. On curved alignment, place the fabric and wire on the face of the post against which the normal pull of the fabric and wire will be exerted.

Attach fence fabric and barbed wire to each post according to recognized standard practice for fence construction and as shown or directed.

(b) Splicing Fabric and Wire - Splices of fabric and splices of separate lines of wire between posts will be allowed provided that not more than two fabric or separate wire splices, spaced at least 50 feet apart, occur in any one run of fence. Use wrap or telephone-type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than 6 complete turns.

(c) Stretching Fabric - Stretch the barbed wire and woven wire fabric. Use care in stretching woven wire fabric, so the pull is evenly distributed over the longitudinal wires and not more than 1/2 of the original depth of the tension curves is removed.

(d) Fastening Fabric and Wire:

(1) At End, Intermediate End, Corner, and Gate Posts - Terminate the fence fabric and barbed wire at each end, intermediate end, corner, and gate post in the new fence line. Wrap each line of barbed wire and each longitudinal wire of the fence fabric around the post and then itself with at least four turns.
(2) **At Line Posts** - Fasten woven wire fabric to the post at top and bottom and at intermediate points not exceeding 12 inches apart. Fasten each line of barbed wire to each line post. Use approved wire ties or clamps to fasten the wires to metal posts. Drive staples, for use with wood posts, crosswise with the grain of the wood and pointed slightly downward. Drive the staples just short of actual contact with the wires to permit free longitudinal movement of those wires and to prevent damage to the protective coating.

(3) **At Intersection of New and Existing Fence** - Where existing fences intersect the new fence, cut the existing fence materials, or splice basically in-kind new materials as necessary, and fasten each longitudinal wire of the fabric and each line of barbed wire to the new end post according to 01050.44(d)(1).

(e) **Swinging Panels at Waterway Crossings** - At waterway crossings subject to floating debris, if directed, construct wood framed swinging panels of fence fabric, barbed wire or combinations. Attach the panels to the lower wire(s) of the fence to provide fenced closure of the waterway so there will be no unfenced side or bottom openings exceeding 6 inches when the waterway is at its lightest flow or is dry.

(f) **Additional Panels at Depressions** - If depressions in the ground surface leave unfenced openings greater than 12 inches in height beneath the bottom line of the fence, provide additional panels of fence fabric, barbed wire, or combinations between line posts, as approved, across the opening so no side or bottom openings exceeds 6 inches. If the bottom line of the fence leaves an unfenced opening beneath it of 12 inches or less, pull the fabric and wires down between posts and anchor with pins or posts driven at least 18 inches into the ground so there will be no bottom opening at any point along the fence greater than 6 inches in height.

(g) **Stay Wires and Final Adjustments** - Free the fabric and barbed wire in final position from warp and sag with stay wires placed approximately vertical to the grade of the fence. Appearance shall reflect first-class work. Retighten brace guys and leave the lever restrained against the fence fabric or fence wires.

01050.45 **Chain Link Fence:**

(a) **Concrete Footings** - Construct concrete footings according to 01050.43(a-3).

(b) **Chain Link Fence Rails and Tension Wires** - Place longitudinal rails and longitudinal tension wires along the line of chain link fence, except at gates.

(1) **Rails** - Attach rails to end, gate and corner posts by clamps and sockets, and thread through loop caps on the end of line posts. Provide expansion sleeves or couplings at spacings not exceeding 200 feet in longitudinal top and bottom rails.
(2) Tension Wire - Attach tension wire to end, gate and corner posts by bands and clamps. Either thread the top tension wire through line post loop caps or hold in open slots in a manner to limit vertical movement. Tie or attach the bottom tension wire to the bottom of line posts by ties or clamps in a manner that prevents vertical movement. Provide tension wires with one turnbuckle or one ratchet take-up in each run of fence.

(c) Chain Link Fence Fabric and Wire - Assemble and install chain link fence fabric and wire according to 01050.44 and the following:

(1) Splicing Fabric - Use spiral pickets of specified chain link fabric material for fabric splices. Use wrap or telephone-type splices for tension wire and barbed wire with each end wrapped around the other wire for not less than 6 complete turns.

(2) Fastening Fabric - Fasten fabric to end, gate and corner posts and to gate frames as shown. Attach fabric to line posts with wire ties at top and bottom and at intermediate spacings not exceeding 18 inches. Fasten fabric to top and bottom rails and to longitudinal tension wires with metal bands or tie wires spaced as shown, but in no case greater than 24 inches apart.

(3) Screening Pickets - If shown, insert the screening pickets vertically in each diamond.

01050.46 Protective Fence for Bridges - If welding of special connections for protective fence is required, pre-qualification of welders will not be required and inspection of welding will be visual.

01050.47 Fence Grounding:

(a) General - Except for bridge protective fence, provide at least one "ground" for each run of fence and place at any post within the run according to 00960.50(b). Fence grounding for bridge protective fence is not required. Fasten each line of barbed wire, alternate longitudinal wires of fence fabric, and the rails and tension wire of chain link fences to the ground wire by clamps. Clamp the ground wires to the grounding rods.

(b) At Electrical Lines - Ground the fence directly below the point of crossing at each location where an electric transmission, distribution or secondary line crosses over the fence.

Ground the fence at each end or gate post or at intervals not to exceed 500 feet when an electric transmission, distribution or secondary line runs parallel or nearly parallel to and within 100 feet of the fence.
01050.48 **Gate Installation:**

(a) **Metal Gates** - Install metal gates and fittings between gate posts previously set as specified. Firmly attach the fittings to the posts and gates. Hinge each single gate in a manner which will prevent removal of the gate without tools. Set the gate in an approximately horizontal plane to swing freely inward and outward, and so it can be fastened securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings.

Gates shall swing open at least of 90° in each direction.

(b) **Gateways** - Construct gateways of the same material as the fence and as shown. Construct wire splices according to 01050.44(b). Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

01050.49 **Removing and Rebuilding Fence** - Remove and rebuild existing fences as shown or directed. Construct fences to approximately the same condition as the original fence. Salvage the materials in existing fences to be removed and rebuilt and incorporate in the rebuilt fences. Replace fence materials damaged beyond reuse at no additional cost to the City. Firmly reset posts to the staked alignment. Post spacing and the number of wires to be strung and stapled to the posts shall be the same as the original fence. Furnish and use new staples or clips to fasten the wires to the posts.

**Measurement**

01050.80 **Measurement** - The quantities of fences, protective fences, gates, and associated items performed under this Section will be measured according to the following:

(a) **Barbed and Woven Wire Fence and Gateways** - Barbed wire fence, woven wire fence, and barbed and woven wire fence will be measured on the length basis. Gateways will be considered as fence of the type which adjoins them, and will be measured as a continuing part of that type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates. Where existing fences are extended to intersect the new fence, the length of extension, from point of joining to the center of the new end post, will be measured and included for payment, if similar in design or type to a Pay Item; otherwise this work will be paid for according to 00140.60.

(b) **Metal Gates for Barbed and Woven Wire Fence** - Metal gates for barbed and woven wire fence will be measured on a unit basis per each by actual count of each size of single gate and of each size of double gate, respectively. The size designation of gates for barbed wire and woven wire fence gates will be by width. The width will be the width of opening the gate is to fit.
(c) **Chain Link Fence** - Chain link fence will be measured on the length basis of each type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

(d) **Metal Gates for Chain Link Fence** - Chain link fence metal gates will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of chain link fence gates will be by width and height. The width will be the width of opening the gate is to fit.

(e) **Protective Fence for Bridges** - Bridge protective fence will be measured on the length basis.

Measurement will be between beginning and ending locations as shown.

(f) **Removing and Rebuilding Fence** - Removing and rebuilding existing fence will be measured on the length basis, including gates. Measurement will be from center to center.

### Payment

01050.90

**Payment** - The accepted quantities of fences, protective fences, gates, and associated items performed under this Section will be paid for according to the following.

(a) **Barbed and Woven Wire Fence** - Barbed and woven wire fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Type ____ Fence</td>
<td>___________________________ Foot</td>
</tr>
<tr>
<td>(b) ____ Foot Single Gates</td>
<td>___________________________ Each</td>
</tr>
<tr>
<td>(c) ____ Foot Double Gates</td>
<td>___________________________ Each</td>
</tr>
</tbody>
</table>

In item (a) the type of fence will be inserted in the blank.

In items (b) and (c) the width of the gate opening will be inserted in the blank.

(b) **Chain Link Fence** - Chain link fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ____ Chain Link Fence</td>
<td>___________________________ Foot</td>
</tr>
<tr>
<td>(b) ____ Chain Link Fence with ___</td>
<td>___________________________ Foot</td>
</tr>
<tr>
<td>(c) ____ Foot x ____ Inch Chain Link Single Gates</td>
<td>___________________________ Each</td>
</tr>
<tr>
<td>(d) ____ Foot x ____ Inch Chain Link Double Gates</td>
<td>___________________________ Each</td>
</tr>
</tbody>
</table>

In item (a) the type of fence will be inserted in the blank.
In item (b) the type of fence will be inserted in the first blank and the type of material or pickets used for screening will be inserted in the second blank.

In items (c) and (d) the width of the gate opening will be inserted in the first blank and the height of gate be inserted in as the second blank.

(c) Protective Fence for Bridges - Bridge protective fence will be paid for at the Contact unit price, per foot, for the item "____ Foot Type ____ Protective Fence".

The height of the fence will be inserted in the first blank. The type of fence will be inserted in the second blank.

(d) Removing and Rebuilding Fence - Removing and rebuilding fence will be paid for at the Contact unit price per foot for the item "Removing and Rebuilding Fence".

New material necessary to complete the rebuilding of fence will be included in payment made for the removing and rebuilding fence item.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for materials, equipment, and labor involved in constructing panels of fence additional to normal fence construction at waterways and at ground surface depressions, according to 01050.44(e) and 01050.44(f), will be paid for according to Section 00196.
Section 01070 - Mailbox Supports

Description

01070.00 Scope - This work consists of removing and maintaining mailboxes and supports at temporary locations during construction, and installing mailboxes and newspaper boxes affected by construction on new or existing supports at permanent locations as shown or directed.

Materials

01070.10 Reinforcement - Furnish reinforcement for concrete collars meeting the requirements of Section 00530.

01070.11 Concrete - Furnish concrete for concrete collars meeting the requirements of Section 00440.

01070.12 Tube Support Frame - Furnish tube support frames meeting either of the following requirements:

- Requirements of ASTM A 500, Grade B, and galvanized according to AASHTO M 111 ASTM A 123
- Tensile requirements of ASTM A 53, Grade B, and galvanized with a minimum 0.9 ounce per square foot coating, as tested according to ASTM A 90, on the exterior surface followed by a chromate conversion coating and a cross link polyurethane acrylic coating. A zinc base corrosive resistant interior coating shall also be applied.

01070.13 Mounting Brackets and Hardware - Furnish mailbox mounting brackets, angles, adapter plates, and hardware as shown and galvanize according to ASTM A 153. Furnish mounting brackets for newspaper boxes as shown on the standard drawings.

01070.14 Post Mounting Socket - Furnish Flush V-Wing Post Mounting Socket manufactured by Foresight Industries of Cheyenne, Wyoming, or an approved equal.

Construction

01070.40 General - Protect and maintain mailboxes and supports at locations accessible to the delivery agent and as convenient as possible for the public being served. This may require removing and relocating the mailboxes and supports more than once to maintain service. When roadway construction is completed, install the mailboxes and newspaper boxes on new supports in their permanent locations as shown or directed.

Repair damaged galvanized surfaces, such as the cut end of the tube support frame or drilled holes, according to 02420.10(d), except add 1 1/2 ounces of leafing aluminum powder to each quart of high zinc dust content paint.

Install mounting brackets of the proper size to fit each existing mailbox.
If multiple supports are furnished for fewer than 5 mailboxes, install on the support Size 1 mounting brackets for the empty spaces.

If property owners want to keep the original mailbox support, place the support on the owner's property adjacent to the work. Otherwise, dispose of the original mailbox support according to 00290.20.

**Measurement**

**01070.80 Measurement** - The quantities of mailbox supports and concrete collars will be measured on the unit basis of each kind of mailbox support and the number of concrete collars, regardless of size, installed in permanent locations.

**01070.81 Existing Supports** - The quantities of mailboxes and supports removed, maintained and reinstalled will be measured on the unit basis of each kind of mailbox support, regardless of type, installed in permanent locations.

**Payment**

**01070.90 Payment** - The accepted quantities of mailbox supports and collars will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Single Mailbox Supports</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Multiple Mailbox Supports</td>
<td>Each</td>
</tr>
<tr>
<td>(c) Mailbox Concrete Collars</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Remove and Reinstall Mailbox Supports</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment for item (d) includes installing existing supports to be reused in temporary locations before installing in the permanent location.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- removing existing mailbox supports
- providing temporary installations
- installing new supports in permanent locations
- installing owner-furnished mailboxes and newspaper boxes
Section 01090 - Gravel Beds and Blankets

Description

01090.00 Scope - This work consists of preparing areas for gravel beds and gravel blankets, and furnishing and placing soil sterilant, weed control geotextile, and gravel bed aggregates or gravel blanket aggregates at locations shown or directed.

Materials

01090.10 Soil Sterilant - Furnish products with current legal labels listing active ingredients, which may include simazine, diuron, bromacil, suffometuron-methyl or from the CPL. Submit a sample of the proposed soil sterilant’s registered label to the Engineer for approval before using.

01090.11 Weed Control Geotextile - Furnish the following weed control geotextiles:

- "Weed-Chek Landscape Mat"
- 3 ounce, UV stabilized, non-woven, polypropylene fabric
- 3.75 ounce, UV stabilized, needle-punched, polypropylene fabric
- Weed control geotextile from the CPL

01090.12 Aggregates - Provide clean, uncrushed, nearly round rock for gravel beds and gravel blankets meeting the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Gravel Bed 3/4&quot; - 1/2&quot;</th>
<th>Gravel Blanket 1 1/2&quot; - 1/2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>80 - 100</td>
<td>80 - 100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>0 - 15</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>80 - 100</td>
<td>—</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>0 - 10</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

The Engineer may accept aggregates by visual inspection.

Construction

01090.40 General - Prepare gravel bed and gravel blanket areas, and furnish and place soil sterilant, geotextile, and aggregates as follows:

(a) Excavation - Excavate and shape the areas for gravel beds and gravel blankets as shown or directed and according to Section 00330.

(b) Soil Sterilant - Furnish and place the approved soil sterilant at a rate of application recommended by the Manufacturer. During use of soil sterilant strictly adhere to label cautions, especially those concerning existing plants or waterways in the immediate area.
(c) **Geotextile** - After the area has been treated with soil sterilant, place the weed control geotextile over the prepared ground surface according to 00350.41(a). Extend or lap the geotextile as follows:

- **Gravel Beds** - Extend the geotextile approximately 2 inches up the sides of the bed and overlap at least 12 inches.
- **Gravel Blankets** - Lap the ends of the sheets 18 inches and the sides 12 inches.
- **Aggregates** - Place aggregate cover as follows:
  - **Gravel Beds** - Cover the geotextile with gravel bed aggregates to the depth specified then level and roll with a water-filled landscape roller for a minimum of 2 complete coverages.
  - **Gravel Blankets** - Cover the geotextile with gravel blanket aggregates to the depth specified or directed.

**Measurement**

| Measurement | The quantities of gravel beds will be measured on the volume basis. The quantities of gravel blankets will be measured on the area basis by surface measurement of the material in place limited to the established neat lines and grades. |

**Payment**

| Payment | The accepted quantities of gravel beds and gravel blankets will be paid for at the Contract unit price, per unit of measurement, for the following items: |

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Gravel Beds</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(b) Gravel Blanket</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, or weed control geotextiles.
PART 01100 - WATER SUPPLY SYSTEMS

Section 01120 - Irrigation Systems

Description

01120.00 Scope - This work consists of installing irrigation systems and associated equipment at locations shown or specified and as directed.

01120.01 Qualifications - In order to install certain kinds of equipment or systems, manufacturer's certifications may be required, if described in the Special Provisions.

Materials

01120.10 General - Furnish only commercial quality materials and equipment. All items proposed for use will be subject to testing to ensure compliance with the Specifications. Provide materials of the same function that are of the same type and the same manufacturer.

Submit a list of proposed materials for approval as soon as practicable after Award and before arranging for procurement of any materials, especially those materials or products not shown or specified. If any initially proposed materials are not approved, submit substitutes for approval. Any materials installed without approval will be subject to removal and replacement with acceptable material at the Contractor's expense.

Materials may be designated by trade name or by manufacturer's catalogue information as shown or specified. The use of a substitute material may be permitted if a written request for substitution and proof of equivalent quality and suitability are furnished. Make any request for substitution with ample time for approval without delaying the work.

When alternate equipment, such as sprinkler heads, is proposed for use with hydraulic characteristics differing from that originally shown, the following will be required:

- A redrafted, legible plan that shows the redesigned layout, location, or sizes of every affected system element as required for proper operation as originally designed. Furnish a plan showing every relevant system element, site feature, and plan element that was shown on the original plan. A plan made by marking up the original plan will not be accepted.
A hydraulic calculation table for the alternate equipment. At a minimum, show a complete calculation for one average sprinkler zone (section) and a complete calculation for the "worst case" sprinkler zone (i.e., the section that is farthest from the point of connection (POC.), is the largest, or otherwise presents the most challenging hydraulics). Starting from the POC, show the calculation with a step-down method with flow and loss at each piece of equipment and length of pipe run between equipment. Show the new total water required for each zone and the total for all zones to ensure that maximums for meter size, pipe sizes, and watering times will not be exceeded.

Where any controller run-time change will be required, submit a separate page showing the total timing per controller required for each section, to show that timing changes will still allow all zones to be run within a reasonable time period.

A cost page showing the Contractor's actual discount cost from the supplier(s), comparing the original plan costs versus the proposed equipment costs for each type of item, such as pipe by size, where there is a change required. Show the line total of each type of item and the grand total for the proposed change.

Pipe, Tubing and Fittings - Furnish galvanized iron or steel, PVC, or polyethylene pipe as shown or specified that meets the following requirements:

(a) Galvanized Pipe and Fittings - Furnish pipe of standard weight, hot-dip galvanized iron or steel, standard threaded, coupled, and that meets the requirements of ASTM A 53/A 53M. Non-standard threaded fittings will be rejected.

(b) Polyvinyl Chloride Pipe and Fittings - Furnish PVC pipe and fittings of PVC compound Type 1, Grade 1, conforming to ASTM D 2241 and certified approved by the National Sanitation Foundation. Provide pipe and fittings free from defects caused by poor materials, low quality of work, or rough handling. Dimensional and quick burst tests of pipe and fittings may be required after arrival at the job site before materials will be accepted.

Furnish pipe and fittings as follows:

<table>
<thead>
<tr>
<th>Used for</th>
<th>Class or Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caps</td>
<td>Schedule 80 PVC</td>
</tr>
<tr>
<td>Direct bury pipe, not in sleeves, placed under road beds or other paved areas</td>
<td>Schedule 40 PVC</td>
</tr>
<tr>
<td>Irrigation sleeves</td>
<td>Schedule 40 PVC</td>
</tr>
<tr>
<td>Main and lateral lines</td>
<td>Schedule 40 PVC</td>
</tr>
</tbody>
</table>

Furnish PVC threaded pipe of PVC 1120, Schedule 80 material conforming to ASTM D 1785.
Provide PVC solvent-weld pipe of PVC 1120 materials having a 200 psi minimum pressure rating with SDR 21 walls that conform to ASTM D 2241.

Furnish PVC pipe fittings conforming to ASTM D 2466, Type I, Grades 1 or 2.

Pipe may be belled on one end with the dimensions of the tapered bell conforming to ASTM D 2672.

Install PVC pipe with walls heavier than SDR 21 when shown or specified.

(c) Non-Potable Colored Coded Pipe - Wherever non-potable, reclaimed or reuse water is used, furnish PVC pipe that is tinted purple and imprinted with the warning "Caution: Reclaimed Water - Do Not Drink". Provide pipe meeting the same AWWA and ASTM specifications as the potable water pipe sizes on which they are based.

(d) Polyethylene Pipe - Furnish polyethylene pipe of Class 80, SDR 15, medium density, meeting the requirements of ASTM D 2239, conforming to U.S. Commercial Standard CS-255, and approved by the National Sanitation Foundation (NSF).

(1) Micro Tubing and Fittings - Where drip emitters are not required, furnish a blank type and provide any connections necessary. Provide tubing consisting of nominal-sized linear, low-density, minimum 1/4 inch outside diameter (OD) polyethylene.

(2) Low Volume (Drip) Tubing - Furnish drip tubing manufactured from specially formulated, chemical-resistant, low to medium density, virgin polyethylene or polybutylene which is selected for excellent weatherability and stress cracking resistance, and is designed specifically for use in drip irrigation systems. Provide drip tubing having a minimum wall thickness of 0.044 inch.

01120.12 Automatic Controllers - Provide Underwriter's Laboratories (UL) approved controller(s) as shown or specified. Furnish each outdoor controller with either a pedestal or wall mount brackets when appropriate. Provide and install the controller in a weatherproof and vandal-proof cabinet of corrosion-resistant metal. Furnish the controller housing or cabinet with hasp and lock or locking device. Provide locks or locking devices that are master-keyed and include three sets of keys for the locks. If the irrigation system serves both lawns and planting beds, furnish a controller that has a dual programming capability. Provide controllers that are compatible with and capable of operating the irrigation system as constructed.

The following are definitions of some controller-associated equipment:

Central Controller - A computer system programmable to receive data from and provide commands to multiple irrigation systems remotely located from the central system location.

Flow Sensor - The hardware located in a pipeline that senses water flow and sends resulting data by electronic pulses to the pulse output transmitter.
Pulse Decoder - A microprocessor-based device designed to read electrical pulses originating at the flow sensor (or other type of monitoring device) and send the data to a central control system for analysis and action. When reading water flow data, the pulse decoder may also be referred to as a flow monitor.

Pulse Output Transmitter - A device that reads electronic pulses from the flow sensor and sends data to the pulse-decoding device.

Rain Sensor - A sensor able to interrupt the power from the irrigation controller to the valves when the rainfall exceeds a pre-selected amount. Furnish rain sensors that are compatible with the system controller and are fully adjustable.

Satellite Controller - A satellite controller similar to a normal stand-alone controller and able to operate as one, but designed to be operated by a central controller located off-site.

Soil Moisture Sensor - A sensor that interrupts programmed irrigation cycles until the soil moisture reaches a predetermined condition at the sensor's probe location.

Weather Station - A field station that collects and stores various weather data for access and use by a central control system in modifying an irrigation program for weather conditions. Typical data collected over a time period are wind speed, wind direction, relative humidity, rainfall, solar radiation and air temperature.

01120.13 Quick-Coupling Equipment - Furnish quick coupling equipment with a body of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584, and a service rating not less than 125 psi for non-shock cold water. Provide couplers having standard male pipe threads at the top and standard female pipe threads at the base. Ensure that the valve is designed to open only upon inserting a coupler key and close completely after removing the key, with absolutely no leakage of water between the coupler and valve body. Provide valve bodies to receive couplers that are designed with double worm slots to allow smooth opening and closing action with a minimum of effort. Ensure that slots notched at the base will hold the coupler firmly in the open position. Furnish couplers of one piece construction with steel reinforced side handles attached, a locking top and of the same material as the valve body. The coupler shall have stainless steel double guide lugs to fit the worm slots. Furnish two couplers and two hose swivels for operation of the valves, and two keys for the locking caps if quick-coupling valves are required. For non-potable water systems, furnish a color-coded, purple tinted cap that bears the printed warning “Caution: Reclaimed Water - Do Not Drink”.

01120.14 Hose Bibs - Furnish bronze or brass hose bibs, with angle-type thread to accommodate a 3/4 inch hose connection, and with a key-operated design that prevents operation by wrench or pliers.
01120.15 **Cross-Connection Control Devices** - Cross-connection control devices will be shown on the plans. Furnish and install cross-connection control devices meeting the requirements of the Oregon Health Division and the local water authority.

01120.16 **Water Meter** - Water meter procurement, installation, and associated costs will be the responsibility of the City. Be responsible for coordinating water meter needs in a timely fashion with the City.

01120.17 **Valves:**

(a) **Gate Valves** - Furnish gate valves of heavy-duty bronze conforming to the requirements of ASTM B 62. Provide valves of the same size as the pipes on which they are placed and install with union or flange connections. Service rating (for non-shock cold water) shall be 150 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and hand wheel or suitable cross wheel for standard key operation. The valves shall have the manufacturer's name, type of valve, and size clearly cast on them.

(b) **Drain Valves** - Furnish bronze or brass drain valves, 1 inch or 3/4 inch in size, manual angle globe type, with rising stem, hex brass union, removable bonnet and stem, and adjustable packing gland. Ensure that valves are designed for underground installation with a suitable cross wheel operable with a standard key. The valves shall have a service rating of not less than 150 psi non-shock cold water. Furnish three standard operating keys.

(c) **Check Valves** - Furnish heavy duty bronze or steel check valves which function by means of a hinged disc suspended from the body, and which is able to close of its own mass. Furnish valves that are of the same size as the pipes on which they are placed, unless otherwise specified, and with union or flanged connections. Provide valves that are rated for non-shock cold water service of not less than 150 psi. The valves shall have the manufacturer's name, valve type, and size cast on them.

(d) **Pressure-Reducing Valves** - Furnish pressure-reducing valves with a minimum of 150 psi working pressure and an adjustable outlet range of 20 to 70 psi, rated for non-shock cold water service up to 175 psi. The valves shall be factory set as shown or specified.

(e) **Isolation Valve** - Furnish isolation valves as shown on the plans or Special Provisions. If no isolation valve is shown, furnish ball valves as shown below.

(f) **Ball Valves** - Furnish bronzed-bodied ball valves conforming to ASTM B 62 and with a hard, chrome plated ball conforming to ASTM B 124/B 124M. The valve shall be non-shock cold water service-rated at not less than 400 psi. Plastic valves will not be accepted.

(g) **Air Relief Valve** - The air relief valve automatically relieves air pressure to break an air vacuum in the pipe section where it is located. Install air relief valves at the exact high point of each pipe section where relief is needed. (Note - air relief valves are not associated with backflow prevention).
(h) Control Valves:

(1) **Manual Control Valves** - Furnish manual valves of bronze or brass, angle type, with hex brass union, and with a service rating not less than 150 psi non-shock cold water. Provide valves for underground installation designed with a cross wheel suitable for operation with a standard key. Furnish three suitable operating keys per irrigation system. Furnish valves that have removable bonnet and stem assembly, with adjustable packing gland housing for the long acme-threaded stem to ensure full opening and closing. Provide valves with discs that are full floating with replaceable seat washers.

(2) **Automatic Control Valves** - Furnish automatic control valves of a normally closed design, operated by an electric solenoid of the required rating, but not more than 6.5 W and operating on 24 V AC power. Ensure that solenoids directly attached to the valve bonnets or bodies have completely internal control parts. Provide bodies that are not less than 150 psi if brass or bronze and not less than 125 psi if plastic, with a manual control bleed cock to operate the valve without electric current. Ensure that the closing speed is not less than 5 seconds and the opening speed is not less than 3 seconds. Both shall be at a constant rate of opening and closing so the water flow is completely stopped when the valve is either manually or electrically closed. Provide valves having manual shutoff stems with cross handles that will adjust the valve from fully closed to wide open with the valve automatically operable in the adjusted position.

(3) **Automatic Control Valves with Pressure Regulator** - Furnish valves of the same manufacture as the automatic control valves, capable of reducing the inlet pressure to a constant lower pressure regardless of supply fluctuations, and which are fully adjustable.

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01120.18 **Valve Boxes and Protective Sleeves** - Provide automatic control valves, flow control valves, pressure reducing valves, backflow preventers, filters and other serviceable fixtures with valve boxes that are extendable to obtain the depth required. Furnish boxes constructed of thermoplastic, with locking lids, green in color, and of the type shown or specified. Include a protective sleeve and cap with all manual drain valves and manual control valves.

01120.19 **Electrical Wire and Splices** - Unless otherwise specified, furnish electrical wiring used as a hot wire for each zone between the automatic controller and automatic valves of copper, minimum size AWG No. 14, and red in color. Furnish common wire that is a minimum AWG No.12 and white in color. Furnish type USE that is chemically cross-linked Polyethylene or Thermoplastic. Furnish Type UF that is color-coded or marked with number identification.
Make low voltage splices with one of the following:

- Furnish a kit containing a "T" shaped open cell with a centering device and a plastic bag of urethane and hardener, which is mixed at the time of installation. The resin used with the "T" shaped centering device shall be a quick curing, flexible compound with a set up time of about 4 minutes at 70 °F. Acceptable kits are "3-M DBY", "RainBird Snap-Tite", "Pen-tite PVC Socket and Sealing Plus" or approved equal.


Provide and install an extra wire with all wiring runs that is the same gauge, but of a different color than the hot wire and common wire. The extra wire will be reserved for future use or modifications to the system.

01120.20 Communication Cable - Furnish communication wire in central satellite control systems that is 18 gauge polyethylene (PE) 89, minimum 6 pair, or approved equal. Provide sufficient pairs to connect all decoding, sensing and monitoring devices to the Central Control Unit.

01120.21 Detectable Wire and Marking Tape - Provide a detectable wire at the elevation of all main and lateral lines using continuous #14 gauge, single strand locator wire that is blue in color. Provide marking tape above all main and lateral lines consisting of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Furnish color-coded tape with the type of line buried below and the word "Caution" imprinted continuously over its entire length in permanent black ink. Provide tape of the width recommended by the manufacturer for the depth of installation used.

Construction

01120.40 General - The irrigation plans are a schematic design and may require adjustment. Do not install the sprinkler system as shown if it is evident that obstructions, grade differences, or differences in area dimensions create conditions different than anticipated in the design. Bring all such obstructions or differences to the attention of the Engineer. In the event this notification is not performed before construction begins on a part of the system where discrepancies exist, any revisions necessary to make the system operate as designed will be the Contractor’s responsibility.

(a) Plumbing - Install all parts of the irrigation system according to the Oregon Plumbing Code and State and local laws. Make water service connections as shown and specified. Conform to the requirements of the jurisdictional water authority. Ensure that water velocities in PVC pipe do not exceed 5 feet per second, unless approved in writing by the City. Bring any velocities exceeding 5 feet per second created by pipe sizes shown on the plans to the attention of the City before beginning construction. Correct excess velocities existing after construction, or caused by changes from the plans, at the Contractor’s expense, unless a written agreement has been made authorizing otherwise.
(1) Double Check Valve Assembly (DCVA) - Install, inspect, and test the DCVA according to applicable regulations of the Oregon Health Division and the local water authority. Furnish test records on forms approved by the Oregon Health Division. Furnish forms filled out by a State-licensed Backflow Device Tester documenting that the DCVA is in good operating condition before any flushing and testing of downstream water lines. During the life of the Contract, test the DCVA annually or more often if successive inspections indicate repeated failure. Repair or replace the DCVA whenever it is found to be defective.

(2) Reduced-Pressure Backflow Device (RPBD) - Install, inspect, and test the RPBD according to the applicable portions of the Oregon Plumbing Code and applicable regulations of the Oregon Health Division and the local water authority. Apply the same specific testing requirements as stated for the DCVA above.

(b) Electrical Service - Install electrical service according to 00960.49, the National Electrical Code, and all State and local laws. Power sources will be as shown or as directed. Be responsible for coordination and installation of electrical service. Furnish and install meter bases at the power source conforming to the requirements of the power supplier. Give the power supplier's representative notice before making any installation. Provide a separate, dedicated circuit for the controller.

01120.41 Layout of Irrigation System - Stake the irrigation system, following the schematic design on the plans, before construction begins. With prior approval, make alterations and changes in the layout to conform to ground conditions and to obtain adequate coverage of water. Call before you dig. Comply with the requirements of 00150.50.

01120.42 Excavation - Excavate trenches no wider than necessary to lay the pipe or install the equipment. Keep the top 6 inches of topsoil, if applicable, separate from subsoil and replace this topsoil as the top layer when backfilling. Provide smooth trench bottoms of sand or other material, free from rocks and unsuitable material. Excavate trenches in rock or other unsuitable material at least 6 inches below the required depth and backfill with sand or other suitable material free from rocks.

Exercise care when excavating near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, hand excavate and tunnel the pipe trench. When large roots are exposed, wrap them with heavy burlap for protection and to prevent excessive drying. When digging trenches by machine adjacent to trees having roots 2 inches and less in diameter, hand trim the sides of the trench, making a clean cut of the roots. Treat all cut and trimmed roots 1/2 inch or larger in diameter with an approved tree wound dressing. Backfill trenches having exposed tree roots within 24 hours unless protected by continuously moist burlap or canvas.
Place detectable marking tape in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits installed under existing or planned pavement. Use tape widths recommended by the manufacturer for the burial depth.

Pipe installation using a "pipe puller" may be approved if there is adequate topsoil depth and the topsoil is free of rock. Obtain the Engineer’s approval before using a pipe puller. Include any resultant changes in material or design with the request for use of this method.

If unforeseen bedrock is encountered during excavation that prevents the pipe from being buried at the specified depth, immediately bring it to the attention of the Engineer.

01120.43 Piping - Backfill all pipe between the top of the pipe and finished grade with a minimum of 18 inches of fill according to 01120.49. Where possible, place mains and laterals or section piping in the same trench. Separate all pipes by at least 2 inches. Place all pipe lines a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, fences, traffic barriers or walls unless otherwise approved.

Place marking tape above all pressurized mainline, according to the manufacturer's instructions.

Place all live mains to be constructed under existing pavement in sleeves jacked under the pavement, unless otherwise shown. Place all PVC pipe installed under pavement in pipe sleeves of Schedule 40 PVC, unless steel sleeving is shown or specified. Furnish pipe caps of Schedule 80 PVC. Install sleeves 2 feet below subgrade when passing under roadways. Extend sleeves 2 feet beyond the edge of gravel, edge of sidewalk or back of curbs. Mark sleeves with a 2 feet piece of #4 rebar driven flush with the ground or other adjacent surface. Place PVC caps over both ends of sleeves but do not glue. Solvent-weld sleeve sections. Pipe bedding and backfill shall conform to Section 00405. Extend the sleeve a minimum of 12 inches beyond the edge of pavement. Perform all jacking operations according to an approved jacking plan. If obstacles are encountered during required jacking, notify the Engineer, who may authorize corrective measures according to 00140.60. Provide for complete drainage of all pipe lines with manual drain valves installed at section low points. Drain valves may not be shown on the plans.

01120.44 Pipe Jointing:

(a) General - During construction, plug or cap pipe ends to prevent entry of dirt, rocks and other debris.

(b) Galvanized Steel Pipe - Ensure that galvanized steel pipe has clean cut, well fitted standard pipe threads. Ream all pipe to its full diameter and remove burrs before assembly. Construct threaded joints using either a non-hardening, non-seizing multipurpose sealant, Teflon tape, or paste as recommended by the pipe manufacturer. Make all threaded joints tight with wrenches, without using handle extensions. Clean and remake joints that leak with new material. Use of caulking or thread cement to make joints tight will not be permitted.

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(c) **PVC Pipe** - Handle and install PVC pipe, couplings and fittings according to the manufacturer's recommendations. Chamfer the outside of the PVC pipe to a minimum of 1/16 inch at approximately 22°. Join pipe and fittings by solvent welding. Use only solvents that penetrate the surface of both pipe and fitting with a result of complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer. On plastic to metal connections, work the metal connection first. Use a non-hardening compound on threaded connections. Thread connections between metal and plastic using only female threaded PVC adapters with threaded Schedule 80 PVC nipples.

(d) **Polyethylene Pipe** - Install polyethylene pipe and fittings according to the manufacturer's recommendations. Cut the ends of the polyethylene pipe square and insert the fitting to its full depth. Use stainless steel clamps for insert fittings.

01120.45 **Installation:**

(a) **Sprinkler Heads** - Position turf heads and other pop-up heads between 1/2 inch and 1 inch above finish grade, measured from the top of the sprinkler. Place sprinklers as close as practical to walks, curbs, pavement and lawn edges, but leave enough space to allow height adjustment. Do not place heads on risers in areas with any potential for pedestrian traffic, unless otherwise shown. Use swing riser assemblies that allow positioning for correct sprinkler height.

(b) **Drip Emitters** - Install emitters directly above the root mass of the plant being watered, according to the plans or the manufacturer's recommendations.

(c) **Low Volume Drip Tubing** - Install drip irrigation tubing according to the plans or the manufacturer's recommendations.

(d) **Controllers** - Install controllers according to the manufacturer's recommendations and as shown. Receive approval of the location before installing. Since the controller will need to be accessed frequently, install it at a height, position, and location that allow ease of access.

(e) **Valve Boxes and Quick Couplers** - Position the tops of valve boxes, capped sleeves, and quick coupler valves between 1/2 inch and 1 inch above finish grade or mulch.

(f) **Valves** - Install valves so that access for maintenance is maintained.

(g) **Central Control Equipment** - If shown or specified, install the following equipment according to the manufacturer's recommendations:
• Rain sensors
• Soil moisture sensors
• Flow meters
• Central control system with satellite controllers
• Weather stations

01120.46  **Low Voltage Electrical Installation** - Use direct burial wiring between the automatic controller and automatic valves. The wiring may share a common neutral. When more than one automatic controller is required, provide a separate common neutral for each controller and the automatic valves it controls. Run separate control conductors from the automatic controller to each valve. Provide and install an extra wire according to 01120.40.

Install wire adjacent to or beneath the irrigation pipe. Use plastic tape or nylon tie-wraps to bundle wires together at 10 foot intervals. Snake the wire from side to side in the trench to provide slack in the wire run. When it is necessary to run wire separate from the irrigation pipe, bundle and place the wire under detectable marking tape. Splices will be permitted only at junction boxes, valve boxes, pole bases, or control equipment. Leave a minimum of 2 feet of excess conductor at all splices, terminals and control valves to facilitate inspection and future splicing.

01120.47  **Flushing and Testing:**

(a) **General** - Provide gauges used in the testing of water pressures that are certified correct by an independent testing laboratory immediately before use on the Project. Retest gauges when directed. Test automatic controllers by actual operation for a period of 2 weeks under normal operating conditions. Should adjustments be required, adjust according to the manufacturer's direction and test until operation is accepted as satisfactory.

(b) **Sprinkler Head Flushing** - Flush all sprinkler heads as recommended by the manufacturer.

(c) **Sprinkler Head Testing** - Test for leaks in heads and connections and correct as required.

(d) **Main Line Flushing** - To remove debris that may have entered the line during construction, flush main supply lines twice with the supply valve fully open. Flush first before placing valves and again after placing valves and before pressure testing.

(e) **Main Line Testing** - Purge all main supply lines of air and test with static water pressure of at least 150 psi for 60 minutes without introduction of additional service or pumping pressure. Test with one pressure gauge installed on the line where directed. Install an additional pressure gauge at the pump when directed. Lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct rejected installations and retest for leaks.
(f) **Lateral Line Flushing** - Flush all lateral lines once with the supply valve fully open prior to placement of sprinkler heads, emitters and drain valves. Flush long enough to remove any debris that enters the lateral lines during construction.

(g) **Lateral Line Testing** - Purge all lateral lines of air and test under operating line pressures with risers capped and drain valves closed. Maintain operating line pressures for 30 minutes through open valves and pressure regulating devices. Lines showing leaks when visually inspected at the end of the specified test periods will be rejected. Correct and retest lateral line installations that have been rejected.

(h) **Lateral Line Alternate Test Method** - When conditions prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, maintain the static water pressure equal to the operating line pressure in the lines for 30 minutes, with valves closed and without introduction of additional service pressure. Lateral lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct and retest lateral line installations that have been rejected.

(i) **Testing of Micro Tubing** - Micro tubing will be tested by visual inspection while operating and before burial. Tubing that has obvious leaks or that doesn't operate as designed will be rejected. To fully test micro tubing, a water collection procedure recommended by the manufacturer may be required. Correct all faults before retesting.

01120.48 **Adjusting System** - Before final inspection, adjust and balance all sprinklers to provide adequate and uniform coverage. Balance spray patterns by adjusting individual sprinkler heads with the adjustment screws or by replacing nozzles to produce a uniform pattern. Unless otherwise specified, water spray will not be permitted on pavement, walks or structures.

01120.49 **Backfill** - Do not start backfill until all piping has been inspected, tested and approved. Complete backfilling as soon as possible after approval. Ensure that backfill material placed within 6 inches of the pipe is free of rocks or other unsuitable material that might cut or otherwise damage the pipe. Backfill from the bottom of the trench to approximately 6 inches above the pipe with continuous compaction in a manner that will not damage the pipe or wiring, and proceed evenly on both sides of the pipe. Thoroughly compact the remainder of the backfill without using heavy equipment within 18 inches of any pipe. Ensure that the top 6 inches of the backfill is topsoil material or, if suitable, is the first 6 inches of material removed in the excavation.

Pipe bedding material conforming to 00405.12 may be authorized in quantities determined by the Engineer. When authorized to proceed, fill the bottom 2 inches of the trench with approved bedding before laying pipe. After the pipe is in position, add enough bedding material to bring the backfill height to 2 inches above the pipe. Continue backfilling as usual.
If sufficient suitable backfill material is not available from trench excavation or other sources on the Project, notify the Engineer. Provide an estimate of imported backfill required, if possible. Unless otherwise shown or specified, imported pipe bedding material will be authorized according to 00140.60.

Maintenance

01120.60 System Operation - Repair, flush and test all main and lateral lines that sustain a break or disruption of service. Upon restoration of the water service, bring the affected lines up to operating pressure. After pressurizing, conduct a thorough inspection of all sprinkler heads, emitters, and other fittings, located downstream of the break or disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

Completely install and test the irrigation system, and make it automatically operable before planting in a unit area except where otherwise shown, specified, or approved. Be fully responsible for all maintenance, repair, testing, inspection and automatic operation of the entire system until all work is complete and approved.

This responsibility includes, but is not limited to, draining the system before winter and reactivating the system in the spring and at other times as directed.

Be responsible for having annual inspections and tests performed on all cross connection control devices as required by the State Health Division.

In the spring, when the drip irrigation system is in full operation, make a full inspection of all emitters. This involves visual inspection of each emitter under operating conditions. Make all adjustments, flushing or replacements to the system at this time to ensure the proper operation of all emitters.

01120.61 Drip Line Warranty - The warranty of 00170.85(b) applies to drip tubing installed under this Section. Provide a written warranty from the manufacturer against defects in manufacturing, rot, electrolytic corrosion, and stress cracking for at least 5 years from the time of installation.

Finishing and Cleaning Up

01120.70 As-Built Plans and System Orientation - Upon completion of the work, submit corrected working drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected plans showing the work as constructed. Provide drawings of sizes conforming to 00150.35(m). Prepare and present a training and orientation session covering the operation, adjustment and maintenance of the irrigation system. Review corrected drawings and explain all features. At this session, provide the Engineer with parts lists and service manuals for all equipment. Notify the Engineer in writing 2 weeks before the proposed date of the training and orientation session. The date and time of the session will be mutually agreed to.

Measurement

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01120.80  Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

01120.90  Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Irrigation System".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and Incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, backfill, electrical service and system orientation.
Section 01140 – Potable Water Pipe and Fittings

Description

01140.00 Scope - This work consists of constructing potable water pipe and fittings. Install pipe in the materials, sizes and lengths and at the locations shown or as directed to the lines and grades established. Furnish and construct joints, fittings, accessories and appurtenances as necessary, for complete installation of the potable water system.

Materials

| 01140.10 Materials | Furnish materials meeting the following requirements:

Bolted, sleeve-type couplings for plain end pipe ....................... 02475.60
Commercial grade concrete in thrust blocks ............................... 00440
CLSM ....................................................................................... 00442
Concrete Cylinder Pipe ......................................................... 02470.36
Detectable marking tape or wire ............................................... 02470.60
Ductile iron pipe fittings ....................................................... 02475.20
Ductile iron pipe ...................................................................... 02470.20
Polyethylene encasement ....................................................... 02470.50
Reinforcement .......................................................................... 00530
Restained joints ........................................................................ 02475.50
Steel pipe - 6 inches and larger ................................................ 02470.30
Steel pipe fittings - 6 inches and larger ...................................... 02475.30
Steel pipe fittings - under 6 inches .......................................... 02475.35

01140.11 Handling Pipe and Fittings:

(a) General - Handle pipe and fittings so as to prevent damage to the pipe, fitting, lining, or coating. Load and unload pipe and fittings using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded, or rolled against other pipe or fittings. If any part of the coating or lining is damaged, repair in an approved manner. Damaged pipe and fittings will be rejected. Immediately separate all damaged pipe and fittings and remove from the job site.

(b) Thread Protection - Protect threaded pipe ends with couplings or other means until installed. Inspect the pipe and fittings and notify the City of any defects.

(c) Storage and Delivery - Pipe shall be delivered with protective covering on pipe ends to prevent entry of dirt, groundwater, or other foreign material. Store pipe on cradles and maintain protective covering during storage.
(d) Bracing - For concrete cylinder pipe and steel pipe, furnish pipe and fittings with temporary bracing inside as shown or as recommended by the manufacturer. Bracing shall be installed as soon as practicable after cement mortar lining is applied. Maintain bracing in place until the pipe zone backfill has been placed and compacted. Prevent damage to the pipe when removing bracing. Pipe end shall be sealed by the manufacturer to keep moisture in and prevent cracking of lining material.

(e) Placement - Keep the pipe or pipe joint free of dirt or other foreign material during handling and laying operations.

01140.12 Cutting Pipe:

(a) General - The minimum length of cut pipe used for adjustments, proper spacing of valves, tees or special fittings shall be no less than 2 feet.

(b) Cutting Operation - Cut pipe with abrasive saws or by special pipe cutters. Square all pipe ends with the longitudinal axis of the pipe. Ream and otherwise smooth the cut ends so that good connections can be made. Cut threads cleanly. Flame cutting of ductile iron pipe will not be allowed. Inspect trimmed pieces to ensure cement lining was not damaged during the cutting process per manufacturer recommendations.

Construction

01140.40 Trench Work - Excavate trench, install bedding, pipe zone material, backfill, and dispose of excavated material according to Section 00405 and the following:

(a) Dewatering Trenches - Remove water encountered in the trench during pipe laying operations and maintain the trench until the ends of the pipe are sealed and provision is made to prevent floating of the pipe. Do not allow trench water or other deleterious or foreign materials to enter the pipe at any time. Pipe shall not be installed in standing water.

(b) Bedding and Pipe Zone - For the purpose of these Specifications, all potable water pipes are considered flexible pipes. Use bedding and pipe zone material for flexible pipes as described in 00405.12 and 00405.13 and as shown.

(c) Work in Contaminated Soils - Contract Work in Contaminated Soils or Suspected Contaminated Soils, cleanup and treatment of the contaminated soils must be done in accordance with DEQ regulations and requires special training and certification from DEQ. If unexpected contaminated soils are encountered, comply with 00291.45.

(d) Installation in Paved Areas - If pipe is installed within paved areas to be preserved, perform the installation according to Sections 00405 and 00495.

(e) Scheduling - Schedule work so that pipe trench is backfilled daily.
01140.41  Pipe Installation:

(a) General - Lay pipe to the lines and grades shown and established.

(b) Ductile Iron Pipe - Install ductile iron pipe according to AWWA C600 and the manufacturer’s recommendations.

   (1) Depth of Cover - Depth of cover shall be from the finish grade to the top of the pipe. Where no pipe grade elevations are shown, install pipe with at least 36 inches of cover for pipe 8 inches in diameter and smaller; install pipe with at least 42 inches of cover for pipe 12 inches in diameter; install pipe with a minimum of 48 inches of cover for pipe 16 inches in diameter and larger. Do not backfill pipe unless approved.

   (2) Curves and Deflections - Lay long radius curves, either horizontal or vertical, with standard pipe by deflecting the joints. If the pipe is shown curved in the plans and no special fittings are shown, assume that curves may be achieved by deflecting the joints with standard lengths of pipe. Do not exceed 80% of the manufacturer’s printed recommendations for the amount of deflection at each joint when the pipe is laid on a horizontal or vertical curve.

   (3) Pipe Laying Procedure - When ductile iron pipe is laid on a curve, join the pipe and fittings in a straight alignment and then deflect it to the curved alignment. Pipe shall not hug trench wall. Make trenches wider on curves for this purpose.

   (4) Layout - Pipe may be strung along the street a maximum distance of 300 lineal feet or enough pipe for one day of installation, whichever is less. Do not block driveways or otherwise interfere with the use of private property. Distribute the pipe so that no hazard will be presented to occupants of the adjoining property, or pedestrian and vehicular traffic. Ensure all pipe, fittings and construction materials are secured from movement while staged.

   (5) Fittings - Do not use cast plain-end fittings. Fabricated ductile iron spools are permitted.

(c) Steel Pipe and Concrete Cylinder Pipe:

   (1) Installation - Install steel pipe and concrete cylinder pipe according to the manufacturer’s recommendations. Install steel pipe and concrete cylinder pipe on curves according to 01140.41(b)(3).

   (2) Steel Welds - Steel welds shall conform to the requirements of AWWA C206. For 36 inch nominal diameter and larger pipe, lap joints shall be full fillet double welded. The City shall perform weld inspection that may include a certified welding inspector (CWI).

(d) Compliance with OAR 333 – Install new water lines and appurtenances in compliance with OAR 333 regulations governing the horizontal and vertical separations between water and sewer facilities.

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(1) Variance - If variance is proposed, submit written proposal for review and approval by the Portland Water Bureau. Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and the corrective measures proposed. Each variance will be considered on a case-by-case basis.

(2) Review Time - Allow a minimum of 5 working days review and response to each proposal.

(e) Restraint – All joints within the designated restrained joint area shown or as directed, shall be restrained. Additional restrained ductile iron pipe and fittings may be required to resolve conflicts with utilities and obstructions, or for changes in alignment, change in location of appurtenances, or change in testing locations or change in connection locations.

(f) Utility Crossings – Install Schedule 80 PVC pipe or 40 mil reinforced geomembrane for encasement of waterlines where the new waterline crosses any cathodically protected utility lines for 20 feet of length, 10 feet on each side of the crossing. See Section 01180 for additional requirements.

(g) Pipe Cleanup – As pipe-laying progresses, keep the pipe interior clean and free of all debris. Completely clean the interior of the pipe, including fittings and appurtenances, and remove any sand, dirt, mortar splatter, and any other debris before testing and disinfecting the system.

01140.42 Jointing Pipe:

(a) General - Clean all parts of the pipe ends, couplings, fittings, and appurtenances to remove oil, grit, or other foreign matter from the joint. Keep the joint from contacting the ground. When assembling gasketed joints, apply an ANSI/NSF Standard 61, Drinking Water System Components – Health Effects, or equivalent (NSF 61) approved lubricant as specified by the pipe manufacturer. Maintain cover on pipe ends until installation. Mark pipe not furnished with a depth mark before joint assembly. Plug, cap, or otherwise close the last section of pipe installed with a watertight plug. Coating of field joints shall be applied after all welding operations are complete and inspected. Refer to Section 01180 for additional requirements.

(b) Steel Pipe: 6 Inches and Larger Joint Protection:

   (1) Inside Joints – Install cement mortar in joints as specified by AWWA C205 – Field Joints. Apply the lining after the pipe is installed, backfilled, compacted and interior surfaces have been cleaned. Cement mortar lining must be NSF 61 approved and as recommended by the pipe manufacturer.
(2) Outside Joints:

a. **Tape Coating** - Apply a hot or cold applied coal tar tape coating in accordance with AWWA C203 or AWWA C209 respectively. The cold applied coal tar tape can be used only if the Contractor furnishes an affidavit of compliance with AWWA C209 and the tape meets the materials specifications with a minimum width of 4 inches and a total wrapping thickness of not less than 80 mils.

b. **Mortar Coating** - Clean the exposed metal at the exterior space and fill the annular space with a Portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer's recommendations. Commercially approved diapers with integral banding may be used.

c. **Concrete Cylinder Pipe Joint Protection:**

(1) **Inside Joints** - After the trench backfill has been placed and compacted, dampen the inside joint space with clean water or a neat cement slurry and fill by compacting into the joint an NSF 61 approved Portland cement grout. Grout shall be one part cement to not more than two parts fine sand with sufficient clean water to form a stiff mix. Finish the surface to a dense troweled surface free of projections or depressions and flush with the inside pipe surface. Do not put the pipeline into service until the mortar has cured per the manufacturer’s recommendations.

(2) **Outside Joints** – Clean the exposed metal at the exterior space and fill the annular space with a Portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer’s recommendations. Commercially approved diapers with integral banding may be used.

01140.43 **Polyethylene Encasement** - Furnish and install according to 01180.18 and 01180.46 as shown or directed.

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01140.44 **Concrete Thrust Blocks** - Place concrete thrust blocks when shown or directed, at bends, tees, dead ends, and crosses. Wrap pipe or fittings with 8 mil thickness polyethylene encasement before pouring concrete. Cast concrete thrust blocks in place against solid, undisturbed earth at the sides and bottom of the trench excavation. Shape the blocks so as not to obstruct access to the joints of the pipe or fittings. At no time allow fly ash or calcium containing cementation materials to come into contact with the ductile iron or ferrous materials.

01140.45 **Detectable Marking Tape or Wire:**

(a) **Installation** - Install detectable marking tape or wire over all nonmetallic water lines, including service connections. Place the tape or wire approximately 1 foot above the top of the pipe for its full length. Tracer wire shall be blue 18 gauge minimum. Splices are allowed with an approved kit only. Detection tape shall have printed along length “water” or “water line”.

(b) **Accessibility** - Make ends of tape or wire accessible in water meter boxes, valve boxes or casings, or outside the foundation of buildings where the pipe enters the building. Provide detectable marking tape or wire access at locations less than 1,000 feet apart or as shown.

01140.46 **Connections to Existing Mains:**

(a) **Service Connections and Main Tie-ins** - The City will make the service connections and the main tie-ins to the existing water system, unless otherwise specified or directed.

(b) **Valve Operation** - Do not operate any valves on the existing water system. Coordinate with the Engineer to make all necessary arrangements for notification and temporary services prior to disrupting any existing services.

01140.47 **Maintaining Service:**

(a) **Coordination** - Where existing services are to be transferred from old to new mains, plan and coordinate the work with that of the City so that service will be resumed with the least possible inconvenience to the public. City will review potential disruptions of service on a case by case basis.

(b) **Connection Work by Contractor** - Verify line and grade on all key connection points. Do not operate the system once it has been connected without written pre-approval.

(c) **Connection Work by the City** - The City will make connections of the new pipe at such locations as the City may elect to supply customers with water, after the affected section of pipe has passed hydrostatic and bacteriological tests. The installation of any such connections by the City shall not be construed as an acceptance by the City of any part of the work required under the contract.

01140.48 **Backfilling** - After the pipe is installed and inspected, backfill the trench according to Section 00405 and as shown.

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01140.49 Out-of-Service Water Mains - Submit abandonment plan identifying locations and limits of work, CLSM mix design, method of installation of CLSM and CLSM volumes for each pipe section. Drain out-of-service potable water mains and install plug or cap on opposing pipe ends or as directed. Remove valve boxes, risers, and meter boxes. Remove out-of-service pipes as shown or approved in writing. For mains 12 inches and larger that are not removed, install tapped caps with vent/grout/standpipe piping and fill pipe with CLSM. Vent/grout/standpipe piping shall allow water and air to be expelled from the pipe and verification that pipe section is completely filled. CLSM shall attain a 28-day compressive strength of 100 to 150 psi. CLSM shall be pumped or gravity fed into one end of the out-of-service pipe section. After CLSM filling is complete, cut and remove vent/grout/standpipe piping.

Testing

01140.50 Filling and Flushing:

(a) Pipe Filling - Fill pipes slowly with potable water at a maximum velocity of one foot per second in the main while venting all air. Take all required precautions to prevent entrapping air in the pipes. Refer to 00170.02 and 00405.49 for batch discharge permit.

(b) Pipe Flush - Flush sections of pipe to be tested and disinfected to remove any solids or contaminated material that may have become lodged in the pipe during manufacture, delivery or construction. Flushing shall not exceed the allowances listed in the discharge permit from the applicable regulatory authority.

(c) Disposal of Treated Water - Dispose of treated water flushed from mains. Neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel. Dispose of disinfecting solution to the satisfaction of the Engineer and the applicable agencies. If approved, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer. Refer to the applicable discharge permit for maximum flow rates.

01140.51 Hydrostatic Testing:

(a) General - Test all water mains and appurtenances under a hydrostatic pressure equal to 1 1/2 times the working pressure, but at least 150 psi, measured at the highest point of the test section. High pressure systems will require higher test pressures. Furnish all labor, materials and equipment necessary for performing the test. City will furnish a calibrated pressure gauge for hydrostatic testing. Refer to Section 01180 to coordinate hydrostatic testing with corrosion protection testing.

(1) Backfill - Do not begin hydrostatic test until backfill has been placed, compacted and passed required testing and the thrust blocks have reached 75% of the design strength. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.
(2) **Pre-Test Preparation** - Furnish all labor, materials, and equipment such as but not limited to air tanks, fittings, pumps, hoses, valves, and meters, necessary to fill and test the line except for the calibrated pressure gauges to be furnished by the City. Fill the mains with water and allow to stand under 75% test pressure for at least 12 hours to allow the escape of air and to allow the lining of the pipe to absorb water. The City will furnish the water to fill the pipeline at no cost to the Contractor for flushing and testing the water pipeline on water projects only. Transportation of the water from the source to the site shall be the Contractor’s responsibility. A hydrant permit and an approved backflow prevention device are required for water main testing.

(3) **Test Time** - Test by pumping the main up to the required pressure for at least 2 hours. Continuously maintain pressure within 5 psi of that required. During the test, observe the section being tested to detect any visible leakage. Use a clean container to hold water for pumping up pressure on the main being tested. Sterilize this makeup water by adding chlorine to a concentration of 25 mg/L.

(4) **Measure Quantity** - The City will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

(5) **Loss Formula** - The maximum allowable hourly leakage rate calculation is as follows:

\[ L = \frac{SD(P)^{1/2} \times 128}{148,000} \]

In the above formula:
- \( L \) = Allowable leakage in ounces per hour
- \( S \) = Length of pipe tested, in feet
- \( D \) = Nominal diameter of pipe, in inches
- \( P \) = Test pressure during the leakage test in psi

The test lasts for 2 hours and each hour’s loss stands on its own and will not be averaged. This formula is not applicable to HDPE or PVC pipe.

(6) **Pressure Loss** - There shall be no appreciable or abrupt loss in pressure during the test period.

(7) **Leakage** - Correct any visible leakage regardless of the allowable leakage specified above. After correcting the leak, restart the test for 2 hours.
(8) **Use of Hydrant Valves** - Make all tests with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the pipe test has been completed, test each gate valve in turn by closing it and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure beyond the valve is relieved. Verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

(9) **Test Section Length** - Limit section to be tested to 1,200 feet, unless otherwise shown or approved. The City may require that the first installed section of pipe, not less than 1,200 feet in length, be tested. Do not continue pipe laying more than an additional 1,200 feet until the first section has been tested successfully.

(10) **Test Equipment Readiness** - Prior to calling out the City to witness the pressure test, set up all equipment completely ready for operation and successfully perform the test to ensure that the pipe is in a satisfactory condition.

(11) **Defective Materials or Workmanship** - Replace defective materials or workmanship discovered during hydrostatic testing. Whenever it is necessary to replace defective material or correct the workmanship, repeat the hydrostatic test until a satisfactory test is obtained. Repairs shall be at the Contractor’s expense.

(b) **Air Testing** – Air testing on steel pipe for full double welded lap and double welded butt strap joints shall conform to the requirements of AWWA C206 and as modified:

(1) **Tap Installation** - Provide a 1/4 inch IPT tap into the welded joint. Apply a static air pressure of 100 psi minimum into the joint for a minimum of 10 minutes.

(2) **Welds** - While the joint is under pressure, coat welds, inside and out, with a soapy water solution.

(3) **Leakage** - If bubbling or leakage is visible, repair or replace the defective joint and repeat the test.

| 01140.52  Disinfecting - **Disinfect all new mains according to the following:** |

(a) **General** - After passing the hydrostatic testing, disinfect the new water mains according to the procedure outlined in 01140.52(d). Allow a minimum of 5 days for testing and disinfection.

(b) **Temporary Sample Points** - For temporary service and air release sample points, temporary 2 inch construction, test and flushing/sample risers, sample stations are required at 1200 foot maximum intervals and on all side branches, or as directed. Hydrants may not be used as temporary sample points.
(c) **Dechlorination** - All water having chlorine residual shall be dechlorinated and disposed of in a manner which meets the DEQ standards and is accordance with 01140.50(d). No chlorinated water shall be discharged into a storm drainage system or stream prior to approved dechlorination treatment.

(d) **Chlorination Procedure** - Chlorinate all new mains according to the following:

1. **Isolate Main** - Ensure that the main is completely isolated (physical separation or closed valve) from the system before proceeding with the disinfection process. Approved backflow protection is required if the source water for flushing or disinfection is the active distribution system. Do not test against a closed isolation valve on a live system.

2. **Valve Position** - All non-isolation valves on the new main, fire hydrants and branches shall be in the fully open position.

3. **Pipe Flush** - Flush new main, branches and services thoroughly with potable water to remove any sediment and debris. The minimum flushing velocity for this step is 2.5 feet per second (per AWWA Standard C651) unless conditions of the batch discharge permit make this flushing velocity unattainable.

4. **Chlorine Amount** - Calculate the amount of liquid sodium hypochlorite necessary to achieve the minimum residual required by DHS regulations, 25 ppm. In order to ensure that this is achieved; use a target residual of 50 ppm unless otherwise directed. Maximum residual is 75 ppm unless otherwise directed. Any sodium hypochlorite used for the disinfection process must be NSF 60 certified and conform to AWWA B300.

5. **Chlorine Application** - Maintain a steady flow rate while injecting the main with chlorinated water. Flow (bleed) a blow-off, standpipe, or hydrant at the high point(s) to allow air to escape and ensure that all interior pipe surfaces are wetted.

6. **Chlorine Residual** - Measure chlorine residual with the high-range chlorine test kit at a point near to the injection point while filling the main. Adjust the dose rate as necessary to maintain the target dose rate.

7. **Residual Measurements** - Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 1200 feet of main and once for each main branch, or 2 inch service or as directed. The measured chlorine residual shall be at least 25 ppm and not greater than 75 ppm. If any chlorine residual measurement is less than 25 ppm or greater than 75 ppm, repeat steps (3) through (6).

8. **Retention Time** - Wait 24 hours. The City will measure another set of chlorine residuals with the high-range chlorine test kit. The measured chlorine residuals shall be at least 10 ppm. If the chlorine residual is less than 10 ppm, repeat steps (3) through (7). If chlorine residual is 10 ppm or higher, proceed to the next step.
01140.80

(9) Refill and Flush - Thoroughly flush the main, branches, and services with potable water until the chlorine residual in the main is approximately the same as the source water (approximately 2 ppm). There is no minimum flushing velocity for this step.

(e) Bacterial Testing - After completing the chlorination procedure test the main according to the following:

(1) Bacterial Sampling - DHS rules and the AWWA standards referenced therein require that a main pass 2 successive sets of bacteriological tests (the successive sets of samples shall not be collected on the same day). Two consecutive negative (passing) test results are required. Allow 24 hours for the test results for each sample.

(2) Sampling Locations - The City will take one bacteriological sample from the end of the main and on each branch. For long runs of main, at least 1 sample will be taken for every 1200 feet of new main and as directed.

(3) Sample Testing - The City will test the sample set for coliform bacteria and publish the test results within 24 hours.

(4) Evaluating the Test Results - If all test results of the sample set are negative (passing) repeat steps (2) through (4). When 2 consecutive sample sets test negative for coliform bacteria, the bacterial testing is complete. If 1 or more of the sample set tests positive for coliforms (fails), repeat steps (2) through (4) after correcting the cause of the failure and as directed by the Engineer.

(5) Completion of Bacterial Testing - Upon completion of bacterial testing notify the City in writing that the testing is complete and the main is ready for tie-in.

(6) Multiple Positive (Failing) Test Results - If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

Measurement

01140.80 Pipe:

(a) Unrestrained Pipe - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings.
(b) **Restrained Pipe** - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings. Measurement will only include the quantities of restrained pipe shown. No measurement will be made of additional restrained pipe installed for Contractor convenience.

(c) **Sanitary Sewer Crossings** - Pay length for sanitary sewer replacement or encasement when listed as separate pay items will be measured on a foot basis along the horizontal centerline of the finished trench.

01140.81 **Couplings** - Flex couplings and insulated flex couplings will be measured on a unit basis by size. All other couplings will not be measured.

01140.82 **Additional Ductile Iron Pipe and Fittings** - Measurement for additional ductile iron pipe and fittings added to resolve conflicts with utilities and obstructions will be made per the restrained ductile iron pipe pay item and Sections 00195, 00196 and 00197.

**Payment**

01140.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>inch Ductile Iron Pipe ........................................... Foot</td>
</tr>
<tr>
<td>(b)</td>
<td>inch Ductile Iron Pipe Restrained ......................... Foot</td>
</tr>
<tr>
<td>(c)</td>
<td>inch Concrete Cylinder Pipe .................................. Foot</td>
</tr>
<tr>
<td>(d)</td>
<td>inch Concrete Cylinder Pipe Restrained ................. Foot</td>
</tr>
<tr>
<td>(e)</td>
<td>inch Steel Pipe ................................................. Foot</td>
</tr>
<tr>
<td>(f)</td>
<td>inch Steel Pipe Restrained .................................. Foot</td>
</tr>
<tr>
<td>(g)</td>
<td>inch Sanitary Sewer Crossing ................................ Foot</td>
</tr>
<tr>
<td>(h)</td>
<td>inch Flex Couplings ........................................... Each</td>
</tr>
<tr>
<td>(i)</td>
<td>inch Insulated Flex Couplings ................................ Each</td>
</tr>
</tbody>
</table>

The Contract unit price for the appropriate pay items reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if provided in the plans).

In items (a) through (i) the nominal diameter of pipe or coupling will be inserted in the blank.

Payment will be payment in full for furnishing and placing materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

Trench work will be paid for according to Section 00405.

Trench resurfacing will be paid for according to Section 00495.

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Tunneling, jacking or boring will be paid for according to Section 00406.

No separate or additional payment will be made for:

- concrete thrust blocks
- detectable marking tape and wire
- flushing, hydrostatic testing and disinfection
- geomembrane of water line and appurtenances
- polyethylene encasement of water line and appurtenances
- temporary blocking and restraint
- abandoning out-of-service pipes
- temporary blow offs
- test sampling points
- all couplings, other than flex couplings and insulated flex couplings
Section 01150 - Potable Water Valves

Description

01150.00 Scope - This work consists of furnishing and installing valves in potable water systems at the locations shown or at other locations as directed.

Materials

01150.10 Materials - Furnish materials meeting the following requirements:

- Backflow prevention devices ................................................ 02480.70
- Ball valves ............................................................................02480.23
- Blowoff assemblies............................................................... 02480.71
- Butterfly valves ..................................................................... 02480.22
- Combination air release/air vacuum valves .........................02480.60
- Commercial grade concrete in precast concrete blocks ..........00440
- Commercial grade concrete in thrust blocking .................00440
- Gate valves ........................................................................02480.20
- Hydraulic cushion check valves ....................................... 02480.40(c)
- Hydraulically operated valves..............................................02480.50
- Polyvinyl Chloride (PVC) Pipe ..............................................02410.70
- Power-actuating devices ......................................................02480.24
- Spring-loaded plug or disc check valves ..........................02480.40(b)
- Swing check valves ..........................................................02480.40(a)
- Tapping sleeve and valve assemblies................................02480.30
- Valve boxes..........................................................................02480.25
- Valve operator extensions ....................................................02480.26

01150.11 Handling:

(a) Damage Prevention - Handle valves so as to prevent damage to the valve, lining or coating. Load and unload valves using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped or skidded. Damaged valves will be rejected. If damage is confined to the coating or lining, replace or propose a repair method to be approved. Immediately remove damaged valves from the site.

(b) City-Furnished Materials - Arrange with the Engineer to obtain City-furnished valve boxes a minimum of 2 working days in advance, with pickup times between 9 a.m. and 3 p.m. Monday through Friday at the City's Interstate Yard. No pick up will be allowed on weekends and City observed holidays. Confirm order approval with Engineer prior to pick up.

(c) Materials Return - Return all unused and surplus City-furnished materials to the City’s Interstate Yard no later than 3 working days prior to final inspection. Make arrangements with Engineer for material return time and date. The City will not accept the returned materials if they are not clean and in the same good condition as originally supplied. Cost for unacceptable returned materials will be deducted from the final payment.
01150.12 **Connecting Ends** - Furnish valves with connecting ends as shown and as required for connection to pipe and fittings furnished.

**Construction**

01150.40 **Valves:**

(a) **General** - Install valves according to the plans and the manufacturer’s recommendations. Install valves in a manner that prevents any injury or damage to any part of the valve. Join to the pipe as set forth in Section 01140 and AWWA Standards for the type of connecting ends furnished. Thoroughly clean and prepare joints prior to installation. Where full face gaskets of a flanged type are used, no trimming of material will be allowed.

(b) **Valve and Valve Box Installation** - Set valves and valve boxes plumb. Operating nut on butterfly valves shall face the nearest curb, if applicable. Center the valve boxes over the operating nut of the valve. Place PVC tee and valve box over the valve or valve operator so that the valve box does not transmit shock or stress to the valve. Valve boxes installed in gravel or native landscaping shall be set in a circular concrete pad 18 inches in diameter, 6 inches minimum in depth. Do not bury or block access to any valve.

(c) **Valve Operator Extensions** - Install a valve operator extension with rock guard on any valve where the valve nut operator is installed more than 4 feet below finish grade. Extensions shall be hot dip galvanized after fabrication. Extension operator nuts shall be 2 feet from finish grade.

(d) **Backfilling** - Carefully tamp backfill around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench, whichever is closer. Backfill around valves shall be in accordance with Section 00405. Set the CIV box cover flush with the roadbed or finish paved surface. Prior to substantial completion, all valve box covers and PVC risers shall be cleaned and free of all debris.

(e) **Large Valve Installation** - For all valves 16 inch and larger, place precast concrete block or valve pad concrete on undisturbed earth in the trench bottom. Construct valve pads with reinforcing steel to elevations and dimensions shown. Allow a minimum of 5 days curing time before placing the valve on the pad.

01150.41 **Combination Air Release/Air Vacuum Valves** - Install combination air release/air vacuum valves as shown. Slope all piping to permit escape of any entrapped air. Perform trenching and backfilling according to 01170.40 and Section 00405.

01150.42 **Blowoff Assemblies** - Construct blowoff assemblies as shown.
01150.50

Testing

01150.50 Valve Operation Testing - After installation and hydrostatic testing, operate valves from full open to full closed to make sure valves do not bind during operation. Correct any malfunction in the operation of the valves. Verify and record the number of turns to 1/4 turn and direction from full open to full closed and submit documentation for the City’s records prior to completing final project as-constructed drawings. Leave all valves open after testing is complete.

01150.51 Hydrostatic Testing - Subject valves to hydrostatic testing according to 01140.51. Correct any defects in design, materials or workmanship to the satisfaction of the Engineer.

01150.52 Disinfecting - Disinfect valves according to 01140.52.

Measurement

01150.80 Measurement - The quantities of valves will be measured on the unit basis.

01150.81 Blowoff Assemblies - Blowoff assemblies will be measured on the unit basis.

Payment

01150.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ____ inch Gate Valve, MJ</td>
<td>Each</td>
</tr>
<tr>
<td>(b) ____ inch Butterfly Valve, MJ</td>
<td>Each</td>
</tr>
<tr>
<td>(c) ____ inch Combination Air Release/Air Vacuum Valve</td>
<td>Each</td>
</tr>
<tr>
<td>(d) ____ inch Air Release</td>
<td>Each</td>
</tr>
<tr>
<td>(e) ____ inch Blowoff Assembly</td>
<td>Each</td>
</tr>
</tbody>
</table>

In items (a) through (e) the size of the valve or assembly will be inserted in the blank.

Item (e) includes main line tee or tapping sleeve, gate valve, fittings, ductile iron pipe or copper pipe, joint restraint, testing and cleanup and surface restoration.

Payment will be payment in full for furnishing and placing the materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for earthwork not covered under other pay items, jointing, blocking of valves, protective coatings, valve boxes, valve operator extensions, valve pads, PVC riser and hydrostatic testing.
01150.91 Incidental - Payment for 6 inch gate valves used for hydrants shall be incidental to the fire hydrant assembly specified in 01160.91. Payment for 2 inch valves for 2-inch service lines are also incidental to the 2 inch service specified in Section 01170.

01150.92 City Furnished Materials - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.
Section 01154 - Precast Concrete Vaults and Appurtenances

Description

01154.00 Scope - This work consists of furnishing and installing precast concrete vaults for meters, control valves, and other water system appurtenances at the locations shown or at other locations directed.

Materials

01154.10 Materials - Furnish materials meeting the following requirements:

| Base Aggregate ................................................................. | 02630 |
| Potable Water Fitting Materials ......................................... | 02475 |
| Potable Water Pipe Materials ............................................. | 02470 |
| Potable Water Service Connection Materials, 2 Inch & Smaller .... | 02490 |
| Potable Water Valve Material ............................................ | 02480 |
| Precast Concrete Vaults .................................................. | 02484 |

Construction

01154.40 Precast Concrete Vault - Install the vault plumb, free from movement and firmly set in place in location shown or as directed. Vault shall be installed watertight.

01154.41 Structural Backfill:

(a) Bedding - Place the vault on a minimum 6 inch thick layer of Class B backfill placed and compacted according to 00405.46. Place and level fill material to reduce the occurrence of voids between the vault and the backfill.

(b) Sidewall Backfill - Place 1" - 0 or 3/4" - 0 aggregate along each wall of the vault and compact to 95% Standard Proctor.

01154.42 Pipe, Fittings and Appurtenances - Install pipe, fittings, valves and appurtenances as shown.

01154.43 Pipe Penetrations - Core drill penetrations of piping, valve boxes and electrical conduits. Verify location of holes prior to core drilling. All core drills shall be water tight once piping is complete.

01154.44 Paint, Sealers and Coatings - Apply paint and sealant as shown. All vaults shall be coated with Co-Ma-Seal or approved equal according to manufacturer's recommendations.

01154.45 Ladder and Ladder Extension - Ensure that ladder is securely fastened to concrete vault wall. Ladder installation shall conform to all safety requirements of the Oregon Occupational Safety and Health Code, Stairways and Ladders. Ladder installation shall provide a minimum 3 feet extension and a maximum of 4 feet extension above finish grade.
01154.90  

**Finishing and Cleanup** - Prevent entrance of dirt, grout, and other materials into drainage piping. Clean out rock, debris, and asphalt from around CIVs, access hatch and sump.

**Testing**

01154.51  **Hydrostatic Testing** - Hydrostatically test and flush all piping through the vault according to Section 01140.

**Measurement**

01154.52  **Disinfecting** - Disinfect according to and in conjunction with 01140.

**Payment**

01154.90  **Unit Basis** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following item:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ Inch, ____ Type Vault and Assembly</td>
<td>...................... Each</td>
</tr>
</tbody>
</table>

In the item above, the following will be inserted in the blanks:

- The size of the vault and assembly in inches will be inserted with a separate pay item for each size.
- The dimension type of the vault and assembly will be inserted in the second blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidental necessary to complete the work as specified.

**No separate or additional payment will be made for valves, appurtenances, earthwork, and acceptance testing.**
01160.00  

Section 01160 - Hydrants and Appurtenances

Description

01160.00  Scope - This work consists of furnishing and installing dry-barrel fire hydrants and appurtenances in potable water systems at the locations shown or at other locations as directed.

Materials

01160.10  Materials - Furnish materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary gate valves</td>
<td>02480.20</td>
</tr>
<tr>
<td>Concrete hydrant pad</td>
<td>00440</td>
</tr>
<tr>
<td>End connections</td>
<td>02485.20</td>
</tr>
<tr>
<td>Fire hydrants</td>
<td>02485.10</td>
</tr>
<tr>
<td>Guard posts</td>
<td>02485.70</td>
</tr>
<tr>
<td>Hydrant dimensions</td>
<td>02485.30</td>
</tr>
<tr>
<td>Hydrant extensions</td>
<td>02485.40</td>
</tr>
<tr>
<td>Traffic flange</td>
<td>02485.50</td>
</tr>
<tr>
<td>Valve boxes</td>
<td>02480.25</td>
</tr>
<tr>
<td>Valve operator extensions</td>
<td>02480.26</td>
</tr>
</tbody>
</table>

01160.11  Handling of Hydrants:

(a)  Loading and Unloading - Handle hydrants so as to prevent damage to the hydrant, lining or coating. Load and unload hydrants using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded or rolled against other hydrants. Damaged hydrants will be rejected. If damage is confined to the coating or lining, it may be repaired in an approved manner. Immediately place all damaged hydrants apart from the undamaged and remove the damaged hydrants from the site as soon as possible. Damaged hydrants shall be marked with a tag or a steel crayon until removed.

(b)  End Caps - Provide factory-applied end cap on pipe connection end. Maintain end cap through shipping, storage and handling to prevent damage and prevent dirt and moisture from entering the hydrant.

(c)  Delivery Inspection - Inspect hydrants upon delivery in the field to ensure proper working order.
01160.40 Setting Hydrants:

(a) **Hydrant Installation** - Install hydrant assemblies as shown and in conformance with applicable provisions of Section 01140. Set hydrants plumb with nozzles parallel, or at right angles to the curb, with the pumper nozzle facing the curb. Set the traffic flange (breakaway flange) at least 2 inches but not more than 6 inches above the finish grade. Measure from the back of the hydrant flange at the lowest bolt elevation. Provide a minimum 6 foot unobstructed working area extending from the hydrant center out on both sides, and a minimum 3.5 feet unobstructed working area extending behind from the hydrant center, around all hydrants including proximity to any permanent structures including guard posts, signs, guy wires, buildings, and other vertical objects. Maintain a 4 foot skin-to-skin clearance between all hydrants and poles supporting or conducting electrical power. In curbed locations, set hydrant back from street as shown.

(b) **Drainage Gravel** - Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

(c) **Drain Rock Cover** - Place textile fabric to cover drain rock prior to placement of backfill. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

(d) **Touchup Painting** - After installation and testing is complete, paint the exposed portion of the hydrant with a minimum of one coat of the type and color coating as directed. Paint hydrants according to Section 02485.

(e) **Out-of-Service Hydrants** - To indicate that a fire hydrant is not operational, secure with reflective tape a yellow or orange plastic bag over the entire hydrant assembly or an approved out-of-service cover. The Contractor may also use an out-of-service ring in addition to the bag or cover in case of removal of the cover. Maintain the plastic bag or cover until the waterline is accepted or the water line has been connected to the live water system.

01160.41 **Hydrant Laterals** - Install hydrant laterals, consisting of 6 inch ductile iron pipe, from the auxiliary gate valve at the main to the hydrant, according to Section 01140 and as shown.

01160.42 **Hydrant Restraints** - Fully restrain all hydrant laterals with mechanical restraint from the main to the hydrant assembly as shown.

01160.43 **Auxiliary Gate Valves and Valve Boxes** - Install auxiliary gate valves and valve boxes according to Section 01150.

01160.44 **Hydrant Guard Posts** - Construct hydrant guard posts at the locations shown. Excavate holes 16 inches in diameter for hydrant guard posts to a depth of 36 inches. Install hydrant guard posts plumb, and center in the holes. Backfill the holes and fill the hydrant guard posts with Commercial grade concrete. Paint the exposed portion of each guard post with one coat of the type and color coating as directed.
**01160.45 Hydrant Extensions** - Install hydrant extensions where required. Set the traffic flanges a minimum of 2 inches above finish grade and a maximum of 6 inches above finish grade from back of flange at lowest bolt elevation.

**01160.45 Hydrant Pads** - Hydrants shall have a 3 feet x 3 feet x 6 inches, 4,000 psi concrete pad installed after the hydrant has been set to grade as shown. Center hydrant pad on hydrant. Set hydrant pad flush with surrounding surfaces or as directed. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than one foot in any one direction.

**Testing**

**01160.50 General** - After installation, operate hydrants from full open to full closed to make sure they do not bind during operation. Correct any malfunction in the operation of the hydrants.

**01160.51 Hydrostatic Testing** - Subject hydrants to hydrostatic testing in accordance with 01140.51.

**01160.52 Disinfecting** - Disinfect hydrants according to 01140.52.

**Measurement**

**01160.80 Measurement** - The quantities of work performed under this Section will be measured on the unit basis.

**Payment**

**01160.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Hydrant Assemblies</td>
<td>.................................................................. Each</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing all materials, equipment, labor, and incidentals necessary to complete the work as specified and as shown.
No separate or additional payment will be made for:

- hydrant extension for grade adjustment
- restraint on hydrant run and the main run for the hydrant tee and hydrant run
- excavation, bedding and backfill
- valve operator extension
- hydrant guard posts
- out of service cover
- painting
- compaction
- testing
- surface restoration and clean up
- PVC riser for CIV box and cover

**01160.91 City Furnished Materials** - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.
01170.00

Section 01170 - Potable Water Service Connections, 2 Inches and Smaller

Description

01170.00 Scope - This work consists of furnishing and installing service connections, 2 inches in diameter and smaller, from the main to the water meter, and furnishing and installing sampling stations. The water meter will be furnished and installed by City unless specified otherwise in the Special Provisions or on the plans.

01170.02 Definitions:

Long Run - A long run service is a service connection that crosses the roadway centerline between the main and the meter box.

Short Run - A short run service is a service connection up to the meter box that lies on the same side of the roadway as the main.

Materials

01170.10 Materials - Furnish materials meeting the following requirements:

Brass and bronze pipe nipples ................................................. 02490.40(d)
Brass and bronze service fittings ........................................... 02490.40(c)
Copper pipe .............................................................. 02490.40(a)
Corporation stops ........................................................................ 02490.30
Meter boxes ......................................................................... 02490.70
Meter setters ....................................................................... 02490.50
Saddles ............................................................................... 02490.20
Sampling stations ...................................................................... 02490.80

01170.11 PVC Sleeves - PVC sleeves shall meet the requirements of AWWA C900

01170.12 Steel Casings - Steel casings shall meet the requirements of AWWA C200 for sizes 6 inch and larger.

Construction

01170.40 Service Lines:

(a) General - All copper service lines shall be installed continuous, without joints or splices, complete from the new water main (insulating corporation stop) to the new meter location, install all facilities to the new meter location. Install service pipelines perpendicular to the main, unless shown otherwise. Install service runs parallel to existing services with a perpendicular distance of 2 feet minimum to 5 feet maximum from existing services and a minimum perpendicular distance of 18 inches from property line.
(b) **Excavation Depth** - Construct the depth of trench for service connection piping to provide a minimum of 30 inches of cover over the top of the pipe from finish grade or street profile. Do not damage the main in any way during the installation of the service. Excavate and backfill for service connections according to Section 00405. Where no meter is to be installed, place angled meter stop at 18 inches from face of curb with 12 inches to the springline in an approved box.

(c) **Fittings and Appurtenances** - Install necessary service saddles, valves, valve boxes, tubing, pipes, bends, fittings, and couplings necessary to complete service line installations.

(d) **Corrosion Protection** - Install cathodic protection items when required including dielectric insulating corporation stops, dielectric insulating joints, tape wrap, and grounding rod.

(e) **Pipe Tools** - Cut service pipes using tools specifically designed to leave a smooth, even and square end on the pipe. Ream cut ends to the full inside diameter of the pipe. Clean pipe ends to be connected using couplings that seal to the outside surface of the pipe to a sound, smooth finish before the couplings are installed. Adjust the meter box to the finished grade after the surface has been acceptably restored.

(f) **Testing and Disinfection Preparation** - Install temporary risers and appurtenances as required to facilitate testing and disinfection. Place a Valve Box and Cover (CIV) over the test riser after testing and disinfection.

(g) **Service Line Connections** - City will connect all service lines at the new meters or to existing service piping as shown.

(h) **Casings or Sleeves** - Install services through casings or sleeves as shown.

01170.41 **Reconnecting Existing Services** - When new service lines are not installed for existing services, City will connect all existing service lines to the new mains.

01170.42 **Sampling Stations** - Install sampling stations at the locations shown or as directed. Set at the depth shown or specified. Perform trenching and backfilling according to 01170.40.

01170.43 **Service Taps:**

(a) **Installation Equipment** - All direct service taps shall be made with a drilling and tapping machine intended for use on ductile iron pipe as manufactured by Mueller or approved equal. The drilling and tapping machine shall have alignment tool guides and a placement strap. Direct threaded taps shall engage a minimum of 4 full threads. Hand held equipment is not allowed. Coupons shall be removed from pipe.
01170.50

(b) **Thread Tape** - Direct service taps shall require the use of 2 layers of 3 mil tetrafluoroethylene (TFE) tape on the threads of the corporation stop. Liquid TFE will not be allowed. Direct taps for 1 inch services are allowed only on mains that are 6 inches in diameter or larger.

(c) **Service Saddles** - Service Saddles are required on water mains 4 inches in diameter and for all services taps larger than 1 inch. Double strap service saddles are required on all service taps larger than 1 inch.

(d) **Swing Joint** - Install swing joint on all 2 inch services.

**Testing**

01170.50 **Testing** - Testing shall be performed according to Section 01140.

**Measurement**

01170.80 **Measurement** - The quantities of service line installation will be measured on the unit basis by size for short runs and for long runs. Any service length greater than 20 feet will be measured on the length basis for the distance beyond 20 feet.

01170.81 **Service Start** - Services will begin at the centerline of the main for 1 inch and 2 inch copper services.

01170.82 **Casing or Sleeve** - Casings or sleeves for services will be measured on the length basis.

**Payment**

01170.90 **Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ____ inch Service Line, Short Run......................... Each</td>
<td></td>
</tr>
<tr>
<td>(b) ____ inch Service Line, Long Run.......................... Each</td>
<td></td>
</tr>
<tr>
<td>(c) ____ inch Service Line, Footage Exceeding 20 ft........ Foot</td>
<td></td>
</tr>
<tr>
<td>(d) ____ inch PVC Sleeve ......................................... Foot</td>
<td></td>
</tr>
<tr>
<td>(e) ____ inch Steel Casing....................................... Foot</td>
<td></td>
</tr>
</tbody>
</table>

In items (a) through (e), the size will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
No separate or additional payment will be made for:

- excavation
- bedding and backfill
- piping
- service saddles
- fittings
- valve
- vaults
- meter boxes
- restrain
- tape wrap
- testing
- flushing
- disinfection
- cathodic protection
- complete restoration and cleanup

**City Furnished Materials -** No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.
Section 01180 - Water System Piping Corrosion Control

Description

01180.00 Scope - This work consists of requirements for corrosion control materials and construction methods for the City water system piping. Provide the corrosion control system specified herein for transmission mains; for distribution mains and service lines proximate to foreign pipelines and to electric rail; for casing pipe; for pipe in vaults and above ground facilities; and for pipe on bridges. Impressed current corrosion protection systems are not covered.

01180.01 Abbreviations:

mdft - Mils Dry Film Thickness, referring to coating applications.

NACE - National Association of Corrosion Engineers.

01180.02 Definitions:

Casings and Sleeves - Protective pipe or geomembrane through which the main or service is run.

Distribution Mains - Piping systems designed to distribute water to services.

Exothermic Welding and Pin Brazing - A specialized process used for electrical connections to the exterior of pipe and fittings.

Pipe on Bridges - Pipe, fittings, and appurtenances above ground and exposed, generally attached to bridge structures.

Piping in Vaults and Facilities - Pipe, fittings, and appurtenances enclosed inside vaults, pump stations, or other buildings.

Services - The piping between the distribution main and the water meter.

Transmission Mains - Piping systems with minimal service connection, includes conduits, interties, supply mains, and pump mains.

01180.07 Submittals:

(a) Products - Provide submittals for all products referenced in this section.

(b) Testing - Submit written documentation of experience as a professional engineer regularly performing cathodic protection work or certification as a NACE Cathodic Protection Specialist for all personnel performing field testing.

(c) Test reports - Submit 3 copies of all field test reports.
01180.10 Exothermic Welds and Pin Brazing:

(a) Weld Materials - Molds, cartridges, and all required materials for exothermic (copper) welding shall be as produced by “Cadweld”, Erico Products, Inc., or approved equal. Provide molds and cartridges of a size and material as recommended in writing by the manufacturer. Molds for exothermic welding shall be graphite; ceramic molds are not acceptable.

(1) Ductile Iron Pipe - For connection to ductile iron pipe, use “Cadweld” XF-19 alloy weld metal or approved equal.

(2) Cast Iron Pipe - For connection to cast iron pipe, use “Cadweld” XF-19 alloy weld metal or approved equal.

(3) Steel Pipe - For connection to steel pipe, use “Cadweld” F-33 alloy weld metal alloy or approved equal.

(b) Terminals - All wires used with exothermic welds shall have formed sleeve terminals and shall be welded using the reduced weld size and special weld mold for formed terminals, as specified in writing by the manufacturer. The formed terminals may be factory fabricated or may be field formed using sleeves and a hammer die. Connections to mortar coated steel or concrete cylinder pipe shall be exothermically welded to a 1/2 inch diameter steel rod preinstalled on the pipe by the pipe manufacturer.

(c) Pin Brazing - Pins, studs, lugs and ferrules shall be as recommended in writing by the manufacturer for the wire size, pipe material, and pin braze machine settings.

(d) Weld Caps - Furnish weld caps of high-density plastic, 10 mils (minimum) thickness Handy Cap IP, as manufactured by Royston Laboratories, or approved equal. Provide caps that incorporate a dome for the weld, a tunnel to contain the lead wire from the weld connection, and a base plate to cover the prepared pipe surface. Weld caps shall be pre-filled with mastic/adhesive and have an integral primer for adhesion to the pipe or structure. Weld caps shall be sized for the exothermic or pin brazed connection.
01180.11 **Galvanic Anodes** - Supply galvanic anodes of the quantity, composition, dimensions, metal weight, and packaged backfill as shown or noted on the drawings. Provide magnesium anodes, nominal 20 inches long and nominal 30 pound bare metal weight. Magnesium anodes shall meet the requirements of ASTM B-843-M1C High Potential Magnesium Alloy and ASTM G97 with an open circuit potential of (-)1.7VDC to CSE and a current efficiency of 50%. The anodes shall be prepackaged in a permeable cloth bag containing the manufacturer’s prescribed backfill and the packaged anode shall be a minimum of 2.5 times the bare anode weight. The anode lead wire shall be solid copper wire, AWG #12 or #10, with TW-, THHN-, or USE-type insulation, and the connection to the anode shall be silver soldered by the manufacturer and shall be of an un-spliced length specific to the application but not less than 15 feet.

01180.12 **Test Stations and Coupons:**

(a) **Test stations** - Flush-mounted test stations will be City-furnished CIV boxes and covers.

(b) **Cathodic Protection Monitoring Coupons** - Provide coupons, steel or ductile iron, to match the pipe material type. The coupon shall have 2 wires connected with a silver soldered potted connection, and with a minimum length of 10 feet. Provide MC Miller IR-Free coupons or approved equal. The coupon access drop tube shall be Schedule 40 PVC pipe, 2 inches in diameter.

01180.13 **Wire** - Wire for test stations and joint bonds larger than AWG #10 shall be single-conductor, stranded copper, with USE-type insulation. Wire AWG #10 or smaller shall be solid not stranded, with TW-, THHN-, or USE-type insulation. Provide the wire size as specified or shown.

01180.14 **Split Bolts and Insulation for Split Bolt Connections** - Provide bronze split bolts, sized for the wire to be joined; insulating putty, 3M Scotchfill or approved equal; and vinyl electrical tape, 3M Scotch Super 33 or approved equal.

01180.15 **Ground Rods and Clamps** - Provide hot-dipped galvanized ground rods, 5/8 inch diameter 8 foot length. Provide bronze clamps, and AWG #6 or #4 stranded copper wire with USE-type insulation for connections between pipe and ground rod.

01180.16 **Insulation for Dielectric Isolation:**

(a) **Insulating Flange Joints** - Flange insulation shall include a full face insulating gasket, a full-length insulating sleeve for each bolt, and two insulating washers and two steel bearing washers for each flange bolt.

(1) **Sleeves and Washers** - Insulating sleeves and washers shall be Pyrox G-10. Both the insulating washers and the steel washers shall fit over the outside diameter of the sleeve and shall fit within the bolt facing of the flange.
(2) **Gaskets** - Gaskets shall be full faced, Styrene Butadiene Rubber (SBR), Nitrile (Buna-N), Neoprene, polytetrafluoroethylene (PTFE) or compressed vegetable fiber. Gaskets shall have adequate dielectric properties, 300V/mil minimum, and shall be suitable for the operating and test pressures of the pipe system.

(3) **Joint Assembly** - An insulating joint assembly shall consist of 2 flange by plain end or 2 flange by mechanical joint (FLG x PE or FLG x MJ) adapters, a full face insulating gasket, with full length insulating sleeves, 2 insulating washers, and 2 steel bearing washers for each flange bolt.

(b) **Insulating Flexible Couplings** - Flexible couplings size 12 inches in diameter or smaller shall be ductile iron and couplings larger than 12 inches in diameter shall be steel. All flexible couplings shall be fusion-bonded epoxy coated and furnished with high strength alloy bolts and nuts.

(1) **Insulating Boots** - Provide insulating flexible couplings with two insulating boots that cover and prevent contact between pipe ends. Insulating flexible couplings shall be Romac Industries, Inc. style IC501 or IC400 or approved equal.

(2) **Reducing Couplings** - Where couplings are for differing pipe sizes use reducing couplings. Transition couplings are not acceptable. Couplings shall be specially ordered and sized for an insulating boot on one side and thrust restraint on the other side.

(c) **Insulating Copper Service Fittings** - Fittings shall have insulators integral to the body of the fitting, as manufactured by Mueller Company or approved equal. The design of the fitting shall include a mechanical restriction to prevent the copper tube from passing through the insulation.

(d) **Insulating Wall Seals** - Wall seals shall consist of compression disks and pressure plates made of dielectric materials. Insulating wall seals shall be Model C Insulating Type as manufactured by Link Seal or approved equal.

01180.17 **Casings and Sleeves:**

(a) **Casing Spacers and Casing End Seals** - Casing spacers shall be constructed with fusion-bonded epoxy coated steel bands and reinforced insulating runners. If stainless steel bands are approved by the Owner, the bands shall be separated from the pipe with a manufacturer's elastomeric boot. Casing end seals shall be pull-on style with stainless steel clamps, custom sized for the OD of the casing and carrier pipe. Provide end seals, Type C, as manufactured by PSI or approved equal. Polyethylene encasement shall extend through the end seal and casing.

(b) **Sleeve Slip-on and End Seals** - Sleeves shall be ASTM D1785 Schedule 80 PVC pipe, 4 inch minimum pipe diameter.
(1) **Sleeve End Seals for DI Pipe** - End seals for sleeved pipe shall be concentric elastomeric couplings PVC to DI with stainless steel clamps as manufactured by FERNCO, Inc. or approved equal. Couplings shall be sized to specific pipe type and size.

(2) **Sleeve End Seals for Copper Service** - End seals for sleeved copper services shall be pull on elastomeric molded pipe sleeve seals with stainless steel clamps. Provide pipe sleeves by Fernco, Inc. or approved equal. Step down from 4 inch to the required copper tube size with schedule 80 PVC reducers. Molded end seals shall be sized specific to the pipe type and size.

(3) **Sleeve Wrapped** - Furnish 40 mil PVC reinforced geo-membrane with 300V/mil dielectric strength and minimum 150 pound puncture resistance and 150 pound tensile strength.

### 01180.18 Polyethylene Encasement and Tape Wrap:

**(a) Polyethylene Encasement for DI Pipe** - Furnish 4 mil Type 2 high density cross laminated polyethylene film in accordance with AWWA C105 tube type encasement. Polyethylene sheet is not acceptable. Furnish polyethylene encasement from the same manufacturer that supplies the ductile iron pipe.

**(b) Tape Wrap Coating for Casing** - Provide tape wrap coating for casing pipes in accordance with AWWA C203, AWWA C209, AWWA C214, or AWWA C216. Provide tape system per manufacturer’s requirements for repair and to cover holdbacks.

**(c) Tape Wrap for Copper Tube** - Provide a 20 mil minimum PVC tape wrap coating for copper services and insulating joints. Provide Scotchwrap 51 or approved equal.

**(d) Tape Wrap Coating for Specials** - When specified provide petrolatum wax tape system per AWWA C217 with an auxiliary thin film conforming stretch outlet wrap.

### 01180.19 Thin Film Coatings:

**(a) Epoxy Coating for Buried Casing** - Provide coating materials per AWWA C210, AWWA C213, except no coal tar epoxy will be allowed.

**(b) Epoxy Repair** - Provide 100% solids 2 component quick cure epoxy coating, NSF approved for potable water. Provide 3M Scotchkote 323 brush grade or approved equal.

**(c) Epoxy Coatings for Pipe on Bridges** - Provide epoxy primer and intermediate coats with an aliphatic polyurethane topcoat. Provide Pota-Pox epoxy primer and intermediate coats and an Endura-Shield polyurethane topcoat all by Tnemec or approved equal.
01180.23

(d) **Moisture Cured Urethane Coating for Pipe on Bridges** - Provide a zinc and micaeous iron oxide moisture-cured urethane system. Provide an MC-Miozinc primer, an MC-Miomastic intermediate coat, and a Ferrox A topcoat all by Wasser High Tech Coatings or approved equal.

(e) **Thixotropic Mastic Coating** - Provide a thixotropic mastic coating for field repair of existing coal-tar enamel that is not in contact with potable water. Provide Carboline Bitumastic 50 or approved equal.

(f) **Leafing Aluminum Epoxy Coating** - Provide a leafing aluminum epoxy mastic for marginally prepared surfaces. Provide Carbomastic 15 LO by Carboline or approved equal.

(g) **Galvanizing** - Galvanized items shall be per ASTM A123 & ASTM A153. Provide zinc base alloys for repair per ASTM A780. Hot stick method, zinc-rich paints are not acceptable.

(h) **Silicate Concrete Coating** - Provide a water based silicate sealer for waterproofing the exterior surface of new concrete vaults.

01180.20  **Mortar, Grout, Grout Band** - Mortar and grout shall be a chloride free Portland cement and sand mix with not less than 1 part cement to 3 parts sand or a proprietary cementitious chloride free mix approved in writing by the pipe manufacturer. The grout band shall physically contain the mortar/grout and prevent moisture loss.

01180.21  **Backfill** - Backfill in the pipe zone shall be aggregate or sand. Controlled density fill (CDF) and controlled low strength material (CLSM) are not acceptable. For tape wrapped pipe and polyethylene encased pipe, backfill shall be Class C backfill produced from crushed gravel.

01180.22  **Miscellaneous:**

(a) **Pipe Hangers** - All pipe hangers shall be hot-dip galvanized after fabrication.

(b) **Aluminum** - Aluminum in contact with concrete or stainless steel shall be paint coated in areas of contact with a non-alkyd based paint suitable for contact with concrete.

(c) **Stainless Steel** - The exterior surface of stainless steel that is in contact with ductile iron shall be paint coated with a coal tar mastic or surface tolerant epoxy.

01180.23  **Gravel** - Use gravel conforming to 00405.14(c)
01180.40

Construction

01180.40 Corrosion Protection:

(a) Transmission Mains - Transmission mains are piping systems with minimal service connections including conduits, interties, supply mains, and pump mains. Transmission mains shall be made electrically continuous with welded joints or joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 750 foot maximum length.

(1) Transmission mains crossing an electric rail track shall be cased under the track and for a minimum of 10 foot horizontal distance beyond the track slab.

(2) Test stations shall be provided at dielectric isolation joints, casings, where transmission mains cross cathodically protected foreign lines, and as shown.

(3) Transmission mains made of ductile iron pipe shall have polyethylene tube encasement and anodes. Steel transmission mains shall have tape wrap and anodes. Mortar-coated steel and concrete cylinder pipe (CCP) transmission mains shall have continuous mortar coating over all in-line valves, fittings, and special appurtenances, or when directed by Engineer, inline valves, fittings and special appurtenances shall be dielectrically coated and protected with anodes. All branch lines that are not mortar-coated shall be dielectrically isolated from the mortar coated main.

(b) Distribution Mains and Services:

(1) Cathodically Protected Foreign Lines - Distribution pipe and copper services crossing a cathodically protected foreign line shall be sleeved in PVC pipe or sleeved with a PVC geo-membrane wrap for a minimum of 10 feet from the centerline of the foreign line. Copper service pipe shall be tape-wrapped within the PVC pipe or geo-membrane wrap. Distribution pipe paralleling a cathodically protected foreign line shall be installed with a minimum of 5 feet skin-to-skin separation between pipes.

(2) Electric Rail Systems - Distribution pipe crossing an electric rail system shall be cased under the track and for a minimum of 10 feet beyond the track slab. Copper services crossing electric rail track shall be tape wrapped and sleeved in PVC pipe under the track and for a minimum of 10 feet beyond the track edge. Distribution pipe paralleling an electric rail shall be installed with a minimum of 10 feet horizontal separation between track slab and edge of the pipe. The pipe shall be made electrically continuous with joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 500 feet maximum length. In addition, the pipe shall have polyethylene encasement, anodes, and test stations.
(c) **Casings** - Casing pipe shall have welded joints, dielectric coating, and be protected with galvanic anodes. Casing pipe installed in an open trench shall have tape wrap coating, and casing pipe that is bored shall have epoxy coating with field-coated joints and all appurtenances shall be epoxy coated. Casing installations shall include dielectric spacers, end seals, anodes, and test stations.

(d) **Piping in Vaults and Facilities** - Piping in vaults and above ground facilities shall be painted with a leafing aluminum epoxy mastic. All pipe hangers and pipe supports shall be hot-dip galvanized.

(e) **Pipe on Bridges** - Pipe on bridges shall be painted with leafing aluminum epoxy mastic system, an epoxy/polyurethane coating system, or a moisture-cured urethane coating system. All pipe hangers and pipe supports shall be hot-dip galvanized.

01180.41 **Exothermic Welding and Underground Electrical Connections:**

(a) **General** - Unless otherwise specified, all electrical connections to the pipe shall be by exothermic welding or pin brazing. Properly cover exothermic or pin brazed welds with weld caps or in the case of mortar coated steel or Concrete Cylinder pipe (CCP), tape the exposed copper of weld and wire with vinyl electrical tape then encase in mortar. Provide sufficient space between adjacent exothermic welds to install a full sized weld cap on each weld. Repair all damaged pipe coating in accordance with the manufacturer's recommendations. Prior to coating, test all exothermic or pin brazed welds by striking with a hammer in a manner approved by the professional engineer or specialist in cathodic protection.

(b) **Pipe Joint Bonds** - Provide pipe joint bonds to assure electrical continuity except where electrical isolation is specified. Connections to the pipe shall be by exothermic welding or by pin brazing. Bond wires shall be un-spliced wire with field connections made in the trench. Alternatively, "pig tails" can be pre-welded or pin brazed to the pipe then the pig tails spliced together in the trench with split bolt connectors. Joint bonds with lug terminals can be field connected to pin brazed threaded studs. To permit inspection of the welds and pin brazing and to prevent damage to the weld caps, apply all protective coating after the joint is in place and complete. Insulate the split bolt and all exposed copper wire by encapsulating with electrical insulation putty, Scotchfill® Insulating Putty or approved equal, molding the connection smooth, and then wrapping the connection at 50% overlap with vinyl electrical tape, Scotch Super 33 or approved equal.
(c) **Joint Bond Configuration** - There shall be a minimum of 2 parallel joint bond wires, AWG #2, at each pipe joint. Valves and fittings may be bypassed by bond wires, but the valve or fitting must be made electrically continuous with the pipeline by a single wire, AWG #2 or AWG #4 that connects directly to a pipe section or connects to a joint bond wire (header run) with a split bolt connection. An assembly of valve and fittings may have a single bond wire (tap) from each component piece split bolt connected to a header run (AWG #2) that connects at each end, directly to a pipe section by exothermic weld or by split-bolt connection to a joint bond wire.

(d) **Wiring** - All wiring is to be splice-free, except where splices are specified or shown or as approved. Coil or snake all buried wire with sufficient slack to prevent stress from backfill operations and earth settlement. All wire is to be buried a minimum of 30 inches below finish grade or installed in rigid conduit. All wire at test stations shall extend a minimum of 30 inches below finished grade or shall be installed in rigid conduit. Repair any damage to the wire insulation with self-adhering butyl rubber electrical tape, Scotch No. 130C or approved equal, and over wrap with vinyl electrical tape, Scotch No. 33 or approved equal. Spirally apply each layer at 50% overlap. This repair method is not applicable to repair of any wire in an impressed current system.

(e) **Split Bolt Connections** - Split bolt connections shall be limited to the connection of two wires. Three or more wires at one split bolt are not allowed. Connection of taps to header runs may be accomplished by stripping an appropriate length of insulation from the header without cutting the wire and connecting the tap at that point with a split bolt for each tap.

01180.42 **Ground Rods** - If the service is dielectrically isolated from the main, provide a ground rod, installed per National Electric Code, and connected to the customer side of the service.

01180.43 **Galvanic Anode Installation:**

(a) **General** - Unless specified otherwise, install anodes 5 feet below the pipe invert, positioned under the pipe or up to 3 feet perpendicular from the pipe edge. Do not place the anodes within 3 feet of a neighboring metallic structure. When anodes are distributed along the pipeline, alternate the perpendicular offset from one side of the pipe to the other.

(b) **Location** - Install the anode in clean, native backfill and not in the select bedding material. Locate anodes a minimum of 5 feet apart. Thoroughly soak the anode in water prior to installation. Compact the backfill to 95% of maximum density to 1 foot above the anode. Evenly distribute anodes along main and branch line installations. Anodes may be grouped at the ends of casings and short runs of pipe; maintain 5 foot minimum distance between anodes.
(c) **Connection** - The anode lead wire shall be exothermically welded to the pipe. Alternatively the anode shall be connected to a joint bonding wire by using a split-bolt connection. Distances between anodes are nominal lengths and anode connections shall be made at pipe joints. Unless otherwise specified, for ductile iron water mains and steel pipe and casings, provide anodes as shown.

**01180.44 Test Station Installation** - Locate test stations as follows:

(a) **Isolation Joint Test Stations (TSIJ)** - Provide a test station at all buried insulated flanges and insulated couplings, except insulated connections on copper services. Provide a test station at the dielectric isolation between mortar coated steel or CCP lines and dielectrically isolated branch lines, unless the Engineer elects to not install test stations at these locations. Insulating Joint Test stations shall have 2 AWG #8 wires welded to each side of the dielectric joint, 4 wires total.

(b) **Casing Test Stations (TSC)** - Provide one test station at each end of the casing. Casing Test Stations shall have 2 AWG #8 wires welded to the main and (2) AWG #8 wires welded to the casing, 4 wires total.

(c) **Monitoring Test Stations (TSM)** - Provide a monitoring test station with cathodic protection monitoring coupons where water mains cross cathodically protected foreign lines and where water mains cross electric rail tracks. Monitoring Test Stations shall have 2 AWG #8 wires welded to the main, and 2 cathodic protection monitoring coupons, each with 2 AWG #12 wires, 6 wires total.

(d) **Combination Test Stations (TSC/IJ)** - When 2 or more test stations on the same pipe are adjacent to each other (within 15 feet) they may be combined and the test wires run to a single flush mounted test station. A TSIJ near the end of a casing may be combined with the TSC into a single test station with 2 AWG #8 wires to the casing, 2 AWG #8 wires to the casing side of the dielectric joint and 2 AWG #8 wires to the far side of the dielectric joint, 6 wires total. A TSM can be included in the combined test station by providing 2 cathodic protection monitoring coupons without additional wires to the pipe or casing.

**01180.45 Dielectric Isolation:**

(a) **General** - Provide pipe isolation with insulating flange joints, or insulating flexible couplings. Insulating joints shall be separate assemblies and not incorporated into joints with valves or other appurtenances with the exception of branch lines connected to Mortar Coated Steel Pipe (MCSP) or Concrete Cylinder Pipe. Where a branch line connects to a flange integral with a section of MCSP or CCP, a separate assembly is not required. Copper services shall be isolated with meter stops designed with integral insulation. Use insulating wall seals at all concrete wall penetrations.
(b) **Insulating joints** - Mechanical joint assemblies of flange coupling adapters may be assembled above grade complete with attached test wires. Tape the flange edge of insulating joints with PVC tape to prevent particle bridging across the flange faces. Insulating flexible couplings shall have an insulating boot on each pipe end. Reducing insulating flexible couplings shall have a boot on one pipe end and restraining bolts on the other. Transition couplings are not acceptable. Use reducing couplings to accommodate differing pipe size. Joint restraint at flexible couplings shall only use hot-dip galvanized rod and nuts and shall be insulated from the non-cathodically protected side of a joint, or insulated from the mortar coated side of a joint, or insulated on one side of the joint if both sides are cathodically protected.

01180.46  Polyethylene Encasement **Sleeve Wrapped** and **Tape Wrapped**:

(a) **Polyethylene Encasement Installation** - Install polyethylene encasement, tube type, on all ductile iron pipe and appurtenances. Install one length of polyethylene tube encasement for each length of pipe in accordance with AWWA C105, Method A. Every 6 feet along the pipe, secure the polyethylene tube encasement with tape full circumference. The use of polyethylene sheets will not be allowed. Install 40 mil geo-membrane around mechanical joints and similar connections where the polyethylene can be punctured or ripped. Tape the ends and seams of the geo-membrane with PVC tape and then cover the pipe joint with the adjoining polyethylene encasement. Bedding and backfill around polyethylene or geo-membrane encased pipe shall be Class C backfill produced from crushed gravel.

(b) **Sleeve Wrapped Installation** - Install geo-membrane when crossing a cathodically protected foreign line where the pipe configuration does not allow for a PVC pipe sleeve.

(c) **Tape Wrapped Coating for Casings** - Apply tape wrapped coating on steel casing pipe in accordance with AWWA C203, AWWA C214, AWWA C216 for manufacturer applied tape wrap and AWWA C209 for minor field applications. For tape wrapped coating repairs and other coating holdback areas, apply repair tape system per manufacturer’s requirements. Apply petrolatum wax tape per AWWA C217 with outer wrap only where directed.

(d) **Tape Wrapped Coating for Copper Services** - Provide 20 mil PVC tape wrap and apply at 50% overlap, 40 mil total. Wrap the copper tube, and all fittings including corporation and meter stop.

(e) **Mortar Coated Steel (MCSP) and Concrete Cylinder Pipe (CCP)** - Transmission mains shall have continuous mortar coating over all in-line valves, fittings, and other appurtenances, regardless of underlying coating, except when the application of a dielectric coating and installation of anodes at a valve, fitting or other appurtenance is allowed in lieu of mortar coating.
Thin Film Coatings:

(a) **Paint for Buried Casings, Casing Welds** - Provide an epoxy coating per AWWA C210 and AWWA C213. Any angle iron, c-channels, lubricating or grout pipe, fins, or other appurtenances connected to the casing shall be epoxy coated on all sides. For field repairs, prepare the surface by power tool cleaning, SSPC-SP3, and repair with a 100% solids epoxy, one coat of 25 mil dry film thickness (mdft), or when permitted, coat the weld with a thixotropic coal tar mastic, one coat of 20 mdft.

(b) **Paint Coating for Pipe in Vaults and Facilities** - Coat all piping except fittings and specials that are factory coated with fusion-bonded epoxy. Prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC-SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on ductile iron pipe and fittings, but it is not necessary to remove all asphaltic coating. All work in vaults and facilities shall be done with HEPA filter equipment. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coats minimum with 6 mdft per coat, 12 mdft total.

Steel pipe, fittings and specials, 16 inches diameter and larger, shall be shop coated, except for hold backs, prior to installation. Surface preparation shall be near white abrasive blast SSPC-SP10 and the coating shall be a leafing aluminum epoxy mastic, 2 coats 6 mdft per coat, 12 mdft total.

(c) **Paint Coating for Pipe on Bridges** - Shop blast and shop coat pipe except for hold back areas. Surface preparation and application of coatings shall be in accordance with manufacturer’s written recommendations

1. **Ductile Iron (DI) Pipe** - For ductile iron pipe prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC-SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on DI pipe and fittings, but it is not necessary to remove all asphaltic coating. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coat minimum with 6 mdft per coat, 12 mdft total.

2. **Steel Pipe** - For steel pipe prepare the surface by near white abrasive blasting SSPC-SP10. Coat with:
   a. leafing aluminum epoxy mastic, 6 mdft per coat 12 mdft total, or
   b. an epoxy coating system, 3 coats of 3-4 mdft per coat, 9-12 mdft total, or
   c. a moisture-cured urethane system at 3 mdft prime coat, 3 mdft intermediate coat, and 2 mdft topcoat, 8 mdft total.

(d) **Galvanizing** - Repair of galvanizing shall be per ASTM A780 using the zinc based alloys “hot stick” method. Zinc-rich paint is not permitted.
Testing and Verification:

(a) Quality Assurance - The portion of the work that involves the installation and testing of the galvanic cathodic protection system shall be conducted by a professional engineer regularly performing cathodic protection work or by an individual who is registered or certified by the National Association of Corrosion Engineers (NACE) as a cathodic protection specialist. Submit verification of registration or certification for written approval prior to the start of the work.

(b) Field Verifications - The professional engineer or specialist in cathodic protection shall field verify the adequacy of the Contractor's personnel in handling and placing anodes, monitoring coupons, exothermic welding, installation of split bolt connectors, repair of coatings including weld caps, and measurements of dielectric isolation and bonding. The professional engineer or specialist in cathodic protection shall at the start of the work provide a list of qualified Contractor personnel and only these listed individuals shall perform such work for the Contractor.

(c) Testing During Construction - Test all isolation joints after installation and prior to backfilling.

(d) Continuity and Isolation Testing - Perform testing as follows:

(1) General - Test all sections of pipeline, appurtenances, services, hydrants, regulator vaults, and appurtenances that are cathodically protected and dielectrically isolated for electrical continuity and dielectric isolation after all Contractor connections have been made.

(2) Test Current Response - Measure the response of the pipe to the application of cathodic protection test current. If the application of the test current causes the pipe-to-soil potential to become more negative, electrical continuity of the pipeline, service runs, and appurtenances is indicated between that point and the point at which the test rectifier negative connection was made. The response of the potential shall be of a magnitude to demonstrate low resistance joint bonds. Electrical isolation across insulating fittings shall be indicated by the pipe-to-soil potential being more positive or only slightly negative in relation to the structure connected to the test rectifier.

(e) Lack of Continuity or Isolation - If electrical continuity or electrical isolation is not achieved, locate the deficiency and complete the necessary repairs. The engineer or specialist shall retest the system before final acceptance.

(f) Repairs - Make all repairs necessary to correct any deficiencies and repair any joint not passing the electrical continuity or isolation test at no cost to the City.
(g) **Final System Testing** - Final system testing shall be performed prior to the hydrostatic testing of each segment and prior to the substantial completion. Final testing shall be performed directly by the professional engineer or specialist in cathodic protection and witnessed by the City and shall include the following as a minimum:

1. **Test and Service Locations** - Provide pipe-to-soil potential measurements for all test stations and for all service connections.

2. **Continuity and Isolation Measurements** - Provide a report consisting of continuity and isolation measurements and other data for all cathodically protected sections of pipe, appurtenances, and for all service connections.

3. **Documentation** - Provide 3 copies of a report documenting all testing and installation of cathodic protection system. The professional engineer shall stamp or the cathodic protection specialist shall sign the report. Include the specialist’s NACE registration or certification number.

(h) **Warranty** - The 2 year warranty period specified in the Contract shall apply to the entire corrosion control system installed.

### Measurement

01180.80 **Measurement** - No measurement of quantities will be made for work performed under this Section.

### Payment

01180.90 **Lump Sum Basis** - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item “Corrosion Control”.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

01180.91 **Insulating Flex Couplings** - When insulating flex couplings are required, payment will be according to Section 01140.

01180.92 **City Furnished Materials** - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.
PART 02000 - MATERIALS

Concrete Materials and Additives

Section 02001 - Concrete

Description

02001.00 Scope - This Section includes the requirements for Portland cement concrete for structures, precast prestressed or paving applications. Provide quality control and certified technicians according to Section 00165.

02001.01 General - Produce concrete according to these Specifications.

02001.02 Abbreviations and Definitions:

- **ASTV** - Actual Strength Test Value - The average of the test cylinders' compressive strengths
- **cm** - Cementitious Materials
- **f'c** - Minimum Specified or Compressive Strength at 28 days
- **f'cr** - Average Compressive Strength Over-design. The average strength required to assure that with normal variations, the concrete will meet f'c.
- **GGBFS** - Ground Granulated Blast Furnace Slag
- **HPC** - High Performance Concrete
- **HRWRA** - High-Range Water-Reducing Admixture (super-plasticizer)
- **PPCM** - Precast prestressed concrete member
- **w** - Water
- **WRA** - Water Reducing Admixture

**Cementitious Materials** - Included but not limited to Portland cement, fly ash, silica fume, ground granulated blast furnace slag and metakaolin

**High Performance Concrete (HPC)** - Structural concrete, with enhanced durability and strength characteristics, for use in structures where improved durability and performance is required.

**Moderate Exposure** - Elevations below 1,000 feet.

**Modifiers** - Pozzolans, latex.

**Pozzolans** - Fly ash.
02001.10

**Severe Exposure** - Elevations 1,000 feet and above.

### Materials

02001.10 **Materials** - Furnish materials meeting the following requirements:

- Admixtures ................................................................. 02040
- Aggregates .............................................................. 02690
- Cement ........................................................................ 02010
- Modifiers ...................................................................... 02030
- Water .......................................................................... 02020

02001.20 **Concrete Properties, Tolerances, and Limites** - Provide concrete that is a workable mixture, uniform in composition and consistency, and having the following properties:

**(a) Strength** - Provide concrete meeting the required Classes shown in the Contract Documents. The class of concrete designates the minimum required compressive strength, $f'_c$ at 28 days, and the nominal maximum size of aggregate to be used in the concrete (for example, Class 3300 - $3/4 f'_c$ is 3,300 psi with a nominal maximum size aggregate of 3/4 inch).

<table>
<thead>
<tr>
<th>Type of Concrete</th>
<th>Strength (psi)</th>
<th>Maximum w/cm Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>3300 (Seal)</td>
<td>0.45</td>
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<tr>
<td>Structural</td>
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<td></td>
</tr>
<tr>
<td>4000</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>4000 (Deck)</td>
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<td></td>
</tr>
<tr>
<td>HPC4000</td>
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<td></td>
</tr>
<tr>
<td>5000 and above</td>
<td>0.40$^1$</td>
<td></td>
</tr>
<tr>
<td>HPC5000 and above</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Paving</td>
<td>4000</td>
<td>0.43$^1$</td>
</tr>
</tbody>
</table>

$^1$ PPCM's with cast-in-place decks and no entrained air may have w/cm as follows: 5000 psi - 0.48; 5500 psi - 0.44; 6000 psi and up - 0.42

**(b) Air Entrainment** - Provide all concrete, except PPCM with cast-in-place decks, seal concrete, and drilled shaft concrete with entrained air in the amounts shown in Table 02001-2. Field measured entrained air content shall be within ± 1.5% of target air entrainment values.
### Table 02001-2

<table>
<thead>
<tr>
<th>Nominal Maximum Size Aggregate</th>
<th>Severe Exposure (Percent)</th>
<th>Moderate Exposure (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>7.0</td>
<td>6.0</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>6.5</td>
<td>5.5</td>
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<td>6.0</td>
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<tr>
<td>1&quot;</td>
<td>5.5</td>
<td>4.5</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>5.0</td>
<td>4.5</td>
</tr>
</tbody>
</table>

(c) **Slump** - Provide concrete at the appropriate slump shown in Table 02001-3. Take corrective action to maintain a consistent slump at the point of discharge from the delivery vehicle.

### Table 02001-3

<table>
<thead>
<tr>
<th>Condition</th>
<th>Slump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete without WRA</td>
<td>4” max.</td>
</tr>
<tr>
<td>Concrete with WRA</td>
<td>5” max.</td>
</tr>
<tr>
<td>Concrete with HRWRA</td>
<td>5 1/2” ± 2 1/2”</td>
</tr>
<tr>
<td>Precast Prestressed</td>
<td>10” max.</td>
</tr>
<tr>
<td>Concrete with HRWRA</td>
<td></td>
</tr>
<tr>
<td>Seal Concrete</td>
<td>8” ± 2”</td>
</tr>
<tr>
<td>Drilled Shaft Concrete</td>
<td>8 1/2” ± 1 1/2”</td>
</tr>
</tbody>
</table>

(d) **Temperature** - Provide concrete, at time of placement, at a temperature between a minimum of 50 °F and a maximum of 90 °F, except the maximum bridge deck concrete temperature shall be 80 °F.

**Concrete Mix Designs**

02001.30 **Concrete Mix Design** - Submit new or current mix designs, prepared by a CCT, for each required class of structural or paving concrete to the Engineer for review. Allow 14 calendar days for the review. Design mixes by the volumetric method in ACI 211.1 to achieve the properties of 02001.20. Do not proceed with concrete placement until the Engineer has determined that the mix design complies with the Specifications. Review of concrete mix designs does not relieve the Contractor of the responsibility to provide concrete meeting the Specification requirements.
High performance concrete (HPC) mix designs shall either contain cementitious material with 66% Portland cement, 30% Fly ash, and 4% Silica fume; or have trial batches performed to demonstrate that the alternate mix design provides a maximum of 1,000 coulombs at 90 days when tested according to AASTHO T 277.

02001.31 Concrete Mix Design Constituents:

(a) Portland Cement - Use AASHTO M 85 or ASTM C 150 Type I or II cement for structural or paving concrete. Type III cement for precast and prestressed concrete.

(b) Pozzolans - Except for HPC or GGBFS may be used separately or in combinations up to 30% of the total cementitious materials content.

(c) Modifiers - Modifiers may be used separately or in combination as approved by the Engineer.

(d) Blended Hydraulic Cement - Blended hydraulic cement may be used subject to the limits of 02001.31(b) and 02010.20.

(e) Chemical Admixtures - Use chemical admixtures according to the manufacturer's recommendations. Use WRA in all seal concrete and in Class 5000 concrete or greater. Use HRWRA in all HPC.

(f) Aggregate - If the nominal maximum size of the coarse aggregate is not included as a part of the class of concrete shown on the plans, any size from 1 1/2 inch to 3/8 inch nominal maximum size aggregate may be used, as the Contractor elects, except:

- Use 3/4 inch nominal maximum size, or larger, aggregates in bridge decks.
- Use 1 1/2 inch nominal maximum size aggregates in concrete paving unless otherwise indicated.
- Use 3/8 inch nominal maximum size aggregates in drilled shafts unless otherwise indicated.

Proportion all HPC to include a minimum course aggregate absolute solid volume according to Table 02201-4:
<table>
<thead>
<tr>
<th>Maximum Nominal Aggregate Size</th>
<th>Cu. Yd. (aggregate)</th>
<th>Cu. Yd. (concrete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>0.46</td>
<td></td>
</tr>
</tbody>
</table>

Two or more aggregate products or sources meeting specifications may be blended to improve concrete properties. Blending non-specification aggregate materials, except for gradation, with specification materials is not allowed.

**02001.32 New Mix Designs** - Prepare new mix designs for submittal according to the following:

(a) **Trial Batch Method** - Make at least one trial batch for each concrete mix design. Prepare and test the trial batch using the same materials and having the same plastic properties of concrete that will be used on the Project. Simulate haul time and mixing conditions to ensure proper workability at the jobsite.

(b) **Plastic Concrete** - For each trial batch, test the temperature, slump, density, and air content, and compute the w/cm ratio and yield according to the following tests methods:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling Fresh Concrete</td>
<td>WAQTC TM 2</td>
</tr>
<tr>
<td>Slump</td>
<td>AASHTO T 119</td>
</tr>
<tr>
<td>Density</td>
<td>AASHTO T 121</td>
</tr>
<tr>
<td>Yield</td>
<td>AASHTO T 121</td>
</tr>
<tr>
<td>Air Content</td>
<td>AASHTO T 152</td>
</tr>
<tr>
<td>Concrete Temperature</td>
<td>AASHTO T 309</td>
</tr>
<tr>
<td>Molding Concrete Specimens</td>
<td>AASHTO T 23 or R 39</td>
</tr>
<tr>
<td>Water-Cement Ratio</td>
<td></td>
</tr>
</tbody>
</table>

1 Cast cylinders in single-use plastic molds
2 Use ODOT’s Field Operating Procedure for AASHTO T 121 in the MFTP
(c) **Strength Tests** - For each trial batch, cast at least 3 test cylinders 6 inch x 12 inch or 4 inch x 8 inch single-use plastic molds. Cast and cure all strength specimens according to AASHTO T 23 or T 126, and test at least 28 days according to AASHTO T 22.

Cast three flexural beams for concrete paving mixtures according to AASHTO T 23. Test beams for concrete paving mixtures at 28 days according to AASHTO T 97.

### 02001.33 Required Strength $f_{cr}$ for New Mix Designs

- Provide test data and calculations demonstrating compliance of the trial batch cylinder's ASTV with the requirements of either (a) or (b) below:

  (a) $f_{cr} = f'_c \times 1.20$ Up to Class 6000  
  $f_{cr} = f'_c \times 1.15$ for Class 6000 and higher.

  (b) $f_{cr} = f'_c + 1.34 \times S$ Up to Class 6000  
  $f_{cr} = f'_c + 1.28 \times S$ for Class 6000 and higher.

Where $S$ = standard deviation of 28-day cylinder strengths from a similar class (≥ 1,000 psi) mix design produced at the same plant. There shall be at least 15 sets of 28-day cylinders from this similar class mix design to use option (b).

(c) **Flexural Beams** - Flexural beams for concrete paving mixtures shall achieve 600 psi at 28 days.

### 02001.34 Current Mix Designs

- Mix designs that meet the requirements for the specified class of concrete and are currently being used or have been used within the past 12 months on any project, public or private may be submitted for review.

### 02001.35 Required Submittals for Mix Designs

- Submit the following information for each concrete mix design:

  (a) **Supplier's Unique Mix Design Identification Number**

  (b) **Mix Design Constituent Proportions:**

     - Weight per cubic yard (pounds per cubic yard) of cementitious material, modifiers, fine and coarse aggregates (SSD), and mix water.
     - Absolute volumes of cementitious material, modifiers, fine aggregates and coarse aggregates (SSD), and mix water.
     - Dosage rates for chemical admixtures.

  (c) **Aggregates** - Identify the aggregate source by the ODOT source number. Report current values of the following:
- Bulk specific gravities (SSD)
- Fine aggregate absorptions
- Coarse aggregate absorptions
- Dry-rod density of coarse aggregates
- Fineness modulus of sand used in the mix design calculations

(d) **Cementitious Material** - For each cementitious material used, identify the following:

- Manufacturer
- Brand name
- Type
- Relevant Specification
- Source or location plant

(e) **Modifiers** - For each modifier used, identify the following:

- Manufacturer
- Brand name
- Source
- Relevant specification
- Class

(f) **Admixtures** - For each admixture used, identify the following:

- Manufacturer
- Brand name
- Design dosage rate

(g) **Water** - Identify the source of water to be used.

(h) **Plastic Concrete Tests** - Report the temperature, slump, density, air content, yield, and w/cm ratio of the trial batch or the average of these values for the cylinder sets presented for evaluation of a current mix design.

(i) **Compressive Strength Test Results** - Report the individual test results and the ASTV of cylinders from the trial batch or the average for the cylinder sets presented for evaluation of a current mix design.

(j) **Strength Analysis** - Provide an analysis, showing all calculations, demonstrating that the mix design meets the requirements of 02001.33.

(k) **Quality Control Personnel** - Provide the name and certification number of the CCT who prepared the mix design, the QCT who performed the plastic concrete tests and cast the test cylinders, the laboratory where the cylinders were tested, and the CSTT who tested the cylinders.
02001.36 **Adjusting Concrete Proportions** - After a mix design has been reviewed and accepted, submit any proposed adjustments to concrete proportions for review. Significant changes to the mix design (such as decreases in cementitious material content, increases in pozzolans that replaces cement, or the use of aggregates from a different source) may require verification of compressive strength performance by trial batch, according to 02001.32, or test results from field tests according to 02001.33. Aggregates from new sources shall meet aggregate source quality requirements according to Section 02690.

02001.37 **Trial Batch Costs** - Furnish all materials, equipment and work required for designing the mixes, testing materials, and making trial batches to verify the design for final use at no additional cost to the City.

02001.40 **Concrete Production** - Produce concrete according to the following sections of ASTM C 94, Standard Specification for Ready-Mixed Concrete:

<table>
<thead>
<tr>
<th>ASTM Section</th>
<th>ASTM Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>Measuring Materials</td>
</tr>
<tr>
<td>10.</td>
<td>Batching Plant</td>
</tr>
<tr>
<td>11.</td>
<td>Mixers and Agitators</td>
</tr>
<tr>
<td>12.</td>
<td>Mixing and Delivery</td>
</tr>
</tbody>
</table>

02001.50 **Quality Control Personnel** - Provide the following certified technicians:

1. **Certified Aggregate Technician (CAgT):**
   - **Duties:**
   - Sample and test aggregates.
   - Sample and test each stockpiled size according to the test procedures and at the frequencies shown in the Field Tested Materials Guide section of the MFTP.
   - Record and evaluate test results according to Section 00165.
   - Provide Stat-Spec results to the Engineer.

2. **Quality Control Technician (QCT):**
   - **Duties:**
   - Attend pre-placement meetings for bridge deck pours and paving.
   - Be at the concrete placement site when concrete placement is in progress.
   - Have a copy of the mix design on site and available during concrete placement.
• Obtain and check each batch ticket upon arrival of the concrete at the jobsite for the correct mix design.
• Sample the concrete and test for ambient air temperature, plastic concrete temperature, slump, air content, density, w/cm ratio and yield at the frequencies required by and according to the tests listed in the MFTP, after concrete mixture proportions are adjusted in the field, and at such times as requested by the Engineer.
• Notify the Contractor and the Engineer immediately when the concrete is not in compliance with the Specifications.
• Be in direct contact with the CCT by telephone, radio or other means to convey information.
• Notify the CCT of loads rejected and the reason for rejection.
• Notify the CCT immediately whenever the density of the plastic concrete varies from the mix design target by more than ± 3 pounds per cubic foot.
• Notify the CCT immediately whenever the w/cm ratio varies from the mix design target by more than ± 0.03.

(c) Concrete Control Technician (CCT):

<table>
<thead>
<tr>
<th>Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare new concrete mix designs.</td>
</tr>
<tr>
<td>Adjust current mix designs.</td>
</tr>
<tr>
<td>Control production of the concrete.</td>
</tr>
<tr>
<td>Test the fine and coarse aggregates for total moisture content according to AASHTO T 255 before batching is started and when there is a significant change in the slump of the concrete. Moisture testing may be by an alternate method if approved by the Engineer. Provide moisture content test results to the Engineer upon request.</td>
</tr>
<tr>
<td>Visually inspect the coarse aggregate for changes in moisture content throughout the day. Perform necessary testing for total moisture, and make mixture adjustments if necessary.</td>
</tr>
<tr>
<td>Monitor concrete properties and compressive strength tests throughout the duration of the Project.</td>
</tr>
<tr>
<td>Make adjustments to maintain a satisfactory over-design $f'cr$.</td>
</tr>
<tr>
<td>Perform an analysis and make necessary adjustments whenever the unit weight of the plastic concrete varies from the mix design by more than ± 3 pounds per cubic foot. Submit a written analysis along with any recommendations to the Engineer by the middle of the following work shift.</td>
</tr>
</tbody>
</table>
• Submit to the Engineer, in writing, adjustments made to the mix design.
• Perform an analysis and verify the accuracy of coarse and fine aggregate moistures whenever the water-cementitious material ratio varies from the mix design target by more than ± 0.03 and submit to the Engineer by noon of the following workday.

<table>
<thead>
<tr>
<th>(d) Concrete Strength Testing Technician (CSTT):</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Duties:</td>
</tr>
<tr>
<td>• Receive concrete test cylinders</td>
</tr>
<tr>
<td>• Record data</td>
</tr>
<tr>
<td>• Strip cylinders</td>
</tr>
<tr>
<td>• Store cylinders</td>
</tr>
<tr>
<td>• Test Cylinders</td>
</tr>
<tr>
<td>• Record test data</td>
</tr>
<tr>
<td>• Report test data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>02001.60 Delivery Tickets - Send a concrete delivery ticket with each load of concrete supplied to the Project. Each delivery ticket shall include the following information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Concrete supplier’s name, address and telephone number</td>
</tr>
<tr>
<td>▪ Address and telephone number of batch plant if different from above</td>
</tr>
<tr>
<td>▪ Date and time the concrete batch was produced</td>
</tr>
<tr>
<td>▪ ODOT mix design number</td>
</tr>
<tr>
<td>▪ Size of load batched</td>
</tr>
<tr>
<td>▪ Weights or volumes of constituents batched in the load</td>
</tr>
<tr>
<td>▪ Amount of water that can be added at the job site</td>
</tr>
</tbody>
</table>

| Record the amount of water added at the job site on the delivery ticket. |
Section 02010 - Portland Cement

Description

02010.00 Scope - This Section includes the requirements for Portland cement and blended hydraulic cement.

Materials

02010.10 Portland Cement:

(a) Types - Furnish one or another of the following types as elected:

- Type I
- Type II
- Type III

Do not mix or alternately use differing brands or types of cement, or the same brand or type of cement from different mills without prior written approval.

(b) Specifications - Portland cement shall conform to the requirements of AASHTO M 85 for low alkali cement except as follows:

- Cement used west of the summit of the Cascade Mountains shall have a total alkali content (sodium and potassium oxide calculated as Na₂O + 0.658 K₂O) not exceeding 0.80%.
- Types I or III shall contain a maximum of 10% tricalcium aluminate.
- The time-of-setting tests will be by either the Gillmore Test or the Vicat test.
- The maximum fineness (specific surface, square yards/pound) as determined by the air permeability test shall be 430 for any field-sampled check test. Results of field-sampled check tests will not be averaged.

(c) Acceptance - Portland cement shall be from the CPL.

02010.20 Blended Hydraulic Cement - Blended hydraulic cement shall be either Type IP Portland-pozzolan cement or Type SM slag-modified portland cement conforming to AASHTO M 240, supplemented or modified as follows:

- The cement constituent of the blended cement shall conform to 02010.10.
- The pozzolan constituent of the blended cement shall be a fly ash conforming to 02030.10 or ground granulated blast furnace slag (GGBF) slag conforming to 02030.40.
Section 02020 - Water

Description

02020.00 Scope - This Section includes the requirements for water used in mixing concrete, mortar, grout, and other applications when specified or directed.

Materials

02020.10 Water:

(a) General - Water used in mixing or curing concrete, for mortar and grout, and in mixing cement-treated base shall be reasonably clean, and free of oil, sugar, organic matter or other substances injurious to the finished product.

(b) Potable - Potable water may be used without testing if the Contractor provides a quality compliance certificate verifying that the water has met the limits of this Section according to tests made within the last 2 years.

Water approved for public use by the Oregon Health Division may be accepted for use without testing.

(c) Nonpotable or Unknown Quality - Water of non-potable, unknown or suspected quality will be tested at the Contractor's expense according to AASHTO T 26 before use in the Project and shall meet the following limits:

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Chloride Ion, %</td>
<td>-</td>
<td>0.15</td>
</tr>
<tr>
<td>Sulphate Ion, %</td>
<td>-</td>
<td>0.50</td>
</tr>
<tr>
<td>Total Dissolved Solids, ppm</td>
<td>-</td>
<td>6500</td>
</tr>
<tr>
<td>Total Suspended Solids, ppm</td>
<td>-</td>
<td>2000</td>
</tr>
</tbody>
</table>

If any of the test data are outside these limits, the water may be accepted on the basis of an evaluation of the reduction in 7 day compressive strength, which shall not exceed 10.0%.

In marine environments, the chloride ion percentage shall be limited to a maximum of 0.10%.

(d) Recycled Mix Water - Water from mixer washout operations may be used in mixing concrete provided it is:

• Within the limits of ASTM C 94, Table 1, Acceptance Criteria for Questionable Water Supplies, and ASTM C 94, Table 2, Chemical Limitations for Wash Water. In addition the specific gravity maximum limit is 1.03.
- Tested at a weekly interval for at least four weeks prior to use on the Project. The testing frequency may be reduced to monthly thereafter providing no single test exceeds the limits set above. Required tests include the physical tests in Table 1 of ASTM C 94, the chemical tests in Table 2 of ASTM C 94 and testing for specific gravity. The testing shall be at no additional cost to the City. The test results shall be provided to the Engineer prior to use on the Project.

- Made up from a dilution process rather than a concentration process. (A dilution process in one in which the reclaimed water is extensively diluted and continuously agitated to keep solids in a state of suspension.)

- Free of coloring agents.

- Not used when the ambient temperature is 85 °F or above.

- Not used when the ambient temperature is 40 °F or lower.

- Not used as more than 75% of the water added to the batch.

- Not used in structure decks.
Section 02030 - Modifiers

Description

02030.00 Scope - This Section includes the requirements for fly ash, silica, fume, latex, and ground granulated blast furnace slag (GGBFS) used in Portland cement concrete.

Materials

02030.10 Fly Ash:
(a) Types - Fly ash shall be Class C, Class F, or Class N from the CPL, and shall conform to AASHTO M 295, including Table 2, except that:
- Loss on Ignition (LOI) shall be 1.5% maximum
- Moisture content shall be 1% maximum
- Amount retained on the No. 325 sieve shall be 30% maximum
(b) Acceptance - Fly ash will be accepted for immediate use if accompanied by a test results certificate according to 00165.35.

As a check on material conformance, fly ash may be sampled at the site of work for verification testing.

02030.20 Silica Fume:
(a) Types - Provide the silica fume admixture as a slurry containing silica fume, water and a high-range water reducer, or as a densified powder. The silica fume portion shall conform to AASHTO M 307, including Table 1a, Optional Chemical Requirements.
(b) Acceptance - Silica fume will be accepted for immediate use if accompanied by a test results certificate according to 00165.35. If the silica fume admixture is supplied as a slurry, the certificate shall indicate the silica fume content of the slurry as a percent by weight. If the silica fume is supplied as a densified powder, do not allow the packaging to enter the concrete mixture.

02030.30 Formulated Latex Admixture - Formulated latex admixture shall be from the CPL and be a nontoxic, film-forming, polymeric emulsion in water to which all stabilizers have been added at the point of manufacture. It shall be homogeneous and uniform in composition, and meet the following requirements:
<table>
<thead>
<tr>
<th>Polymer Type Stabilizers</th>
<th>Styrene Butadiene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latex</td>
<td>Nonionic Surfactants</td>
</tr>
<tr>
<td>Portland Cement Composition</td>
<td>Polydimethyl Siloxane</td>
</tr>
<tr>
<td>Solids, % by weight, min.</td>
<td>46.0</td>
</tr>
<tr>
<td>Volume Density, lb/gal, min</td>
<td>8.4 at 77 °F</td>
</tr>
<tr>
<td>pH</td>
<td>9.0 to 11.0</td>
</tr>
<tr>
<td>Color</td>
<td>White</td>
</tr>
</tbody>
</table>

Latex admixtures that have not been stored according to the manufacturer's recommendations will not be accepted.

02030.40 **Ground Granulated Blast Furnace Slag (GGBFS)** - GGBFS shall meet the requirements of AASHTO M 302.
Section 02040 - Chemical Admixtures

Description

02040.00 Scope - This Section includes the requirements for air-entraining, water-reducing, retarding and accelerating admixtures.

Materials

02040.10 Materials - Furnish admixtures from the CPL, except as follows:

An admixture that does not appear on the CPL may be used if, prior to use, the Contractor provides a test results certificate demonstrating the admixture has been tested and conforms to these Specifications. The City may sample and test admixtures according to 00165.35.

Chloride content of any admixture used in Portland cement concrete in contact with embedded metals shall not exceed 0.5% by weight of the admixture when tested according to ODOT TM 505.

Admixtures shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Admixture</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-entraining</td>
<td>AASHTO M 154 (ASTM C 260)</td>
</tr>
<tr>
<td>Water-reducing</td>
<td>AASHTO M 194 (ASTM C 494)</td>
</tr>
<tr>
<td>Retarding</td>
<td>AASHTO M 194 (ASTM C 494)</td>
</tr>
<tr>
<td>Accelerating</td>
<td>AASHTO M 194 (ASTM C 494)</td>
</tr>
</tbody>
</table>
Section 02050 - Curing Materials

Description

02050.00 Scope - This Section includes the requirements for liquid compounds, evaporation reducers, polyethylene films and curing blankets used to cover concrete and other surfaces to retain moisture and to cure.

Materials

02050.10 Liquid Compounds - Furnish liquid membrane-forming curing compounds from the CPL and meeting the requirements of AASHTO M 148, except that testing will be done according to ODOT TM 721. The specified drying time requirement will be waived. The test application rate shall be 1 gallon per 200 square feet.

All compounds shall be class A. Solvent-based compounds shall be Type 1-D.

02050.20 Polyethylene Films - Furnish clear or white polyethylene films for curing concrete meeting the requirements of AASHTO M 171.

02050.30 Curing Blankets - Furnish curing blankets from the CPL.

02050.40 Liquid Evaporation Reducer Compounds - Furnish evaporation reducer compounds from the CPL.
Section 02060 - Sealers

Description

02060.00 Scope - This Section includes the requirements for epoxy cement sealers.

Materials

02060.10 Epoxy Cement - Furnish epoxy cement from the CPL.
Section 02070 - Bonding Agents

Description

02070.00 Scope - This Section includes the requirements for epoxy and non-epoxy bonding agents.

Materials

02070.10 Epoxy Bonding Agents - Furnish epoxy bonding agents from the CPL.

02070.20 Non-Epoxy Bonding Agents - Furnish non-epoxy bonding agents from the CPL.
02080.00

Section 02080 - Grout

Description

02080.00 Scope - This Section includes the requirements for epoxy, non-epoxy, keyway, and Portland cement grout.

Materials

02080.10 Epoxy Grout - Furnish epoxy grout from the CPL.

02080.20 Non-Epoxy Grout - Furnish non-epoxy grout from the CPL.

02080.30 Keyway Grout - Furnish grout used in the keyways of precast, prestressed concrete members that is non-shrink, nonferrous, non-epoxy grout with a minimum design strength of 5,000 psi in 28 calendar days. Furnish keyway grout from the CPL and use according to the manufacturer's recommendations.

02080.40 Portland Cement Grout - Furnish Portland cement grout consisting of 1 part Portland cement and 3 parts sand by weight, thoroughly mixed with a minimum amount of water to produce a thick, creamy consistency. Sand shall meet the requirements of 02690.30 and cement shall meet the requirements of Section 02010.

02080.50 Tendon Grout - Furnish tendon grout from the CPL that meets vertical rise requirements.

02080.60 Grout for Mortar Beds and Joints - Furnish Portland cement mortars that meet the requirements of ASTM C 270-01a and the following:

<table>
<thead>
<tr>
<th>Type</th>
<th>Average Compressive Strength At 28 days min (psi)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>2500</td>
<td>Sidewalk mortar bed</td>
</tr>
<tr>
<td>M</td>
<td>3000</td>
<td>Street mortar bed</td>
</tr>
<tr>
<td>N</td>
<td>750</td>
<td>Sidewalk grout joint</td>
</tr>
<tr>
<td>M</td>
<td>3000</td>
<td>Street grout joint</td>
</tr>
</tbody>
</table>

Type M - Typically 3 parts Portland cement, 1 part lime and 12 parts sand.
Type N - Typically 1 part Portland cement, 1 part lime, 6 parts sand.

Mortar/unit paver bond strength (shear and tensile): 500 psi minimum
Mortar water absorption: 4% maximum
Section 02090 - Lime

Description

02090.00 Scope - This Section includes the requirements for granular quicklime and hydrated lime.

Materials

02090.10 Granular Quicklime - Furnish granular quicklime (CaO) that has a minimum calcium hydroxide content of 113% and meeting the following:

Grading Requirements

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 100</td>
<td>25 maximum</td>
</tr>
</tbody>
</table>

Determine grading and hydroxide content by testing according to AASHTO T 27 and T 219.

02090.20 Hydrated Lime - Furnish hydrated lime meeting the requirements of ASTM C 1097.

02090.30 Acceptance - Provide a quality compliance certificate for lime according to 00165.35.
Wood Products

Section 02110 - Posts, Blocks and Braces

Description

02110.00 Scope - This Section includes the requirements for wood posts and blocks for guardrail, median barrier, signs, fence posts, and braces for fencing.

Materials

02110.10 Guardrail Posts:

(a) General - Furnish posts for guardrail and median barrier of the size shown, manufactured from Douglas fir, Hem-fir, or Southern Yellow Pine. Wood for posts shall have a minimum extreme fiber bending stress ($F_b$) of 1,200 psi. Only treated posts from approved suppliers that are listed in the "Nonfield-Tested Materials Acceptance Guide" will be allowed.

(b) Grading - Grading of posts shall conform to the following:

- **Douglas Fir** - Conform to the requirements for No. 1 posts and timbers as specified in either paragraph 80.11 of the current WWPA Grading Rules, or paragraph 131-b of the current WCLIB Grading Rules.

- **Hem-fir** - Conform to the requirements for select structural posts and timbers as specified in either paragraph 80.10 of the current WWPA Grading Rules, or paragraph 131-a of the current WCLIB Grading Rules, except that seasoning checks, single or opposite each other, shall be limited to a total of half the thickness.

- **Southern Yellow Pine** - Conform to the requirements for No. 1 timbers as specified in section 402 of the current Southern Pine Inspection Bureau (SPIB) Grading Rules.

(c) Certificates - Furnish certificates of lumber inspection by a recognized inspection agency.

(d) Fabrication - Before preservative treatment, bore all holes and make all necessary cuts as shown.

(e) Preservative Treatment - Treat posts according to Section 02190.

(f) Seasoning and Checking - Each preservative treated post shall show evidence of reasonable amount of seasoning or conditioning having occurred prior to treatment, so that further shrinkage of treated posts will not create checking which would expose untreated wood.
At the time of inspection at the plant and at the time of installation each treated post will be subject to inspection for evidence of seasoning having occurred. The presence of checking on the surface of the post will not be cause for rejection unless the width of the widest check, shake, or split exceeds 1/2 inch (surface measurement).

If an otherwise acceptable treated post has a through check, shake, or end split in the same slope of grain or plane as the bolt hole and extending from the top of the post to within 3 inches of the bolt hole, the post will be rejected unless it is provided with a tight fastening across the separation, centered on the post, and 2 inches below the top. Fasten with a 1/2 inch diameter galvanized bolt and nut with a galvanized washer under the bolt head and under the nut after final curing of post is achieved. Treat holes for fastenings according to 00570.40.

(g) Inspection, Rejection and Marking at Plant - Posts shall be subject to inspection at the treating plant at any time before, during or after treatment. Normally, inspection of treated posts will be made by the City's inspector not later than 10 calendar days after treatment, provided the inspector is notified of the time that treating is to be done.

Inspection of treated posts for compliance with the requirements of 02110.10(e) will be according to applicable AWPA standards, except as follows:

- The inspector will choose the number of treated posts from any one charge of the treating cylinder for determining penetration of treatment.
- Each post selected for testing shall be representative as a basis of acceptance or rejection of a pro rata number of posts in the charge.
- If 20% of the posts randomly selected for testing fail to conform to requirements, all of the posts in the entire charge from which they are selected may be classed as unacceptable.

At the inspector's discretion, each treated post or a representative random selection of treated posts may be inspected for compliance with the requirements of 02110.10(f) "Seasoning and Checking".

Posts which fail to conform to requirements of this subsection will be subject to rejection at the treating plant singly, by partial lots, or by whole lots. (A "lot" comprises the posts in any charge of the treating cylinder.)

Each treated post shall bear a permanent mark or metal tag which identifies the supplier and year of treatment, placed by the supplier either:

- On the top of the post, or
- On the back of the post, 8 inches to 10 inches below the bolt hole.
(h) Field Inspection, Acceptance and Rejection - Use only treated posts from approved suppliers as listed in the "Non-field" Testing and Acceptance Guide." At the time of installation, inspect each post for:

- Width of widest check, shake, or split
- Damage to treated wood affecting soundness
- Visible exposure of untreated wood
- Conformance to the requirements of 02110.10(b) through 02110.10(f)
- Preservative visibly leaching from the post

Posts that show a check, shake, or split exceeding 1/2 inch in width (surface measurement) on any surface will be rejected.

Posts that show surface damage may be repaired by field treating with preservatives according to AWPA Standard M 4. Repair posts that have splits, checks, or where shakes have opened or deepened sufficiently to expose untreated wood by treating with a field preservative from the CPL applied to all opened or deepened wood separations and completely filling the separations to the surface of the post.

Remove treated wood posts that have been rejected for any one or more of the above deficiencies or faults and not repaired as stated above.

Acceptance of material will be according to 00165.35, 02110.10(g) and these Specifications.

02110.20 Guardrail Blocks:

(a) General - Furnish wood guardrail blocks of the dimensions shown. Blocks shall be either Douglas fir or Hem-fir meeting the requirements of 02110.10, or pine or Southern Yellow Pine meeting the requirements of 02110.20(b) and 02110.10 except for 02110.10(b). The requirements of marking and branding the treated blocks, according to the last paragraph of 02110.10(g), will be waived provided that the supplier of the treated blocks furnishes certification with each shipment stating that the blocks conform to Specifications and that the preservative treating was done under the inspection and with the approval of the Engineer.

(b) Grading - Pine guardrail blocks shall conform to the requirements of paragraph 80.11 of the current WWPA Grading Rules. Southern Yellow Pine guardrail blocks shall conform to the requirements for No. 1 timber as specified in section 402 of the current SPIB Grading Rules.

(c) Recycled Plastic - Recycled plastic guardrail blocks from the CPL may be used.

(d) Acceptance - Acceptance of material will be according to 00165.35 and this Section.
02110.30 **Fence Posts and Braces** - Fence posts and brace rails shall be of the sizes and dimensions shown and shall be of sound Douglas fir, western hemlock, or western pine free from decay, end splits, and multiple crooks. Seasoning checks of not more than 5/16 inch width (surface measurement) will be allowed. Allowable crooks may be in one plane only. A line drawn between the centers of the butt and tip of each post and brace rail shall not fall outside of the actual longitudinal centerline of the post or rail by more than 1.67% of its length, with an allowable maximum of 2 inches.

Posts and brace rails may be square, rough, or dressed lumber, or may be peeled round posts, as the Contractor elects. Round members shall be free from bark, protruding knots and irregularities detrimental to a pleasing appearance.

Fabricate posts and brace rails before pressure treatment. Where field boring or field cutting of a treated member is required, field-treat the exposed untreated surface of the member according to 00570.40. The size of holes after treatment shall not exceed the size of the dowels or bolts to be inserted by more than 1/16 inch.

Posts intended to be driven may be machine-pointed on either the small end or the large end, before pressure treatment.

Pressure-treat the posts and brace rails according to Section 02190.

Acceptance of material will be according to 00165.35 and these Specifications.

02110.40 **Wood Sign Posts** - Fabricate wood sign posts form either Douglas fir, surface four sides (S4S) and free of heart center (FOHC) or Hem-fir (S4S) (FOHC).

(a) **Grading** - Grading requirements for wood sign posts shall conform to the applicable paragraphs of either the current WCLIB Grading Rules or the current WWPA Grading Rules, as follows:

<table>
<thead>
<tr>
<th>Species</th>
<th>4&quot; x 4&quot;</th>
<th>4&quot; x 6&quot;</th>
<th>6&quot; x 6&quot; and Larger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas Fir</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>124-c WCLIB</td>
<td>123-c WCLIB</td>
<td>131-b WCLIB</td>
</tr>
<tr>
<td></td>
<td>42.12 WWPA</td>
<td>62.12 WWPA</td>
<td>80.11 WWPA</td>
</tr>
<tr>
<td>Hem-Fir</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>124-b WCLIB</td>
<td>123-b WCLIB</td>
<td>131-a WCLIB</td>
</tr>
<tr>
<td></td>
<td>42.11 WWPA</td>
<td>62.11 WWPA</td>
<td>80.10 WWPA</td>
</tr>
</tbody>
</table>
(b) **Posts** - Construct wood sign posts according to the applicable portions of Section 00570, modified or supplemented as follows:

1. **Length** - The length of the posts shall be shown or, where not shown, each post shall be of sufficient length to provide proper sign mounting, a proper mounting height and the required foundation depth.

2. **Framing and Boring** - Cut, frame and bore timber before pressure treating, to the extent practical.

3. **Preservative Treatment** - Pressure-treat wood sign posts after fabrication according to Section 02190.

4. **Cuts and Abrasions** - Treat cuts, abrasions and bolt-holes, prior to shipping, with the same preservative as originally used to treat the post, except that if the post was originally treated with pentachlorophenol - volatile petroleum solvent (LPG) solution, cuts, abrasions and bolt-holes shall be treated with pentachlorophenol - mineral spirits solvent solution according to AWPA Standard M4.

5. **Field Repair** - Field treat damaged or drilled pressure-treated posts according to 00570.40.

(c) **Acceptance** - Acceptance of material will be according to 00165.35 and this Section.
Section 02120 - Poles and Piling

Description

02120.00 Scope - This Section includes the requirements for wood poles for use in illumination and signal installations, and timber piling for structures.

Materials

02120.10 Wood Poles - Furnish all wood poles meeting the current edition of ANSI O5.1, Specifications and Dimensions (for Wood Poles), for Class 4 machine shaved Douglas fir, and treated meeting the requirements of Section 02190. All poles shall be round, sound, well proportioned from butt to tip, and without short kinks or crooks.

02120.20 Timber Piling - Furnish timber piling meeting the requirements of ASTM D 25.

The butt or tip size, or whether the piling are to be friction or bearing piles, will be identified in the Special Provisions. All foundation piles shall be Douglas fir.

Treat timber piling according to Section 02190.

02120.30 Timber Pile Straps - Straps shall be approximately 1 1/4 inch wide, 0.03 inch thick, manufactured from cold-rolled, heat-treated steel having a minimum ultimate tensile strength of 150,000 psi. The strap shall encircle the pile once and be fastened with a clip that is crimped so that the joint will have a minimum tensile strength of 80% of the tensile strength of the strap. Install the strap after pressure treating of the pile.

02120.40 Acceptance - Acceptance of poles and piling will be according to 00165.35 and this Section.
Section 02130 - Timber and Lumber

Description

02130.00 Scope - This Section includes the requirements for timber and lumber.

Materials

02130.10 Timber and Lumber - Unless otherwise shown or specified, all lumber and timber shall be S4S Douglas fir. Grading requirements shall be according to the Special Provisions.

All lumber shall be grade-stamped by an American Lumber Standards certified inspection agency.

Acceptance of material will be according to 00165.35 and this Section.
Section 02140 - Glued Laminated Timber Members

Description

02140.00 Scope - This Section includes the requirements for glued laminated timber members.

02140.01 Abbreviations:

AITC - American Institute of Timber Construction

Materials

02140.10 General - Furnish all structural glued laminated lumber as shown and specified.

Manufacture of structural glued laminated work shall conform to the manufacturing requirements of the current ANSI/AITC A190.1 American National Standard, Structural Glued Laminated Timber.

Provide quality control according to the AITC 200 "Inspection Manual for Glued Laminated Timber".

Lumber shall be Douglas fir, southern pine, western larch, or other species, as shown or specified. Lumber used shall be of a stress grade to provide glued laminated members with the minimum stress values in bending and tension shown or specified.

Adhesives shall meet the requirements of the glued laminated lumber standards, and be waterproof.

Unless otherwise specified, appearance of members shall be architectural grade as defined in AITC 110 Standard Appearance Grades for Structural Glued Laminated Timber.

Seal surfaces of members with penetrating sealer and apply a coat of end sealer to the ends of all members as soon as practical after end trimming, according to AITC Standard for Preservative Treatment of Structural Glued Laminated Timber. Use a clear sealer compatible with the preservative treatment used according to Section 02210.

Bundle wrap members according to AITC Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection.

Furnish shop details from the fabricator and obtain approval before commencing the work. Details shall conform to the current AITC Typical Construction Details.

02140.20 Acceptance - Glued laminated timber members will be accepted according to 00165.35 and this Section.

1125 City of Portland 2010
02150.00  Section 02150 - Lumber and Timber Connectors

Description

02150.00  Scope - This Section includes the requirements for connectors, bolts, nuts, nails, and miscellaneous hardware for joining lumber and timber.

Materials

02150.10  Lumber and Timber Connectors:

(a) General - Galvanize connectors for treated structures, except those of malleable iron, or lightweight connectors, according to AASHTO M 111 (ASTM A 123).

(b) Split Ring Connectors - Provide 2 5/8 inch and 4 inch inside diameter split rings manufactured from steel conforming to AISI C1010, SAE 1010. Each ring shall form a closed true circle with the principal axis of the cross section of the ring metal parallel to the geometric axis of the ring. Bevel the metal section from the central portion toward the edges to a thickness less than the mid-section. Cut through the ring in one place in its circumference to form a tongue and slot.

Cut connector grooves in timber concentric with the bolt hole and conforming to the cross-sectional shape of the rings, to provide a snug fit. The inside diameter of the groove shall be larger than nominal ring diameter so that the ring can expand slightly during installation.

(c) Shear Plate Connectors:

(1) Pressed Steel Type - Provide 2 5/8 inch diameter pressed steel shear plates manufactured from steel conforming to ASTM A 830 (AISI C1010, SAE 1010). Each plate shall be a true circle with a flange around the edge, extending from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole and two small perforations on opposite sides of the hole and midway between the center and circumference.

(2) Malleable Iron Type - Provide 4 inch diameter malleable iron shear plates manufactured according to ASTM A 47, Grade No. 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge projecting from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole reamed to size with an integral hub concentric with the bolt hole and extending from the same face as the flange.

(d) Bolts, Nuts, Nails, and Miscellaneous Hardware - Provide machine bolts, drift bolts and dowels according to ASTM A 307 or ASTM A36. Washers may be cast ogee or malleable castings, or they may be cut from steel plate.
Galvanize rough hardware, drive pins, expansion bolts, clamps, washers, anchors, joist hangers, bolts and nuts, lag screws, wood screws, spikes and nails according to AASHTO M 232 (ASTM A 153). Provide these items in standard type and make, or as shown.

(e) Lightweight Metal Connectors - Lightweight metal connectors are mass produced plate or sheet steel connectors with a maximum thickness of 0.25 inches used to connect wood members to wood, concrete or masonry. Provide lightweight metal fasteners as shown with the required minimum capacities as stated in the special provisions. Provide copies of the test reports from the International Code Council (ICC-ES) showing that the supplied fastener meets the minimum capacities listed in the Special Provisions. All lightweight metal connectors shall be galvanized according to ASTM A 653 (coating designation G185), ASTM A 123, or stainless steel.

02150.20 Acceptance - Lumber and timber Connectors will be accepted according to 00165.35 and this Section.
Section 02190 - Preservative Treatment of Timber

Description

Scope
- This Section includes the requirements for preservative treatment of lumber, timber, timber piling, guard rail posts and blocks, sign posts, fence posts, and other items as specified.

Materials

General
- All preservative treatment shall be according to AASHTO M 133 and its referenced AWPA Standards, except that only the following preservatives are allowed:
  - Ammonacal Copper Quat, Type B, D, or D
  - Ammoniacal Copper Zinc Arsenate
  - Chromated Copper Arsenate, Type A, B, or C
  - Copper Naphthenate
  - Creosote
  - Pentachlorophenol (any solvent)

Drying Time
- When using ACZA, air-dry items as defined in AWPA P5, a minimum of 30 calendar days before installation. Kiln drying for 2 calendar days may be substituted for 30 calendar days of air-drying. During the period September 1 through May 31, the air-drying shall be under cover at the treatment facility. During the 30 calendar day drying period and until the treated items are installed on the Project, separate each layer of treated items using spacers that are at least 1/2 inch thick. The maximum moisture content shall be 19% prior to installation. Collect all spacers and other treated wood waste from the construction site and dispose of them according to 00290.20.

Field Treatment
- Field-treat damaged or drilled wood surfaces with a preservative listed in the CPL.
Coatings

Section 02210 - Coating Materials for Timber and Concrete

Description

02210.00 Scope - This Section includes the requirements for coating materials used on timber and concrete.

Materials

02210.10 General:

(a) Manufacturing - Furnish coating material meeting the following requirements:

- Be prepared at the factory ready for application or mixing of multi-component coatings. Multi-component coating materials shall be proportioned by the manufacturer with each component in its correct proportion and furnished in separate containers ready for field mixing.
- Be homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Include additives for control of sagging, pigment settling, leveling, drying, dryer absorption, skinning, or other properties that affect application and curing.
- Not require a pretreatment chemical or material prior to application of the prime coat except as specifically stipulated in these specifications.
- Include required tinting and coloring materials at the time of manufacture. When successive coats are specified, each coat shall be tinted to provide contrast between coats. The tinting material shall be compatible with the coating material and not detrimental to performance.
- Not vary in composition without prior notice by the manufacturer and approval of the Engineer. No reformulation will be allowed.

All coats in the coating system shall be from the same manufacturer.

Apply coating materials before expiration of the manufacturer's recommended shelf life.

(b) Packaging - Package the material in containers meeting the following requirements:

- Be new steel or plastic of not more than 6 gallon capacity.
- Have a lug-type crimp lid with a ring seal, and shall be equipped with ears and bails.
- Meet U.S. Department of Transportation's Hazardous Material Shipping Regulations.
02210.20

- Be lined, if necessary, to prevent attack by the coating material. The lining shall not come off the container.
- Be original and unopened.
- Be labeled with a quality compliance certificate according to 00165.35 showing the following:
  - Manufacturer's name
  - Exact title of coating material
  - City Specification number, if any
  - Manufacturer's batch number
  - Date of manufacture
  - Shelf life or expiration date
  - Identification of all toxic substances
  - Handling and application precautions

02210.20  Coating Materials for Timber - Furnish coatings for timber from the CPL under the category "Timber Coatings".

02210.21  Sealer for Timber - Furnish clear sealers for timber from the CPL under the category "Timber Sealers".

02210.30  Coating Materials for Concrete - Furnish coatings for concrete from the CPL under the category "Latex Emulsion Paint".
Geosynthetics and Slope Protection

Section 02320 - Geosynthetics

Description

02320.00 Scope - This Section includes the requirement for geosynthetics use in various applications.

02320.01 Definitions - Geosynthetic terms are defined in 00350.01.

Materials

02320.10 Acceptance:

(a) General Requirements - Furnish all geosynthetics meeting the following requirements:

- Free of defects, cuts or tears
- Resistant to ambient temperatures, acid and alkaline conditions, micro-organisms and insects
- For the intended purpose and have dimensional stability
- Free of asbestos containing material

(1) Geotextiles - Furnish woven or non-woven geotextiles meeting the following requirements:

- Be composed of long chain, synthetic polymeric filaments or yarns formed into a stable network that retains its relative structure during handling, placement and design service life. At least 95%, by weight, of the long chain polymers shall be a polyolefin or polyester
- Meet or exceed the properties specified in 02320.20 Table 2320-1
- Be free of any chemical treatment or coating which might significantly reduce permeability
- Have the selvage finished so the outer fibers are prevented from pulling away from the fabric

(2) Geogrids - Furnish geogrids meeting the following requirements:

- A regular network of integrally connected, polymer, tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock
- Dimensionally stable and able to retain their geometry under manufacture, transport and installation
(3) **HDPE Geomembrane Swale Liner**

- Material shall be 40 mil High Density Polyethylene (HDPE) geomembrane, textured on both sides or approved equal. An experienced firm regularly engaged in manufacturing textured HDPE shall manufacture the geomembrane.

(b) **Acceptance Requirements** - The actual minimum average roll values furnished by the manufacturer shall be based on representative test results from the manufacturing plant which produced the geosynthetic, and shall meet or exceed each of the specified minimum values. All geosynthetics shall be clearly labeled as being part of the same production run certified as meeting all applicable requirements.

(c) **Manufacturer’s Documentation** - Furnish a Level A or Level B certification, as indicated in the Special Provisions for the applicable geosynthetics.

(1) **Level A - Manufacturer’s Test Result Certificate** - Furnish a Test Result Certificate according to 00165.35 from the geosynthetic manufacturer. The certificate shall:

- Include the minimum average roll values for each of the specified properties from the same production run as the delivered material
- Include test results for factory seams
- Include production run number, production plant name and location

If the geosynthetic material is modified, remanufactured, relabeled or sewn, furnish an additional certificate from the supplier making the changes that explain the altered properties, seam strength or relabeling.

(2) **Level B - Manufacturer’s Quality Compliance Certificate** - As a basis of acceptance, furnish either a manufacturer’s brochure or a quality compliance certificate, according to 00165.35, with geosynthetic properties shown.

If the brochure or certificate lists typical or average roll values instead of minimum average roll values, then increase by 25% the specified minimum values in Table 02320-1 for grab tensile strength, burst strength and puncture strength to determine compliance.

(d) **Manufacturer’s Sampling/Testing** - The manufacturer’s reported property values shall be based on the following sampling and testing requirements:

(1) **Sampling** - Sample all geosynthetics according to ASTM D 4354. The production unit used for sampling shall be a roll or sheet.
(2) **Testing** - Perform the specified tests to determine Geotextile properties for the intended application(s). The tensile strength requirements shall be tested in both machine and cross-machine directions.

(e) **City Check Tests** - The City reserves the right to sample and test products for compliance with pertinent requirements according to 0165.02. When the City performs check tests, the entire production run will be accepted or rejected according to 00150.80(g). If any of the average roll values of tested rolls are less than the specified minimum values.

02320.11 **Seam Testing and Acceptance:**

(a) **Factory Seams** - Where factory seams are made, the sheets of Geotextile shall:

- Be sewn together using a lock-type stitch Type 301 or 401 as shown.
- Be sewn with polymeric thread that is at least 95%, by weight, polyolefin or polyester, and as resistant to deterioration as the Geotextile being sewn.
- Have test results showing that the seams meet or exceed 90% of the specified tensile strength minimum values for the intended application.
- Nylon thread will not be allowed.

(b) **Field Seams** - Where field sewn seams will be used, furnish:

- The manufacturer's test result certificate, according to 00165.35, that includes wide strip, tensile strength test results and verifies that seam tensile strength and seam grab tensile strength meet or exceed 90% of the minimum specified tensile strength values for the geotextile.
- A field-stitched seam test sample.
<table>
<thead>
<tr>
<th>Geotextile Property</th>
<th>Test Method</th>
<th>Units</th>
<th>Drainage Geotextile</th>
<th>Riprap Geotextile</th>
<th>Sediment Fence Geotextile</th>
<th>Separation</th>
<th>Reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab tensile strength (minimum)</td>
<td>ASTM D 4632</td>
<td>lb</td>
<td>80</td>
<td>180</td>
<td>200</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>Machine Direction</td>
<td></td>
<td></td>
<td>80</td>
<td>180</td>
<td>200</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>Cross Machine Direction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grab Elongation (minimum)</td>
<td>ASTM D 4632</td>
<td>%</td>
<td>15</td>
<td>15</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Burst Strength, Diaphragm method (minimum)</td>
<td>ASTM D 3786</td>
<td>psi</td>
<td>130</td>
<td>290</td>
<td>320</td>
<td>435</td>
<td>—</td>
</tr>
<tr>
<td>Puncture strength (minimum)</td>
<td>ASTM D 4833 or UDOT TM 816</td>
<td>lb</td>
<td>35</td>
<td>80</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Apparent opening size (ACS) (maximum), U.S. Standard Sieve</td>
<td>ASTM D 4751</td>
<td>in</td>
<td>No. 70</td>
<td>No. 70</td>
<td>No. 30</td>
<td>No. 30</td>
<td>No. 30</td>
</tr>
<tr>
<td>Permeability (minimum)</td>
<td>ASTM D 4491</td>
<td>m/s</td>
<td>0.5</td>
<td>0.5</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Ultraviolet stability (Retained Strength) (minimum)</td>
<td>ASTM D 4355</td>
<td>%</td>
<td>—</td>
<td>70</td>
<td>70 after 500 hours of exposure</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Asphalt retention (minimum)</td>
<td>UDOT TM 817</td>
<td>oz/in²</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Melting point (minimum)</td>
<td>ASTM D 276</td>
<td>°F</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

1 Silt film or silt tape fabrics are not acceptable.
2 As measured according to ASTM D 4632.
### 02320.21 Geogrid Property Values:

<table>
<thead>
<tr>
<th>Biaxial Geogrid Property</th>
<th>Test Method</th>
<th>Units</th>
<th>MD</th>
<th>TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Initial Modulus (Secant Modulus)</td>
<td>ASTM D 6637-01</td>
<td>lb/ft</td>
<td>27,420</td>
<td>41,130</td>
</tr>
<tr>
<td>Tensile Strength at 2% Strain</td>
<td>ASTM D 6637-01</td>
<td>lb/ft</td>
<td>410</td>
<td>545</td>
</tr>
<tr>
<td>Rib Thickness</td>
<td>ASTM D 1777</td>
<td>inch</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Flexural Stiffness</td>
<td>ASTM D 5732-95</td>
<td>mg-cm</td>
<td>750,000</td>
<td></td>
</tr>
<tr>
<td>Junction Efficiency</td>
<td>GRI:GG2-87</td>
<td>%</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Secant Aperture Stability Modulus at 20 kg-cm</td>
<td>US Army Corp Methodology of Torsional Rigidity</td>
<td>kg-cm/deg</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

Aperture Size Range

| I.D. Caliper | inch | 0.75 - 1.50 |

MD = Machine Direction along roll length
TD = Transverse Direction or cross machine direction across the roll
GRI = Geosynthetic Research Institute

### 02320.22 HDPE Resin
- Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.

### 02320.23 HDPE Geo-membrane Swale Liner
- Geo-membrane shall meet the following standards for textured 40-mil HDPE.
<table>
<thead>
<tr>
<th>Tested Property</th>
<th>Test Method</th>
<th>Min. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, (minimum average) mil</td>
<td>ASTM D 5994</td>
<td>38</td>
</tr>
<tr>
<td>Lowest individual for 8 out of 10 values</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>Lowest individual for any of the 10 values</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>Density, g/cm³</td>
<td>ASTM D 1505</td>
<td>0.94</td>
</tr>
<tr>
<td>Tensile Properties (each direction)</td>
<td>ASTM D 6693, Type IV</td>
<td></td>
</tr>
<tr>
<td>Strength at Break, lb/in-width</td>
<td>Dumbell, 2 ipm</td>
<td>60</td>
</tr>
<tr>
<td>Strength at Yield, lb/in-width</td>
<td></td>
<td>84</td>
</tr>
<tr>
<td>Elongation at Break, %</td>
<td>G.L. = 2.0 in</td>
<td>100</td>
</tr>
<tr>
<td>Elongation at Yield, %</td>
<td>G.L. = 1.3 in</td>
<td>12</td>
</tr>
<tr>
<td>Tear Resistance, lb</td>
<td>ASTM D 1004</td>
<td>28</td>
</tr>
<tr>
<td>Puncture Resistance, lb</td>
<td>ASTM D 4833</td>
<td>60</td>
</tr>
<tr>
<td>Carbon Black Content, %</td>
<td>ASTM D 1603</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Shall not exceed a combined maximum total 1% by weight additives other than carbon black.

Shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

Furnish in roll form. Identify each roll with labels indicating roll number, thickness, length, width and manufacturer.
Section 02340 - Rock Gabion Baskets

Description

02340.00 Scope - This Section includes the requirements for rock gabion baskets of twisted or welded wire mesh.

Materials

02340.10 General - Provide wire mesh material free of breaks in the wire, breaks at weld points or other deficiencies. Individual wires of either style mesh shall meet the following minimum requirements:

- Galvanizing ........................................0.80 oz per sq. ft. minimum
- Tensile strength 1 .......................................60,000 psi minimum
- Wire diameter tolerance limit..........................±0.004"

1 Tensile area includes galvanizing

Welded wire shall also conform to AASHTO 55 (ASTM A 185) except that the weld shears shall be 600 pounds for 11 gauge, and 800 pounds for 9 gauge wires. All wire sizes are after galvanizing.

Tie wires and internal connecting wires shall be galvanized and no smaller than 13 1/2 gauge. Spiral binders may be used as an alternate to tie wire for basket assembly and basket-to-basket connections. Spiral binders shall be 3.9 gauge, galvanized, and have a 3 inch pitch. High tensile fasteners of the locking spring steel clip or clamp-on ring type may be used as alternates to tie wire for basket assembly only. High tensile fasteners shall be fabricated from 11 gauge steel wire with a minimum tensile strength of 240,000 psi. Provide a Class 3 zinc coating according to ASTM A 764. High tensile fasteners shall provide a closed position tensile strength of 600 pounds.

All wire shall be galvanized according to ASTM A 641.

02340.12 Twisted Wire Mesh Gabion Baskets - Furnish gabion panels of the twisted mesh style shall be manufactured from 11 gauge with 9 gauge selvage wires. The mesh shall form a uniform hexagonal pattern and shall be formed with a non-raveling twist. The major axis (maximum line dimensions) of any hexagonal opening shall not exceed 4.75 inches. The area of the hexagonal opening, approximately 3.2 inches by 4.5 inches, shall not exceed 9.5 square inches.

02340.20 Welded Wire Mesh Gabion Baskets - Furnish gabion panels of the welded mesh style shall be manufactured from 11 gauge or 9 gauge wire. The mesh shall form a nominal 3 inch by 3 inch grid pattern and conform to ASTM A 185. The maximum line dimension of any opening shall not exceed 4.75 inches. The 12 inch and 18 inch high mattresses shall be made from 11 gauge panels. Gabions of square cross section (cubical-celled units) may be made with either 9 gauge or 11 gauge panels, except that within the same unit, panels of dissimilar wire sizes may not be mixed.
Galvanized 9 gauge stiffeners, placed diagonally in the baskets at the vertical 1/3 points, as shown on the plans or as recommended by the manufacturer, may be used instead of perpendicular cross ties.

02340.30 PVC Coated Wire Mesh Gabion Baskets - The wire type used for PVC coated wire mesh gabions shall be either twisted wire mesh or welded wire mesh and shall conform to 02340.00 and 02340.12 or 02340.20.

The PVC coating for twisted wire mesh gabions shall be extruded onto the wire core before weaving the coated wire into a double twisted hexagonal mesh. The use and minimum diameter of the various wires is as follows:

- Gabion Panel wire core shall be manufactured from galvanized 12 gauge wire core. The overall minimum diameter of the galvanized wire core plus PVC coating shall be 0.136 inch.
- Selvage and reinforcing wire shall be of heavily galvanized 10 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.165 inch.
- Lacing and connecting wire shall be of heavily galvanized 13 1/2 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.120 inch.

02340.40 Fabrication - Fabricate gabions so that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the specified sizes. Dimensions for heights, lengths and widths of gabion baskets shall be as indicated on the plans with a tolerance of plus or minus 3%. Gabions shall be of single unit construction. Either connect the base, lid, ends and sides into a single unit or connect one edge of these members to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

If the length of the gabion exceeds its horizontal width, equally divide the gabion by diaphragms into cells whose length does not exceed the horizontal width. The diaphragm material shall be of the same mesh and size as the body of the gabions. Furnish the gabion with the necessary diaphragms secured in proper position on the base in such manner that no additional tying at this juncture will be necessary.

Assemble the wire mesh panels (base, ends, sides, diaphragms and lid) so strength and flexibility at connections is at least equal to that of a single panel.

02340.50 Acceptance - Provide a quality compliance certificate for gabion baskets according to 00165.35.
Section 02350 - Metal Bin Retaining Walls

Description

02350.00 Scope - This Section includes the requirements for galvanized steel sheets and hardware for the assembly of metal bin retaining walls.

Materials

02350.10 Base Metal, Galvanizing and Thickness - Design all members, fittings and appurtenances as integral units or parts of the whole assembly. The galvanized sheets used in fabricating the members shall conform to the requirements of AASHTO M 218. Bolts, nuts and miscellaneous hardware shall be galvanized or otherwise protected with approved coatings and shall be of sizes and shapes suitable for use with the members furnished.

Fabricate the members from the specified base metal of the thickness shown. In the absence of given thickness or dimensions for any member, fitting or appurtenance, the thickness of metal or dimensions of the member shall be as required to fully develop the strength of the members whose thickness and dimensions are given, and which are used in structural combination.

02350.20 Fabrication - Fabricate all members so members of the same nominal size are fully interchangeable. Fabricate and punch the members so no drilling, punching or drifting to correct defects in manufacture will be required during field assembly. Any members having improperly punched holes will be rejected. Replace with a member with properly punched holes.
02410.00  **Section 02410 - Concrete and Plastic Pipe**

**Description**

02410.00 **Scope** - This Section includes the requirements for non-reinforced and reinforced concrete pipe, polyethylene pipe and polyvinyl chloride (PVC) pipe.

**Materials**

02410.10 **Concrete Pipe** - Use concrete sewer pipe conforming to the requirements of the Material Specifications for Precast Concrete Products (MSPCP) Manual published by the City of Portland Materials Testing Laboratory.

(a) **Defects on Sealing Surfaces** - The surfaces of the pipe bell and spigot in contact with the gasket, and any adjacent surfaces that could contact the gasket within the specified joint movement range, shall be free from defects.

(b) **Reinforced Concrete Pipe** - Any fabrication or procurement of concrete pipe materials performed before approval of the pipe details is at the Contractor's risk. City approval of the pipe details will not relieve the Contractor of its responsibility to meet all the requirements of these Specifications and to provide pipe with details that conform to the MSPCP. The Contractor is responsible for checking pipe dimensions and for any problems arising from incorrect pipe dimensions.

(c) **Lubricants** - Use only manufacturer approved jointing material lubricants.

(d) **Jointing Materials** - Jointing materials for concrete sewer pipe shall conform to the requirements of the MSPCP.

02410.60 **High Density Polyethylene Pipe** - Use pipe made from Premium High Density Polyethylene resin qualified as Type III, Category 5, Class C, Grade P34 in ASTM D1248. This material shall have a long term hydrostatic strength of 1600 psi when tested and analyzed by ASTM D2837, and shall be listed by the Plastic Pipe Institute as a P.E. 3408 Resin. Pipe sizing shall conform to ASTM F714 and ASTM D3035.

(a) **Applicable ASTM Specifications:**

HOPE material shall comply with the following minimum engineering design specifications:

- ASTM D638 Tensile Strength Yield (2 in./min.) > 3200 psi.
- ASTM D638 Elongation at break 750%
- ASTM D638 Modulus of Elasticity 105,000 psi
- ASTM D3350 Flexural Modulus 124,000 psi
- ASTM D1693 Environmental stress crack resistance > 5000 F20 hrs. (E.S.C.R.) Condition C.
- ASTM D2837 Long Term Hydrostatic Strength at 73.4 °F. 1600 psi. (L.T.H.S)
(b) **Recycled Resin** - The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.

(c) **Uniformity** - The polyethylene pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be uniform in color, opacity, density and other physical properties.

(d) **Marking** - The following information shall be continuously marked on the pipe or spaced at intervals not exceeding 5 feet:

1. Name or trademark of the pipe manufacturer
2. Nominal pipe size
4. Resin Type
6. A production code from which the date and place of manufacture can be determined.

(e) **Certification** - The pipe supplier shall certify compliance with requirements of these specifications in writing.

(f) **Method of Joining** - Join all High Density Polyethylene (HDPE) pipe and fittings by the heat fusion process per ASTM A2657 and the manufacturer's specific recommendations or by approved coupler. The tensile strength at yield of the butt fusion joints shall not be less than the pipe.

(g) **Record Keeping** - Record and document the profile of each fusion joint made during the project. The data recording system shall be fully compatible with the pipe, and fusion equipment manufacturer's recommendations. Submit documentation to confirm this agreement.

(h) **Data to be Recorded** - The data recording system shall document all recordable information for each heat fusion process joint. Information may include but is not limited to: Date and Time, Joint Number, Project Number, Employee ID, Machine ID, Piston Area, Pipe Material and size, Interfacial Pressures, Recommended Gauge pressures and other recorded data.

(i) **Data Reporting and Compliance** - Provide the Engineer with a copy of each joint profile printout immediately after its completion. The Engineer must receive and review each joint profile printout for conformity with pipe and equipment manufacturer's recommendation before accepting any joint. The Engineer has discretion to waive this requirement at any time. Repair and replace any joint that fails to meet these specifications at no additional cost to the City.
(j) **Fittings for HDPE Pipe** - Standard fittings and special fittings shall be manufactured from the same class of material as the pipe is manufactured and be fully compatible. Fittings shall be manufactured in accordance with ASTM D3261. Fabricated fittings shall be pressure rated to match the system piping.

(k) **Couplings** - Mechanical connections to fittings or other materials shall be by means of flanged connections (flanged coupling adapters and ANSI backup rings rated for the same pressure service as the system piping) or flexible couplings designed for joining similar or different pipe material such as a PVC coupler, as approved. Flanged joints shall use bolts of compatible material. Provide gaskets when joining to non-polyethylene materials. Evenly torque the flange bolts using a crisscross pattern following the manufacturer’s recommendation. Retorque flanged joints after 1 hour or more has passed or as recommended by manufacturer.

(l) **Service Laterals** - Tee and wye fittings to connect service laterals shall be either molded butt fusion fittings, or molded saddle fusion fittings in accordance with ASTM D3261.

(m) **Connections to Manholes** - Make connection to manholes and other structures with an approved cast-in-place gasketed adapter, sanded manhole adapter or other approved method.

(n) **Corrugated Polyethylene Drain Pipe** - Furnish pipe meeting the requirements of AASHTO M 252.

02410.70 **Polyvinyl Chloride (PVC) Pipe** - All PVC pipe and fittings shall conform to ASTM D3034 SDR 35 standards. Unless otherwise approved, joints shall be bell and spigot with a rubber gasket conforming to ASTM D3212 and ASTM F477. Additives and fillers, including but not limited to, stabilizers, antioxidants, lubricants, etc. shall not exceed 10 parts by weight per 100.

(a) **Gravity pipe applications 4” to 15” Diameter PVC Pipe** - All PVC pipe and fittings shall be integral wall and spigot, rubber gasket joint, unplasticized Polyvinyl chloride (PVC) pipe. All PVC pipe shall have a minimum pipe stiffness of 46 psi at 5% deflection at 32 °F when tested in accordance with ASTM Designation D2412, external loading properties of plastic pipe. Pipe shall have a minimum impact strength based on test methods of ASTM D3034 with the exception that conditioning temperature for sample shall be 32 °F plus or minus 2 °F.

All PVC pipe and fittings manufactured and installation shall meet or exceed the ASTM recommended specifications D3034, SDR 35, unless otherwise specified, and all installation shall be in strict compliance with ASTM D2321 and the manufacturer’s instructions. All pipe shall be clearly marked with the date of manufacture. All pipe shall be provided with the reference mark for proper spigot insertion. Joint gaskets shall be fabricated from a compound of which the basic polymer shall be a synthetic rubber consisting of styrene, butadiene, polyisoprene or any combination thereof and shall meet the requirements of ASTM F477.
(b) Gravity pipe applications 18 Inch to 36 Inch Diameter PVC Pipe - All PVC pipe and fittings shall be integral wall and spigot, rubber gasket joint, unplasticized Polyvinyl chloride (PVC) pipe. All PVC pipe shall have a minimum pipe stiffness of 46 psi at 5% deflection at 32 °F when tested in accordance with ASTM Designation D2412, external loading properties of plastic pipe. The pipe shall be made of PVC plastic having a minimum cell classification of 12364 or 12454 as defined in ASTM D 1784. Homopolymer PVC compounds must equal or exceed the requirements of above listed minimum cell classification number. Pipe shall have a minimum impact strength based on test methods of ASTM F679.

All PVC pipe and fittings manufactured and installation shall meet or exceed the ASTM recommended specification F679, unless otherwise specified, and all installation shall be in strict compliance with the manufacturer's directions. All pipe shall be clearly marked with the date of manufacture. All pipe shall be provided with the reference mark for proper spigot insertion. Joint gaskets shall be fabricated from a compound of which the basic polymer shall be a synthetic rubber consisting of styrene, butadiene, polyisoprene or any combination thereof and shall meet the requirements of ASTM F477.

(c) Perforated PVC Pipe - When specified, the perforations shall consist of 2 rows of 3/8 inch diameter holes at 3 inches on center. The holes shall be oriented 60° from the invert on each side of the pipe. The 2 rows of holes shall be 120° apart. Do not use perforated pipe greater than 8 inches without written approval.

02410.71 Proof Tests and Allowable Joint Deflections - The intent of this requirement is to prequalify joint system components that meet the joint requirements as to the water tightness capability of the joint system. This proof test shall be understood to apply to all pipes that are to be tested for water tightness before Acceptance. The manufacturer shall provide material and test equipment for proof testing. Joints shall meet the requirements of yard testing specified below. The pipe manufacturer shall submit results of the yard tests made, certified by an approved testing agency. When approved, a suitable joint tester may apply internal hydrostatic pressure. In general, each pipe material and joint assembly shall be subject to the following three proof tests at the discretion of the Engineer.

(a) Pipe in Straight Alignment - Assemble no less than 3 nor more than 5 pipes selected from stock by the Project Manager according to the manufacturer's installation instructions with the ends suitably plugged and restrained against internal pressure. Subject the pipe to 10 pounds per square inch (psi) hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall will be ground for rejection of the pipe.

(b) Pipe in Maximum Deflection Position - Deflect a test section as described hereinafter for each pipe material. Subject the pipe to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall will be ground for rejection of the pipe.
(c) Joints under Differential Load - Support the test section on blocks or otherwise as described hereinafter for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10 psi internal hydrostatic pressure for 10 minutes.

(d) Alternative to Hydrostatic Test - An external hydrostatic test or a vacuum test effectively meeting the same time and pressure requirements will be an alternative to the internal hydrostatic pressure test as approved.

02410.80 Acceptance - Except as provided in 02410.10(b)(3) above, acceptance of non-reinforced concrete pipe, reinforced concrete pipe, concrete drain pipe, concrete drain tile, polyethylene pipe, polyvinyl chloride pipe, and hardware will be according to 00165.35 and this Section.
Section 02420 - Metal Pipe

Description

02420.00 Scope - This Section includes the requirements for corrugated steel pipe, helical rib pipe, arch-type pipe, aluminum pipe, ductile iron pipe, and special sections intended for use for storm drainage, underdrains and culverts, and not intended for the conveyance of sanitary or industrial waste.

Materials

02420.10 Corrugated Steel Pipe and Pipe Arches - Furnish corrugated steel pipe, helical rib pipe, pipe arches and special sections meeting the requirements of AASHTO M 36 (ASTM A 760) Types I, IA, and II, except as follows:

(a) Shapes - Provide either full-circle or elliptical pipe, as the Contractor may elect, unless otherwise shown or specified. The shapes of pipe fabricated and furnished may include any of the following:

- Arch-Type Pipe
- Elliptical Pipe - Full-circle pipe distorted 5% out-of-round by shop fabrication to form an elliptical cross section with the major axis vertical.
- Full-Circle Pipe - Fabricate helical rib pipe in full-circle cross section only.
- Half-Circle Pipe - Fabricate as half sections of full-circle pipe of the same diameter.
- Nestable Pipe - Fabricate in two separate half sections designed to fit and fasten together to form a full-circle cross section of specified diameter. Fasten the two half sections together by approved means which shall provide at least 90% of the strength of a standard riveted longitudinal seam.

(b) Connecting Bands - Use connecting bands conforming to the details shown on the plans to make field joints for pipes and pipe arches not requiring watertight joints.

(c) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends, reducers and flared inlets as shown or as directed.

Generally, special sections shall conform to the requirements specified for the pipe with which they are used, and shall be connected to the pipe or to each other with connecting bands specified for use with the pipe to which they are connected.

For elbows of 30° or greater total angle, use three-piece sections of approximately equal length and equal-angle segments or pieces.
Weld joints according to recognized standard practice and repair any damaged zinc or aluminum coating according to 02420.10(d).

**Repaired of Damaged Coating** - In addition to the methods given in AASHTO M 36 (ASTM A 760) the Contractor may repair damaged zinc or aluminum coating by removing all loose or cracked coating, removing all welding flux, wire brushing the damaged area, and applying 2 coats (minimum 2 mils total thickness) of a high zinc dust content paint conforming to the general requirements of ASTM A 780.

Damaged zinc or aluminum coating within 3/8 inch of the ends of pipe sections caused by production cut-off of pipe need not be repaired. Coating damage on edges of connecting bands need not be repaired.

**Irrigation Pipe** - In irrigation pipe installations, where Type D coating (AASHTO M 190) is not specified, the Contractor will be allowed to furnish pipe with Type D coating.

1. **Riveted Seams** - If pipes are not furnished with Type D coating, do the following:

   - Place a bead or strip of approved caulking compound, 1/8 inch minimum diameter or thickness, between the laps of all riveted seams.
   - Rivet the annular seams of riveted pipe at spacings not greater than 3 inches. Rivet in a single row the longitudinal seams of pipes less than 42 inches in diameter. Place one rivet in each valley and one on each crest of the corrugations.
   - Double rivet the longitudinal seams of pipes 42 inches and larger in diameter in each valley of the corrugations and place a single rivet on each crest of the corrugations.
   - At the intersection of longitudinal and circumferential seams, close the gap caused by the three-sheet lap by special fabrication. Fabricate a special longitudinal seam at the ends of pipe sections for a sufficient distance to clear the coupling bands.

   Spot welding of the seams of corrugated metal pipe used in irrigation pipe installations will not be permitted.

2. **Field Joints** - Use connecting bands conforming to the details shown, and make the field joints watertight.

**Siphon Pipe** - Fabricate corrugated steel pipe used in siphons with watertight seams.

Field joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent separation of pipe sections and provide a watertight joint. Attach the connecting bands so they lap a nearly equal portion of each pipe section to be connected.
(g) **Sloped or Skewed Ends** - If the ends of pipe culverts require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish. Restore zinc or aluminum coating as directed according to 02420.10(d), and bituminous protective coatings and linings when specified.

02420.11 **Ductile Iron** - Furnish ductile iron pipe conforming to the requirements of AWWA C150. Use Pressure Class 150 - 350 or Special Thickness Class 50 - 56, as directed.

02420.20 **Protective Coatings** - If specified or shown, furnish corrugated metal pipes with protective coatings as follows:

(a) **Bituminous Protective Coatings** - Provide corrugated metal pipe and connecting bands with bituminous coatings conforming to the requirements of AASHTO M 190 and the following:

- Before immersion, the metal shall be free of grease, dirt, dust, moisture or other contaminants.
- Apply the initial bituminous coating by one of the processes under 002420.20(a)(1) or 02420.20(a)(2).
- If a second dip is required to meet the coating thickness requirements of AASHTO M 190, the time and temperature requirements of 02420.20(a)(1) or 02420.20(a)(2) need not be followed for the second dip.
- The paved invert for both Type B and Type C coatings on either circular or arch-type pipe shall fill the corrugations for at least 40% of the circumference of the pipe.

1. **Pipe Not Preheated** - The temperature of the asphalt at the time of pipe immersion shall be 400 °F plus or minus 5 °F and the duration of the immersion shall conform to the following schedule:

<table>
<thead>
<tr>
<th>Metal Thickness (inch)</th>
<th>Minimum Immersion Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Aluminum</td>
</tr>
<tr>
<td>0.064</td>
<td>0.060</td>
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<tr>
<td>0.079</td>
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<td>0.109</td>
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<td>0.138</td>
<td>0.135</td>
</tr>
<tr>
<td>0.168</td>
<td>0.164</td>
</tr>
</tbody>
</table>

2. **Pipe Preheated** - At the time of pipe immersion the asphalt shall have a temperature of 380 °F plus or minus 5 °F and the pipe shall be preheated to a temperature 300 °F to 350 °F.
02420.30

(b) Type D, Fully-Bituminous Coated, Fully-Lined - The interior lining shall be smooth, uniform and free from sags and runs. Slight residual corrugations due to cooling and shrinkage of the lining will not be cause for rejection. At the three-sheet lap an interior non-uniformity equal to the thickness of the sheet will be allowed. Maintain the thickness of the lining to the ends of the pipe.

(c) Optional Paved Invert - If an asphalt coated pipe with a paved invert (Type C coating) is shown or specified, a centrifugally-applied interior lining conforming to Type D coating may be furnished as an alternate, providing the minimum thickness of bituminous coating over the crests of the corrugations is not less than 1/4 inch.

(d) Polymeric Coatings - If polymeric coating is shown on the pipe data sheet, use a coating from section 02420.20 of the CPL.

02420.30 Corrugated Steel Pipe for Underdrains - Furnish corrugated steel pipe for underdrains conforming to the requirements of AASHTO M 36 (ASTM A 760) Type III - Underdrain Pipes, except as modified in 02420.10(c) and 02420.10(d), and as follows:

(a) Class IV - Semicircular pipe may be used only as an alternate with the 6 inch size of perforated full-circle drain pipe.

(b) Connecting Bands - Connecting bands for underdrain pipe field joints shall conform to the designs shown.

02420.40 Corrugated Aluminum Alloy Pipe - Furnish corrugated aluminum alloy pipe, helical rib pipe, pipe arches and special sections conforming to the requirements of AASHTO M 196 (ASTM B 745), Types I, II and III, except as follows:

(a) Shapes - The shapes of the pipes to be furnished may include any of the shapes described in 02420.10(a).

(b) Connecting Bands - Use connecting bands conforming to the requirements of AASHTO M 196 (ASTM B 745) and the details shown to make field joints for pipes and pipe arches not requiring watertight joints.

(c) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends, reducers and flared inlets as shown or as directed.

Generally, special sections shall conform to the requirements specified for the pipe with which they are used, and shall be connected to the pipe or to each other with connecting bands specified for use with the pipe to which they are connected.

For elbows of 30° equal-angle segments or pieces.

(d) Irrigation Pipe - In irrigation pipe installations where Type D coating is not shown or specified, the Contractor will be allowed to furnish pipe with Type D coating.

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If pipes are not furnished with Type D coating, all riveted seams shall conform to the applicable provisions of 02420.10(e)(1).

Use connecting bands conforming to ASTM B 745/B 745M and the details shown, and make the field joints watertight for pipe installations used in irrigation.

(e) **Siphon Pipe** - Fabricate corrugated aluminum alloy pipe used in siphons with watertight seams.

Field joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent separation of pipe sections and provide a watertight joint. Fabricate the connecting bands from aluminum alloy conforming to AASHTO M 196 (ASTM B 745). Attach the connecting bands so they lap a nearly equal portion of each pipe section to be connected.

(f) **Sloped or Skewed Ends** - If the ends of pipe culverts require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish. Repair bituminous protective coatings and linings when specified.

02420.50 **Corrugated Aluminum Alloy Pipe for Underdrains** - Furnish corrugated aluminum alloy pipe for underdrains conforming to the requirements of AASHTO M 196 (ASTM B 745) Type III, except as follows:

(a) **Special Sections** - The provisions of 02420.40(c) apply.

(b) **Connecting Bands** - Connecting bands for field joints shall conform to the requirements of AASHTO M 196 (ASTM B 745) and the details shown.

02420.60 **Acceptance** - Acceptance of pipes, underdrains, and protective coatings will be according to 00165.35 and this Section.
Section 02430 - Structural Plate Pipe

Description

02430.00 Scope - This Section includes the requirements for steel and aluminum alloy plates and hardware for structural plate pipe.

Materials

02430.10 Galvanized Steel Plates:

(a) General - Furnish galvanized steel plates for structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A 761).

(b) Plates for Pipe Arches - The top plate(s) shall form an arc between 180° and 155°. The bottom plate(s) shall form an arc between 50° and 10°. Join the top plate(s) at each end to the bottom plate(s) with corner plates to form an arc with a radius between 16 inches and 21 inches or between 29 inches and 34 inches, as applicable, and forming an arc between 87.5 and 75°.

(c) Forming and Punching Plates - Form plates to provide lap joints. Punch the bolt holes so that all plates with the same dimensions, curvature, thickness, and number of bolts per foot of seam are interchangeable. Curve each plate to the proper radius so that the cross-sectional dimensions of the finished structure will be as shown or as specified.

Unless otherwise specified, fabricate bolt holes as follows:

- Two rows along longitudinal seams
- Center-to-center spacing not more than 10 inches along circumferential seams
- Center of hole to edge of the plate at least 1.75 times the diameter of the bolt
- Longitudinal seam bolt holes shall not exceed the diameter of the bolt by more than 1/8 inch

The above provisions are for standard punching. Provide additional bolt holes for special conditions of installation when specified or shown.

(d) Sloped and Skewed Ends - Cut plates for forming sloped ends, skewed ends or both, to give the angle of slope or skew shown. Burnt edges shall be free from oxide and burrs. Legibly identify each cut plate to designate its proper position in the finished structure.

02430.20 Aluminum Alloy Plates - Furnish aluminum alloy plates for structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B 746). Fabricate according to 02430.10(b) through 02430.10(d).
02430.90  **Bolts, Nuts, and Washers** - Furnish bolts, nuts and washers for use with galvanized steel structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A 761) and be galvanized according to AASHTO M 232 (ASTM A 153).

Furnish bolts, nuts and washers for use with aluminum alloy structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B 746) and be galvanized according to AASHTO M 232 (ASTM A 153).

02430.95  **Acceptance** - Acceptance of structural plate pipe and hardware will be according to 00165.35 and this Section.
Section 02440 - Joint Materials

Description

02440.00 Scope - This Section includes the requirements for joint fillers, seals, gaskets and water stop for concrete pipe joints, manhole section joints, bridge joints, and miscellaneous concrete applications.

Materials

02440.10 Preformed Joint Fillers for Concrete - Furnish preformed joint fillers for concrete from the CPL conforming to the requirements of AASHTO M 153 or AASHTO M 213. Fillers conforming to AASHTO M 213, except the binder, if other than bituminous material, may be used provided they otherwise meet this Specification and they have been demonstrated to be rot and vermin proof for a period of at least 5 years. Unless otherwise specified or indicated, the Contractor may elect to furnish either type specified in this subsection.

02440.11 Poured Joint Sealant - Furnish a two-component, low modulus, rapid-cure joint sealant.

02440.14 Backer Rod - Furnish a closed-cell, non-gassing foam material backer rod from the CPL.

02440.15 Lubricant/Adhesive - Furnish a lubricant/adhesive that is recommended by the seal manufacturer.

02440.19 Steel Bridging Plate - Furnish a hot-dip galvanized conforming to AASHTO M 111 (ASTM A123), merchant quality steel bridging plate with a minimum thickness of 1/4 inch and a width of 8 inches, cut in lengths of 4 feet or more. Drill spike holes at 12 inch centers along the centerline of the plate before galvanization according to ASTM A 780.

02440.20 Preformed Joint Seals - Furnish compression joint seals conforming to the requirements of AASHTO M 297. Use strip seals conforming to ASTM D 5973.

02440.21 Elastomeric Concrete - Furnish elastomeric concrete from the CPL. Use a multi-component binder-base material designed to provide a strong matrix and to promote bond between the concrete nosing and the substrates. Mix the binder and aggregate according to the manufacturer's recommendations. Use an aggregate gradation recommended by the manufacturer.

02440.22 Epoxy Adhesive for Steel Members - Use a low-modulus epoxy adhesive to bond steel members when indicated. Bond steel members together using a Type 3 non-sag epoxy resin from the CPL, or as approved.

02440.30 Hot Poured Joint Filler - Furnish hot poured joint filler from the CPL and conforming to the requirements of AASHTO M 324, Type II (ASTM D 6690, Type II).
02440.40  Gaskets for Concrete Pipe and Precast Manhole Section Joints:

(a) Preformed **Flexible Joint Sealant** - Furnish materials for tongue and groove or key lock manhole joints conforming to the requirements of AASHTO M 198 (ASTM C 990).

(b) **Rubber Gaskets** - Furnish materials for O-ring manhole and concrete pipe joints conforming to AASHTO M 315 (ASTM C 443).

02440.50  Joint Materials for Concrete Precast Manhole Section Joints:

(a) **Mortar** - Furnish mortar conforming to the requirements of ASTM C 387 or proportioned 1 part Type II Portland cement to 2 parts clean, well-graded sand passing a No. 6 screen. Admixtures may be used not exceeding the following percentages by weight of cement:

- Hydrated lime............................................................................. 10%
- Diatomaceous earth or other inert materials .............................. 5%

The consistency of the mortar shall be such that it will readily adhere to the precast concrete if using the standard tongue-and-groove type joint.

(b) **Non-Epoxy (Non-Shrink) Grout** - Furnish non-epoxy (non-shrink) grout from the CPL. Place or pack non-shrink grouts only with the use of non-epoxy bonding agent from the CPL, applied to all cured concrete surfaces being grouted. Use a bonding agent compatible with the grout used.

02440.60  Plastic Compound for Precast Manhole Section Joints - Furnish a plastic compound that is specifically manufactured for the intended use and:

- Has a putty-like, preformed homogeneous blend of hydrocarbon resins and rubber or plasticizing materials with not more than 50% by weight of inert mineral filler
- Is pliable at temperatures between 32 °F and 135 °F. A specimen at 77 °F and 1/2 inch square in cross section shall stretch at least 1 1/2 inches before rupture when tested with the apparatus described in ASTM D 113.
- Adheres firmly and cohesively to the precast manhole sections when the compound-sealed joint is flexed to its maximum extent
- Includes a primer solution recommended by the compound manufacturer
- Conforms with Federal Specification SS-S-00210 (GSA-FSS)

02440.70  **Water Stop** - Furnish either plastic or rubber water stop, as the Contractor elects, manufactured to the dimensions called for on the plans and meeting the following:
(a) **Plastic** - Polyvinyl chloride water stop shall be manufactured from virgin polyvinyl chloride (PVC) compound. No reclaimed PVC will be allowed. The water stop shall have the following properties:

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength, psi</td>
<td>D 412</td>
<td>1,800</td>
</tr>
<tr>
<td>Elongation, %</td>
<td>D 412</td>
<td>350</td>
</tr>
<tr>
<td>100% Modulus, psi</td>
<td>D 412</td>
<td>760</td>
</tr>
<tr>
<td>Low Brittle Temperature</td>
<td>D 746</td>
<td>-50 °F</td>
</tr>
<tr>
<td>Cold Bend Test</td>
<td></td>
<td>No Failures</td>
</tr>
</tbody>
</table>

1 Samples maintained at -70 °F for 2 hours, then bent quickly around a 1/4 inch mandrel to 180°.

Furnish test samples of the material from which water stop is to be manufactured. Samples shall be in sheet form having a uniform thickness of from 1/16 inch to 1/8 inch and a total area of not less than 2 square feet. Each sample shall be comprised of pieces not smaller than 6 inch by 6 inch.

(b) **Rubber** - Manufacture rubber water stop to the dimensions shown, in such a manner that the finished product has an integral cross section which will be dense, homogeneous, and free from porosity and other imperfections. The water stop shall have the following properties:

- **Hardness** - The Shore A Durometer hardness of 60 to 70 when tested according to ASTM D 2240.
- **Elongation** - Minimum of 450%.
- **Tensile Strength** - Minimum of 3,000 psi.
- **Water Absorption** - Maximum of 5% by weight after immersion in water for 2 days at 158 °F.
- **Tensile Strength after Aging** - The test specimen, after accelerated aging of 7 days at 158 °F, shall retain not less than 80% of the original tensile strength. The tensile strength of the test specimen, after accelerated aging of 48 hours in oxygen at 158 °F and tensile stress of 300 psi, shall be not less than 80% of the original tensile strength.
- **Compression Set** - Not more than 30% when tested according to ASTM D 395, method B after 22 hours at 158 °F.
- **Specific Gravity** - 1.17 ±0.03.
- **Defects** - Minor surface defects such as surface peel covering less than 1 square inch, surface cavities or bumps less than 1/4 inch in longest lateral dimensions and less than 1/16 inch deep will be acceptable.
02440.80 Acceptance - Acceptance of joint materials will be according to 00165.35 and this Section.
Section 02450 - Manhole and Inlet Materials

Descriptions

02450.00 Scope - This Section includes the requirements for precast manhole and sump sections, metal frames, covers, and grates.

Materials

02450.10 Precast Concrete Manhole Sections - Furnish precast risers, cones and cover slabs for precast concrete manholes conforming to the requirements of AASHTO M 199 (ASTM C 478) and the requirements of the Material Specifications for Precast Concrete Products (MSPCP) Manual published by the City of Portland Materials Testing Laboratory.

02450.20 Precast Concrete Sump Sections - Furnish precast rings and lids for precast concrete sumps of Portland cement concrete conforming to AASHTO M 199 (ASTM C 478) and the requirements of the Material Specifications for Precast Concrete Products (MSPCP) Manual published by the City of Portland Materials Testing Laboratory.

02450.30 Metal Frames, Covers, and Grates - Comply with the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>AASHTO/ASTM Designation</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manhole frames and covers</td>
<td>M 105</td>
<td>Class 30 B</td>
</tr>
<tr>
<td>Inlet frames and grates</td>
<td>M227/A 663</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>M270/A 709/A 36</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>M 103/A 27</td>
<td>65 - 35</td>
</tr>
</tbody>
</table>

Provide steps for manholes from the CPL.

As an alternate, steps for manholes may be steel-reinforced plastic conforming to AASHTO M 199 (ASTM C 478) and AASHTO MT 280 (ASTM C 497) and the requirements of the MSPCP. The steel shall be deformed reinforcing bar conforming to AASHTO M 31 (ASTM A 615) Grade 60, No. 4 minimum. The plastic material surrounding the reinforcing monolithic steel bar shall be injection molded, with a textured, non-slip surface and a minimum thickness over the steel of 1/16 inch and conforming to ASTM A 615. Voids in the plastic will be cause for rejection of the step.

Frames, covers and grates for use one with another shall have even and uniform bearings.

002450.31 Manhole Covers Provide manhole covers meeting the non-slip requirements of 02484.35(a).

02450.50 Acceptance - Acceptance of manholes and inlets will be according to 00165.35 and this Section.
Section 02470 - Potable Water Pipe Materials

Description

02470.00 Scope - This Section includes the requirements for various potable water pipe materials.

02470.10 General - Clearly mark all pipe with the type, class, thickness, and manufacturer’s name, as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent (NSF 61).

Materials

02470.20 Ductile Iron Pipe:

(a) Conformance Requirements - Use centrifugally cast ductile iron pipe meeting the requirements of AWWA C151. Ductile iron pipe shall be fully gauged, standard thickness Class 52 or the thickness class specified or indicated. Nonrestrained joints shall be rubber gasket, push-on type, or mechanical-type meeting the requirements of AWWA C111. Restrained joints shall conform to 02475.50.

(b) Lining and Coating - Ductile iron pipe shall have a shop applied double thickness cement-mortar lining and asphaltic coating in accordance with AWWA C104.

(c) Flanged Pipe - Flanged ductile iron pipe with threaded ductile iron flanges shall conform to AWWA C115. Flanges shall be drilled in accordance with ASME/ANSI B16.1, Class 125 complete with styrene butadiene rubber (SBR) full face gaskets. Bolts shall protrude through the assembled nut at least 2 threads but not more than 1/2 inch. Flanged connections shall not be buried, unless shown buried. Flanges shall be wrapped with 2 layers of 10 mil tape along edge of flanges.

02470.30 Steel Pipe 6 Inch and Larger:

(a) Conformance Requirements - Steel pipe 6 inches in diameter and larger shall conform to AWWA C200, and shall have a minimum wall thickness of 1/4 inch and a minimum working pressure rating of 150 psi, or as shown. The type of protective coating and lining and other supplementary information required by AWWA C200 shall be as called for in the specifications or as indicated.

(b) Length and Diameter - Steel pipe shall have inside diameters as specified in uniform lengths with a range of 20 to 40 feet. Provide shorter lengths as required for changes in alignment and grade.
(c) **Pipe Ends** - Pipe shall have ends fabricated for bell and spigot (push-on) joints, flanged joints, or welded joints, as specified. Joint grout shall be chloride free and NSF 61 approved.

(1) **Push-On Joints** - Pipe ends and joints shall conform to AWWA C200. Push-on joints are not acceptable on pipe larger than 48 inches in diameter.

(2) **Flanged Joints** - Flanges, gaskets and bolts shall conform to AWWA C207 and shall be rated for the working pressures specified but not less than 150 psi.

(3) **Welded Joints** - Joints shall conform to the requirements of AWWA C206. For pipe 36 inch nominal diameter and larger, lap joints shall be full fillet double welded.

(d) **Lining and Coating:**

(1) **Mortar Lining** - Pipe shall be supplied with a shop-applied NSF 61 approved, double Type II cement mortar lining, conforming to AWWA C205.

(2) **Exterior Coating** - Pipe shall be supplied with an exterior protective coating in accordance with AWWA C214 (cold applied, tape coating) or AWWA C205 (cement-mortar protective coating).

02470.35 **Steel Pipe under 6 Inch** - Steel pipe less than 6 inches in diameter shall be hot-dip galvanized inside and out and meet the requirements of ASTM A 53/A 53M. Steel pipe thickness shall be Schedule 40 or the thickness class specified or indicated.

02470.36 **Concrete Cylinder Pipe:**

(a) **General** - Concrete cylinder pipe shall conform to AWWA C303 with a minimum cylinder thickness of 1/4 inches.

(1) **Bonding Connection Points** - Concrete cylinder pipe shall have bonding connection points as recommended by the manufacturer.

(2) **Length and Diameter** - Concrete cylinder pipe shall have inside diameters as specified in uniform lengths with a range of 20 to 40 feet. Provide shorter lengths as required for closures and changes in alignment and grade.

(3) **Manufacturer Testing** - Hydrostatically test the pipe at the manufacturing plant in accordance with AWWA C303. Pipe shall have ends fabricated for bell and spigot (push-on) joints, flanged joints, or welded joints, as specified. If no information is provided about the type of joint to be used, provide push-on joints. Joint grout shall be chloride free and NSF 61 approved.
(b) Push-On Joints - Pipe ends and joints shall conform to AWWA C303. Push on joint gasket shall conform to AWWA C303.

(c) Flanged Joints - Flange joints, including gaskets, nuts and bolts shall conform to AWWA C207 and shall be rated for the working pressures specified but not less than 150 psi.

(d) Welded Joints - Joints shall conform to the requirements of AWWA C206.

(e) Lining and Coating - Pipe shall be supplied with Type II cement mortar lining and coating conforming to AWWA C303 and NSF 61 approved.

02470.50 Polyethylene Encasement - Polyethylene tube encasement shall conform to AWWA C105 and tube encasement shall be provided by the pipe manufacturer. Polyethylene sheet is not acceptable.

02470.60 Detectable Marking Tape or Wire:

(a) External Properties - Detectable marking tape shall consist of inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil, with a metallic foil core to provide the most positive detection by pipeline locators. The width of the tape shall be as recommended by the manufacturer for the depth of installation. Tape shall be blue and imprinted continuously over its entire length in permanent black ink with the words "Caution - Water", or "Water" or "Water-line".

(b) Internal Properties - Detectable marking wire shall be No. 12 AWG, minimum, solid copper with blue colored polyethylene insulation. Joints or splices in wire shall be waterproof. Runs less than 500 feet shall have no more than one splice for new construction.

02470.70 Acceptance - Potable water pipe materials will be accepted according to 00160.06, 00165.35, and this Section.
Section 02475 - Potable Water Fitting Materials

Description

02475.00 Scope - This Section includes the requirements for fittings, restrained joints and couplings for ductile iron pipe, steel pipe, concrete cylinder pipe and polyvinyl chloride (PVC) pipe for potable water systems.

Materials

02475.10 General:

(a) Securing Fittings - Bolts, nuts and washers used for securing fittings shall be of similar materials.

(b) Nuts and Bolts - Steel bolts shall meet the requirements of ASTM A 307 for carbon steel, or ASTM F 593 for stainless steel. Nuts shall meet the requirements of ASTM A 563 for carbon steel and ASTM F 594 for stainless steel. Iron bolts and nuts shall meet the requirements of ASTM A 536, grade 65-45-12.

(c) Galvanize - Galvanize carbon steel bolts, nuts and washers according to Section 02560.

(d) Conformance Requirements - All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

(e) Pressure Ratings - All fittings and appurtenances shall meet or exceed the design pressure rating for the pipe.

02475.20 Ductile Iron Pipe Fittings:

(a) Conformance Requirements - Fittings for ductile iron pipe shall meet the requirements of AWWA C110 or AWWA C153, and shall have a minimum working pressure rating of 250 psi. Joints shall meet the requirements of AWWA C111.

(b) Linings and Coatings - Fittings shall be cement mortar lined and seal coated, meeting the requirements of AWWA C104. Double thickness cement mortar lining is preferred, but single thickness cement mortar lining will be accepted.

(c) Gaskets - Gaskets for flat faced or raised faced flanges shall be 1/8 inch thick rubber having a Durometer reading of 60, plus or minus 5.

(d) Bolts and Nuts - The type, material and identification mark for bolts and nuts shall be provided.

(e) Large Fittings - Fittings 24 inches to 48 inches shall be of non-compact mechanical joint type conforming to AWWA C110.
02475.30 Fittings for Steel Pipe 6 Inches and Larger - Fittings for steel pipe 6 inches in diameter and larger shall conform to AWWA C200, have a minimum working pressure rating of 150 psi or as specified or indicated, and shall receive a protective coating and lining to match the steel pipe provided. Flex couplings shall be compression type. When flanges are required, they shall meet the requirements of AWWA C207, and gaskets shall conform to 02475.20. Steel pipe fittings shall have a minimum wall thickness of 1/4 inch.

02475.31 Fabricated Steel Drip Tee Fittings:

(a) General - Drip tee fittings and accessories shall be new and unused. The manufacturer's identification shall be distinctly cast upon flanges and fittings. All fittings shall be shipped less accessories unless specifically stated otherwise. Drip tees are a special fabrication for the City for use in service installations and regulator installations.

(b) Fabrication - Drip tees shall be fabricated of steel pipe; forged steel, threaded branch connection; and ring-type steel slip-on flanges. Pipe shall conform to AWWA C200 for 6 inch pipe and larger. The 4 inch pipe shall conform to Schedule 80, ASME/ANSI B36.10 for pipe material. Branch connection shall be a Threadolet as manufactured by Bonny Forge Co., P.O. Box 359, Allentown, PA 18105, or approved equal, in the size listed below for 2 inch outlet. Flanges for the assembly shall meet AWWA C207, Class D, 175 psi rating.

(c) Coating - Fabricated assembly shall be coated with a fusion bonded epoxy coating in conformance with AWWA C213.

(d) Special Requirements - Fabricated assembly uses the following components and shall be of overall length as shown. The branch connection (Threadolet, or approved equal) shall be oriented so that the fitting can be at the top or rolled 90° for side outlet use, and centered between the flanges.

<table>
<thead>
<tr>
<th>Fabricated Assembly</th>
<th>Branch Outlet</th>
<th>Ring-type Slip-on Flanges</th>
<th>Overall Assembly Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>4x4x2</td>
<td>4-3-1/2x2</td>
<td>2-Class D</td>
<td>9 inches</td>
</tr>
<tr>
<td>6x6x2</td>
<td>6x2</td>
<td>2-Class D</td>
<td>9 inches</td>
</tr>
<tr>
<td>8x8x2</td>
<td>10-8x2</td>
<td>2-Class D</td>
<td>11 inches</td>
</tr>
<tr>
<td>12x12x2</td>
<td>18-12x2</td>
<td>2-Class D</td>
<td>11 inches</td>
</tr>
</tbody>
</table>

02475.32 Plain End Fittings - Factory cast plain-end fittings are only allowed as shown.

02475.35 Fittings for Steel Pipe under 6 Inches - Fittings for steel pipe less than 6 inches in diameter shall be malleable iron threaded type with a pressure rating of 150 psi or as specified or indicated. Dimensions shall meet the requirements of ANSI B16.3. Threading shall meet the requirements of ANSI B2.1. Material shall meet the requirements of ASTM A 47/A47M, Grade 22010. Fittings shall be banded and hot-dip galvanized inside and out.

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02475.36 **Fittings for Concrete Cylinder Pipe** - Fittings for concrete cylinder pipe shall conform to AWWA C303 with a minimum cylinder thickness of 3/16 inches and shall have bonding connection points as recommended by the manufacturer.

02475.50 **Restrained Joints** - Restrain ductile iron pipe, fittings and valves by using a manufacturer and Engineer approved system. Provide the restraint system to operate at a working pressure equal to the hydrostatic test pressure required in 01140.51(a) or as shown. No device utilizing round point set screws will be permitted. Provide gaskets and core 10 type or better T-bolts from same manufacturer of the restrained systems or manufacturer’s supplier. Loose bound (bulk) gaskets and bolts shall have accompanying documentation from the manufacturer.

02475.60 **Bolted, Sleeve-Type Couplings for Plain-End Pipe:**

(a) **Conformance Requirements** - Bolted, sleeve-type couplings, reducing or transition couplings, and flanged coupling adapters used to join plain-end pipe shall meet the requirements of AWWA C219. Buried couplings to connect ductile iron, gray cast iron or PVC pipe shall be ductile iron. Buried couplings for connecting steel pipe to steel pipe shall be steel, coated and lined to match the steel pipe provided.

(b) **Shop Coat Enamel** - Ductile iron sleeves and end rings shall have a shop coat enamel finish.

(c) **Epoxy Finish** - Steel sleeves and end rings shall have fusion bonded epoxy finish suitable for potable water systems meeting NSF 61 regulations.

(d) **Bolts** - Bolts shall be high strength, low-alloy steel manufactured to ASTM A325 with heavy hexagon nuts manufactured to ASTM A563.

(e) **Gaskets** - Full gaskets shall be rubber of all new materials compounded to resist oil, acids, alkalis, and water.

02475.70 **Acceptance** - Acceptance of fittings, restrained joints and couplings will be according to 00160.06, 00165.35 and this Section.
Section 02480 - Potable Water Valve Materials

Description

02480.00 Scope - This Section includes the requirements for gate valves, butterfly valves, ball valves, power actuating devices, valve boxes, valve stem extensions, tapping sleeve and valve assemblies, check valves, hydraulically operated valves, combination air release/air vacuum valves, and backflow prevention devices for potable water systems.

Materials

02480.20 Gate Valves - Gate valves shall meet the requirements of AWWA C509.

(a) Conformance Requirements - The minimum design working pressure shall be 200 psi for valves 2 inches to 12 inches in diameter. Non-rising stems shall be used for buried valves. Sizes not specified in AWWA C509 shall not be allowed for use without approval prior to purchase.

(b) Directional Indicator - Each valve shall open left (counterclockwise) and shall have an arrow showing the direction of opening. Position indicators will not be required.

(c) Component Properties - The valve gate shall be cast gray or ductile iron, with guide bars or channels for controlled movement, and may have an integral 2 inch bronze stem nut. The gate and gate guide bars or channels shall be fully encapsulated by a resilient rubber material bonded to the metal. The gate stem hole, if not also encapsulated, shall be epoxy coated. The method used to provide the rubber-to-metal bond shall be in accordance with the requirements of ASTM D429. The peel strength shall not be less than 75 pounds per inch.

02480.22 Butterfly Valves:

(a) Conformance Requirements - Butterfly valves shall be rubber seated and shall meet the requirements of AWWA C504, Class 150B. Shaft seals shall be standard O-ring seals, designed for replacement under line pressure.

(b) Operating Criteria - Valves shall be bi-directional flow, capable of performing in applications involving throttling service, frequent operation, and operation after long periods of inactivity.

(c) Valve Construction - Valve construction shall meet the following requirements:

   (1) Valve shafts - Wrought stainless steel or Monel.

   (2) Valve seat mating surface - Stainless steel, Monel or plasma welded nickel-chrome.
(3) **Valve coatings** - Valves with a complete rubber liner shall not be accepted. Butterfly valves shall have fusion bonded epoxy coating for the exterior valve body.

(4) **Thrust Bearing** - Two-way type.

(5) **Valve Testing** - Valves shall be tested in accordance with AWWA C504. Leakage tests shall be performed in both directions.

(d) **Large Butterfly Valves** - Butterfly valves 30 inches and larger in diameter shall be constructed so that complete seat replacement can be made without valve disassembly, and without removing the valve from the line.

(e) **Valve Operators** - Valve operators shall be of the traveling nut or worm gear type, sealed, gasketed and permanently lubricated for buried service. Construct valve operators to the standard of the valve manufacturer to withstand all anticipated operating torques, and design to resist submergence in ground water. Operators for buried services shall be equipped with a 2 inch square operating nut. Valves shall close with a clockwise rotation of the nut. Operator nut shall be installed between the water main and the short side to the curb.

(f) **Open to Close** - Minimum number of turns from fully open to fully closed shall be as follows:

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Turn Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inches to 8 inches</td>
<td>16 turns</td>
</tr>
<tr>
<td>10 inches to 12 inches</td>
<td>28 turns</td>
</tr>
<tr>
<td>14 inches to 18 inches</td>
<td>30 turns</td>
</tr>
<tr>
<td>20 inches to 24 inches</td>
<td>44 turns</td>
</tr>
<tr>
<td>30 inches</td>
<td>60 turns</td>
</tr>
<tr>
<td>36 inches</td>
<td>72 turns</td>
</tr>
<tr>
<td>48 inches</td>
<td>96 turns</td>
</tr>
<tr>
<td>54 inches and larger</td>
<td>200 turns</td>
</tr>
</tbody>
</table>

02480.23 **Ball Valves:**

(a) **Conformance Requirements** - Ball valves shall be double seated, with rubber seat materials mating with metal seating surface, and shall meet the requirements of AWWA C507. The minimum design working pressure shall be 150 psi. Shaft seals shall be standard O-ring seals, designed for replacement under line pressure.
(b) **Valve Operators** - Valve operators shall be of the traveling nut or worm gear type, sealed, gasketed and permanently lubricated for buried service. Valve operators shall be constructed to the standard of the valve manufacturer to withstand all anticipated operating torques and shall resist submergence in ground water.

02480.24 **Power-Actuating Devices** - Power-actuating devices for valves shall meet the requirements of AWWA C540. The type of power-actuating devices to be furnished and the operating requirements will be as indicated and shown.

02480.25 **Valve Boxes** - City will furnish valve boxes and covers (CIV). The 8 inch PVC pipe, ASTM D3034, shall be Contractor-furnished.

02480.26 **Valve Operator Extensions** - Valves with an operating nut more than 4 feet below the finished grade shall have valve operator extensions installed. Valve operator extensions shall be manufactured per plan. Hot dip galvanize operator extensions after fabrication.

02480.30 **Tapping Sleeve and Valve Assemblies:**

(a) **General** - The City shall perform all tapping on the active/live water system unless otherwise specified.

1. **Tapping Sleeves** - Tapping sleeves shall be capable of installation on several classes of ductile iron pipe as well as A and C cast iron. Installation shall require no special tools, shims, welding, or caulking.

2. **Tapping Valves** - Furnish tapping valves with flanged inlet end connections. The outlet ends shall conform in dimensions to the ASME/ANSI B16.1 for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine.

3. **Associated Equipment** - The valves shall be used with a Mueller drilling machine, Model No. CC-25, or approved equal. The seat opening of the valve shall permit a diameter cut no less than 1/2 inch smaller than the valve size.

4. **Conformance Requirements** - Valves specifically designed for tapping meeting the requirements of AWWA C500, and valves meeting the requirements of AWWA C509, will be permitted. Tapping valves shall be of the same type as other valves on the Project.

5. **Assembly Rating** - The installed assembly must be rated by the manufacturer for a minimum working pressure of 175 psi and capable of a minimum test pressure of 125% without leakage or pressure loss.

(b) **Steel - Flanged - Tapping Sleeves** – Sleeves shall be manufactured from materials per AWWA C200 and be finished with fusion bonded epoxy, minimal 12 mils exterior, NSF 61 approved. Fabrication shall be in accordance with AWWA C200 and C207.
(c) **Ductile Iron - Mechanical Joint - Tapping Sleeves** – Sleeves shall be manufactured from materials per AWWA C110, C111, C115, C150, or C153 as applicable. Sleeves shall be manufactured in accordance with MSS SP111.

(d) **Outlet Flanges** – Flanges shall be recessed to mate with standard tapping valves per MSS SP60 up through 12 inches in size. Steel flanges shall comply with AWWA C207, Class D with ASME/ANSI B16.5, 150 psi drilling. Ductile iron flanges shall comply with AWWA C110, C115, C150 with ASME/ANSI 16.1, class 125 drilling.

02480.40 **Check Valves:**

(a) **Swing Check Valve** - Swing check valves shall meet the requirements of AWWA C508, with rubber seat materials mating with metal seating surfaces. The minimum design working pressure shall be 175 psi for check valves with diameters of 12 inches and smaller, and 150 psi for 14 inch and 16 inch diameters. Check valves shall be nonassisted, unless otherwise indicated.

(b) **Spring-Loaded Plug or Disc Check Valves** - Spring-loaded plug or disc check valves shall be bronze mounted with bronze, cast or ductile iron body, bronze plug or disc, stainless steel spring, and resilient seating suitable for potable water service. The valves shall provide drop-tight sealing. The plugs or discs shall be easily replaceable. The minimum design working pressure of the valves shall be 150 psi.

(c) **Hydraulic Cushion Check Valves** - Hydraulic cushion check valves shall be of bronze, cast or ductile iron, with bronze disc and disc faces, seat rings and pivot pins. The valves shall provide droptight sealing. The valves shall be fitted with adjustable speed, integrally mounted, oil dashpot mechanical snubber systems. The minimum design working pressure of the valves shall be 150 psi.

02480.50 **Hydraulically Operated Valves:**

(a) **General** - Hydraulically operated valves shall be pilot controlled and diaphragm operated, bronze or stainless steel mounted with bronze, cast or ductile iron body, globe or angle orientation as indicated. Provide valve position indicators. The minimum design working pressure of the valves shall be 175 psi. Pilot controls and piping shall be bronze, designed to operate the main valves as indicated, and shall include stop valves, strainers and adjustable closing speed controls.

(b) **Size 2 ½ Inches and Under** - Valve shall have cast iron body with female IPT threaded ends and shall be direct acting or pilot operating depending on system requirements. Valve shall have adjustable outlet pressure ranging from 15 to 75 psi.

(c) **Size 3 Inches and Above** - Valve shall have cast iron body, globe style with flanged ends of either 125 or 250 drilling based on system requirements. Valve shall have adjustable outlet pressures ranging from 15 to 100 psi.
02480.51 **Pressure Relief Valves** - Valve, 1/2 to 2 1/2 inches in size, shall have bronze body with soft seat design and shall have female IPT ends with inlet ranging from 1/2 to 2 inches and outlet ranging from 3/4 to 2 1/2 inches. Orifice sizes range from 0.121 to 1.399 square inches. The valve shall have a temperature range of −20 °F to 800 °F and average pressure range of 15 to 500 psig. Valve shall meet ASME Section VIII, designed for high capacity, low pressure applications on assorted media.

02480.60 **Combination Air Release/Air Vacuum Valves:**

(a) **General** - Combination air release/air vacuum valves shall operate with potable water under pressure to permit discharging a surge of air from an empty line when filling, and relieve the vacuum when draining the system. The valves shall also release an accumulation of air when the system is under pressure. This shall be accomplished in a single valve body designed to withstand 300 psi.

(b) **Conformance Requirements** - Combination air release/air vacuum valves shall meet the requirements of AWWA C512. The body and cover shall be cast iron conforming to ASTM A 48/A 48M, Class 30. Floats shall be stainless steel conforming to ASTM A 240/A 240M and designed to withstand 1,000 psi. Seats shall be Buna N rubber. Internal parts shall be stainless steel or bronze.

02480.70 **Backflow Prevention Devices** - Backflow prevention devices shall be capable of withstanding a minimum design working pressure of 150 psi, and shall conform to the following:

(a) **Reduced Pressure Principle Backflow Prevention Assembly** - Reduced pressure principle backflow prevention assemblies shall consist of a mechanical, independently operating, hydraulically dependent relief valve located between two independently operating, spring loaded check valves that are located between two tightly closing resilient seated shutoff valves, with four resilient seated test cocks, all meeting the requirements of AWWA C511 and the Oregon State Health Division.

(b) **Double Check Valve Backflow Prevention Assembly** - Double check valve backflow prevention assemblies shall consist of two spring loaded, independently operating check valves, located between two tightly closing resilient seated shutoff valves, with four resilient seated test cocks, all meeting the requirements of AWWA C510 and the Oregon State Health Division.

02480.71 **Blowoff Assemblies** - Use materials as shown.

02480.80 **Acceptance** - Acceptance of potable water valve materials will be according to 00160.06, 00165.35 and this Section.
Section 02484 - Precast Concrete Vault Materials

Description

02484.00 Scope - This Section includes the material requirements for precast concrete vaults.

Materials

02484.10 General - Furnish a precast concrete vault complete with floor, roof, grated sump, access door, manhole riser ring(s) and lid, ladder, ladder extension, coal tar epoxy joint sealer, waterproofing surface sealer, incidentals and appurtenances, as shown. Provide vault type and size with the appropriate top to accommodate either an access door or manhole, as specified and shown or as directed. Vault shall be watertight and shall support a minimum of H-20 traffic loading. Vault shall have solid walls 4 inches thick minimum with no knock outs.

02484.20 Concrete Vault Sections - Concrete vault sections shall be designed and manufactured per ACI 318-89, AASHTO 92 and ASTM C913/857, with H-20 loading and 30% impact factor over an 8 inch wide x 20 inch long area. Design loading assumptions are as follows:

- Soil Cover (5 foot Maximum) .................................................. 100 pcf
- Fluid Pressure above water table ............................................. 30 pcf
- Fluid Pressure below water table ............................................. 75 pcf

Concrete shall have a minimum 28-day compressive strength of 4500 psi. Details and placement of reinforcing bar shall be in accordance with ASTM A-615. Concrete components shall meet the following standards:

- Type II/III Cement ......................................................... ASTM C-150
- 3/4" Rock (washed) ......................................................... ASTM C-33
- Sand ................................................................. ASTM C-33
- Plasticizer ................................................................. ASTM C-494
- Water Reducer ............................................................ ASTM C-494
- Air Entrainment ............................................................ ASTM C-260
- Reinforcing Mesh ......................................................... ASTM A-185
- Reinforcing Bar .......................................................... ASTM A-615 GR 60

Removable lifting eyes shall be provided for each individual section.

02484.25 Precast Vault Roof - Provide precast vault roof with access hatch or manhole and valve box opening of the dimensions and orientation as shown.

02484.27 Joint Sealant - Butyl rubber joint sealant shall be provided for the vault and manhole section joints and for all riser rings.

02484.30 Pipe Penetration Seals - Pipe penetrations through walls or vaults shall be made watertight by the use of a modular-mechanical type seal
consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

02484.35 Access Doors:

(a) General - Access doors where required shall be of spring-assisted diamond plate type with locking latch and angle iron frames cast in one 6 inch minimum concrete riser ring. Doors shall be water-tight, rated for H-20 loading and be constructed of steel, hot dipped galvanized after fabrication; or aluminum, with non-slip surface having a static coefficient of friction between 0.60 and 1.00 as determined by ASTM C1028. Access hatches on inclines greater than 4% shall have a coefficient of 0.80 to 1.00.

(b) Single and Double Doors - Doors shall be a single opening or double opening lid secured with non-removable, penta head bolts. Single doors shall utilize one bolt. Double doors shall have two bolts mounted on the corners of the overlapping door. Each door shall have two 90° ‘hold open’ arms.

02484.40 Ladder and Ladder Extension - Center/Base vault sections shall include chamber ladder and extension. Use structural steel with a minimum yield strength of 36,000 psi per ASTM A-36. Ladder and all mounting hardware shall be hot dipped galvanized after fabrication, in accordance with ASTM A-123. Nuts and bolts shall be all stainless steel, minimum 1/2 inch in diameter. Length of ladder and mounting details shall be as shown.

02484.45 Grates - Grates shall be hot dipped galvanized after fabrication in accordance with ASTM A-123.

02484.50 Valve Box and Cover (CIV) - CIV boxes and covers for installation into the vault roof as shown will be furnished by the City. Provide non-shrink grout around valve boxes.

02484.55 Paint, Sealers and Coatings - A two coat system, aluminum mastic, with all paint material, shall be Carbo Mastic 15 as manufactured by Carboline, Inc., or approved equal.

02484.60 Bedding Backfill and Cover - The aggregate used for bedding and backfill shall be Class B and conform to Section 02630. Cover material shall be as shown.

02484.65 Filter Fabric - Filter fabric shall be non-woven meeting the requirements of Section 00350.

02484.70 Drain Rock - Drain rock shall be washed round aggregate, with a maximum size of 3 inches with 0% passing the No. 4 screen.

02484.80 Sump Drain Valve - The sump drain valve shall be model 4FH manufactured by Flood-Guard or approved equal.

02484.85 Acceptance - Precast concrete vault materials will be accepted according to 00160.06, 00165.35, and this Section.
Section 02485- Hydrants and Appurtenance Materials

Description

02485.00 Scope - This Section includes the requirements for hydrants, hydrant appurtenances and guard posts for potable water systems.

Materials

02485.10 Fire Hydrants:

(a) General - Fire hydrants shall be dry-barrel, conforming to AWWA C502, of standard manufacture and of a pattern approved by the City. Hydrants shall be designed for a minimum working pressure of 150 psi.

(b) Conformance Requirements - All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects (NSF 61), or equivalent.

(c) Seals and O-rings - Hydrants shall have O-ring stem and valve seals. Main valve seat ring and seat ring bushing shall be bronze. Removal of main valve assembly including seat ring shall be by a tool that engages the stem either at the breakaway stem coupling or the upper stem section.

(d) Lubricant Fixtures - Operating nut thrust collar and threaded stem drive shall be one piece bronze. Oil filler plug or grease fitting shall be furnished in bonnet to lubricate thrust collar and stem drive. Lubricant reservoir shall be a permanently sealed reservoir. Anti-friction thrust washer shall be Teflon, or equal, fitted on top of thrust collar. Furnish a positive stop to prevent over travel of the stem.

(e) Drain Valves - Furnish two or more bronze bushed drain valves. Drain valve shall close within 6 turns, at start of opening hydrant.

02485.20 End Connections - End connections shall be mechanical joint conforming to the requirements of AWWA C110 and C111.

02485.30 Hydrant Dimensions and Nozzles:

(a) Configuration - Hydrant connection pipes shall be 6 inches inside diameter with 6 inch auxiliary gate valve. Hydrant length, measured from the bottom of the hydrant to the sidewalk ring shall provide sufficient cover at each installed location. Valve openings shall be 5 inches minimum diameter. Hydrants shall have two 2 1/2 inch hose nozzles and one 4 1/2 inch pumper nozzle.

(b) Nozzles - Nozzle threads shall conform to National Fire Protection Association (NFPA) No. 1963 - Standard Specification for National Fire Hose Coupling Screw Threads. Hydrant nozzle caps shall have inside neoprene gaskets. Do not furnish nozzle cap chains or cable. Hydrant nozzles shall be lug or screw type and shall be brass.
(c) **Nozzle Caps** - Fit nozzles with cast iron threaded caps with operating nuts of the same design and proportions as the hydrant stem nuts. Operating and nozzle cap nuts shall be pentagon shape, 1 1/4 inches from point to opposite flat at base of nut and 1 3/16 inches from point to opposite flat at top of nut with a tolerance of 1/64 inches for each dimension from flat to opposite point. Thread caps to fit the corresponding nozzles and fit with suitable gaskets to ensure positive water tightness under test pressure. The direction of opening shall be counterclockwise and shall be clearly marked on the operating nut or hydrant top.

**02485.40 Hydrant Extensions:**

(a) **General** - Hydrant extensions shall be gray cast iron or ductile iron with an inside diameter of at least 6 inches, and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant.

(b) **Operating Stem Extensions** - Hydrant extensions shall also include the necessary hydrant operating stem extensions.

**02485.50 Traffic Flange** - Provide hydrants with a traffic flange. Hydrants shall be equipped with breaking devices at the traffic flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. Also provide, at this point, a safety stem coupling on the operating stem that will shear upon impact. Aluminum couplings are not acceptable.

**02485.51 Other Materials** - Drain rock shall conform to Class D backfill as specified in Section 00405. Geotextile fabric for drain rock shall conform to Type 1 drainage geotextile as specified in Section 02320. Furnish material conforming to Section 00440 for concrete hydrant pads.

**02485.52 Out of Service Cover** - Provide yellow or orange plastic bag or cover with reflective tape and, if necessary, approved plastic hydrant out-of-service rings.

**02485.70 Guard Posts** - If shown, guard posts for hydrants shall be galvanized steel pipe, 6 inches in diameter, meeting the requirements of ASTM A53/A 53M, Schedule 40, filled with commercial grade concrete, and with the concrete domed at the top.
02485.75  **Painting** - Hydrants shall be painted in accordance with AWWA C502. Exterior paint shall conform to Federal Specification TT-E-489 G. Furnish the hydrant with standard exterior colors as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrant Barrel</td>
<td>OSHA Safety Orange</td>
</tr>
<tr>
<td>Nozzle Caps</td>
<td>Black</td>
</tr>
<tr>
<td>Pumper Caps</td>
<td>OSHA Safety Red</td>
</tr>
<tr>
<td>Dome or Top</td>
<td>OSHA Safety Orange</td>
</tr>
</tbody>
</table>

02485.80  **Acceptance** - Acceptance of hydrants and hydrant appurtenances will be according to 00160.06, 00165.35, and this Section.
Section 02490 – Potable Water Service Connection Materials, 2 Inch and Smaller

Description

02490.00 Scope - This Section includes the requirements for materials for potable water service connections 2 inches in diameter and smaller, and sampling stations.

Materials

02490.10 General - Service line materials shall conform to the latest version of AWWA C800 and these specifications. Unless otherwise specified, the minimum working pressure rating of all service line materials shall be 150 psi. In addition, all service line materials provided shall be rated for the test pressures indicated in Section 01140.51. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects (NSF 61).

02490.11 Stops and Valves - All corporation stops, curb stops and meter valves shall be of the ball-valve design with full port opening and have a flow passage area equivalent to the fitting outlet flow area.

02490.12 Padlock Wings - Curb Stops and meter valves shall be provided with padlock wings.

02490.13 Valve Balls - Balls for the corporation and curb valves shall be fabricated from the same material as the body. A Teflon or Nitrile seat or another material proven not to deteriorate when exposed to chemicals such as chloramides shall support the ball.

02490.14 Gaskets - Each compression nut shall be fitted with a gasket and shall contain a groove in its inner surface to locate a stainless steel gripper band. The gasket shall contain a built-in metal conductor spring at one-end to provide electrical continuity between the copper tubing and the coupling.

02490.20 Saddles - Saddles shall be bronze. Saddles used for 1 inch services may be single strap saddles and have AWWA tapered thread outlet. Saddles used for 2 inch services shall be double strap and have AWWA tapered thread outlet.

02490.30 Corporation Stops:

(a) General - Make corporation stops of bronze alloy. Corporation stops for direct tapping shall have AWWA tapered thread inlet and outlet connections compatible with copper tubing.

(b) Threads - Corporation stops used with 1 inch and 2 inch outlet saddles shall have AWWA tapered thread inlets and outlet connections compatible with copper tubing. Thread patterns for the saddle outlet and corporation stop inlet shall be the same.
02490.40 Service Pipe and Fittings:

(a) **Copper Pipe & Tubing** - Copper tubing shall be in accordance with ASTM B 88. Tubing shall be Type K, seamless, and annealed. Sizes 1 inch and below shall be soft drawn design, 0.065 inch wall thickness. Sizes larger than 1 inch shall be hard drawn design, 0.083 inch wall thickness.

(b) **Brass Pipe** - Brass Pipe shall conform to the standard dimensions, weights, and tolerances for "regular" weight pipe in accordance with ASTM B43. Material composition shall be copper alloy UNS No. C23000. Pipe shall be furnished in the annealed condition to Standard No. "O 61" in accordance with ASTM B601. Pipe shall meet the test requirements of ASTM B43.

(c) **Brass and Bronze Service Fittings** - Brass and bronze service fittings shall have an alloy composition of copper, tin, lead and zinc in accordance with ASTM B62. The material shall be copper alloy UNS No. 83600. Mechanical services shall have a 100% machine finish with no gaps or low spots due to insufficient parent material. All fittings shall either be stamped or embossed with the manufacturer's name.

(d) **Brass and Bronze Pipe Nipples** - Brass pipe nipples shall be in conformance with ASTM B687. Material, composition and mechanical properties for pipe nipples furnished shall be the same as for Category B copper alloy UNS No. C83600. Threads for pipe nipples will conform to Sections 6 and 11 of AWWA C800, and ASME/ANSI Standard B1.1 as noted in Category B. Standard length and size of nipples shall conform to Section 7 and Table 2 of ASTM B687 for standard close nipples. All other provisions of ASTM B687 "Brass, Copper and Chromium-Plated Pipe Nipples" shall apply to the materials furnished.

02490.50 Meter Setters:

(a) **General** - Meter Resetters shall be made of materials as per AWWA C800 specifications and assembled with lead-free solder.

(b) **Properties** - Resetters shall be made of Type "L" copper tubing and 85-5-5 quality brass and shall have saddle nuts for easy resetting of meters. The length between the saddle nuts will be the same as the brass bar that is threaded and the length of the meter desired.

(c) **Resetter Support** - Resetter shall have a brass bar to support the front and back side. Resetter support shall have the same length of existing meter, with matching threads. Connect before the old existing meter couplings (meter threads).
(d) **Configuration** - The inlet side shall have a length of copper tubing bent to the size ordered and soldered (lead-free) into the brass bar from the top of the brass bar of 90° bend. At the top of the copper tubing, solder (lead-free) an IPT brass bushing with an angle curb stop with a saddle nut shall be attached. The outlet side shall have a length of copper tubing bent to the size ordered and soldered (lead-free) into the brass bar from the top of the brass bar for a 90° bend. At the top of the copper tubing, it will be formed to a flat surface of 1/4 inches with a saddle nut for ease in service installation of meter.

(e) **2 Inch Meter Setters** - The 2 inch meter setters shall be specially designed and must conform to approved drawings on file.

02490.70 **Meter Boxes** - Meter boxes will be City-furnished and installed by the Contractor.

02490.80 **Sampling Stations** - Sampling stations shall have a 3/4 inch inlet with the depth of bury indicated, and a 3/4 inch unthreaded nozzle. Enclose the sampling station in a lockable, non-removable, cast aluminum housing. When opened, the station shall require no key for operation, and the water shall flow in an all-brass waterway. All working parts shall also be of brass and be removable from above ground with no digging. Exterior piping shall be brass. Include at each station a copper vent tube with a ball valve to enable the station to be pumped free of standing water to prevent freezing.

02490.90 **Acceptance** - Materials for potable water service connections will be accepted according to 00160.06, 00165.35, and this Section.
02510.00 Scope - This Section includes the requirements for bars, dowels, and strand reinforcement and tendon ducts.

Materials

02510.10 Deformed Bar Reinforcement - Deformed bar reinforcement shall conform to the requirements of ASTM A 706 or AASHTO M 31 (ASTM A 615). Unless otherwise specified or shown, all reinforcing bars shall be Grade 420 (Grade 60).

02510.11 Epoxy Coated Reinforcement:

(a) General - Epoxy coated reinforcement shall conform to the requirements of AASHTO M 284 (ASTM A 775) and (b), (c) and (d) below.

(b) Coating Voids - Patch visible voids in the coating, regardless of cause, according to 00530.48.

(c) Handling - All systems for handling coated bars shall have padded contact areas for the bars wherever possible. Pad all bundling bands and lift all bundles with strongbacks, multiple supports or platform bridges so as to prevent bar-to-bar abrasion from sags in the bar bundle.

(d) Coated Reinforcement Ties and Supports - Ties for coated reinforcement shall be nonmetallic coated. Where coated bars are tied to uncoated bars, the ties shall be nonmetallic coated.

(e) Prequalification, Sampling and Testing - Prequalify all epoxy coating and patching/repair material according to ASTM A 775/A 775M. All testing shall be performed by a qualified private testing laboratory. The Department's Materials Laboratory will review all test data to determine whether the material meets the prequalification requirements.

At the time of epoxy coated reinforcing bar shipment, furnish the Engineer a written certification that the coated bars were cleaned, coated and tested according to ASTM A 775/A 775M and according to (b), (c), and (d) above, and that the coating material used on the project is the same as that prequalified.

(f) Plant Certification - Epoxy coated reinforcement shall be produced in a Concrete Reinforcing Steel Institute (CRSI) Certified Epoxy Coating Plant.
02510.20 **Mechanical Splices** - Mechanical splices for reinforcing bars are systems which connect the bars without raising their temperature above 1,300 °F.

- Provide mechanical splices from the CPL that develop at least 135% of the specified minimum yield strength of the reinforcing bars in tension. Where bars of different sizes or strengths are connected, the governing strength shall be the strength of the smaller or weaker bar.
- The total slip of reinforcing bars within a splice sleeve shall not exceed 0.040 inch, measured between gauge points clear of the splice sleeve, when the reinforcing bars are loaded in tension to 67% of the specified minimum yield strength of the reinforcing bar.

02510.30 **Galvanized Reinforcement:**

(a) **General** - Galvanized reinforcement shall conform to the requirements of ASTM A 767/A 767M, Class II, including Supplementary Requirement S3, and ASTM A 143.

(b) **Fabrication** - The bars may be fabricated before or after galvanizing. If the bars are fabricated after galvanizing, Supplementary Requirements S1 and S2 of ASTM A 767/A 767M shall apply.

(c) **Handling** - All systems for handling galvanized bars shall be according to 02510.11(c).

(d) **Ties and Supports** - Tie all mats of galvanized steel bars with galvanized ties. Precast concrete blocks that support galvanized reinforcement shall have galvanized ties.


02510.50 **Dowels** - Dowels shall conform to the requirements of AASHTO M 31 (ASTM A 615), for Grades 40 and 60, or AASHTO M 227 (ASTM A 663) for Grades 70, 75, and 80.

02510.60 **Wire Reinforcement** - Wire reinforcement shall conform to the requirements of AASHTO M 32 (ASTM A 82). Deformed wire shall conform to the requirements of AASHTO M 225 (ASTM A 496).

02510.70 **Acceptance** - Acceptance of reinforcement will be according to 00165.35 and this Section.
Section 02515 - Prestressing Reinforcement

Description

02515.00 Scope - This Section includes the requirements for seven-wire strand, high tensile strength wire, high tensile strength steel alloy bars, tendon duct and couplings.

Materials

02515.10 Seven-Wire Strand - Seven-wire strand, (bright wire) shall conform to the requirements of AASHTO M 203 (ASTM A 416), Grade 270, supplement 1 (low relaxation strand), minimum ultimate strength, 270,000 psi.

02515.20 Wire, High Tensile Strength - High tensile strength wire shall conform to the requirements of AASHTO M 204 (ASTM A 421).

02515.30 Bars, High Tensile Strength - High strength steel bars shall conform to the requirements of AASHTO M 275 (ASTM A 722).

02515.40 Seven-Wire Strand Epoxy Coated Reinforcement - Epoxy coated reinforcement shall conform to the requirements of ASTM A 882.

02515.50 Tendon Duct - Provide rigid galvanized steel ducts for post-tensioned structures. Transition couplings connecting rigid ducts in anchoring devices need not be galvanized.

Rigid ducts may be fabricated with either welded or interlocking seams. Galvanizing of the welded seam is not required. Provide ducts with sufficient strength to maintain their correct alignment during placing of concrete and resist denting during construction.

Minimum wall thickness of ducts shall be 26 gauge for 2 5/8 inch diameter and smaller ducts, and 24 gauge for ducts that are larger than 2 5/8 inch diameter.

02515.60 Couplings - Provide couplings that develop at least 95% of the minimum specified ultimate strength of the prestressing steel without exceeding anticipated set. The coupling of tendons shall not reduce the elongation at rupture below the requirements of the tendon itself.

02515.70 Shipping Protection - Package prestressing steel to protect the steel against physical damage and corrosion. Place a corrosion inhibitor that prevents rust or other results of corrosion in the package, or use a corrosion inhibitor type packaging material, or when allowed, apply directly to the steel. Provide a corrosion inhibitor that has no deleterious effect on the steel or concrete or bond strength of steel to concrete. Immediately replace or restore damaged packaging.

Mark the shipping package with the type of corrosion inhibitor used, and the date packaged.

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Acceptance - Acceptance of prestressing reinforcement will be according to 00165.35 and this Section.
Section 02520 - Steel and Concrete Piles

Description

02520.00 Scope - This Section includes the requirements for steel pipe, steel H-beams, steel sheets and prestressed concrete used for piling.

Materials

02520.10 Steel Piles:

(a) General - All steel piles, except steel pipe piles, shall meet the requirements for camber and sweep of in AASHTO M 1605 (ASTM A 6).

(b) Steel Pipe Piles - Steel pipe piles shall be either spirally welded or longitudinally welded, constant in section and conforming to ASTM A 252, Grade 2. Seal tips with a 1 inch thick steel plate or an approved cast steel point welded in place, when specified. Concrete used to fill steel pipe pile shall be Class 3300 - 1 1/2, 1, or 3/4. Add the following:

Provide cutting shoes conforming to the following:

- ASTM A 27, Grade 65 - 35
- ASTM A 27, Grade 70 - 36
- ASTM A 27, Grade 70 - 40
- ASTM A 148, all grades

(c) Steel H-Piles - Steel H-piles shall be rolled steel pile sections of the size and weight shown. Steel shall conform to the requirements of ASTM A 36. The manufacturer's name, brand or trademark may be shown by die stamping in the web at intervals not exceeding 20 feet along the length of the pile.

(d) Steel Sheet Piles - Steel sheet piles shall conform to AASHTO M 202 (ASTM A 328).

(e) Reinforced Pile Tips - Reinforce the tips of steel H-piles points, pipe pile shoes, or points of any proprietary steel pile tip reinforcement. Legibly mark or tag each cast steel point delivered to the Project site with the heat or lot number. Submit certified mill test reports showing the physical and chemical properties of each heat or lot number. If the heat or lot number cannot be read or if the mark or tag is missing, the point or shoes will be rejected.

Provide reinforced tips for steel H-piles from the CPL. In addition, all cast steel points or shoes shall conform to the following:

- ASTM A 27, Grade 65 - 35
- ASTM A 27, Grade 70 - 36
- ASTM A 27, Grade 70 - 40
- ASTM A 148, all grades
For steel H-piles provide no less than a 5/16 inch fillet weld full width of each flange.

The Engineer may randomly sample from each heat or lot number, at least one pile tip or up to 10% of the tips for larger projects, of the pile tips delivered for incorporation into the Project.

The selected tip(s) shall be non-destructively tested as follows:

- Determine the weight of the tip(s)
- Grind 5 smooth spots on each randomly selected tip

The Engineer will test each smooth spot on each tip with an ODOT portable hardness tester. The hardness reading of each spot shall be greater than or equal to 74 on the "B" scale.

Three or more spots with a "B" scale reading below 74, will be cause for rejection of the tested tip and may result in rejection of the entire lot. Replace rejected tips with new tips and rejected lots with new lots at Contractor's expense. New tips and new lots may also be tested according to the requirements above.

Install cast steel point according to manufacturer's recommendations but with no less than a 5/16 inch fillet weld full width of each flange.

No other cast steel points will be accepted unless the following conditions are met at the Contractor's expense:

- Install proposed cast steel points on 3 piles
- Drive the piles to ultimate capacity
- Pull piles and examine the points
- No damage to the cast steel points is discernible

(f) Sampling and Field Testing Pile Tips - The Engineer may randomly sample from each heat or lot number, at least one pile tip or up to 10% of the tips for larger projects, of the pile tips delivered for incorporation into the project.

The selected tip(s) shall be tested as follows:

- Grind 5 smooth spots on each randomly selected tip. The Engineer will test each smooth spot on each tip with a portable hardness tester or in a laboratory. If 3 or more of the 5 spots tested have a reading below 74 on the "B" scale, the tested tip and the entire lot shall be rejected.
- For steel H-piles, determine the weight of the tip(s). Each cast steel H-pile point shall have a weight not less than 30% of the weight of a 1 foot section of the H-pile to which it will be attached. If any of the tested tips fail to pass the minimum weight criteria the entire lot shall be rejected.
Pile tips that are supplied unattached to the pile may be selected for nondestructive testing as described above. Pile tips passing the field test may be incorporated into the project. Pile tips selected for testing that are supplied already attached to the pile will be destructively tested as determined by the Engineer. Provide replacement tips for the tips that are destructively tested at no cost to the City. Replace rejected tips with new tips and rejected lots with new lots at no additional cost to the City. No time extension or other compensation will be granted for materials or work required in testing pile tips, replacing rejected pile tips or for replacing tips that are destructively tested. New tips and new lots may also be tested according to the requirements above.

02520.20 Prestressed Concrete Piles:

(a) General - Prestressed concrete piles shall be manufactured according to Section 00550 and as shown.

(b) Concrete - Concrete in precast, prestressed piles shall be Class 5000 - 1 or 3/4. Minimum concrete strength at transfer of prestressing force shall be 4,000 psi. Concrete in pile extensions or "build-ups" shall be Class 3600 - 1 1/2, 1, or 3/4.

(c) Prestressing Reinforcement - Prestressing reinforcement steel shall consist of seven-wire, low-relaxation strands conforming to 02515.10.

(d) Mild Steel Reinforcement - Spiral reinforcement shall be plain reinforcing steel meeting the requirements of 02510.10 or cold-drawn wire meeting the requirements of 02510.60. All other mild reinforcing steel shall meet the requirements of AASHTO M 31 (ASTM A 615), Grade 60.

(e) Forms - The use of steel forms on concrete founded casting beds is required. Forms shall enclose all except the top horizontal surface, and shall be mortar-tight. Forms for piles shall not cause the formation of fins at the intersection of surfaces.

(f) Tolerances - The maximum sweep (deviation of straightness measured along 2 perpendicular faces of the pile, while not subject to bending forces) shall not exceed 1/8 inch in any 10 feet of length, 3/8 inch in 40 feet, or 3/16 inch x total length in feet per 20 feet.

(g) Finish - The tops of concrete castings shall be given a uniformly smooth finish to match the finish surface of the formed sides.

02520.30 Acceptance - Material for piles will be accepted according to 00165.35 and this Section.
Section 02530 - Structural Steel

Description

02530.00 Scope - This Section includes the requirements for structural steel used in the fabrication of bridges and non-bridge structures.

Materials

02530.10 Structural Steel for Bridges - Structural steel for bridges shall conform to the following, as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)
- AASHTO M 270, Grade 50 (ASTM A 709, Grade 50)
- AASHTO M 270, Grade 50W (ASTM A 709, Grade 50W)
- AASHTO M 270, Grade HPS 70 (ASTM A 709 Grade HPS 70)
- AASHTO M 270, Grade HPS 70W (ASTM A 709 Grade HPS 70W)

Supplementary Requirement S4 AASHTO M 270 (ASTM A 709), Fracture-Critical, F, Material; Toughness Tests and Marking, is mandatory for all fracture critical steel. Toughness requirements for all areas of Oregon shall be according to Zone 2 requirements.

Supplementary Requirement S6, Limitation on Weld Repair, is mandatory for all fracture critical steel.

Supplementary Requirement S2, Product Analysis, of ASTM A 6/A 6M is mandatory for all steel plate that will be welded. The product analysis shall be on a heat frequency. It shall include all elements listed in Table A of AASHTO M 160 (ASTM A 6), regardless of the material specification, except that nitrogen need not be reported unless specified in the product specification. The product analysis shall be submitted to the Engineer immediately upon receipt of the steel.

02530.20 Structural Steel for Non-Bridge Structures - Structural steel for metal sign structures and other non-bridge structures shall conform to the following, or as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)
- ASTM A 36
- AASHTO M 270, Grade 50 (ASTM A 709, Grade 50)
- ASTM A572

Notch toughness of all structural steel members and plates greater than 1/2 inch thick in load carrying members of sign bridges and cantilever sign supports shall conform to Zone 2 requirements of AASHTO M 270.
02530.21 Structural Steel for Pipe Sign Posts - Use Schedule 40 pipe that shall conform to the following, or as shown or specified:

- ASTM A53, Grade B

02530.40 Ultrasonic Inspection of Plate - Ultrasonically inspect flanges 2 inches and thicker for welded plate girders before fabrication according to ASTM A 578 except as follows:

- Section 7, Acceptance Standard - Level A, and Section 8, Acceptance Standard - Level B, do not apply. Use Supplementary Requirement S2.1 for acceptance standard.
- Inspection of flanges of rolled shapes with flanges thicker than 1 3/4 inches.

02530.50 Universal Mill Plate - Universal mill plate shall not be used.

02530.60 Rolled Shapes - With the approval of the Engineer, rolled shapes having equal or greater section properties and meeting minimum flange and web thickness requirements may be substituted for members specified on the plans, at no additional cost to the City.

02530.70 Galvanizing - Galvanizing shall be by the hot-dip process according to the following, as applicable:

- AASHTO M 111 (ASTM A 123)
- AASHTO M 232 (ASTM A 153)

Steel that will be finished by hot-dip galvanizing for use as sign bridges, illumination poles, traffic signal poles, sign supports, bridge rail and items designated on the plans as "Galvanize - Control Silicon" shall have controlled silicon content. The silicon content shall be in either of the ranges 0 - 0.04% or 0.15% - 0.25%. Before galvanizing, submit mill test certificates verifying silicon content to the Engineer and the galvanizer.

02530.71 Repair of Hot-Dip Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A 780 and ASTM A 123. Minimum zinc content for Method A2 is 94% on the dry film.

02530.80 Acceptance - Acceptance of structural steel will be according to 00165.35 and this Section.
Section 02540 - Forgings, Shafting, Castings and Nonferrous Materials

Description

02540.00  Scope - This Section includes the requirements for forgings, shafting, castings and nonferrous materials except those used in potable water systems. For potable water system requirements, see Sections 02470, 02475, 02480, and 02490.

Materials

02540.10  Steel Forgings - Steel forgings shall conform to the following:
   - Carbon steel forgings ................... AASHTO M 102 (ASTM A 668), Class C
   - Alloy steel forgings  ....................... AASHTO M 102 (ASTM A 668), Class G

02540.20  Steel Shafting - Steel shafting shall be cold-finished and shall conform to AASHTO M 169 (ASTM A 108), Grades 1016 - 1030, inclusive.

02540.30  Steel Castings - Steel castings shall conform to the following:
   - Carbon steel castings.............. AASHTO M 103 (ASTM A 27), Grade 70-36
   - Alloy steel castings.......... AASHTO M 163 (ASTM A 743), Grade CA-15

   Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Allowance will be made in dimensions for reasonable pattern draft.

   Castings shall be boldly filleted at angles and the arises shall be sharp and perfect.

   Sandblast castings or otherwise effectively clean off scale and sand to present a smooth, clean and uniform surface.

02540.40  Iron Castings - Iron castings shall conform to the following:
   - Gray Iron Castings - AASHTO M 105, Class 35 with the test bar size, A, B, C or S as appropriate to the dimensions of the casting.
   - Ductile Iron Castings - ASTM A 536, Grade 60-40-18, or as specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing over 1,000 pounds.
   - Malleable Iron Castings - ASTM A 47, Grade 32510.

   Finish iron castings according to Section 02540.30.

   Clean iron castings according to Section 02540.30.
02540.50 **Nonferrous Materials** - Nonferrous materials shall conform to the following:

- Bronze castings: AASHTO M 107 (ASTM B 22) Copper Alloy UNS No. C91100
- Copper alloy plates: AASHTO M 108 (ASTM B 100) Copper Alloy UNS No. C51000

02540.60 **Acceptance** - Acceptance of forgings, shafting, castings, and nonferrous materials will be according to 00165.35 and this Section.
Section 02560 - Fasteners

Description

02560.00 Scope - This Section includes the requirements for fasteners.

Materials

02560.10 Carbon Steel Fasteners:

(a) Bolts - Carbon steel bolts shall conform to ASTM A 307, Grade A.

(b) Nuts - Nuts for carbon steel bolts shall conform to the requirements of the following, or equivalent:

Plain (Non-coated) Bolts:

- 1/4 inch - 1 1/2 inch - AASHTO M 291 (ASTM A 563), Grade A, hex
- Over 1 1/2 inch - 4 inch - AASHTO M 291 (ASTM A 563), Grade A, heavy hex

Galvanized Bolts:

- All - AASHTO M 291 (ASTM A 563), Grade A, C, D, or DH, heavy hex

(c) Washers - Washers for carbon steel bolts shall conform to ASTM F 436.

02560.20 High-Strength Fasteners:

(a) Bolts - High-strength bolts shall conform to AASHTO M 164 (ASTM A 325). High-strength bolts used in noncoated weathering steel connections shall be Type 3.

(b) Nuts - Nuts for high-strength bolts shall conform to the requirements of the following, or equivalent:

Type 1 Plain (Non-coated) Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade C, D, or DH

Type 1 Galvanized Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade DH
Type 3 Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade C3 or DH3

(c) Washers - Washers for high-strength bolts shall conform to ASTM F 436. Use Type 3 washers with Type 3 bolts.

(d) Direct Tension Indicators - Direct tension indicators shall be the compressible-washer type, mechanically galvanized, conforming to ASTM F 959. Adjust bolt lengths to accommodate both direct tension indicators and hardened washers.

(e) Markings - All bolts, nuts, washers and direct tension indicators shall be marked according to the appropriate AASHTO/ASTM specifications and with a symbol identifying the manufacturer.

(f) Lock-Pin and Collar Fasteners - The shank and head of high-strength steel lock-pin and collar fasteners shall meet the requirements of 02560.20(a) and the chemical composition and mechanical property requirements of ASTM A 325 types, as specified. Each fastener shall have the following:

- A solid shank body of sufficient diameter to provide tensile and shear strength equivalent to or greater than the bolt specified
- A cold-forged round head on one end, of type and dimensions as approved
- A shank length suitable for the thickness of the material fastened
- Annular locking grooves
- A breakneck groove (annular)
- Annular pull grooves (all annular grooves) on the opposite end
- A steel locking flange type collar, of proper size for the shank diameter used. The collar shall be cold-swaged into the locking grooves by means of suitable installation tools, approved by the fastener manufacturer, to form a head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collars shall be equipped with tab locks to prevent slippage during installation and shall be a standard product of an approved, established manufacturer of lock-pin and collar fasteners.

Where lock-pin and flange type collar fasteners are used, flat washers will not be required.

Clean the exposed end of the pin, where the pintail breaks away from the pin, with a wire brush and solvent. After cleaning, coat the exposed end with a zinc and micaceous iron oxide-filled single-component moisture-cured urethane primer, followed by micaceous iron oxide-filled single-component top coat colored to match the work. On galvanized fasteners, the exposed end of the pin may also be repaired according to ASTM A 780.
Type 3 fasteners do not require coating.

02560.30 Tie Rods and Anchor Rods:

(a) **Carbon Steel Tie Rods and Anchor Rods** - Carbon steel tie rods and anchor rods shall conform to: AASHTO M 314, Grade 36 or 55; ASTM F 1554, Grade 36 or 55; or ASTM A 307.

(b) **High-Strength Tie Rods and Anchor Rods** - High-strength tie rods and anchor rods shall conform to: AASHTO M 314, Grade 105; ASTM F 1554, Grade 105; or ASTM A 449, Type 1.

(c) **Nuts** - Nuts for tie rods and anchor rods shall conform to the requirements of the following, or equivalent:

Plain Carbon Steel Tie Rods and Rods:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade A

Galvanized Carbon Steel Tie Rods and Anchor Rods:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade A, C, D, or DH

Plain Or Galvanized High-Strength Tie Rods or Anchor Rods:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade DH, heavy hex

(d) **Washers** - Washers for anchor rods shall conform to ASTM F 436, Type 1.

02560.40 Galvanizing and Coating of Fasteners, Tie Rods, and Anchor Rods:

(a) **Galvanizing of Fasteners, Tie Rods, and Anchor Rods** - Hot-dip galvanize fasteners, tie rods, anchor rods, nuts and washers according to AASHTO M 111 (ASTM A 123) or AASHTO M 232 (ASTM A 153) as appropriate to the product.

When specified, mechanically galvanize fasteners according to ASTM B 695, Class 50, Type 1.

Match galvanized bolts, tie rods, and anchor rods with appropriate galvanized nuts for assembly. Ship nuts in the same container consisting of bolts, tie rods, or anchor rods.

Overtap nuts for galvanized fasteners, galvanized tie rods, and galvanized anchor rods according to AASHTO M 291 (ASTM A563).

Measure the zinc thickness on the wrench flats or top of bolt head of galvanized bolts and on the wrench flats of galvanized nuts.
(b) **Galvanizing of Direct Tension Indicators** - All galvanized compressible washer-type direct-tension indicators shall be mechanically galvanized according to ASTM B 695, Class 50, Type 1, by the manufacturer.

(c) **Repair of Hot-Dip Galvanizing** - Repair damaged hot-dip galvanizing according to ASTM A 780. Minimum zinc content for Method A2 is 94% on the dry film.

**Testing**

02560.60 Testing:

(a) **Rotational Capacity Test** - Test all high-strength fasteners, except anchor rods and tie rods, according to Method 1 or 2 below, as applicable. Perform the test on coated or galvanized fasteners after coating, galvanizing, oversize tapping and lubricating. Use nuts from those supplied with the bolts for the job. Use washers for this testing. Repeat the rotational capacity test at the job site prior to installation to verify the effectiveness of the lubricant. The rotational capacity test is not required for lock-pin and collar fasteners. Use Method 1 for long bolts and Method 2 for short bolts.

Test each combination of bolt production lot, nut lot and washer lot as an assembly. Assign a rotational capacity lot number to each combination of lots tested. The minimum frequency of testing shall be two assemblies per rotational capacity lot. The test shall meet one of the following requirements:

(1) **Method 1:**

Place the lubricated fastener, including a washer, in a device capable of indicating direct bolt tension. Use spacers or washers with the hole size the same nominal diameter as the hole in the washer for the fastener to be tested. Allow 3 to 5 full threads of the bolt to be exposed between the bearing surfaces of the bolt head and the nut. Tighten the nut to a snug-tight condition to produce an initial load in the bolt equal to 10% of the tension required in Table 00560-1 of Section 00560. Mark the nut’s position relative to the fixed bolt for this snug-tight position. Tighten the nut using a calibrated torque wrench and record the measured torque with the nut in motion to reach the tension required by Table 00560-1.

The above measured torque to produce the required bolt tensions shall not exceed the torque value calculated by the following equation:

\[ T = 0.25PD \]

Where:

- **T** = Torque in foot pounds
- **P** = Measured Bolt Tension in pounds
- **D** = Nominal Bolt Diameter in feet

Reject assemblies with torque values exceeding the calculated value.
Continue to tighten the nut until the nut has turned twice the rotation shown in Table 00560-3 of Section 00560 from its snug-tight position mark. Record the measured bolt tension. The tension shall not be less than 1.15 times the tension shown in Table 00560-1. Reject assemblies not meeting this tension.

Loosen and remove the nut. Examine the threads on the nut and bolt. Reject assemblies showing evidence of thread shear failure, stripping or torsional failure of the bolt.

(2) Method 2:

Bolts that are too short to be tested in a direct bolt tension indicating device shall be tested in a steel joint.

Place the lubricated fastener including a washer in one or more flat structural steel plates. The total thickness including the washer shall be such that 3 to 5 full threads of the bolt are located between the bearing surfaces of the bolt head and the nut. The hole in the joint shall have the same nominal diameter as the hole in the washer. Using a calibrated torque wrench, tighten the nut to a snug-tight condition to produce an initial torque in the bolt equal to approximately 10% of the torque calculated using the equation given in Method 1 above where P shall be the minimum tension in the bolt according to Table 00560-1 of Section 00560. Mark the nut's position relative to the fixed bolt for this snug tight position.

Using the calibrated torque wrench, further tighten the nut until the nut has turned the rotation shown in Table 00560-3 of Section 00560 from its snug-tight position mark. Prevent the bolt head from turning during the tightening process. Record the measured torque with the nut in motion. The measured torque shall not exceed 1.15 times the torque value calculated in the preceding step of Method 2. Reject assemblies with torque values exceeding the calculated value.

Tighten the nut further until the nut has turned twice the rotation shown in Table 00560-3 from its snug-tight position mark. Reject assemblies which fail this rotation either by stripping or fracture.

Loosen and remove the nut. Examine the threads on the nut and bolt. Reject assemblies showing evidence of thread shear failure, stripping or torsional failure of the bolt.

(3) Shipping - Ship bolts, nuts and washers from each rotational capacity test lot in the same container. If there is only one rotational capacity test lot for each size of bolt, the bolts, nuts and washers may be shipped in separate containers. Permanently mark each container with the rotational capacity test lot number to enable identification at any stage before installation.

(b) Other Test Requirements - Proof load testing on all high-strength bolts and nuts is mandatory. Test bolts according to ASTM F 606, Method 1, and nuts according to ASTM F 606, paragraph 4.2, with frequency of tests
according to paragraph 9.3 of ASTM A 563. Test galvanized bolts, rods, and nuts after galvanizing, overtapping and lubricating. Coated bolts, rods, and nuts may be tested before coating.

Wedge test all bolts according to ASTM F 606, paragraph 3.5, with frequency of testing according to ASTM A 325. Test galvanized bolts after galvanizing. Coated bolts may be tested before coating.

Perform other tests called for on the plans.

Provide certified test results for all tests required by these Specifications or the individual product specifications.

Provide 3 extra high strength bolt assemblies per size per lot for check testing.

Provide 1 extra high strength tie rod or anchor bolt per size per lot for check testing.

**Lubricating Fasteners** - Lubricate all galvanized and coated fasteners with a lubricant containing a visible dye of any color that contrasts with the color of galvanizing or coating so a visual check can be made for the lubricant at the time of field installation. Black fasteners shall be "oily" to the touch when installed.

Lubricate galvanized fasteners using commercial wax and coated fasteners using commercial water-soluble wax. Lubricants for galvanized and coated fasteners shall be from the CPL.

Field lubricate galvanized bolts in tapped holes, galvanized anchor rods, and galvanized tie rods with a lubricant from the CPL. Apply lubricant to threads and to bearing surfaces that will turn during installation.

Protect fasteners from dirt and moisture at the job site. Clean, lubricate and retest weathered or rusted fasteners before installing. Do not re-lubricate tension control fasteners designed to automatically provide the tension without consulting with the manufacturer.

The outer surface of the collar in lock-pin and collar fasteners shall be coated with a lubricant as approved by the manufacturer. This lubricant allows the installation tool to swage the collar without removing the corrosion protection from the outer surface.

**Acceptance** - Acceptance of fasteners will be according to 00165.35 and this Section.
Section 02570 - Composite Bearings

Description

02570.00 Scope - This Section includes the material requirements for composite bearings.

Materials

02570.10 Materials - Provide materials meeting the following requirements:

Structural steel ................................................................. 02530.20
Stainless steel sliding surfaces ....................................... ASTM A 240, Type 304
Flat brass rings for pot bearings .............................. ASTM B 36, half hard
Cap screws .......................................................... ASTM A 574 or ASTM F 835
Bolts and nuts .......... AASHTO M 164 (ASTM A 325) and Section 02560
Galvanized Bolts, Nuts, Washers, Cap Screws,
| Sole Plates and Base Plates ................................. 02530.70 and 02560.40
| Woven Polytetrafluoroethylene (PTFE). Section 18 of the current AASHTO
| .................................................................................. LRFD Bridge Construction Specifications

Welded Stainless Steel Overlay - Produce welded stainless steel overlay for the convex rotational surface of spherical bearings using Type 309L electrodes.

Elastomer - Elastomer for elastomeric discs of pot bearings shall be 100% virgin natural polyisoprene (natural rubber) or 100% virgin chloroprene (neoprene) meeting the following requirements:

NATURAL POLYISOPRENE (Natural Rubber):

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Durometer D</td>
<td>D 2240</td>
<td>50 ± 5</td>
</tr>
<tr>
<td>Tensile strength, minimum, psi</td>
<td>D 412</td>
<td>2,250</td>
</tr>
<tr>
<td>Ultimate elongation, minimum, %</td>
<td>D 412</td>
<td>450</td>
</tr>
</tbody>
</table>

Heat Resistance

<table>
<thead>
<tr>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in durometer hardness, maximum points</td>
<td>D 573, 70 hour</td>
</tr>
<tr>
<td>Change in tensile strength, maximum, % at 158 °F</td>
<td>-25</td>
</tr>
<tr>
<td>Change in ultimate elongation, maximum, %</td>
<td>-25</td>
</tr>
</tbody>
</table>

Compression Set

<table>
<thead>
<tr>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 hours at 158 °F, maximum, %</td>
<td>D 395, Method B</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ozone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F</td>
<td>D 1149</td>
<td>No Cracks</td>
</tr>
<tr>
<td>48 hours mounting Procedure D518, Procedure A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adhesion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bond made during vulcanization, lb/in</td>
<td>D 429 Method B</td>
<td>40</td>
</tr>
<tr>
<td><strong>Low Temperature Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brittleness at -40 °F</td>
<td>D 746 Procedure B</td>
<td>No Failure</td>
</tr>
<tr>
<td><strong>VIRGIN CHLOROPRENE:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physical Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardness, Durometer D</td>
<td>D 2240</td>
<td>50 ± 5</td>
</tr>
<tr>
<td>Tensile strength, minimum, psi</td>
<td>D 412</td>
<td>2,500</td>
</tr>
<tr>
<td>Ultimate elongation, minimum, %</td>
<td>D 412</td>
<td>400</td>
</tr>
<tr>
<td><strong>Heat Resistance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in durometer hardness, maximum points</td>
<td>D 573</td>
<td>+15</td>
</tr>
<tr>
<td>Change in tensile strength, maximum, % at 212 °F</td>
<td>D 412</td>
<td>-15</td>
</tr>
<tr>
<td>Change in ultimate elongation, maximum, %</td>
<td>D 412</td>
<td>-40</td>
</tr>
<tr>
<td><strong>Compression Set</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 hours at 212 °F, maximum, %</td>
<td>D 395 Method B</td>
<td>35</td>
</tr>
<tr>
<td><strong>Ozone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F</td>
<td>D 1149</td>
<td>No Cracks</td>
</tr>
<tr>
<td>100 hours mounting Procedure D518, Procedure A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adhesion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bond made during vulcanization, lb/in</td>
<td>D 429 Method B</td>
<td>40</td>
</tr>
</tbody>
</table>

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Low Temperature Test

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Britteness at -140 °F</td>
<td>D 746 Procedure B</td>
<td>No Failure</td>
</tr>
</tbody>
</table>

When test specimens are cut from the finished product a 10% variation in physical properties will be allowed.

**Polyether Urethane** - The properties of polyether urethane for polyether urethane discs of disc bearings shall meet the values of the following tests:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Range of Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Durometer D</td>
<td>ASTM D2240</td>
<td>62 ± 2</td>
</tr>
<tr>
<td>Tensile stress, psi</td>
<td>ASTM D412</td>
<td>2,000 min</td>
</tr>
<tr>
<td>at 100% elongation</td>
<td></td>
<td>3,700 min</td>
</tr>
<tr>
<td>at 200% elongation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>ASTM D412</td>
<td>5,000 min</td>
</tr>
<tr>
<td>Ultimate elongation %</td>
<td>ASTM D412</td>
<td>220 min</td>
</tr>
<tr>
<td>Compression set, 22 hrs at 158 °F</td>
<td>ASTM D395</td>
<td>40 max</td>
</tr>
</tbody>
</table>

**Fabric Pads** - Make preformed fabric pads for fabric pad bearings of multiple layers of duck, impregnated and bound with high quality oil resistant synthetic rubber compressed into resilient pads of uniform thickness according to the following:

- Cotton duck reinforcement shall be either 1 two-ply cotton yarn or a single-ply 50-50 blend cotton-polyester weighing a minimum of 8 ounces per square yard.
- The fabric shall have a minimum tensile strength of 150 pounds per inch width when tested by the grab method.
- The filling count of the duck shall be 40 ± 2 threads per inch.
- The warp count of the duck shall be 50 ± 1 thread per inch.
- The number of plies shall produce the specified thickness after compression and vulcanizing.
- The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi without any sign of distress after the load is removed. The tested pad shall have a shape factor greater than 2.5. The preformed fabric pad shall have a Shore A hardness of 90 ± 5.

**02570.20 Testing** - The manufacturer shall have a typical bearing either tested and certified by an independent testing laboratory, or shall test a typical bearing with the test witnessed and attested to by an independent testing laboratory, for compliance with specified performance requirements as listed below. Tests shall have been performed within five years before Award of the Contract. Provide a test results certificate according to 00165.35 with the submittal of shop drawings.
(a) **Friction Test** - The coefficient of friction between the sliding surfaces shall not be greater than 0.06 when the maximum working stress for the polytetrafluoroethylene (PTFE) surface is 2,000 psi. It shall not be greater than 0.045 when the maximum working stress for the PTFE surface is 3,500 psi. Determine the coefficient of friction at 68 °F according to the requirements of section 18.8.3 of the AASHTO RFD Bridge Construction Specifications.

(b) **Proof Load Test:**

1. **Vertical Proof Load Test** - Apply a vertical load equal to 150% of the vertical design capacity of the tested bearing for a period of one hour. Place the bearing in a rotated position during the test. Rotation shall be 0.015 radians or the design rotation, whichever is greater. The test bearing shall show no indication of failure or other defects such as weld cracking, plate distortion, extrusion of the elastomer or bearing material, or displacement of the elastomer seal while under load or subsequently upon disassembly and inspection.

   The bearing tested for vertical proof load shall have a vertical design capacity no more than 50% greater or no less than 50% smaller than the capacity of the required bearing. The successful test of a bearing with a vertical design capacity of 50 tons or less will be accepted as qualification for all bearings of a similar design with a lesser design capacity.

2. **Horizontal Proof Load Test** - A horizontal proof load test is required when the design horizontal capacity exceeds 10% of the design vertical capacity and no engineer's calculations are submitted. Apply a horizontal load equal to 100% of the horizontal design capacity while also applying a vertical load equal to 100% of the dead load for a period of 2 minutes. The bearing does not need to be in the rotated position. The bearing shall show no indication of failure or other defects such as weld cracking, plate distortion, extrusion of the elastomer or bearing material, or displacement of the elastomer seal while under load or subsequently upon disassembly and inspection.

   The bearing tested for horizontal proof load may be either a bearing specified for use on the Project or a similar type bearing with both a vertical design capacity and a horizontal design capacity within 10% of the design capacities of bearings specified for use on the Project.

(c) **Acceptance** - For each composite bearing used in the structure, provide the manufacturer's quality compliance certificate according to 00165.35 that verifies the bearing has been manufactured according to the design of the tested bearing.
Section 02571 - Elastomeric Bearing Pads

Description

02571.00 Scope - This Section includes the requirements for plain and laminated elastomeric bearing pads.

Materials

02571.10 Elastomeric Compound - The elastomer portion of the elastomeric compound shall be 100% virgin chloroprene (neoprene) meeting the requirements of section 18 of the AASHTO LRFD Bridge Construction Specifications including the properties from the following table:

Table 02571-1

<table>
<thead>
<tr>
<th>Properties</th>
<th>ASTM Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Durometer D</td>
<td>D 2240</td>
<td>60 ± 5</td>
</tr>
<tr>
<td>Tensile strength, min., psi</td>
<td>D 412</td>
<td>2,200</td>
</tr>
<tr>
<td>Ultimate elongation, min., %</td>
<td>D 412</td>
<td>350</td>
</tr>
<tr>
<td>Heat Resistance:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in durometer hardness, max. points after 70 hr. at 212 °F</td>
<td>D 2240</td>
<td>+15</td>
</tr>
<tr>
<td>Change in tensile strength, max. % after 70 hr. at 212 °F</td>
<td>D 573</td>
<td>-15</td>
</tr>
<tr>
<td>Change in ultimate elongation, max. % after 70 hr. at 212 °F</td>
<td>D 573</td>
<td>-40</td>
</tr>
<tr>
<td>Compressive set, max. % after 22 hr. at 212 °F</td>
<td>D 395 Method B</td>
<td>35</td>
</tr>
<tr>
<td>Adhesion: Bond made during vulcanization, lb/in</td>
<td>D 429 Method B</td>
<td>40</td>
</tr>
<tr>
<td>Tear Resistance, psi</td>
<td>D 624 Die C</td>
<td>180</td>
</tr>
</tbody>
</table>

02571.15 Metal Reinforcement - Metal reinforcement shall be rolled, mild steel sheets 14 gauge thick and conforming to ASTM A 1011, Grade 36 Type 1, or ASTM A 1008, Grade 40.
02571.20 Manufacturing Requirements:

(a) Pads - Pads 1/2 inch thick shall be all elastomer. Pads over 1/2 inch thick shall consist of alternate laminations of elastomer and metal.

In metal reinforced pads, the top and bottom layers shall be elastomer 1/4 inch thick, and interior elastomer layers shall be 1/2 inch thick. The nominal thickness of the bearing shown reflects the thickness of the elastomer only. It does not include the steel laminates.

(b) Laminations - Laminations of elastomer shall be of uniform thickness and in no case shall the thickness of an individual lamination exceed 5/8 inch. Variations in thickness of an individual elastomer lamination shall not exceed 1/8 inch and the variation in thickness of all elastomer laminations within a pad shall be such that each metal lamination shall not vary by more than 1/8 inch from a plane parallel to the top or bottom surface of the pad.

(c) Laminated Pads - Laminated pads shall be molded individually to the sizes required. No shearing to size or drilling of holes will be allowed. Cover all edges of metal laminations with a minimum of 1/8 inch, and a maximum of 1/4 inch, of elastomer except at laminate restraining devices and around holes that will be entirely closed when the pad is in place on the structure.

Clean the exposed edge voids in the pads caused by the steel laminate restraining devices with a solvent. Shop seal with an appropriate caulking material before shipment.

Sandblast and clean the steel laminates of all surface coatings such as grease, oil, rust and mill scale before bonding. Free the laminates of sharp edges and burrs.

Pads 1/2 inch in thickness may be sheared. The shearing shall not heat the material and shall produce a smooth finish to 250 microinches with no tears or jagged areas.

(d) Dimensional Tolerances and Finishes - See section 18 of the AASHTO LRFD Bridge Construction Specifications for fabrication tolerances.


02571.30 Laminated Bearing Pad Tests and Acceptance Criteria:

(a) General - Comply with additional test requirements of this subsection. Non-laminated bearing pads do not require these tests.

Independent test all completed bearings by compressive visual inspection according to 02571.30(b). Failure of individual bearings to pass the compressive visual inspection will be cause for rejection of those individual bearings.

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Independently test five standard specimens of laminated pads according to 02571.30(c). Failure of any individual specimen to meet the peel strength test requirements will be cause for rejection of the entire bearings production lot. A lot is defined as 50 or less bearings which are manufactured in a reasonably continuous manner from the same batch of elastomer, cured under the same conditions, and are all the same size and type.

Replace rejected bearings with new acceptable bearings at no additional cost to the City. Provide the sample pad and perform all testing at no additional cost to the City.

Mark all bearings in indelible ink or flexible paint with the Contract number, lot number, date of manufacturer, and bearing identification number. Place the marking on a side face visible after erection of the bridge.

Clean and free the bearings of any foreign substances such as dust, grit and moisture before testing.

(b) Short-Duration Compression Test - Bring all bearings to a temperature of 73 °F and proof load for a compressive load 5 times the maximum design load. The load shall be held for five minutes, removed, then reapplied for a second period of five minutes. Maintain the load constant while the bearing is inspected for visual faults. The following will be cause for rejection:

- A bulging pattern or patterns implying lack of bond between the elastomer or bulging patterns that imply improper laminate placement.
- Three separate surface cracks which are greater than 5/64 inch wide and 5/64 inch deep, or a single crack 3/16 inch deep or wider than 1/4 inch.

(c) Peel Strength Test - Perform a peel strength test according to ASTM D 429 Method B, with the exception that the specimens shall be taken randomly and cut from a production bearing submitted for the Project. The bond between the elastomer and steel laminate in each specimen shall be not less than 40 pounds per inch.

(d) Long Duration Compression Test - Perform long term duration compression tests according to the requirements of AASHTO LRFD Construction Specifications when steel reinforced elastomeric bearings are designed using Method B, or when using Grade 4 elastomer.

02571.31 Acceptance - Provide a quality compliance certification according to 00165.35 that the bearing pads conform to the requirements for materials, fabrication and testing. Provide a test result certificate according to 00165.35 that includes the manufacturer's and independent testing laboratory test results according to 02571.30(a).
02610.00 Scope - This Section includes the requirements for special filter material for backfilling or filling trenches for perforated drains and other subsurface drains.

Materials

02610.10 Special Filter Materials - Furnish a specially graded filter material of coarse sand, and crushed or uncrushed rock that meets the following requirements:

(a) Grading - Sieve analysis will be determined according to AASHTO T 27. The material shall meet the following requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>54 -82</td>
</tr>
<tr>
<td>No. 10</td>
<td>34 - 58</td>
</tr>
<tr>
<td>No. 40</td>
<td>9 - 17</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 3</td>
</tr>
</tbody>
</table>

(b) Sand Equivalent - Special filter material will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.
Section 02620 - Bedding and Joint Sand

Description

02620.00 Scope - This Section includes the requirement for bedding and joint sand for pavers.

Materials

02620.10 Bedding Sand - Furnish a specially graded material of coarse sand that meets the following requirements:

(a) Grading for Sidewalk Use - Sieve analysis will be determined according to AASHTO T 27. The bedding sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80 - 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 - 85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 - 60</td>
</tr>
<tr>
<td>No. 50</td>
<td>5 - 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>1</td>
</tr>
</tbody>
</table>

(b) Grading for Street Use - Sieve analysis will be determined according to AASHTO T 27. The material shall be comprised of naturally occurring silica sand. The bedding sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80 - 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 - 75</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 - 45</td>
</tr>
<tr>
<td>No. 50</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 2</td>
</tr>
<tr>
<td>No. 200</td>
<td>0</td>
</tr>
</tbody>
</table>

(c) Sand Equivalent - Bedding sand will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

(d) Particle Shape - For street use, the shape of the sand grain shall be cuboid. The particles of sand shall be angular and of approximately cubic shape. The shape shall be verified by a picture from an electron microscope.

(e) Geological Deposits - For street use, the sand shall be from Quarternary deposits. The type of deposit shall be verified in writing by a geologist who has visited the quarry site.
02620.11 Joint Sand - Furnish a specially graded material of coarse sand that meets the following requirements:

(a) Grading for Sidewalk Use - Sieve analysis will be determined according to AASHTO T 27. The joint sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Natural Sand Percent Passing</th>
<th>Manufactured Sand Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>95 - 100</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>70 - 100</td>
<td>70 - 100</td>
</tr>
<tr>
<td>No. 30</td>
<td>40 - 75</td>
<td>40 - 100</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 - 35</td>
<td>20 - 40</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 - 15</td>
<td>10 - 25</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 1</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

(b) Grading for Street Use - Sieve analysis will be determined according to AASHTO T 27. The material shall be comprised of naturally occurring silica sand. The joint sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80 - 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 - 75</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 - 45</td>
</tr>
<tr>
<td>No. 50</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 2</td>
</tr>
<tr>
<td>No. 200</td>
<td>0</td>
</tr>
</tbody>
</table>

(c) Sand Equivalent - Joint sand will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

(d) Particle Shape - For street use, the shape of the sand grain shall be cuboid. The particles of sand shall be angular and of approximately cubic shape. The shape shall be verified by a picture from an electron microscope.

(e) Geological Deposits - For street use, the sand shall be from Quarternary deposits. The type of deposit shall be verified in writing by a geologist who has visited the quarry site.
Section 02630 - Base Aggregate

Description

02630.00 Scope - This Section includes the requirements for aggregates in base.

Materials

02630.10 Dense-Graded Aggregate:

(a) Grading - Dense-graded base aggregate shall be crushed rock, including sand. Uniformly grade the aggregates from coarse to fine. Sieve analysis will be determined according to AASHTO T 27. The aggregates shall conform to one of the grading requirements of Table 02630-1 as called for in the Special Provisions or indicated by the pay item(s) in the Schedule of Items.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>2 1/2&quot; - 0</th>
<th>2&quot; - 0</th>
<th>1 1/2&quot; - 0</th>
<th>1&quot; - 0</th>
<th>3/4&quot; - 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 1/2&quot;</td>
<td>95 - 100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2&quot;</td>
<td>–</td>
<td>95 - 100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>–</td>
<td>–</td>
<td>95 - 100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1 1/4&quot;</td>
<td>55 - 75</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1&quot;</td>
<td>–</td>
<td>55 - 75</td>
<td>–</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>–</td>
<td>–</td>
<td>55 - 75</td>
<td>–</td>
<td>90 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>55 - 75</td>
<td>–</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>55 - 75</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>30 - 45</td>
<td>30 - 45</td>
<td>35 - 50</td>
<td>40 - 55</td>
<td>40 - 60</td>
</tr>
</tbody>
</table>

1 Of the fraction passing the 1/4 inch sieve, 40% to 60% shall pass the No. 10 sieve

(b) Fracture of Rounded Rock - Fracture of rounded rock will be determined according to AASHTO TP 61. Provide at least one fractured face based on the following percentage of particles retained on the 1/4 inch sieve for the designated size:

1203       City of Portland 2010
Minimum % of Fractured Particles
by Weight of Material

<table>
<thead>
<tr>
<th>Designated Size</th>
<th>Retained on 1/4 inch Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot; - 0 and larger</td>
<td>50</td>
</tr>
<tr>
<td>Smaller than 1 1/2&quot; - 0</td>
<td>70</td>
</tr>
</tbody>
</table>

(c) Durability - Dense-graded aggregate shall meet the following durability requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion Degradation</td>
<td>AASHTO T 96</td>
<td>35.0% maximum</td>
</tr>
<tr>
<td>(Coarse Aggregate)</td>
<td>ODOT TM 208</td>
<td>30.0% maximum</td>
</tr>
<tr>
<td>Passing No. 20 sieve</td>
<td>ODOT TM 208</td>
<td>3.0&quot; maximum</td>
</tr>
<tr>
<td>Sediment Height</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(d) Sand Equivalent - Dense-graded aggregate will be tested according to AASHTO T 176, and shall have a sand equivalent of not less than 30.

02630.11 Open-Graded Aggregate:

(a) Grading - Open-graded aggregate shall conform to the following grading requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>80 - 98</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60 - 85</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>30 - 65</td>
</tr>
<tr>
<td>No. 10</td>
<td>5 - 20</td>
</tr>
<tr>
<td>No. 40</td>
<td>0 - 6</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 3 (Dry Sieve)</td>
</tr>
</tbody>
</table>
(b) **Fracture of Rounded Rock** - Fracture of rounded rock will be determined according to AASHTO TP 61. Open-graded aggregate fracture requirements shall conform to the following:

<table>
<thead>
<tr>
<th>Material Retained on 3/4”, 1/2”, and 1/4” Sieves (2 fractured faces)</th>
<th>Material Retained on No. 10 Sieve (1 fractured face)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Fracture by Weight</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>75</td>
</tr>
</tbody>
</table>

(c) **Durability** - Open-graded aggregate shall meet the durability requirements of 02630.10(c).
Section 02640 - Shoulder Aggregate

Description

02640.00 Scope - This Section includes the requirements for shoulder aggregate.

Materials

02640.10 Aggregate:

(a) Grading - Shoulder aggregate shall be crushed rock, including sand. Sieve analysis will be determined according to AASHTO T 27. Uniformly grade the aggregates from coarse to fine. The aggregates shall conform to one of the grading requirements of Table 02640-1 as called for in the Special Provisions or indicated by the pay item in the Schedule of Items.

(b) Fracture of Rounded Rock - Fracture of rounded rock will be determined according to AASHTO TP 61. Provide at least one fractured face based on the following percentage of particles retained on the 1/4 inch sieve for the designated size:

Table 02640-1
Grading Requirements - Shoulder Aggregates

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1&quot; - 0</th>
<th>3/4&quot; - 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot;</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>—</td>
<td>90 - 100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>40 - 55</td>
<td>40 - 60</td>
</tr>
</tbody>
</table>

Minimum % of Fractured Particles
by Weight of Material

<table>
<thead>
<tr>
<th>Designated Size</th>
<th>Retained on 1/4&quot; Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot; - 0 and Larger</td>
<td>50</td>
</tr>
<tr>
<td>1 1/2&quot; - 0</td>
<td>50</td>
</tr>
</tbody>
</table>
(c) Durability - The produced aggregates shall meet the following requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>AASHTO T 96</td>
<td>35.0% maximum</td>
</tr>
<tr>
<td>Degradation (Coarse Aggregate)</td>
<td>ODOT TM 208</td>
<td>30.0% maximum</td>
</tr>
<tr>
<td>Passing No. 20 sieve</td>
<td>ODOT TM 208</td>
<td>3.0” maximum</td>
</tr>
<tr>
<td>Sediment Height</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(d) Sand Equivalent - Shoulder aggregate will be tested according to AASHTO T 176, and shall have a sand equivalent of not less than 25.
Section 02690 - PCC Aggregates

Description

02690.00  **Scope** - This Section includes the requirements for coarse and fine aggregates for Portland cement concrete.

Materials

02690.10  **Materials** - The Contractor may request approval to produce coarse and fine aggregates in sizes other than those stated in 02690.20 and 02690.30. The request shall be in writing, and shall state the proposed target value and specified tolerances for each of the individual sieve sizes of the materials the Contractor proposes to produce.

02690.20  **Coarse Aggregate:**

(a) **General Requirements** - Coarse aggregate shall consist of rock, or other approved inert material of similar characteristics having hard, strong, durable pieces free from adherent coatings.

(b) **Harmful Substances** - Harmful substances shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Percent (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T 113</td>
<td>1.0</td>
</tr>
<tr>
<td>Material passing No. 200 sieve</td>
<td>T 11</td>
<td>1.0</td>
</tr>
<tr>
<td>Wood Particles</td>
<td>TM 225</td>
<td>0.05</td>
</tr>
</tbody>
</table>

1 For crushed aggregates, if the material finer than the No. 200 sieve consists of fracture dust, essentially free of clay or shale and is non-plastic, the percentage may be increased to 1.5%.

The materials shall be reasonably free from all other deleterious substances.

(c) **Soundness** - Coarse aggregates for concrete shall be tested for soundness using sodium sulfate salt, according to AASHTO T104. The weighted percentage loss shall not exceed 12% by weight.

(d) **Durability** - Coarse aggregates shall meet the following durability requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>T 96</td>
<td>30.0% Max.</td>
</tr>
<tr>
<td>Oregon Air Aggregate Degradation:</td>
<td>TM 208</td>
<td>30.0% Max.</td>
</tr>
<tr>
<td>Passing No. 20 sieve</td>
<td>TM 208</td>
<td>3.0&quot; Max.</td>
</tr>
</tbody>
</table>

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(e) **PCC Paving Aggregate** - In addition to requirements above, comply with the following:

(1) **Fracture** - Provide aggregate with at least two fractured faces on at least 50% of the particles retained on the 3/8 inch, 1/2 inch, 3/4 inch, 1 inch, and 1 1/2 inch sieves, as determined by AASHTO TP 61.

(2) **Elongated Pieces** - Provide aggregate with elongated pieces not exceeding 10% by weight of the material retained on the No. 4 sieve when tested according to ODOT TM 229 with the proportional caliper device set at a ratio of 5:1.

(f) **Grading and Separation by Sizes for Prestressed Concrete** - Sampling shall be according to AASHTO T 2 and sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. PCC coarse aggregate shall conform to grading and separated sizes as follows:

(1) Where indicated in Table 02690-1, the coarse aggregate shall be separated into two sizes and each separated size shall be measured into the batch in the quantity determined by the mix design.

For each of the indicated maximum sizes of coarse aggregates, the separated sizes shall be as indicated in Table 02690-2:

<table>
<thead>
<tr>
<th>Maximum Nominal Size of Aggregates</th>
<th>Separated Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>1&quot; - No. 4</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot; - No. 4</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot; - 1/2&quot; and 1/2&quot; - No. 4</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot; - 3/8&quot; and 3/8&quot; - No. 4</td>
</tr>
</tbody>
</table>

(2) The grading of each of the specified separated sizes of coarse aggregate shall conform to the following:
### Table 02690-2

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1&quot;-No. 4</th>
<th>3/4&quot;-No. 4</th>
<th>3/4&quot;-1/2&quot;</th>
<th>3/8&quot;-1/2&quot;</th>
<th>3/8&quot;-No. 4</th>
<th>3/8&quot;-No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>90 - 100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>50 - 80</td>
<td>90 - 100</td>
<td>85 - 100</td>
<td>85 - 100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td></td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>85 - 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>15 - 40</td>
<td>20 - 50</td>
<td>0 - 15</td>
<td>35 - 65</td>
<td>85 - 100</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 10</td>
<td>0 - 10</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>0 - 15</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 10</td>
<td>0 - 10</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>0 - 15</td>
</tr>
</tbody>
</table>

**Percent Passing (by Weight)**

1 See 02690.20(b)

### Table 02690-3

**Gradation of Coarse Aggregates**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Combined Sizes</th>
<th>Separated Sizes</th>
<th>Separated Sizes</th>
<th>Separated Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot; - No. 4</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>95 - 100</td>
<td>90 - 100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>20 - 55</td>
<td>95 - 100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>35 - 70</td>
<td>0 - 15</td>
<td>85 - 100</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>25 - 60</td>
<td>0 - 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>10 - 30</td>
<td>0 - 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>0 - 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Percent Passing (by Weight)**

1 For 1 1/2 inch coarse aggregate use two or more separated sizes which when combined shall meet the gradation limits for 1 1/2" - No. 4
Table 02690-4
Gradation of Coarse Aggregates

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Separated Sizes</th>
<th>Separated or Combined Sizes</th>
<th>Separated Sizes</th>
<th>Separated Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4&quot; - 3/8&quot;</td>
<td>3/4&quot; - No. 4</td>
<td>1/2&quot; - No. 4</td>
<td>3/8&quot; - No. 8</td>
</tr>
<tr>
<td>1&quot;</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90 - 100</td>
<td>90 - 100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>20 - 55</td>
<td>---</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0 - 15</td>
<td>20 - 55</td>
<td>40 - 70</td>
<td>85 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
<td>0 - 10</td>
<td>0 - 15</td>
<td>10 - 30</td>
</tr>
<tr>
<td>No. 8</td>
<td>—</td>
<td>0 - 5</td>
<td>0 - 5</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 16</td>
<td>—</td>
<td>—</td>
<td>0 - 5</td>
<td></td>
</tr>
</tbody>
</table>

Percent Passing (by Weight)

02690.30 Fine Aggregates:

(a) General Requirements - Fine aggregate shall consist of natural or crushed aggregates or other inert material consisting of hard, strong, durable particles and conforming to a specified grading.

(b) Different Sources - Do not mix fine aggregates from different sources of supply, or store in the same pile. Do not use alternately in the same class of mix, without prior approval.

(c) Harmful Substances - The amount of harmful substances shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method (AASHTO)</th>
<th>Percent (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T 113</td>
<td>2.0%</td>
</tr>
<tr>
<td>Material passing No. 200 Sieve</td>
<td>T 11</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

1 If this material consists of fracture dust, essentially free of clay and non-plastic, the percentage may be increased to 6.0%.

The material shall also be reasonably free from all other harmful substances, such as shale, alkali, mica, coated grains, and soft and flaky particles.

(d) Soundness - Fine aggregate shall be tested for soundness using sodium sulfate salt, according to AASHTO T 104. The weighted percentage loss shall not exceed 10% by weight.

(e) Organic Impurities - All fine aggregate shall meet the requirements of AASHTO M 6 for organic impurities.

(f) Sand Equivalent - Fine aggregate shall be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 68.

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(g) **Sand For Mortar** - Sand for mortar shall conform to the requirements of this Section.

(h) **Grading** - Sampling shall be according to AASHTO T 2. Sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. Provide aggregates meeting the gradation requirements of Table 02690-5 for structural concrete on projects with more than 100 cubic yards of concrete, and all prestressed concrete. Provide a CAgT to perform sampling and testing when required.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>90 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>70 - 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 - 85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 - 60</td>
</tr>
<tr>
<td>No. 50</td>
<td>5 - 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>0.0 - 4.0</td>
</tr>
</tbody>
</table>

1 Determine the fineness modulus according to AASHTO T 27 and AASHTO T 11. Maintain the fine aggregate fineness modulus within plus or minus 0.20 from the fineness modulus used in the Contractor's mix design. Fine aggregates in which the fineness modulus varies by more than 0.20 from the mix design target shall be rejected unless an adjustment in the aggregate proportions is performed by a CCT according to the provisions of ACI 211.

2 For manufactured sand, where the material passing No. 200 is non-plastic rock dust crusher fines, the specification limits may be increased to 6%.
Railing and Guidance Devices

Section 02810 - Bridge Rail

Description

02810.00 Scope - This Section includes the requirements for the steel in railings for bridges.

Materials

02810.10 Shapes, Plates and Bars - Shapes, plates and bars shall comply with ASTM A 36.

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be according to 02530.70.

02810.20 Structural Steel Tubing - Structural steel rail members shall comply with ASTM A 500, Grade B, or ASTM A 501. Steel conforming to ASTM A 513 or ASTM A 618 may be substituted for ASTM A 500 tubing subject to the following limitations:

- Provide chemical and tensile properties test results.
- Silicon content shall be according to 02530.70.
- Strength and elongation requirements of ASTM A 513 tubing shall meet the requirements of ASTM A 500 tubing.

02810.30 Steel Pipe - Metal parapet rail members shall be standard steel pipe complying with ASTM A 53, Grade B or ASTM A 500, Grade B.

02810.40 Cast Steel Posts - Cast steel posts shall be carbon steel castings complying with AASHTO M 103 (ASTM A 27), Grade 65-35.

02810.50 Metal Thrie Beam Rail - Galvanize steel thrie beam rail according to AASHTO M 180, for Class A rail, Type II coating after fabrication and subject to the single spot test. Backup plates will be accepted with un-galvanized edges and bolt holes, provided these areas are field-coated with an approved galvanizing substitute according to 02530.71. Metal posts and hardware shall meet the requirements of 02820.20 and 02820.30.

02810.60 Incidentals - Plates, caps and miscellaneous pieces necessary to complete the rail shall be as shown or specified.

02810.70 Acceptance - Bridge rail materials will be accepted according to 00165.35 and this Section.
Section 02820 - Metal Guardrail

Description

02820.00 Scope - This Section includes the requirements, for forming galvanized steel sheets into metal beam rail, and the manufacture of guardrail hardware.

Materials

02820.10 Metal Beam Rail - Form metal beam rail from galvanized steel. Galvanized steel beam rail shall conform to the requirements of AASHTO M 180, Class A. The zinc coating shall conform to the requirements of AASHTO M 180, Type II, applied after fabrication and subject to the single spot test. Backup plates will be accepted with un-galvanized edges and bolt holes, provided these areas are field-coated with an approved galvanizing substitute.

02820.20 Metal Guardrail and Median Barrier Posts - Metal posts shall be of structural steel conforming to the requirements of ASTM A 36 and galvanized according to AASHTO M 111 (ASTM A 123).

02820.30 Guardrail Hardware - All bolts, nuts, washers and other fittings for beam-type guardrail shall be galvanized steel meeting the requirements of AASHTO M 180.

All bolts, nuts and washers shall be as detailed, with nuts tapped oversize not to exceed 1/32 inch.

02820.40 Guardrail Anchor Hardware - Provide cable and fittings for guardrail anchors that conform to the requirements of AASHTO M 30, Class C, for Type II cable. Galvanize all fittings according to AASHTO M 111 (ASTM A 123).

For steel anchors, the steel tubing shall meet the requirements of ASTM A 500, Grade B, ASTM A 501 or ASTM A 618. The soil plate shall meet the requirements of ASTM A 36. After fabrication galvanize tubing and plate according to AASHTO M 111 (ASTM A 123).

02820.50 Acceptance of Materials - If feasible, manufacturing plants will be inspected periodically for compliance with specified manufacturing methods, and material samples obtained for laboratory testing for compliance with materials quality requirements. This may be the basis for acceptance of manufacturing lots as to quality.

Acceptance of metal guardrail materials will be according to Section 00165.35 and this Section.
Section 02830 - Handrail

Description

02830.00 Scope - This Section includes the requirements for the steel in handrail for bridges and stairways.

Materials

02830.10 Shapes, Plates and Bars - Shapes, plates and bars shall comply with ASTM A 36.

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall according to 02530.70.

02830.20 Steel Pipe - Steel pipe used for handrail members shall comply with ASTM A 53 or ASTM A 500.

02830.30 Incidentals - Plates, caps and miscellaneous pieces necessary to complete the rail shall be as shown.

02830.40 Acceptance - Acceptance of handrail materials will be according to 00165.35 and this Section.
### Description

**02910.00 Scope** - This Section includes the requirements for backing, sheeting, legend, reflectors and hardware for sign installations.

**02910.02 Types of Signs** - Traffic signs are classified by sign type as follows:

- **"B"** Blue Type III or Type IV sheeting background with silver-white Type III or Type IV permanent or removable legend, or silver-white Type III or Type IV sheeting overlaid with blue transparent paste background with retroreflective silver-white screened legend.

- **"B1"** Blue Type I sheeting background with silver-white Type III or Type IV permanent or removable legend, with retroreflective silver-white screened legend.

- **"B2"** Blue Type III or Type IV sheeting background with white Type VII or Type IX permanent removable legend.

- **"B3"** Blue Type IX sheeting background with white Type VII or Type IX permanent or removable legend or white Type IX sheeting overlaid with blue transparent paste background, with retroreflective silver-white screened legend.

- **"C"** Brown Type III or Type IV sheeting background with silver-white Type III or Type IV permanent or removable legend, or silver-white Type III or Type IV sheeting overlaid with brown transparent paste background, with retroreflective silver-white screened legend.

- **"C1"** Brown Type III or Type IV sheeting background with white Type VII or Type IX permanent or removable legend.

- **"C2"** Brown Type IX sheeting background with white Type VII or Type IX permanent or removable legend or white Type IX sheeting overlaid with brown transparent paste background, with retroreflective silver-white screened legend.

- **"C3"** Brown prismatic lens retroreflective sheeting on extruded aluminum panels, with white prismatic lens retroreflective removable legend.

- **"F"** Silver-white Type III or Type IV sheeting background overlaid with red and blue transparent paste background with retroreflective silver-white screened legend or silver-white Type III or Type IV permanent legend.

- **"F1"** White Type IX sheeting background overlaid with red and blue transparent paste background with white Type VII or Type IX permanent legend.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;G&quot;</td>
<td>Green Type III or Type IV sheeting background with silver-white Type III or Type IV permanent or removable legend, or silver-white Type III or Type IV sheeting background overlaid with green transparent paste background with retroreflective silver-white screened legend.</td>
</tr>
<tr>
<td>&quot;G1&quot;</td>
<td>Green Type III or Type IV sheeting background with white Type VII or Type IX removable legend.</td>
</tr>
<tr>
<td>&quot;G2&quot;</td>
<td>Green Type III or Type IV sheeting background with white Type VII or Type IX permanent legend.</td>
</tr>
<tr>
<td>&quot;G3&quot;</td>
<td>Green Type IX sheeting background with white Type VII or Type IX permanent legend, or white Type IX sheeting background overlaid with green transparent paste background with retroreflective silver-white screened legend.</td>
</tr>
<tr>
<td>&quot;G4&quot;</td>
<td>Green Type IX sheeting background with white Type VII or Type IX removable legend.</td>
</tr>
<tr>
<td>&quot;G5&quot;</td>
<td>Green encapsulated lens retroreflective sheeting background with white prismatic lens retroreflective permanent legend, or white prismatic lens retroreflective sheeting background overlaid with green transparent paste background with white retroreflective screened legend with a screened red transparent paste rose on sheet aluminum. (Street Name Sign)</td>
</tr>
<tr>
<td>&quot;O&quot;</td>
<td>Orange Type I sheeting background with black nonreflective permanent legend.</td>
</tr>
<tr>
<td>&quot;OO&quot;</td>
<td>Orange Type III or Type IV sheeting background with black nonreflective permanent or removable legend.</td>
</tr>
<tr>
<td>&quot;O3&quot;</td>
<td>Fluorescent orange Type VII, Type VIII, Type IX, or Type X sheeting background with black nonreflective permanent legend and red retroreflective symbol (Stop or Yield Ahead Symbol Sign).</td>
</tr>
<tr>
<td>&quot;O4&quot;</td>
<td>Fluorescent orange Type VII, Type VIII, Type IX, or Type X sheeting background with black nonreflective permanent legend.</td>
</tr>
<tr>
<td>&quot;O5&quot;</td>
<td>Fluorescent orange Type VII, Type VIII, Type IX or Type X sheeting background with white nonreflective removable legend.</td>
</tr>
<tr>
<td>&quot;R&quot;</td>
<td>Silver-white Type III or Type IV sheeting background overlaid with red transparent paste background with silver-white Type III or Type IV permanent legend. (Stop Sign, Wrong-Way, Do Not Enter.)</td>
</tr>
<tr>
<td>&quot;R1&quot;</td>
<td>White Type IX sheeting background overlaid with red transparent paste background with white Type VII or Type IX permanent legend.</td>
</tr>
<tr>
<td>&quot;R2&quot;</td>
<td>Silver-white Type III or Type IV sheeting background overlaid with screened red transparent paste triangle and legend or red Type III or Type IV triangle and permanent legend. (Yield Sign)</td>
</tr>
</tbody>
</table>
"R3" White Type IX sheeting background overlaid with screened red transparent paste triangle and permanent legend.

"R4" Rubber STOP flap made of natural rubber with a red background and white lettering.

"W1" Silver-white Type III or Type IV sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"W2" Silver-white Type III or Type IV sheeting background with a screened black nonreflective legend overlaid with a screened red transparent paste circle and continuous diagonal bar. (Prohibition)

"W3" Silver-white Type III or Type IV sheeting background with transparent brown screened legend or brown Type III or Type IV cut-out permanent legend.

"W4" Silver-white Type III or Type IV sheeting background with transparent red screened legend or red Type III or Type IV cut-out permanent legend.

"W5" Silver-white Type III or Type IV sheeting background with transparent green screened legend or green Type III or Type IV cut-out permanent legend.

"W6" White Type IX sheeting background with a screened or cut-out black nonreflective legend overlaid with a screened red transparent paste circle and continuous diagonal bar. (Prohibition sign overhead)

"W7" White Type IX sheeting background with black nonreflective screened or cut-out permanent legend.

"W8" Silver-white Type III or Type IV sheeting background with blue transparent screened legend or blue Type III or Type IV cut-out permanent legend.

"W9" Silver-white Type III or Type IV sheeting background with blue nonreflective screened or cut-out permanent legend.

"W10" White Type IX sheeting background with black nonreflective removable legend.

"W11" Silver-white Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend with red Type III or Type IV symbol. (Bicycle Stop or Bicycle Yield symbol signs)

"Y1" Yellow Type III or Type IV sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"Y2" Yellow Type III or Type IV sheeting background with a screened or cut-out black nonreflective legend and red and green Type III or Type
IV circles. The center yellow circle part shall be part of the background sheeting. (Signal Ahead Symbol Sign)

"Y3" Yellow Type IX sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"Y4" Yellow Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend and red Type III or Type IV symbol. (Stop or Yield Ahead Symbol Sign)

"Y5" Fluorescent yellow Type IX sheeting background with black nonreflective screened cut-out permanent legend, or removable legend.

"Y6" Fluorescent yellow Type IX sheeting background with black nonreflective screened or cut-out permanent legend and red and green Type IX circles. The center yellow circle shall be part of the background sheeting. (Signal Ahead Symbol Sign overhead)

"Y7" Fluorescent yellow Type IX sheeting background with black nonreflective screened or cut-out permanent legend and red Type VII or Type IX symbol. (Stop or Yield Ahead Symbol Sign)

"Y8" Yellow Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend and silver-white Type III or Type IV symbol. (Speed Reduction Symbol Sign)

"YG" Fluorescent yellow-green Type IX sheeting background with black non-reflective legend or cut-out permanent legend.

"YGW" Fluorescent yellow-green Type IX sheeting background with black nonreflective screened or cut-out permanent legend and silver-white Type III or Type IV symbol with black nonreflective screened or cut-out permanent legend and red Type III or Type IV symbol. (In-Street Pedestrian Crossing Symbol Sign)

02910.10   Aluminum - The aluminum materials shall be new and conform to the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum bars or rods</td>
<td></td>
</tr>
<tr>
<td>Aluminum sand castings</td>
<td></td>
</tr>
<tr>
<td>Aluminum sheet</td>
<td></td>
</tr>
<tr>
<td>Extruded aluminum shapes</td>
<td></td>
</tr>
<tr>
<td>Rolled or extruded structural shapes</td>
<td></td>
</tr>
</tbody>
</table>

Aluminum to be color coated shall be of an alloy which is compatible with the coating and the application process. The color-coated aluminum shall have a temper that, after coating and aging, provides an ultimate strength of 30,000 psi and a yield strength of 25,000 psi.

Fabricate sheet aluminum signs from aluminum alloy 6061-T6, 5052-H38, 5154-H38, or approved equal, and give a chromate treatment conforming to
ASTM B 449, Class 2. Provide certified test reports for all heats of aluminum products furnished to the City. Signs shall be of the thickness shown on Table 02910-1 below unless otherwise indicated.

Table 02910-1

<table>
<thead>
<tr>
<th>Sign Width (Horizontal Measure)</th>
<th>Sheet Aluminum Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20”</td>
<td>0.063”</td>
</tr>
<tr>
<td>20” through 30”</td>
<td>0.080”</td>
</tr>
<tr>
<td>31” through 48”</td>
<td>0.100”</td>
</tr>
<tr>
<td>Over 48”</td>
<td>0.125”</td>
</tr>
</tbody>
</table>

Sheeting

02910.20 Reflective and Retroreflective Sheeting:

(a) General - Use reflective sheeting Type I and retroreflective sheeting Type III, Type IV, Type VII, Type VIII, Type 1X, and Type X from the CPL and the following:

(1) Perforation - If required for application, the sheeting may be pre-perforated with holes not greater than 0.02 inch in diameter. The perforations shall be approximately 0.4 inch apart in rows approximately 1.5 inches apart.

(2) Surface - The sheeting and adhesive shall be compatible with non-reflective permanent cut-out legend.

(b) Acceptance - Furnish a quality compliance certification according to 00165.10(b), certifying that the reflective sheeting furnished meets the above requirements.

02910.21 Nonreflective Sheet for Sign Background:

(a) General - The nonreflective sheeting shall be durable, weather resistant, gloss plastic film, and shall have a protected, precoated adhesive backing.

(b) Color - Color of the nonreflective sheeting shall conform to 00940.02. Submit for testing a 4 inch by 4 inch sample of the background color for each color of nonreflective sheeting shown.

(c) Adhesive - Adhere the nonreflective sheeting by a mildew and vandal resistant precoated adhesive that has no staining effect on the sheeting.

(d) Film:

(1) General - The nonreflective sheeting shall be flexible and easily cut to shape. The minimum tensile strength of the sheeting shall be 5 pounds per inch width.
(2) **Surface** - The sheeting surface shall be smooth and flat, to facilitate cleaning and wet performance. The sheeting surface shall be readily processed and compatible with recommended transparent and opaque process inks.

The sheeting shall permit cutting and color processing at minimum temperatures of 60 °F. The sheeting shall be heat resistant and shall permit force curing of applied sheeting at temperatures up to 150 °F. The sheeting surface shall be solvent resistant. Clean according to the manufacturer's recommendations.

(e) **Durability** - Process and apply according to the manufacturer’s recommendations. The material shall be weather resistant, and following cleaning shall show no discoloration, cracking, crazing, blistering or dimensional change.

The sheeting surface shall be capable of being readily refurbished when cleaned and clear over-coated according to the manufacturer’s recommendations.

(f) **Acceptance** - Furnish a quality compliance certificate according to 00165.35, certifying that the nonreflective sheeting furnished meets all the above requirements.

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02910.32 **Reflectorized Removable Legend:**

(a) **General** - The letter and numerals for all removable legend shall conform to the design of the FHWA "Standard Rounded Capital Letter Alphabets". The letters and numerals for removable legend for all freeway and expressway signs shall conform to the design of Series "E" modified version of the FHWA Standard Rounded Capital Letter Alphabets."

Provide mounting holes within the frames to permit the use of the mounting hardware specified in these Specifications. Provide a sufficient number of mounting holes to ensure a firm attachment of the frames to the sign and meet the requirements of 00940.45(b). This requires a minimum of four mounting holes at each joint in the border.

(b) **Retroreflective Sheeting Legend** - The silver-white or white letters, numerals, symbols and borders shall be of adhesive-coated retroreflective sheeting permanently adhered to a flat aluminum frame. The white retroreflective sheeting shall consist of Type VII or Type 1X sheeting conforming to 02910.20. The silver-white retroreflective sheeting shall consist of Type III or Type IV sheeting conforming to 02910.20.

Letters, numerals, symbols and borders shall be a minimum of 0.032 inch thick aluminum conforming to ASTM B 209/B 209M, alloy 3003-H14. Degrease and etch the aluminum, or treat with a light, tight amorphous chromate type coating.

Apply the reflective sheeting to the prepared aluminum according to the sheeting manufacturer’s recommendations.
The finished letters, numerals, symbols and borders shall be clean-cut and sharp, and shall have a nearly plane surface.

(c) Acceptance - Acceptance of retroreflective removable legend shall be a mill test certificate from the aluminum manufacturer attesting to the correct alloy, temper, and material thickness of the metal supplied. The Engineer may reject damaged or non-specification materials regardless of the test certification furnished.

02910.33 Permanent Legends:

(a) General - Permanent legends consist of silver-white retroreflective screened, red retroreflective screened, black screened or cut-out silver-white reflective sheeting. The letters and numerals of all permanent legends shall conform to the design of the FHWA "Standard Rounded Capital Letter Alphabets".

(b) Retroreflective White Screened Legend - The transparent paste materials used for the reverse screening of retroreflective white legends and for the screening of retroreflective red legends shall conform to the recommendations of the manufacturer of the reflective sheeting.

(c) Retroreflective Cut-out Legend - The material used for retroreflective cut-out legend shall conform to the requirements of 02910.20.

(d) Nonreflective Black Screened Legend - The screen process ink for nonreflective legends shall be Naz-Dar 811 Black Screen Process Ink (Naz-Dar Company), Sherwin Williams Kem Screen Process, color D22-B2 (Sherwin Williams Company), or approved equal.

(e) Nonreflective Black Cut-out Legend - The material used for nonreflective cut-out legend shall conform to 02910.21.

02910.40 Hardware - The bolts, nuts, and washers used to fabricate and erect signs shall be aluminum alloy, stainless steel, or galvanized steel. Aluminum for bolts and nuts shall conform to ASTM B 211, alloys 2024-T4 or 6061-T6 as the Contractor elects. Aluminum washers shall conform to ASTM B 209, alloy Alclad 2024-T4. Stainless steel shall be Type 316. Galvanized steel bolts, nuts, and washers shall be medium carbon steel. Galvanize steel hardware according to AASHTO M 232 (ASTM A 153).

Use nylon washers supplied by the sheeting manufacturer as shown or directed.

All mounting hardware shall be of the design and type shown, or if not shown shall be of such sizes and kinds as approved by the Engineer.

Blind rivets shall be 1/8 inch diameter, 1/4 inch head diameter, domed head, aluminum alloy conforming to ASTM B 316. Aluminum alloys 5052 and 5056 are acceptable alloys. Blind rivets used to attach sign panels to closure strips or wind beams shall be anodized the same color as the sign background.
02910.60 Electronically Cuttable Films for Use on Retroreflective Sheetings:

(a) General - Electronically cuttable films shall consist of durable, transparent, colored films coated with a transparent pressure sensitive adhesive protected by a removable liner. The films shall be designed to be cut on knife-over-roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift and transfer. Use electronically cuttable films from the CPL.

(b) Acceptance - If requested, furnished with each lot or shipment a quality compliance certificate according to 00165.35, certifying that the material supplied is an acceptable product on the CPL.

02910.75 Manufacturer’s Warranty - Furnish a Warranty, for Warranty periods stated below from the manufacturer and signed by a Manufacturer’s Representative, conforming to the following requirements:

For retroreflective Type III, Type IV, and Type VII sheeting used for permanent signs, provide a Warranty, for a Warranty period of 10 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For retroreflective Type IX sheeting used for permanent signs, provide a Warranty, for a Warranty period of 12 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For retroreflective sheeting used for temporary signs, provide a Warranty, for a period of 3 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For purposes of the Warranty, the retroreflective sheeting will be deemed to have failed if it has deteriorated due to conditions inherent to the sheeting (including inks, overlay film, and electronically cuttable film) to the extent that:

- The sign shows discoloration, cracking, delamination, loss of adhesion, or
- The coefficient of retroreflection is less than the following:
  - 80% of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D 4956 for the first 7 years of the Warranty period.
  - 70% of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D 4956 for the remaining 3 years of the Warranty period for Type III, Type IV, and Type VII sheeting and remaining 5 years of the Warranty period for Type IX sheeting.

All coefficient of retroreflection measurements will be made after signs are cleaned according to the Manufacturer’s recommendation.
The Warranty shall recite that, upon written notification by the City that the supplied sheeting or supplied sheeting with applied cuttable film, used according to the Manufacturer's recommendations, has failed, the Manufacturer shall repair or replace the sheeting, or sheeting with applied electronic cuttable film, within 6 months of the written notification according to the following:

- During the first 7 years, the Manufacturer shall restore the sign panel to a condition that meets the remaining warranty conditions at no cost to the City (100% full replacement covering all material and labor costs).
- For the remaining 3 years, (5 years for Type IX sheeting) the Manufacturer shall furnish replacement sheeting required to restore the sign panel to a condition that meets the remaining warranty conditions at no cost to the City (100% sheeting replacement).

When the City makes written notification to the Manufacturer of sheeting failure, the Warranty period will stop for the effected signs until required repairs or replacements are made and accepted.

All repaired or replaced signs and sheeting shall meet current sheeting specifications and be warranted for the remaining Warranty period.

The City will date all approved signs at the time of inspection at the City's material laboratory. That date is the start of the Warranty period.

Applicable warranties for sign sheeting shall be turned over to the City. The City shall be named obligee on all manufacturer's warranties. The warranty document shall have an identifying document number assigned to it that is unique to the project that it is submitted for, such that warranty claims can be processed under a specific document number. The warranty document shall be dated to reflect the date that the document is submitted to the City for approval.
Section 02920 - Common Electrical Materials

Description

02920.00 Scope - This Section includes the requirements for common electrical systems.

Materials

02920.02 Powder Coating - Powder coat materials according to Section 00594:

(a) Galvanized Steel - After galvanizing light brush blast according to SSPC-SP-7 that removes surface contaminants and provides a profile but does not destroy the integrity of the galvanizing. Hand sand and debur as needed to remove rough areas. Preheat galvanized steel before powder coating to eliminate off gassing during curing. Electrostatically apply and oven cure a TGIC Polyester powder according to manufacture specifications to achieve a 50 micron minimum dry film thickness. The time from brush blasting to curing shall take no longer than 8 hours to reduce surface oxidation. Coated galvanized steel shall have a salt spray resistance of 1,000 hours using ASTM B117 without loss of adhesion. Retap threads as required.

(b) Aluminum - Solvent clean according to SSPC-SP-1 followed by a light brush blast according to SSPC-SP-7. Preheat aluminum before powder coating to eliminate off gassing during curing. Electrostatically apply and oven cure a TGIC Polyester powder according to manufacture specifications to achieve a 50 micron minimum dry film thickness. The time from solvent cleaning to curing shall take no longer than 8 hours to reduce surface contamination. Coated aluminum shall have a salt spray resistance of 1,000 hours using ASTM B117 without loss of adhesion. Retap threads as required.

02920.10 Metal Conduit - Furnish metal conduit meeting the following requirements:

- Rigid Metal Conduit - Galvanized rigid metal manufactured of mild steel conforming to UL 6, Rigid Metal Electrical Conduit.

- Liquid-Tight Flexible Metal Conduit - Liquid-tight, nonmetallic, sunlight resistant outer jacket over an inner flexible metal core. Conduit shall conform to UL 360 Liquid-Tight Flexible Steel Electrical Conduit.

02920.11 Nonmetallic Conduit - Furnish nonmetallic conduit conforming to the following:
02920.12 **Conduit Fittings:**

- **Expansion Fittings** - Expansion fittings shall be weatherproof, malleable iron expansion head and body with a hot-dip galvanized finish. Where the plans do not specify an equipment ground wire in the conduit run, furnish fittings with external bonding jumpers.

- **Expansion-Deflection Fittings** - For rigid metallic conduit furnish water-tight expansion-deflection fittings according to NEMA 4, with an integral bonding jumper.

- **Condulets** - Condulets shall be malleable iron conduit body hot dip galvanized with cover and moisture-proof gasket.

- **Conduit Hub** - Hot dip galvanized malleable iron screw-on style with Neoprene "O" ring.

- **HDPE Fittings** - Factory mechanical HDPE coupling with individual reverse locking threads and built in center stop meeting the requirements of ASTM 2176.

02920.13 **Underground Marking Tape** - Provide underground marking tape that is red polyethylene film, 6 inches wide, 4 miles thick minimum, and imprinted with the following or similar legend:

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CAUTION  CAUTION  CAUTION  BURIED ELECTRIC LINE
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02920.14 **Junction Boxes:**

(a) **General** - Junction box covers in vehicle traffic areas shall be rated for AASHTO H-20 highway loading. Surface-mounted boxes shall have overlapping covers.

Junction box covers shall have the appropriate legend either "SIGNALS" or "STREET LIGHTING" stamped or embossed on the cover as appropriate. Letter size shall be no smaller than 1/16 of the box width.

Cover shall be recessed non-slip material with a static coefficient of friction of between 0.8 and 1.0 as determined by ASTM Designation C 1028-89 and verified by an independent testing laboratory.
(b) **Metal Junction Boxes** - Construct metallic junction boxes of cast iron or 1/8 inch nominal welded sheet steel. Make covers from reinforced non-slip steel plate. Use commercial quality steel. Hot-dip galvanize metallic boxes and covers after fabrication according to ASTM A 153/A 153M. Each box shall have a cover gasket that will, with cover in place, form a NEMA 4 watertight fit. Provide covers with stainless steel hex-head cap screws. Recess screw heads in the cover.

Recessed covers shall fit the box so that when the cover is set in the box, the top of the cover shall be even with the top of the box, with not more than a 1/8 inch gap between any part of the top edge of the cover and the inside lip edge of the box.

Flush-mounted boxes shall be outside-flanged with recessed, checkered steel covers.

(c) **Concrete Junction Boxes** - Concrete junction boxes shall be precast concrete, water meter type. Covers shall be capable of withstanding a load of 15,000 pounds over a 10 inch by 10 inch square surface. Covers shall have a skid-resistant surface with a static coefficient of friction of at least 0.8 as determined by ASTM Designation C 1028-89 verified by an independent testing laboratory, and bolt to the junction box with recessed stainless steel hex-head bolts. All covers for concrete junction boxes shall be recessed.

- Steel lids shall be galvanized and bonded.

Recessed covers shall fit the box so that when the cover is set in the box, the top of the cover shall be even with the top of the box, with not more than a 1/8 inch gap between any part of the top edge of the cover and the inside lip edge of the box.

02920.20 **Cable and Wire** - Unless otherwise noted, all electrical conductors shall be approved stranded copper conforming to ASTM B 3 and ASTM B 8, Class B or C. Insulation shall be 600 V plasticized polyvinyl chloride, polyethylene, or chemically cross-linked polyethylene, conforming to ASTM D 2220, ASTM D 1351, ASTM D 2655, and ASTM D 2656. Do not use polyethylene compounds where exposed to sunlight. **Tape the ends of unused and spare conductors with insulating vinyl plastic tape.**

02920.21 **Color Coding:**

(a) **General** - Apply wire color coding mechanically, with striping clearly visible the entire length. Colored tape may be used where striping is worn from handling.

(b) **Illumination Circuits** - Color coding of illumination circuits will be required for three-phase systems only. Color coding of each phase conductor shall remain consistent throughout the entire electrical system.

(c) **Traffic Signal Circuits** - Color coding of traffic signal circuits shall conform to the wiring color code shown or specified.
02920.22  **Cable** - Furnish cable meeting the following requirement:

- **Messenger Cable** - ASTM A 475 utility grade, Class A coating.
- **Tether and Stabilizer Cable** - Galvanized steel seven-strand conforming to ASTM A 475 with Class A coating.
- **Loop Feeder Cable** - Two-conductor No. 14 AWG twisted pair shielded cable with drain wire conforming to IMSA 50-2.
- **Interconnect Cable** - REA PE-38 or PE-39 cable consisting of No. 19 AWG stranded or solid individual conductors. The cable shall contain the number of wire pairs shown.
- **Control Cable** - Comply with IMSA 20-1. Outside jacket insulation shall be black in color.
- **Cable Ties** - Heavy-duty UV resistant black plastic self-locking straps approximately 5/16 inch in width, serrated gripping surfaces through a binding buckle, and minimum tensile strength of 45 pounds.
- **TC Cable** - XHHW conductors with PVC jacket.
- **Polyethylene Pull Line** - An electrical polyethylene pull rope with 1,200 pound minimum break strength.

02920.23  **Wire**:

- **THHN/THWN Wire** - Insulated stranded copper wire rated for 167 °F operation in wet or dry locations and be UL listed as THWN.
- **XHHW Wire** - Insulated stranded copper wire rated for 194 °F dry and 167 °F wet locations and be UL labeled as XHHW.
- **Ground and Bond Wire** - All ground or bond wire shall be stranded copper wire conforming to the NEC. Ground wire circuits shall be THWN green in color when installed in conduit. Minimum size shall be No. 6 AWG or as shown.
- **Loop Wire** - Insulated stranded copper No. 14 AWG Type XHHW conductor inside a polyethylene tube conforming to ISMA Specification N. 51-7.
- **Overhead Service Wire** - Wire used for overhead service installation shall be XHHW-Type 2.

02920.24  **Eyebolts** - 3/4 inch diameter eyebolts meeting the requirements of ASTM A 307.

02920.25  **Electrical Splice Materials** - Furnish electrical splice materials meeting the following requirements:

- **Split Bolt** - Made of silicon bronze to securely join the wires both mechanically and electrically.
- **Heat-Shrink Tubing** - Surface-irradiated tube listed UL 486, 194 °F, with 600 V inner melting wall or liner to provide a void-free encapsulated insulation.

- **Insulating Rubber Tape** - Electrical grade, nondrying, rubber based, elastic-type conforming to ASTM D 4388.

- **Vinyl Plastic Tape** Comply with ASTM D 3005, Type II and UL 510.

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**02920.26 In-Line Fuseholder** - The in-line fuse holder rated for 30 A at 600 V shall be designed to hold a 5 amp KTK fuse. The case shall be rigid plastic with a threaded coupling for joining the two halves. When threaded together, the two halves shall completed enclose the fuse and exert pressure against a neoprene “O” ring to provide a waterproof seal. The load side of the holder shall hold the fuse securely in place, so when the two halves are disconnected, the load side holder will retain the fuse. The line side contact point shall be spring-loaded to provide pressure between the fuse and the contact points. Wire terminals shall be set screw type rated for copper wire. Each in-line fuse connector shall be supplied with a 5 amp KTK fuse.

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**02920.28 Conduit Plug** - Furnish conduit plug material used to seal the ends of conduit composed of closed cell polyethylene foam or duct seal meeting the following requirements:

- **Closed Cell Polyethylene Foam** - Consisting of precut sections with a plug length of 3 inches and a plug diameter 1/2 inch larger than the conduit diameter being plugged. Approximately one third of the plug length shall be exposed after installation.

- **Duct Seal** - UL listed clay putty material to seal electrical conduit.
Section 02925 - Traffic Signal Materials

**Description**

02925.00 Scope - In addition to Section 02920, this Section includes the requirements for traffic signal installations.

**Materials**

02925.01 Materials - Where shown or specified, hardware shall be furnished and installed with hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts and washers. Bolts and screws shall have square or hex heads. Allen head fasteners will not be allowed.

02925.33 Frangible Bases:

(a) General - Bolts, nuts and washers shall conform to 02560.20 and shall be galvanized according to 02560.40.

(b) Vehicle Signal Pedestals - Frangible transformer for vehicle signal pedestals shall be used only when shown or specified. Transformer bases shall be constructed to bolt to shaft flanges. Bases shall be square with rounded corners, tapered from the base to the top and approximately 20 inches in height, and made of cast aluminum.

(c) Pedestrian Signal Pedestals - Pedestrian signal pedestal bases shall be a frangible base type and constructed of cast aluminum. Include a removable access plate and a threaded connection to accept a 4 inch nominal steel pipe.

02925.34 Anchor Bolts - Anchor bolts shall conform to 02560.30 and to the types and sizes shown.

**Cabinets and Control Devices**

02925.40 Cabinets - Construct all cabinets, except signal controller cabinets, from 12 gauge Type 304 stainless steel, or 10 gauge sheet steel and hot-dip galvanize after fabrication according to 02530.70, or 8 gauge 5052-H32 powder-coated aluminum. Cabinets shall be weatherproof, rated NEMA Type 3R, and constructed as shown. Pole-mounted controller cabinets shall be provided with solid bottoms or covers for openings provided for foundation mounting and only the appropriate openings for a conduit connection.

The internal wiring of cabinets shall be done by a UL listed facility. Cabinets shall conform to one or more of the following standards where appropriate:

- UL 50, Cabinets and Boxes
- UL 67, Panel Boards
- UL 869A, Service Equipment
Use a welded conduit hub to make conduit entrances into cabinets. Hubs shall be of the size required and shall be securely welded to the cabinet before galvanizing. Malleable iron screw-on hubs may be used as approved. Conduit entrances into poles from cabinets may be from the bottom of the cabinet through an LB conduit and conduit nipple.

The service cabinet shall be raintight and fabricated from 14 gauge stainless steel with all joints spot welded. A 1 inch stainless steel hub shall be welded to the top of the cabinet and centered near the back. A 1/4 inch stainless steel padlock hasp shall be spot welded to the bottom of the cabinet in such a manner that the hasp will protrude through the front cover when the cover is closed.

Where the plans call for the service cabinet to be mounted on a steel pole, the cabinet shall have a 1 1/4 inch hole drilled in the center of the back near the bottom of the cabinet. A 1/8 inch stainless steel bracket shall be welded to the back near the top of the cabinet for use in banding the cabinet to the pole.

The cabinet shall be 10 inches x 7 inches x 4 inches and shall contain one 40 amp. and one 15 amp. SPST circuit breaker. Space shall be provided for one additional breaker. A blank cover shall be secured to the faceplate to cover the opening for the additional breaker.

Provide each cabinet with a latching device for a standard City padlock.

02925.41 Circuit Control Devices:

(a) General - Install circuit breakers, the copper neutral block, and contactors as shown.

(b) Circuit Breakers - Provide UL489 listed circuit breakers of the rating shown or specified. Circuit breakers shall be of the unenclosed, molded case bolt-on type with end conductor terminals, suitable for surface mounting in the cabinet on a false back or bracket.

(c) Terminal Blocks - Provide sectional channel mount 600 V terminal blocks of sufficient size to accommodate the wiring shown.

02925.42 Traffic Signal Control Devices - Traffic signal control equipment shall meet the specifications of the 2001 Oregon Department of Transportation Standard Specifications for Microcomputer Signal Controller modified and supplemental as follows:
CHAPTER 1
GENERAL SPECIFICATIONS FOR TRAFFIC SIGNAL CONTROL
EQUIPMENT

Replace Section 7, Unit 5 (1.7.5):

1.7.5.1 After successful testing of controller equipment, the Contractor shall pick up and install all tested equipment, except that the City of Portland shall have the option of providing all or selected cabinet control equipment as indicated on the plans. Successful completion of the ODOT test does not relieve the Contractor of equipment warranty obligations.

1.7.5.2 On project where the City of Portland provided controller equipment, the Contractor will pick up the equipment from the City and install the equipment on site.

CHAPTER 2
SPECIFICATIONS FOR MODEL 170E/HC-11 CONTROLLER UNIT

Replace 2.1.10, with the following:

2.1.10 The City licensed traffic signal control program for the Model 170E/HC-11 Controller will be furnished by the City.

CHAPTER 5
SPECIFICATION FOR DETECTOR SENSOR UNITS, ELEMENTS, ISOLATORS, AND DISCRIMINATORS

Replace the entire SECTION 2 - MODEL 222 AND 222T LOOP DETECTOR UNIT REQUIREMENTS with the following:

5.2.1 The loop amplifier shall have an LCD display at least 19.39 mm X 36.49 mm.

5.2.2 The LCD display shall provide for the following displays:

1. Sensitivity Level
2. Actual loop frequency
3. Delay time in seconds
4. Extension time in seconds
5. Display change in inductance during the "Call" state
6. Display of the loop inductance during the "No-Call" state

5.2.3 The detector shall automatically tune and be operational within 2 seconds after application of power or being reset.

5.2.4 Detectors shall reach full sensitivity and hold within 30 seconds after application power or reset signal.
5.2.5 The detector shall be fully self-compensating for environmental changes and loop drift over the full temperature range and the entire loop inductance range.

5.2.6 The detector shall continue to operate with a point short to ground on the loop or loop lead-in. The detector shall tolerate, without damage, a 10 microfarad capacitor charged to 2000 volt being discharged between either loop terminal and earth ground. Should the total inductance of the loop input network go out of range specified for each detector channel, or rapidly changes by more than ± 25%, the detector shall immediately enter the fail-safe mode and display Loop Fail on the front panel. The type of loop failure shall be displayed indicating open loop or shorted loop conditions. The condition shall continue as long as the fault exists. The fail-safe mode shall generate a continuous call in Presence Mode and no calls in Pulse Mode. When the loop is functional, the loop fail message on the front panel shall extinguish and the channel will resume normal operation. Each loop failure shall be accumulated and logged in to Loop Fail Memory.

5.2.7 The response time of the detector shall conform to table shown on typical response times.

5.2.7.1 Scanning:

5.2.7.1.1 The loops connected each detector channel shall activate alternately to minimize cross talk between adjacent loops.

5.2.7.1.2 Typical scanning response times shall not exceed the following:

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<thead>
<tr>
<th>SENSITIVITY</th>
<th>RESPONSE (MILLISECONDS)</th>
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5.2.7.2 Non-Scanning:

5.2.7.2.1 The loops connected to each detector channel shall continuously be activated.
5.2.7.2.2 Typical non-scanning response times shall not exceed the following:

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<thead>
<tr>
<th>SENSITIVITY</th>
<th>RESPONSE (MILLISECONDS)</th>
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5.2.8 All detector setting shall be operator settable from the front panel.

5.2.8.1 The detector shall provide 8 selectable loop frequency settings per channel in the range of 20 to 100 Kilohertz. These settings shall be programmable from the front panel. LCD shall display the loop frequency for each channel on the front panel.

5.2.8.2 The detector shall provide 9 sensitivity levels for each channel, plus Continuous Call and Channel-Off.

5.2.8.2.1 The sensitivity levels shall correspond to the following ranges of changes in inductance:

<table>
<thead>
<tr>
<th>SENSITIVITY AND DELTA L/L</th>
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<tbody>
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<td>9</td>
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<td>Call</td>
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5.2.8.2.1.1 When the detector is set to the Continuous Call state, the channel output will be continuously in the call state regardless of the presence or absence of vehicles over the loop. The option shall be selectable from the sensitivity menu.

5.2.8.2.1.2 When the detector is set to the Channel Off state, the channel output is continuously in the No-Call state regardless of the presence or absence of vehicles over the loop.

5.2.8.3 The detector delay timer will be adjustable from 0 to 255 seconds in 1-second increments (per channel). The Call Delay timer shall be displayed on the front panel and will start counting down when a vehicle enters the loop detection zone. The detector extension timer shall be adjustable from 0 to 25.5 seconds in 0.1 increments (per channel). Extension timer shall be displayed on the front panel and will start counting down when the last vehicle leaves the loop detection zone. Any vehicle entering the loop detection zone during the extension time period shall cause the channel to return to the detect state, and later, when the last vehicle leaves the loop detection zone, the full extension time starts count down again.

5.2.8.4 The detector shall display the total loop inductance on the front panel LCD for each channel (actual Loop Inductance plus actual lead in inductance) in microhenries with an accuracy of ±15% for loop inductance with values less than 700 microhenries.

5.2.8.5 The detector shall display the loop’s delta L/L value on the front panel LCD as a percentage change for each channel (where L is the actual loop inductance plus actual loop lead-in inductance) during the Call State.

5.2.9 The detector shall have two exclusive modes of operation for each channel.

5.2.9.1 Pulse Mode:

5.2.9.1.1 The detector shall have a pulse of 125 ± 10 milliseconds duration generated for each vehicle entering the loop detection zone. Each detected vehicle is automatically tuned out if it remains in the loop detection zone more than 2 seconds. After each vehicle leaves the loop detection zone, the channel shall be capable of detecting another vehicle entering the zone of detection.

5.2.9.2 Presence Mode:

5.2.9.2.1 The detector shall have a call hold time of 4 minutes minimum regardless of vehicle size and typically 1 to 3 hours for an automobile or truck. The detector amplifier shall be capable of operating in either a scanning and non-scanning mode.
5.2.10 The detector shall provide an option for “tuning out” adjacent lane pick or loop drift. The detector shall provide an option of logic generated outputs for queued vehicles and direction detection. The detector shall provide an option for directional detection.

5.2.11 The amplifier units shall pass operational performance testing by the City of Portland.

5.2.11.1 The following amplifier units have been approved by the City:
   1. Reno Model C

Add the following Section 5 to Chapter 5:

SECTION 5 - OPTICOM DISCRIMINATOR UNIT REQUIREMENTS

5.5.1 The Model 752 and 754 discriminators and all cable and installation hardware as required shall be “Opticom” brand, manufactured by the 3M Company.

CHAPTER 6
SPECIFICATIONS FOR CABINET MODEL 332, 334 AND 340

Modify SECTION 1 - GENERAL REQUIREMENTS AND CABINET MODEL COMPOSITION as follows:

6.1.1 Add a 203mm bolted riser frame and a rack mounted communications terminal block.

Modify or replace portions of SECTION 2 - HOUSING REQUIREMENTS as follows:

6.2.1 Delete the Police Panel and add a 203mm bolted riser frame and communications terminal rack.

6.2.3.3 When the door is closed and latched, the door shall not be locked. The door locks shall be padlocks on the latching handle. The handles shall be on the right side of the front door and the left side of the rear door. Door lock holes, if present, shall be securely sealed with watertight stainless steel plugs (Hoffman A-S 100SS or an approved equal).

6.2.3.4 The padlocks shall be Best Company Padlocks 21B722-L-606 Series (or an approved equal) with green construction cores. Two keys shall be supplied with each cabinet. The keys shall be removable in the locked position only.

6.2.6 Police Panel (Delete the entire section. If a police panel is present the door shall be bolted securely shut with stainless steel hardware and all police panel switches shall be disconnected.)
6.2.8 Riser Frame

6.2.8.1 An 8” high aluminum bolted riser frame as shown on ODOT Standard Drawing Number TM423 shall be provided with each cabinet.

Modify portions of SECTION 4 - CABINET ASSEMBLY REQUIREMENTS as follows:

6.4.1 General Requirements

5.4.1.4.1.7 Add the following sentence: The guides shall be plastic.

Modify, add or replace portions of SECTION 5 - CABINET WIRING REQUIREMENTS as follows:

6.5.6 Detector Test Buttons (Delete the entire section. The City of Portland does not require detector test buttons.)

Add the following to SECTION 5 – CABINET WIRING REQUIREMENTS:

6.5.1.4 An electronic version of the cabinet wiring diagram in ".dgn" format shall be provided with the controller.

6.5.2.8.1 Two 10 position or one 20 position AC- terminal bus shall be installed in the cabinet.

6.5.7 Rack Mounted Communication Panel

6.5.7.1 Furnish and install quick telephone - Type 66 termination blocks of the type manufactured by Siemon or Reliance or an approved equivalent, for terminating #22 AWG communications cable and an eight position isolated open faced barrier strip. The termination block shall be six rows across by twenty five rows long and shall not require standoff brackets to be mounted. The barrier strip shall be an 8 position terminal block with 8/32 by 1.11mm (7/16") nickel plated brass binder head screws and nickel plated brass inserts. The blocks shall be mounted on a 140 mm wide aluminum recessed communications terminal panel attached between the uprights of the cabinet cage supports in the top section of the rear of the cabinet.

CHAPTER 7
SPECIFICATIONS FOR CABINET MODEL 336, 336S AND 344

Modify SECTION 1 - GENERAL REQUIREMENTS AND CABINET MODEL COMPOSITION as follows:

7.1.1 Add a rack mounted communications terminal block.

Modify or replace portions of SECTION 2 – HOUSING REQUIREMENTS as follows:

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7.2.1 Delete the Police Panel and add a communications terminal rack.

7.2.3.3 When the door is closed and latched, the door shall not be locked. The door locks shall be padlocks on the latching handle. The handles shall be on the right side of the front door and the left side of the rear door. Door lock holes, if present, shall be securely sealed with watertight stainless steel plugs (Hoffman A-S 100SS or an approved equal).

7.2.3.4 The padlocks shall be Best Company Padlocks 21B722-L-606 Series (or an approved equal) with green construction cores. Two keys shall be supplied with each cabinet. The keys shall be removable in the locked position only.

7.2.6 Police Panel (Delete the entire section. If a police panel is present the door shall be bolted securely shut with stainless steel hardware and all police panel switches shall be disconnected.)

Add portions of SECTION 4 - CABINET ASSEMBLY REQUIREMENTS as follows:

7.4.1.4.1.7 Add the following sentence: The guides shall be plastic.

Add the following to SECTION 5 - CABINET WIRING REQUIREMENTS:

7.5.1.4 An electronic version of the cabinet wiring diagram in ".dgn" format shall be provided with the controller.

7.5.6 Detector Test Buttons (Delete the entire section. The City of Portland does not require detector test buttons.)

7.5.7 Rack Mounted Communication Panel

7.5.7.1 Furnish and install quick telephone - Type 66 termination blocks of the type manufactured by Siemon or Reliance or an approved equivalent, for terminating #22 AWG communications cable and an eight position isolated open faced barrier strip. The termination block shall be six rows across by twenty-five rows long and shall not require standoff brackets to be mounted. The barrier strip shall be an 8 position terminal block with 8/32 by 1.11mm (7/16") nickel-plated brass binder head screws and nickel-plated brass inserts. The blocks shall be mounted on a 140mm wide aluminum recessed communications terminal panel attached between the uprights of the cabinet cage supports in the top section of the rear of the cabinet.
Use the following Chapter 9 for City of Portland projects:

CHAPTER 9  
SPECIFICATIONS FOR MODEL 2070L CONTROLLER  

SECTION 1 - GENERAL REQUIREMENTS  

The Model 2070L shall be furnished, ready for operation, with the following composition:

A Model 2070L complete controller shall consist of:

- 2070-Chassis including: Lite Cage, 1B CPU Module, 2A C1 Field I/O Module with C-1 and C-11 Connector, 3B Front Panel with 8X40 LCD Display, 4B Power Supply Module, 6B 9600 Baud Modern Card and 2 MB Data Key

The controller shall include an OS-9 version 3.3 or later operating system (Ethernet Capable). The controller shall include a Boot Code compatible with NW Signal Voyage Software.

The assemblies listed above shall be compliant with the State of California Department of Transportation (Caltrans) "Transportation Electrical Equipment Specifications" dated August 16, 2002 along with "Errata 1" published August 16, 2002 and "Errata 2" published June 8, 2004.

The following 2070L controllers have been approved by the City of Portland:

1. Econolite Control Products, Inc. (Boot Code 2002 V1.01.08.02b or more recent approved version)
2. Siemens/Eagle - (Boot Code OSO V3.3.0 Operating System 7.0.0.0.15 or more recent approved version)

The current approved version of NWS Voyage Software shall be installed prior to delivery to the Traffic Systems Service Unit of the Oregon Department of Transportation. The installation process shall include the following steps:

1. Load Voyage firmware
2. Load default database
3. Verify I/O functionality
4. Verify Communications Port functionality
5. Run for 24 hours without failure
CHAPTER 12
SPECIFICATIONS FOR CABINET MODEL 337

SECTION 1 - GENERAL REQUIREMENTS AND CABINET MODEL COMPOSITION

12.1.1 Unless otherwise specified, the model shall be furnished, ready for operation, with the following composition:

12.1.1.1 A Model 337 Intersection Cabinet shall consist of:

- Housing (337)
- Power Distribution Assembly
- Input File
- Output File
- Communications Terminal Rack
- DIN Rail Mounted Auxiliary Relay Socket
- C1 Harness
- C2 Harness
- Service Panel
- Controller Unit with Model 400 Modem

12.1.1.2 The controller unit with Model 400 Modem shall be furnished with the Model 337 cabinet. The cabinet shall have all input and output files installed and wired complete for 4-phase operation. However, only those input and output devices, such as detector sensor units, isolator units, and switch packs necessary to provide the operation required by the plans or specifications shall be furnished.

12.1.1.3 A heavy-duty side-opening clear plastic pouch shall be furnished. The pouch shall be mounted on the front door of the cabinet and provide easy access and storage of the wiring diagrams.

12.1.1.4 Cabinet model interface wiring shall be per specified C1 Harness, detailed wiring lists, and required cabinet wiring diagram.

12.1.2 Cabinet Shipping Requirements

12.1.2.1 The cabinet shall be delivered mounted on a plywood shipping pallet. The pallet shall be bolted to the cabinet base. The cabinet housing doors shall be blocked to prevent movement during transportation.

12.1.3 Cabinet Finish

12.1.3.1 Inside and outside of walls, doors, and ceiling of the cabinet shall be anodized after fabrication.

12.1.3.2 All nuts, bolts, washers, screws [4 mm (or larger)], hinges, and hinge pins shall be stainless steel unless otherwise specified.
12.1.3.3 A clear area for the controller unit shall be provided in Model 337 cabinets. The area shall extend 38 mm in front of and 406 mm behind the front EIA mounting angles. A minimum of 184 mm above the supporting portion of the angle shall be kept clear for the controller.

12.1.3.3 All conductors, terminals, and parts that could be hazardous to maintenance personnel shall be protected with suitable insulating material.

SECTION 2 - HOUSING REQUIREMENTS

12.2.1 The housing shall include, but not be limited to the following:

| Enclosure | Communications Terminal Rack |
| Doors | Ventilation |
| Latches/Locks | Gaskets |
| Hinges and Door Catches | Light Fixture |

12.2.2 Housing Construction

12.2.2.1 The housing shall be rainproof with the top of the enclosure crowned to prevent standing water. It shall have single front and rear doors.

12.2.2.2 The enclosure including doors, lifting eyes, gasket channels, police panel (where furnished) and all supports welded to the enclosure and doors shall be fabricated of 3.2 mm minimum thickness, aluminum sheet alloy 5052-H32 or 6061-T6. Bolted-on supports shall either be the same material and thickness as the enclosure.

12.2.2.3 All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filed to a radius of 0.8 mm, minimum. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders, and welding operators shall conform to the requirements and practices on AWS B3.0 and C5.6 for aluminum.

12.2.2.4 Aluminum surfaces shall conform to the following:

12.2.2.4.1 An anodic coating shall be applied to the aluminum surface after the surface has been cleaned and etched. The cleaning procedure shall be to immerse in inhibited alkaline cleaner [Oakite 61A, Diversey 909 (or equivalent) in mix of 45 to 60 g per liter of distilled water] at 71°C for 5 minutes. Rinse in cold water. The etching procedure shall be to immerse in a sodium solution [3.7 g sodium fluoride plus 37.5 g sodium hydroxide mix per liter of distilled water] at 66°C for 5 minutes. Rinse in cold water. Desmut in a 50% by volume nitric acid solution at 20°C for 2 minutes. Rinse in cold water.
12.2.2.4.2 The anodic coating shall conform to MIL-A-8625C (Anodic Coatings for Aluminum and Aluminum Alloys) for Type II, Class I Coating except the outer housing surface coating shall have a 0.018 mm minimum thickness and a 20 mg per 500 mm² minimum coating weight. The anodic coating shall be sealed in a 5% aqueous solution (pH 5.0 to 6.5) of nickel acetate at 99°C for 15 minutes.

12.2.2.5 The enclosure doorframes shall be double flanged out on all four sides and shall have strikers to hold tension on and form a firm seal between the door gasket and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 4 (±2) mm.

12.2.2.6 Gaskets shall be provided on all door openings and shall be dust-tight. Gaskets shall be 6 mm minimum thickness, closed cell neoprene or silicone [BOYD R-10480 (or equal)] and shall be permanently bonded to the metal. If neoprene is used, the mating surface of the gaskets shall be covered with a silicone lubricant to prevent sticking to the mating metal surface. A gasket top channel shall be provided to support the top gasket on the door (prevents gasket gravitational fatigue).

12.2.2.7 The cabinet base layout shall accommodate a standard 101.6mm pedestal slipfitter. The cabinet shall provide sufficient resistance to flexing and eventual metal fatigue at the mounting point. The cabinet shall be supplied with a bolt on adapter for the bottom of the cabinet. The adapter shall provide for the adaption of the 101.6mm pedestal slipfitter to a 63.5mm conduit mount for pole mounting.

12.2.2.8 The cabinet shall be designed to allow for pole mounting. The cabinet shall provide sufficient resistance to flexing and shall withstand pole mounting without warping the cabinet. The cabinet shall be supplied with all required mounting accessories for mounting the cabinet to standard signal poles and pedestals.

12.2.2.9 All exterior bolt heads shall be tamperproof type.

12.2.2.10 Rails shall be provided both front and rear, as an integral part of the cabinet. The rails shall extend the full height of the cabinet and shall conform to the dimensional requirements of Standard EIA RS-310-C. Equipment mounting holes shall be provided with 10-32 threads and shall be located to secure equipment provided.
12.2.3 Door Latches and Locks

12.2.3.1 The latching handles shall have provision for padlocking in the closed position. Each handle shall be 20mm minimum diameter stainless steel rod. The padlocking attachment shall be placed at 100 mm from the handle shank center. An additional 100mm minimum gripping length shall be provided.

12.2.3.2 The latching mechanism shall be a 3-point draw roller type. The pushrods shall be 9.5mm minimum diameter stainless steel rods.

12.2.3.3 When the door is closed and latched, the door shall not be locked. The door locks shall be padlocks on the latching handle. The padlocks shall be Best Company Padlocks 21B722-L-606 Series (or an approved equal) with green construction cores. Two keys shall be supplied with each cabinet. The keys shall be removable in the locked position only. The handles shall be on the right side of the front door and the left side of the rear door. Door lock holes, if present, shall be securely sealed with watertight stainless steel plugs (Hoffman A-S 100SS or an approved equal).

12.2.3.4 The center latch cam shall be fabricated of 4.8mm minimum thickness stainless steel.

12.2.4 The general requirements for housing ventilation including intake, exhaust, filtration, fan assembly, and environmental control, as follows:

12.2.4.1 The front door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 6 mm. A removable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. A filter shell shall be provided that fits over the filter, providing mechanical support for the filter. The shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 5 mm to house the filter. The filter and shell shall be held firmly in place with a bottom bracket and a spring-loaded upper clamp. No incoming air shall bypass the filter. The bottom filter bracket shall be formed to create a waterproof sump with drain holes to the outside housing.

12.2.4.1.1 The filter shall be 152 mm high by 406 mm wide by 22 mm thick. The filter shall trap particles 2 microns and larger.

12.2.4.2 The intake (including filter with shell) and exhaust areas shall pass a minimum of 0.74 m³ of air per minute.

12.2.4.3 The housing shall be equipped with an electric fan with ball or roller bearings and a capacity of at least 2.8 m³ of free air delivery per minute. The fan shall be mounted within the housing and vented.
12.2.4.4 The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33°C and 65°C with a differential of not more than 6°C between automatic turn on and off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 10° increments.

12.2.5 **Hinges and Door Catches**

12.2.5.1 Hinges with 2 bolts per leaf shall be provided to bolt the door to the enclosure. Each door shall have 3 stainless steel hinges. Each hinge shall be 90mm minimum length and have a fixed pin. The pin ends shall be welded to the hinge and ground smooth.

12.2.5.2 Front and rear doors shall be provided with catches to hold the door open at both 90° and 180° (plus or minus 10°). The catches shall be 6mm minimum diameter stainless steel rods. The catches shall be capable of holding the door open at 90° in a 95 km/hr wind, acting at an angle perpendicular to the plane of the door.

12.2.6 **Police Panel**

12.2.6.1 If a police panel is present the door shall be bolted securely shut with stainless steel hardware and all police panel switches shall be disconnected.

12.2.7 **Cabinet Light Fixture**

12.2.7.1 An 8-watt, self-starting fluorescent cabinet light shall be installed in each controller cabinet (see Cabinet Details Drawings). The fixture shall be mounted to the cabinet exhaust area cover plate by screw and self-locking nut. The mounting hardware shall not penetrate the exterior of the cabinet shell. The fixture and fluorescent tube shall not interfere with access to any cabinet component or TBK. The fixture will be controlled from a door-operated switch located at the rear door. The fixture power shall be switched “ON” when the rear door is opened. In addition to the rear door switch, the fixture circuit shall incorporate an accessible power “ON-OFF” switch. Power for the light fixture shall be supplied from the load side of the 15 amp Equipment breaker of the PDA through an “in-line” type fuse holder (1 amp fuse) through the normally closed cabinet rear door switch to the light fixture (see Equipment Mounting Drawings).
SECTION 3 - CABINET ASSEMBLY REQUIREMENTS

12.3.1 Rack Assembly

12.3.1.1 The rack assembly shall be self-supporting and shall allow a free space beneath the lowest horizontal surface and between the side panels of 432mm wide by 406mm deep by 229mm high with both cabinet doors closed. The assembly shall be equipped with mounting ears to allow mounting of Standard EIA rails. Overall width of the assembly shall conform to Standard EIA RS-310-C. Two supports shall be supplied to support the controller unit. The supports shall be designed to support a minimum of 23 kg each. The horizontal side of each support shall be a minimum of 75 mm.

12.3.1.2 The rack assembly shall provide for a Model 204 Flasher, an input file to support 11 input slots, an auto/flash switch, a flash relay, three flash transfer relays, a power distribution assembly, a model 210 conflict monitor and 6 load switches.

12.3.1.2.1 Socket types for the following equipment shall be:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch Pack</td>
<td>BEAU S-5412-XX (or equal)</td>
</tr>
<tr>
<td>Heavy Duty Relay</td>
<td>BEAU S-5408-XX (or equal)</td>
</tr>
<tr>
<td>Flasher Unit</td>
<td>BEAU S-5406-XX (or equal)</td>
</tr>
<tr>
<td>210 Monitor Unit</td>
<td>PCB 28/56S</td>
</tr>
<tr>
<td>Power Distribution Assembly</td>
<td>BEAU S-5413-XX (or equal)</td>
</tr>
<tr>
<td>Auxiliary Relay Socket</td>
<td>PB 27E891</td>
</tr>
</tbody>
</table>

12.3.1.2.2 Connector sockets for flasher unit, power supply, and switch pack modules shall be mounted so that the front face of all plug-in assemblies shall be flush with the front face of the rack assembly. The sole exception shall be the flash relay, which may be mounted with its socket on the same plane as the flash transfer relay sockets.

12.3.1.2.3 The Auxiliary Relay Socket shall be mounted on a 102mm section of DIN Rail Track attached on the left lower portion of the rack assembly as viewed from the back door.

12.3.1.3 The front face of the rack assembly may be inset from the EIA rails a maximum of 13mm.

12.3.1.4 The rack assembly depth shall not exceed 330mm from the front surface of the front EIA rails. Assembly or file depth dimension shall include TBKs.

12.3.1.5 Guides (top and bottom) shall be provided for switch pack modules, flasher units, monitor unit, detector and isolator modules. The guides shall begin 25 (plus or minus 13) mm in from the front panel surface and extend to within 13 mm of the connector socket face.
12.3.1.6 All fuses, circuit breakers, switches (except police panel switches, fan fuse and cabinet light fuse) and indicators shall be readily visible and accessible when the cabinet front door is open.

12.3.1.7 All equipment in the cabinet, when required shall be permanently and clearly labeled. The marker strips shall be made of material that can be easily and legibly written upon using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with all items installed.

12.3.1.8 Assemblies and files shall be fabricated of 1.5 mm minimum thickness aluminum or stainless steel sheet. The metal surface shall be treated with clear chromate.

12.3.1.9 Resistor-capacitor transient suppression shall be provided at all AC relay sockets (across relay coil) except for the flash transfer relays (FTR) in the output files, where one suppression device may be common for all.

12.3.1.10 A leakage resistor which permits a small amount of current to pass through the heavy duty relay coil, shall be installed across the terminals of relay sockets to overcome the residual magnetism.

12.3.1.11 All assemblies and files shall allow air circulation through the top and bottom unless specifically called out otherwise.

12.3.2 Input File (Model 337Cabinets)

12.3.2.1 The file shall have a maximum depth of 215 mm and shall intermate with and support 11, 2-channel detector or isolator units supported top and bottom with plastic guide rails.

12.3.2.2 The file shall provide a PCB 22/44S connector which shall be a DALE EB7CS22GY (or equal) and shall be centered vertically for each 2-channel detector. The associated number and letter side connectors shall be shorted internally. Pins D, E, F, J, K, L, and W shall be brought out to an 8-position TBK on the back of the file. The output emitters shall be common grounded with the ground terminating at TB 15, position 4. Position 8 of the TBK is assigned to EG and is used to terminate lead-in shields.

12.3.2.3 The input file shall be provided with marker strips to identify isolators and detectors in the file.
12.3.2.4 TBK terminal screw size shall be 8-32.

12.3.2.4 TB2, TB3, TB4 and TB5 shall be provided and mounted vertically and parallel to the cabinet sides. In viewing from the back door, TB2 and TB3 shall be mounted on the right side of the cabinet and connected to input file slots 1-3 and 4-5. In viewing from the back door, TB4 and TB5 shall be mounted on the left side of the cabinet and connected to input file slots 6-8 and 9-11.

12.3.2.5 Each detector lead-in pair from the field terminals to the input file terminals, shall be a cable of IMSA Type 50-2 (or better). The stranded, tinned, copper drain wire shall be connected to the "L" terminal on the input file TBKs. This input terminal shall be connected to the equipment grounding bus through a single conductor. Each connection shall be made by using a crimp connector that is soldered after the connector is crimped to the wire. These cables shall be heat shrunk protected - both the drain wire and the foil shield, to prevent shorting against the contacts on the back of the input file.

12.3.3 Output File (Model 337 Cabinets)

12.3.3.1 The Output File shall be capable of containing six Model 200 switch packs, three Model 430 Flash Transfer Relays, one Model 210 Monitor Unit and one Flash Relay. The construction plans shall determine the number of flash transfer relays and switch packs that will be furnished with the output file.

12.3.3.2 The output file shall be provided with marker strips to identify switch packs when mounted in the file.

12.3.3.3 The depth of the file shall not exceed 368 mm.

12.3.3.4 Switch pack connectors, monitor unit connectors, flash transfer relay sockets, and flash programming connectors shall be accessible from the back of the output file without the use of tools or removal of any other equipment.

12.3.3.5 TBK 01 terminal screw size shall be 8-32.

12.3.3.6 TBK 02 terminal screw size shall be 6-32.

12.3.3.7 Field wire TBKs shall be mounted vertically on the back of the assembly. The output file shall have 3 TBKs with 6 positions clearly labeled by both position number and function. Terminal position screw size shall be 10-32.
12.3.3.8 The flash programming connectors shall be Molex Type 1375 (or equal). The receptacle shall be mounted on the file with a programmable plug connected. The plug connector, with programming jumpers, shall be furnished for each circuit to allow red, yellow or pedestrian flash programming. Requirements are: 4 red, 3 yellow and 3 pedestrian plug connectors. Connectors shall be readily accessible without the removal of any other equipment. Plug pins shall be crimped and soldered.

12.3.3.7 Output file connectors and sockets shall be hand wired; printed circuit boards will not be acceptable for current carrying circuits.

12.3.3.8 The monitor unit connectors shall be a rigidly supported printed circuit board edge connector, having 2 rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The CMU connector shall be mounted on a printed circuit board that provides the capability of changing the channel assignments by wire jumper. Jumper wires shall be installed to enable the pedestrian switch pack centers to be used as shown on the plans. The connector shall intermate with the monitor unit.

12.3.3.9 It shall be possible to remove the Model 210 monitor unit without causing the intersection to go into flashing operation. The cabinet shall be wired so that, with the front cabinet door closed and with the monitor unit removed, the intersection shall go into flashing operation.

12.3.3.10 The output file shall have plastic guide rails

12.3.4 Power Distribution Assembly

12.3.4.1 The power distribution assembly shall be completely removable from the cabinet without removing any other equipment and using only a slotted or Phillips screwdriver. The PDA shall be electrically and mechanically interchangeable with any 337 cabinet assembly unit.

12.3.4.2 The following equipment shall be provided with the power distribution assembly:

- 1 - 1 Pole, 30 amp, 120 VAC Main Circuit Breaker
- 1 - 1 Pole, 15 amp, 120 VAC Equipment Circuit Breaker
- 1 - 1 Pole, 30 amp, 120 VAC Signal Bus and Breaker
- 1 - 2 Pole Ganged, 20 amp, 120 VAC Flash Bus Circuit Breaker
- 1 - 24 VDC Power Supply
- 1 - Power Relay and Socket
- 1 - AUTO/FLASH Control Switch
- 1 - Signals/Off Switch
- 1 - FLASH On Indicator Light
1 - 13 Position Connector to intermate with rack assembly
2 - Test Points
2 - Power Supply Fuses (AC and DC)

12.3.4.3 Breaker ratings shall be shown on face of breaker or handle. Breaker function shall be labeled below breaker on front panel.

12.3.4.4 The AUTO/FLASH switch, when placed in FLASH position (down), shall energize the power relay coil and apply a stop time to the controller. When the switch is placed in the AUTO position (up), the switch packs shall control the signal indications. The switch shall be a double-pole single-throw toggle control switch rated for 15 amperes at 120 volts AC.

12.3.4.5 The Power Indicator, labeled "24 VDC PWR", shall be a 24 VDC lamp, Dialight 507 Series LED Cartridge Type 507-4761-3331-500 with Dialight Datalamp Cartridge Holder Type 508-8738-504 or equivalent. The lamp shall be tied across the Power supply output on the fused side.

12.3.4.6 The FLASH indicator light labeled "FLASH ON" shall be mounted on the PDA front panel. The Flash Indicator shall be a 120 VAC lamp, Dialight 507 Series Neon Cartridge Type 507-4537-0937-640 with Dialight Datalamp Holder Type 508-8745-504 or equivalent. The lamp shall be tied across the Power Relay coil.

12.3.4.7 The SIGNALS/OFF switch, when placed in the off position (down), shall energize the power relay coil and interrupt power to the flasher. The switch shall be a 3 pole double throw switch rated for 15 amperes at 120 volts AC. Two of the three poles shall be tied in parallel to provide sufficient switching capacity for flasher power.

12.3.4.8 All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the TBK on the common side, except for the AC power conductor between the service TBK and main circuit breaker. All internal conductors terminating at the blocks shall be connected to the other side of the blocks.

12.3.4.8 Equipment Circuit Breaker - A 15 amp, 120 volt AC circuit breaker shall be installed for equipment circuit protection. The breaker shall be placed on the load side of the main breaker. The breaker shall be located on the front panel of the PDA assembly next to the Main breaker.

12.3.4.9 Signal Bus Circuit Breaker - A 30 amp, 120 volt AC circuit breaker with medium trip delay characteristic shall be provided.
A power supply shall be provided to supply +24 VDC to the input and output files for use by their associated devices. The front panel shall include AC and DC fuses, “POWER ON” light, and test points for monitoring the output voltages. The power supply shall be of ferro-resonant design having no active components and will conform to the following requirements:

1. Line Regulation: 2% from 90 to 135 VAC at 60 Hz, plus an additional 1.6% for each additional 1% frequency change
2. Load Regulation: 5% from 1 amp to 5 amps with a maximum temperature rise of 30°C above ambient
3. Design Voltage: +24 (±0.5) VDC at full load, 30°C, 115 VAC incoming after a 30 minute warm-up period
4. Full Load Current: 5 amps, minimum
5. Ripple Noise: 2 volts peak-to-peak and 500 mV RMS at full load
6. Line Voltage: 90 to 135 VAC
7. Efficiency: 70% minimum
8. Minimum Voltage: +22.8 VDC
9. Circuit capacitors shall be rated for 40 volts, minimum.

Two 0.5 Ω, 10 watt minimum, wire-wound power resistors with a 0.2 μH inductance shall be provided; 1 on the AC+ power line and 1 on the AC- line. Three MOV surge arrestors rated for 20 Joules minimum, shall be provided between AC+ and EG, AC- and EG, and between AC+ and AC-. A 0.68 μF capacitor shall be placed across AC+ and AC- between the 2 power resistors and the MOV’s.

12.3.5 Cabinet Harnesses (337 Cabinet)

12.3.5.1 Connector C1P shall contain 104 pin contact positions and shall intermate with Connector C1S mounted on the controller chassis. Corner guide pins for connector C1P shall be stainless steel and shall be 27.9mm in length. Corner guide socket assemblies shall be stainless steel and shall be 15.9mm in length.

12.3.5.2 Connector C4 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The plug Connector C4 shall be mounted on the Rack Assembly.

12.3.5.3 Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

12.3.5.4 All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered.
12.3.6 Rack Mounted Communications Panel

12.3.6.1 Furnish and install quick telephone - Type 66 termination blocks of the type manufactured by Siemon or Reliance or an approved equivalent, for terminating #22 AWG communications cable and an eight position isolated open faced barrier strip. The termination block shall be six rows across by twenty-five rows long and shall not require standoff brackets to be mounted. The barrier strip shall be an 8 position terminal block with 8/32 by 1.11mm (7/16") nickel-plated brass binder head screws and nickel-plated brass inserts. The blocks shall be mounted on a 140mm wide aluminum recessed communications terminal panel attached between the uprights of the cabinet rack assembly in the lower section of the front of the cabinet.

SECTION 4 – CABINET WIRING REQUIREMENTS

12.4.1 Cabinet Wiring Diagram

12.4.1.1 The cabinet wiring diagram for Models 337 cabinets shall be furnished on current ODOT drawings for the appropriate cabinet model. One full-sized reproducible master copy of the drawing will be furnished, upon request.

12.4.1.2 The Contractor shall add to the drawing all information and details required giving an accurate description of the wiring and operation of each individual cabinet. The information required includes the following:

1. Software program number and C1 connector pin program assigned functions
2. Input file phase and loop number references
3. Output file phase references
4. Location and phase reference for all input/output devices furnished
5. Modifications made to standard cabinet wiring
6. Intersection layout
7. Phase sequence diagram
8. Preemption sequence diagram (if applicable)

12.4.1.3 The intersection layout shall include all vehicle signals, pedestrian signals, vehicle detectors, push buttons, lane usage arrows, and special devices located and identified as shown on the plans. A north arrow shall also be included and the intersecting streets shall be identified.

12.4.1.4 The phase and preemption sequence diagrams shall refer to the phase designations and sequence shown on the plans for both normal phase rotation and preemption.
Four OZALID-type (or equivalent) copies of the wiring diagram shall be furnished with each Model 337 controller cabinet. The copies shall not be reduced in size.

12.5.1.6 An electronic version of the cabinet wiring diagram in ".dgn" format shall be provided with the controller.

12.4.2 Conductors (Model 337 Cabinets)

12.4.2.1 All conductors used in cabinet wiring shall terminate with properly sized, insulated, spring spade type terminals except when soldered to a through-panel solder lug on the rear side of the TBK or as specified otherwise. All spade connectors on wires connecting the input panel to the input files shall be crimped and soldered to the wires.

12.4.2.2 All crimp-style connectors shall be applied with a tool that prevents opening of the handles until the crimp cycle is completed.

12.4.2.3 All conductor sizes shown are AWG.

12.4.2.4 Conductors between the service terminal AC- and EG and their associated bus, the EG bus conductor to power distribution assembly and cage rail, and the AC- bus to power distribution assembly shall be No. 10 (or larger).

12.4.2.5 All conductors, unless otherwise specified, shall be stranded No. 22 (or larger). Conductors shall be rated for 600 volts and shall conform to IMSA Specification 50-2 (or better). The insulation shall have a minimum thickness of 10 mils and shall be Nylon-jacketed polyvinyl chloride, except that conductors No. 14 and larger may have Type THHN/THWN insulation.

12.4.2.6 All conductors, except those that can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

12.4.2.7 All conductors shall conform to the following color-code requirements:

1. The grounded conductors of AC circuits shall be identified by a continuous white or gray color.

2. The equipment-grounding conductors shall be identified by a solid green color or by a continuous green color with one or more yellow stripes.

3. The DC logic ground conductors shall be identified by a solid white color with a red stripe.

4. The ungrounded conductors shall be identified by any color not specified in 1, 2, or 3 above.
12.4.2.8 All wiring harnesses shall be neat, firm, and routed to minimize crosstalk and electrical interference.

12.4.2.9 Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

12.4.2.10 Cabling shall be routed to prevent conductors from being in contact with metal edges. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

12.4.2.11 Within the cabinet, the DC logic ground and EG shall be electrically isolated from the AC grounded conductor and each other by 500 MΩ when tested at 250 volts DC, with the power line surge protector disconnected.

12.4.2.12 The AC copper terminal bus shall not be grounded to the cabinet or connected to logic ground. Nylon screws with a minimum diameter of 6mm shall be used for securing the bus to the service panel.

12.4.2.13 An equipment grounding bus shall be provided in each cabinet. The bus shall be copper and connected to the cabinet chassis.

12.4.2.14 Each detector lead-in pair from the field terminals to the input file terminals, shall be a cable of IMSA Type 50-2 (or better). The stranded, tinned, copper drain wire shall be connected to the “L” terminal on the input file TBKs. This input terminal shall be connected to the equipment grounding bus through a single conductor. Each connection shall be made by using a crimp connector that is soldered after the connector is crimped to the wire. These cables shall be heat shrunk protected - both the drain wire and the foil shield, to prevent shorting against the contacts on the back of the input file.

12.4.3 Terminal Blocks (Model 337 Cabinets)

12.4.3.1 The TBKs shall be barrier type, rated at 20 amps, 600 volts RMS, minimum. The terminal screws shall be 7.9 mm minimum length, nickel-plated, brass binder head type with screw inserts of the same material. Screw size is called out under associated cabinet assembly, file or side panel.

12.4.3.2 The terminals of the power line service TBK shall be labeled “AC+”, “EG”, and “AC-” and shall be covered with an insulating material to prevent inadvertent contact. Terminating lugs large enough to accommodate No. 4 conductors shall be furnished for the service TBK. The AC+, AC-, and EG conductors connecting to the service terminals and appropriate busses shall not be spade lugged.
12.4.4 Detector Test Buttons

12.4.4.1 The City of Portland does not require detector test buttons.

12.4.5 Auxiliary Relay Socket

12.4.5.1 An auxiliary relay socket shall be mounted on a 102mm DIN rail attached to the left side of the rack assembly as viewed from the rear door. C1-100 shall be landed on position 2 of the socket and 24 VDC+ from TB02 position 1 shall be landed on position 7. This relay will be used for controlling auxiliary devices with an output from the controller.

SECTION 5 – CABINET TRANSIENT SURGE SUPPRESSION REQUIREMENTS

12.5.1 Power Line

12.5.1.1 The power line surge protector shall be metal oxide varistor (MOV). One shall be installed between AC+ and EG and the other between AC- and EG. The MOV shall have the following ratings:

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<tr>
<td>Energy rating:</td>
<td>50 Joules, maximum</td>
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<td>Power dissipation:</td>
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<td>Peak current for pulses:</td>
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<tr>
<td>Standby current:</td>
<td>Less than 1 mA</td>
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12.5.1.2 The power line surge protector shall also include a Three-Electrode Gas Tube Type and shall have the following ratings:

| Impulse Breakdown:     | less than 1,000 volts in less than 0.1 microseconds at 10 kilovolts/microsecond. |
| Standby Current:       | less than one mA |
| Striking Voltage:      | greater than 212 volts DC |

12.5.1.2.1 The three-electrode gas tube type surge protector shall be capable of withstanding 15 pulses of peak current each of which will rise in 8 microseconds and fall in 20 microseconds to one half the peak voltage at 3 minute intervals. Peak current rating shall be 20,000 Amps.
12.5.2 **Modem Interconnect Lines** (Model 337 Cabinets)

12.5.2.1 General Requirements:

1. Shall be installed in all cabinets
2. Shall suppress bipolar and bi-directional transients
3. Shall fail in the open circuit configuration
4. Shall be of solid state design and contain no spark gap or gas tube
5. Leakage current to ground, maximum: 0.2 mA
6. Circuit impedance loading: <25Ω

12.5.2.2 TVSS Performance:

1. Rated single transient energy: 75 (10 x 100 µS, Joules)
2. Single pulse transient current: 2,000 (8 x 20 µS, amps peak)
3. Maximum clamping voltage: 36 (1 kV, 200 A 8 x 50 µS, V peak)

12.5.2.3 Physical Characteristics:

1. Operating temperature: -34°C to 74°C
2. Dimensions, maximum: L 125 mm x W 100 mm x D 50 mm
## CITY OF PORTLAND 337 DETAIL #1

### 337 CABINET

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<td>96</td>
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<td>46</td>
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<td>NC</td>
<td>98</td>
<td>07-7</td>
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<td>47</td>
<td>I2-1</td>
<td>IN 9</td>
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<td>IN 14</td>
<td>IF10-W</td>
<td>104</td>
<td>DC-GND</td>
<td>WATCH</td>
<td>C4-6</td>
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NA = NOT ASSIGNED   NC = NO CONNECTION   IF = INPUT FILE CONNECTOR
## City of Portland 337 Detail Sheet #3
### Connector Pin Assignments

#### Cable C4

<table>
<thead>
<tr>
<th>PIN</th>
<th>Source</th>
<th>Destination</th>
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<tbody>
<tr>
<td>1</td>
<td>C 1-101</td>
<td>FR COIL</td>
</tr>
<tr>
<td>2</td>
<td>C 1-1</td>
<td>TB 02-2</td>
</tr>
<tr>
<td>3</td>
<td>C 1-92</td>
<td>TB 02-2</td>
</tr>
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<td>4</td>
<td>C 1-81</td>
<td>IR-N.O.</td>
</tr>
<tr>
<td>5</td>
<td>C 1-82</td>
<td>MU-BB</td>
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<td>6</td>
<td>C 1-103</td>
<td>MU-22</td>
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<td>7</td>
<td>C 1-16</td>
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<td>C 1-17</td>
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<td>C 1-2</td>
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<td>24</td>
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1259 City of Portland 2010
FIELD TERMINAL ASSIGNMENTS

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<tr>
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<th>POS</th>
<th>CONN</th>
<th>POS</th>
<th>CONN</th>
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<td>SWPK3-Y</td>
<td>122</td>
<td>SWPK5-Y</td>
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<td>SWPK3-G</td>
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<td>SWPK5-G</td>
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<td>SWPK6-R</td>
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<td>SWPK4-Y</td>
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<td>SWPK2-G</td>
<td>116</td>
<td>SWPK4-G</td>
<td>126</td>
<td>SWPK6-G</td>
</tr>
</tbody>
</table>

02925.51 Traffic Signal Lamps - ITE compliant flange mounted traffic signal light emitting diode (LED) modules shall be used for all signal indications. The manufacturer shall submit reports from ETL/Intertek that certify full compliance of LED signal modules to these specifications across the temperature range of -40 °F to 165 °F. All LED modules shall have a uniform, non-pixilated appearance, and be supplied from the same manufacturer. The LED unit shall have a conformally coated power supply.

Standard 18 AWG jacketed wires, 3 feet in length shall be provided. The termination end shall terminated with insulated quick connect terminals and spade tab adapters.

(a) LED Ball Signal Modules – 8 inch and 12 inch - All LED Ball signal modules shall be fully compliant to the ITE VTCSH LED Circular Supplement specifications. Typical or Nominal wattage not to exceed the following:

<table>
<thead>
<tr>
<th>Indication</th>
<th>8 Inch Lens Watts</th>
<th>12 Inch Lens Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Yellow</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Green</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

(b) LED Omni-Directional Arrows - All LED arrow signal modules shall be fully compliant to the ITE VTCSH Part 3 LED Vehicle Arrow Traffic Signal Modules specifications. Typical or Nominal wattage not to exceed the following:

<table>
<thead>
<tr>
<th>Indication</th>
<th>12 Inch Lens Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>7</td>
</tr>
<tr>
<td>Yellow</td>
<td>9</td>
</tr>
<tr>
<td>Green</td>
<td>7</td>
</tr>
</tbody>
</table>
Signal Indication and Sign Material

02925.60 Signal Indication Material - The housings, including doors and hoods, shall have a smooth homogeneous finish. Construct the pedestrian and vehicle signal housings and doors of die-cast aluminum alloy. All parts shall be clean, smooth, and free from flaws, cracks, blow holes, and other imperfections. Parts shall be finished inside and out according to 00990.48. All fasteners not specifically noted as hot-dip galvanized shall be Type 304 or 316 stainless steel installed with anti-seize compound.

Except for brass terminal screws, all hardware on pedestrian and vehicle signal heads shall be Type 304 or 316 stainless steel. The stainless steel latching device shall utilize a wing nut or a positive fastener to hold the door securely in place. The reflector retaining rings shall be stainless steel, black powder-coated aluminum, or polycarbonate. All lamp sockets shall be brass with a phosphor bronze center contact. Aluminum sockets are not acceptable.

02925.61 Illuminated Signs:

(a) Part-Time Restriction Signs - Use LED part-time restriction sign:

1) Cabinet - Furnish a cabinet having a frame constructed of extruded aluminum alloy. The back panel shall be polycarbonate plastic, ABS plastic or sheet aluminum. All panels and frame members shall be of sufficient strength and thickness to prevent warping and bowing. Aluminum frame members shall be 6063-T5 and aluminum panels shall be hot-dip galvanized or Type 304 or 316 stainless steel. Provide easy access to the components of the sign for maintenance. Wash exposed exterior aluminum with a cleaning solvent and when dry, apply two coats of flat black paint.

2) Visor - Attach to the sign frame a visor that projects over the sign face and sides. Projection over the sign face shall be approximately 5 inches at the top of the sign and approximately 2 inches at the bottom of the sign. Construct the visor of sheet aluminum of sufficient strength and thickness to prevent warping and bowing. Attach the visor to the sign frame with stainless steel screws and paint as specified in paragraph (a)(1) above.

3) Legend - The legend shall be clearly legible in bright sunlight within 250 feet of the sign. The face of the sign shall be black and the legend shall not be visible even in direct sunlight when the sign is off. The color of the legend shall be as shown on the plans. Obtain the Engineer’s approval of the layout and letters prior to construction.

4) Lighting - The legend shall be made up of strings of LEDs. The LEDs have a minimum viewing angle of 22° and a maximum viewing angle of 30°. The LEDs shall be energized from at least two circuits, to maintain visibility in the event of an LED failure.
(5) **Physical** - The minimum size of the sign face shall be 30 inches wide by 36 inches high, and may vary with the approved legend. The sign shall be capable of continuous operation over a temperature range of -35 °F to 165 °F.

(6) **Mounting** - Mount the sign using mounting hubs. Tether signs installed on messenger cables. Use a minimum of two hubs and two letters, installed as shown.

**02925.62 Signal and Sign Mounting Hardware** - Use cast bronze to construct elevator plumbizers, standard plumbizers, and span wire hangers. Paint the mounting hardware with two coats of zinc-rich aluminum paint. All fasteners not specifically noted as hot-dip galvanized shall be Type 304 or 316 stainless steel, including all hardware and fasteners on tri-stud adapters, spanwire hangers, and plumbizers. The fasteners shall have either square or hex heads. Allen head fasteners are not allowed. Use nylon insert lock nuts on tri-stud adapters and for mounting signal sections together.

Furnish tri-stud adapters with two backing washers and omit the neoprene washer/gasket. Use silicon to seal between the tri-stud and the signal head. The 1/8 inch reinforced plate for the 30 inch by 36 inch interior illuminated signs shall have a minimum 24 square inch bearing surface.

Use silicon to seal between the tri-stud and the signal head. Use an adjustable bracket for vehicle signal assemblies that incorporate 4 or more sections (lenses). The 1/8 inch reinforced plate for the 30 inch by 36 inch interior illuminated signs shall have a minimum 24 square inch bearing surface.

On span wire hangers, use hot-dip galvanized or stainless steel U-bolts in the messenger cable clamp.

**02925.64 Signal Heads** - Each housing shall be of the one-section expandable type. Each section shall be of one-piece construction. The design shall be such that at any time and without the use of other than simple tools, it shall be possible to convert any housing into a one-, two-, three-, four- or five-section housing by the addition or subtraction of housing sections. The entire housing shall be made dust proof and water proof. Vehicle signal heads shall have the screw hole plug installed and shall have a 1/4 inch drain hole drilled in the bottom of the casing or in the plug.

Color code all leads inside vehicle signal heads re, yellow, green, and white.

(a) **Lenses** - Vehicular signal lenses shall conform to ITE Specifications and shall be:

- Glass with a minimum light transmittance of 92%
- Free of bubbles, flaws and other imperfections
- Circular with a nominal diameter as shown or specified. All arrow indications shall have nominal diameter of 12 inches.
- Mounted in a separate door hinged to the signal housing.
Mounted in an endless composition rubber gasket that completely encompasses the edge of the lens and provides a cushion and positive seal between the lens and the door. Use at least 4 lens clips to secure the lens and gasket to the door.

Designed so the lens, when illuminated, is clearly visible to the traffic controlled by the signal face at all distances up to 1,000 feet under all light and atmospheric conditions, except dense fog.

Designed so the sun’s rays do not reflect and produce any appreciable sun phantom effect, even with the sun shining directly into the lens face.

(b) Doors - Gasket each door to provide moisture resistant construction, so when closed it fits snugly against the reflector. Doors shall open and close easily with one hand.

(c) Reflectors - Illuminate each lens independently of any other lens and provide with a parabolic Alzak®-finished aluminum reflector. Hinge reflector frames to either the door or the housing, so access to the rear of the reflector is allowed without breaking the light circuit. Use suitable clips to hold each reflector firmly to its frame so lamp socket inspection is permitted without removing the reflector.

Removal of the reflector shall not be necessary to replace the lamps on either vehicle or pedestrian signals.

(d) Visors - Construct visors of sheet aluminum alloy ASTM B 209/B 209M, nominal thickness 16 gauge. Visors shall be of one-piece construction and attach to the signal housing doors with Type 304 or 316 stainless steel screws. Provide 8 inch lenses with a 7 inch visor and 12 inch lenses with a 9 1/2 inch visor.

Signal housing doors, with visors attached, shall be capable of being opened a minimum of 90°. Use tunnel visors with the bottom portion open, so the signal is visible directly in front of and below the signal head, on all vehicular signal indications.

(e) Backboards - Construct backboards of sheet aluminum alloy ASTM B 209/B 209M, 14 gauge nominal thickness. All backboards shall be louvered. Provide all vehicular signal heads with backboards and include all of the necessary mounting hardware for completing the installation. Backboard dimensions shall fit the signal head housings used, with no gap between backboard and housing. Backboards shall conform to the general design shown. Backboards shall have a border width of 5 inches and a maximum border width of 5 1/2 inches. Powder-coat backboards according to 00990.48(b).

Attach backboards with stainless steel screws and washers. Use washers at least 3/8 inch in diameter.
02925.65 Pedestrian Signal Heads and Pushbutton Devices - Furnish pedestrian signal heads and pushbutton devices meeting the following requirements:

(a) Signal Heads - All pedestrian signal indications shall be single-section LED countdown pedestrian signals.

The light source shall be fully compliant with the ITE PTSCI Part 2: LED Pedestrian Traffic Signal Modules specifications. The manufacturer shall submit to the City of Portland, reports from ETL/Intertek that certify full compliance of LED signal modules to these specification across the temperature range of 40° centigrade to +74° centigrade. Combined nominal wattage for the Hand/Person Countdown pedestrian signal will not exceed 19 watts. All modules shall have a uniform non-pixelated appearance.

Standard 18 AWG jacketed wires, 3 feet in length shall be provided. The wires will be cut 8 inches from the module and terminated on the module side with a fully insulated male tab connector (T&B TNF 18-250FD or approved equal). The module end of the remaining wire shall be terminated with a fully insulated male tab connector (T&B TNF 18-250MD or approved equal). The termination end shall terminated with quick connect terminals and spade tab adapters.

LED Pedestrian Modules - Typical or Nominal wattage not to exceed the following for individual displays:

<table>
<thead>
<tr>
<th>Indication</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand</td>
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</tr>
<tr>
<td>Man</td>
<td>6</td>
</tr>
<tr>
<td>Countdown</td>
<td>5</td>
</tr>
</tbody>
</table>

(b) "H" Bracket Pedestrian Push Button - Where "H" bracket style push buttons are specified, they shall be within an extruded aluminum bracket with signs placed directly on both sides of the extrusion.

(c) APS Pedestrian Push Buttons - Furnish APS pushbuttons for the Project as shown and specified.

02925.67 Coatings:

(a) Signal Heads - Pedestrian signal heads, vehicle signal heads, beacon heads, and backboards shall be powder coated inside and outside to meet Federal Standard 595b-37038 (dull black). Powder coating shall consist of 3 mils of primer and 2 mils of moisture-cured polyurethane.

(b) Signal Controller Cabinets - Anodize signal control cabinets constructed of aluminum.
(c) **Brackets and Hangers** - All exposed conduits and fittings including signal mounting hardware shall be galvanized in conformance with AASHTO M 111 and then primed with 3 mil DFT, dry film thickness, of Wasser MC Ferrox B and top coated with 3 mil DFT Wasser MC-Luster Topcoat. Apply MC-Luster Topcoat Signal Bronze (W21.0298) in accordance with the manufacturer’s recommendations and Steel Structure Painting Council SSPCPA 1 - “Good Painting Practices.”

(d) **Interior Illuminated Metallic Sign Cabinets (Fluorescent Tube)** - Paint cabinets according to the following:

1. **Inside of Cabinet** - Wash all exposed aluminum and steel parts with a metal cleaning solvent. When metal is thoroughly dry, spray on one coat of zinc chromate paint. When dry, finish with two coats of high quality white enamel.

2. **Outside of Cabinet** - Apply 2 coats of aluminum paint to any exposed metal parts, other than aluminum, on the outside of the cabinet.

3. **Handling** - Refinish any scratches or abrasions on the finished surface of the cabinet to the Engineer’s satisfaction.

(e) **Interior Illuminated Metallic Sign Cabinets (Neon Tube)** - Paint cabinets according to the following:

1. **Inside of Cabinet** - Follow the procedure of (d)(1) above, except after the zinc chromate paint is dry, finish with three coats of a dull, flat, gray or white, weather-resistant paint. Finish the front, exposed face louvers and the tube supports on the inside of the hood with three coats of the same paint.

2. **Outside of Cabinet** - Prime the outside of the cabinet and apply two coats of the flat black enamel.

3. **Handling** - Same as (d)(3) above.

(f) **Fiber-optic Sign Cabinets** - Paint cabinets according to the following:

1. **Inside of Cabinet** - Do not paint interior surfaces of the cabinet.

2. **Outside of Cabinet** - Same as (e)(2) above.

3. **Handling** - Same as (d)(3) above.

(g) **Equipment Control Cabinets** - Flasher cabinets, and remote amplifier cabinets which are not stainless steel or anodized shall be primed with 3 mil DFT of Wasser MC Ferrox B and top coated with 3 mil DFT of Wasser with top coat color as indicated on plans or specifications in accordance with the manufacturer’s recommendations and Steel Structure Painting Council SSPCPA 1 – “Good Painting Practices.”
(h) **Reused Material** - Where the plans or specifications allow the reuse of certain materials, such materials shall be cleaned, shot or sand blasted to bare metal. All surfaces shall be clean, dry, sound, and free of all contaminants. Existing unsound paint shall be scraped away by hand to bare metal; and any and all rust, dirt, debris, and unsound material shall be removed by hand with a wire brush and sandpaper. Remove oil or grease with solvent such as turpentine mineral spirits, or xylol in compliance with SSPC-SPI-63 Solvent Cleaning. Care should be taken to ensure a clean, smooth, sound continuous surface for painting.

All surfaces which have been cleaned down to bare metal should be primed within 8 hours when practical, but in any event not later than 24 hours before any visible detrimental rusting can occur.

After cleaning and priming the reused equipment shall be painted as specified for new equipment.

(i) **Terminal Cabinets** - Terminal cabinets shall be galvanized in conformance with AASHTO M 111 and shall be primed with 3 mil DFT of Wasser MC Ferrox B and top coated with 3 mil DFT of Wasser with top coat color as indicated in plans or specifications in accordance with the manufacturer's recommendations and Steel Structure Painting Council SSPCPA 1 - "Good Painting Practices."
Section 02926 - Illumination Materials

Description

02926.00 Scope - In addition to Section 02920 and all applicable portions of AASHTO "Roadway Lighting Design Guide" (2005) and "American Standard Practice for Roadway Lighting" (IES, RP-8, 2000), this Section includes the requirements for highway illuminations installations.

Materials

02926.01 Materials - Where shown or specified, hardware shall be furnished and installed with hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts and washers. Bolts and screws shall have square or hex heads. Allen head fasteners will not be allowed.

Cabinets and Control Devices

02926.40 Cabinets - Construct all cabinets 14 gauge, 304 stainless steel. Cabinets shall be weatherproof, rated as NEMA Type 3R, and be constructed as shown. A 14 gauge stainless steel nameplate shall be attached to the door with a minimum of 6 stainless steel tamperproof fasteners. The nameplate shall be inscribed "Street Lighting" in letters approximately 3/8 inch high.

Construction of pedestal-type cabinets is to be open-bottom with a bottom frame that can be employed to bolt the unit to a concrete pad at a minimum of four points. All working hardware shall be stainless steel. All metal and non-hardware metal parts shall have all slag, burrs, and rough sports cleaned and ground smooth. The service enclosures shall be delivered to the site complete with all equipment installed and wired for correct operation. Arrangement of equipment and wiring shall be in general conformance with the plans and details. All work on the construction of the service cabinets and panels shall be a UL listed facility and the services enclosures shall carry a UL label of approval for use as "service entrance equipment".

All switch gear, relays clocks, etc., shall be mounted on a mounted on a mounting pen, and the enclosure is to be fitted with a dead front panel. No equipment or devices are to be attached to the dead front panel. Dimensions of the service enclosures shall be as specified on the plans and details. These dimensions are minimum and nominal. The dead front panels and mounting pans shall be 14 gauge stainless steel.

Panels controlling two or more circuits shall have schedule affixed to the interior of the cabinet which shall clearly indicate the pole number each pole that is connected to each circuit breaker. Each circuit breaker shall be numbered or otherwise identified.

02926.41 Circuit Control Devices:

(a) General - Install circuit breakers, the copper neutral block, and contactors as shown.
(b) Circuit Breakers - Circuit breakers for illumination shall be GE Type TEB for all 150 amp breakers or smaller; GE Type TED shall be used for all breakers greater than 150 amps.

Circuit breakers shall be of the rating shown or specified. Circuit breakers shall be of the unenclosed, molded case bolt-on type with end conductor terminals, suitable for surface mounting in the cabinet on a false back or bracket.

Circuit breakers shall conform to Federal Specification W-C-375B. All 100 A frame breakers shall be Class 13a for single pole breakers, and Class 18a for multiple pole breakers. 225 A frame breakers shall be Class 20a, 400 A frame breakers shall be Class 21a, and 800 A frame breakers shall be Class 23a.

Install overcurrent protection and relay equipment, as shown or specified, according to the best common practice, with materials and installation conforming to the NEC.

(c) Multiple Light Contactors - For illumination projects, the contactor shall be model Square D 8903, or approved equal.

(d) Test Switch - Furnish and install a 277 V AC rated test switch in the control cabinets if shown. The test switch shall be a heavy-duty single-pole switch or circuit breaker rated at 15 A and shall be installed in the control cabinet as a roadway lighting test switch. The switch shall be wired to shunt the photoelectric relay power contactor and energize the lighting circuit contactors.

(e) Photoelectric Relay - The photoelectric relay shall attach to a three-pole locking receptacle by a twisting motion.

The unit shall have a built-in surge protective device for protection from induced high voltage and follow-through currents. The relay shall meet or exceed the requirements of ANSI C136.10. Factory set turn-on lights shall be 1.4 foot-candle plus or minus 0.2 foot-candle at 120 V AC. When operated at 240 V AC, turn-on shall not change more than plus or minus 0.3 foot-candle from the 120 V value. Maximum off-to-on ratio shall be 1.5:1.

Normal operation shall be designed for dual voltage operation of 105 V - 285 V, 60 Hz.

Power consumption shall be less than 1 W. At the designated voltage, the photoelectric relay shall be capable of controlling a minimum mercury vapor, fluorescent or incandescent lamp load of 1000 W. Minimum operating temperature range shall be from -40 °F to 150 °F.

A time-delay control circuit shall prevent false turn-offs by transient light conditions. Provide a fail-safe circuit for the lighting load to remain on or become energized if any functional failure of the photoelectric control circuit occurs.
**Lamps, Ballasts, and Luminaires**

**02926.50 Illumination Lamps** - All mercury vapor, high-pressure sodium and metal halide lamps shall conform to ANSI Standards. All lamps of the same size and type, on a single Project, shall be from the same manufacturer's lot number.

All lamp bases shall have a brass mogul base mounting with dating system.

Lamps shall have an average minimum initial lumen rating (after 100 burning hours) and an average minimum lamp life (based on 100 hours per start) as follows:

<table>
<thead>
<tr>
<th>Lamp Watts</th>
<th>ANSI Code</th>
<th>Minimum Initial Vertical Lumens</th>
<th>Minimum Average Lamp Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>S68MS-50</td>
<td>4,000</td>
<td>24,000</td>
</tr>
<tr>
<td>70</td>
<td>S62ME-70</td>
<td>6,300</td>
<td>24,000</td>
</tr>
<tr>
<td>100</td>
<td>S54SB-100</td>
<td>9,500</td>
<td>24,000</td>
</tr>
<tr>
<td>150</td>
<td>S55SC-150</td>
<td>16,000</td>
<td>24,000</td>
</tr>
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**02926.52 Ballasts** - Unless otherwise specified on plans, the luminaire ballasts shall be normal power factor reactor type for 150 watt or smaller. Ballasts for 200 watt and larger shall be magnetic regulator type.

If remote-mounted ballasts are shown or specified, mount the ballasts in weatherproof ballast enclosures of corrosion-free aluminum or fiberglass reinforced polyester. A 1 inch threaded nipple shall be molded into the cover. Provide a minimum of 10 inch color-coded and identified leads.

Ballasts directly exposed to rain or water shall have enclosures completely filled with epoxy resin or other suitable material to lock capacitors, core, and coils firmly in place and maintain a watertight seal. Mount starting-aid circuits for high-pressure sodium lamps in the luminaire.

Provide a manufacturer's nameplate on the ballast housing. The nameplate shall have the manufacturer's name, model number, serial number, hook-up diagram, power supply data, lamp type and operating wattage.
02926.53

The ballast shall operate the lamp within the limits specified below throughout the rated life of the lamp:

- The lamp wattage shall not vary more than plus or minus 5% of nominal when the lamp is at its rated nominal voltage (high-pressure sodium lamps only).
- The ballast shall not allow the lamp arc to extinguish when a line voltage dip as shown below occurs for several seconds.
- The ballast shall start and operate the lamp in ambient temperatures down to -20 °F.
- The lamp current crest factor shall not exceed 1.8 for line voltage variation shown below.
- The ballast shall conform to all ANSI Standards.
- Unless otherwise shown or specified, operate ballasts on 240 V or 480 V. When 120 V operation is specified, the ballast shall be a multi-voltage type with taps to allow the ballast to be connected to 120 V, 208 V, 240 V, or 277 V.

02926.53 High-Intensity Discharge Luminaires:

(a) General - Furnish conventional roadway luminaires for horizontal slipfitter end mounting.

Luminaires shall have a cast-aluminum housing and shall attach to 2 inch pipe tenons on mast arms. The luminaire attachment fitting shall provide for a minimum of plus or minus 3 degree adjustment of the luminaire in the vertical direction. The reflector of all luminaires shall be of a snap-on or easily removed design manufactured of polished aluminum or molded from prismatically formed borosilicate glass. The refractor shall be mounted in a door frame assembly hinged to the luminaire and secured in the closed position by means of an automatic latch or a draw latch. The refractor and doorframe assembly, when closed, shall exert pressure against a gasket. Gaskets shall be composed of material capable of withstanding the temperatures encountered and shall be securely held in place. Glassware shall be of the refractor type with prisms.

Reflectors and refractors provided with the luminaire shall be stamped or labeled with a part number. The luminaire photometric submittal (isocandela diagrams) shall indicate the reflector and refractor part number used.

All luminaires shall have their components secured to the luminaire frame with corrosion-resistant mounting hardware. The housing, complete with integral ballast, shall be weather tight.

If sand-cast, the aluminum housing shall be left in its natural finish. If die-cast, the housing shall be given a coat of aluminum paint.

Refractors shall be formed from heat-resistant, high-impact, molded borosilicate glass.

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Lamp sockets shall be adjustable to obtain the light distribution shown or specified.

Socket opening shall be sealed with a heat-resistant filter or filtering gasket to prevent the entry of dirt, insects or moisture into the optical system.

The socket mounting mechanism shall be sufficiently rigid that upon application of a 2 pound load in any direction on the light source center, the light source center will not deflect more than 1/16 inch.

All luminaires shall bear a UL label (or Oregon approved equivalent). Light distribution shall be medium Type III cutoff unless otherwise indicated on plans. Luminaire glassware, reflector and lamp shall be thoroughly cleaned before installation.

(b) Classification of Luminaire Light Distribution - Furnish the following distribution types as shown or specified. The classifications listed shall conform to ANSI definitions.

(1) Vertical Light Distributions - Divide vertical light distributions into three groups: short (S), medium (M), and long (L). Classification of the three groups depends on the maximum candle power point within a grid area according to the ANSI/IES RP-8 (1990) publication for Roadway Lighting.

(2) Lateral Light Distributions - Lateral light distribution patterns shall have the following designations:

<table>
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<tr>
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<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
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The type designations listed above shall conform to ANSI definitions.

(3) Distribution Above Maximum Candle Power - This classification shall be used to control the candle power in the upper portion of the beam above the maximum candle power. The following three classifications shall be used:

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<th>Cutoff</th>
<th>Semicutoff</th>
<th>Noncutoff</th>
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The classifications listed above shall conform to ANSI definitions.

(c) Standard Luminaires - The luminaire shall be as specified on the plan set. All exposed hardware shall be made of stainless steel. The fixture provided shall be as specified for the project, or an approved equivalent.
02926.67 Coating:

(a) Service Cabinets - Pole mounted service cabinets shall be painted to match the pole as specified in Section 00962.48.

(b) Reused Material - Where the plans or specifications allow the reuse of certain materials, such materials shall be cleaned, shot or sand blasted to bare metal. All surfaces shall be clean, dry, sound, and free of all contaminants. Existing unsound paint shall be scraped away by hand to bare metal; and any and all rust, dirt, debris, and unsound material shall be removed by hand with a wire brush and sandpaper. Remove oil or grease with solvent such as turpentine mineral spirits, or xylol in compliance with SSPC-SPI-63 Solvent Cleaning. Care should be taken to ensure a clean, smooth, sound continuous surface for painting.

All surfaces which have been cleaned down to bare metal should be primed within 8 hours when practical, but in any event not later than 24 hours before any visible detrimental rusting can occur.

After cleaning and priming the reused equipment shall be painted as specified for new equipment.
03010.00  Scope - This section includes the requirements for barbed wire, woven wire and chain link fabric, metal posts, braces, hardware, and gates.

Materials

03010.10  Barbed Wire - The barbed wire shall be two-strand and either 12 1/2 gauge or 15 1/2 gauge with four-point barbs spaced at 5 inch intervals conforming to the requirements of AASHTO M 280 (ASTM A 121). Galvanizing shall be Class 3.

All barbed wire installed on the Project shall be new or like new and the same diameter unless otherwise approved.

03010.20  Woven Wire Fabric - The woven wire fabric shall be 12 1/2 gauge galvanized steel wire conforming to the requirements of AASHTO M 279 (ASTM A 116), Class 3 coating or 11 gauge or 12 1/2 gauge aluminum coated steel wire conforming to the applicable requirements of ASTM A 116. The 2 gauge aluminum coated steel wire shall have the same coating thickness required for 11 gauge steel wire in Table 2 of ASTM A 116.

03010.30  Chain Link Fabric, Ties, and Tension Wire - Chain link fabric, ties, and tension wire shall conform to the requirements of AASHTO M 181 supplemented and modified as follows:

- Fabric may be zinc-coated steel meeting Type I, Class D coating requirement, aluminum-coated steel, or aluminum alloy. Use only one type on the Project.
- Wire fabric ties, wire ties, and hog rings may be zinc-coated steel wire, aluminum-coated steel, or aluminum alloy as elected, regardless of the type of wire fabric used.
- Use ductile, zinc-coated steel meeting the coating requirements of ASTM A 641/A 641M, Class 1 for wire fabric ties, wire ties, and hog rings. Aluminum-coated steel wire fabric ties, wire ties and hog rings shall be coated with at least 0.30 ounce per square foot.
- Tension wire shall have a Class 2 coating.
- Fabric for the fence to be installed with pickets shall be 9 gauge wire woven in 3 1/2 inch by 5 1/2 inch diamond mesh. Top and bottom selvage shall be knuckled finish.

03010.31  Pickets - Pickets shall be either standard Grade A redwood or cedar pickets, 3/8 inch x 2 1/2 inch x 6 feet, or industry standard metal, or plastic pickets as shown or approved.
03010.40 **Vinyl Clad Fabric** - Vinyl clad chain link fabric shall conform to AASHTO M 181, Type IV. The color of the PVC coating shall be either medium or dark green.

03010.50 **Metal Fence Posts, Braces, and Appurtenances** - Metal fence posts, braces and appurtenances shall conform to the requirements indicated on the plans and the following:

(a) **Painted Metal Posts** - All painted metal posts shall be of the same kind and color.

(b) **posts, Braces, and Appurtenances for Chain Link Fence** - Posts, braces, and appurtenances for chain link fence shall conform to the requirements of AASHTO M 181.

Posts for bridge protective fence shall be galvanized and conform to the requirements of ASTM A 53, Grade B. Braces and appurtenances for bridge protective fence shall conform to the requirements of AASHTO M 181.

(c) **Posts, Braces, and Appurtenances for Barbed Wire and Woven Wire Fence**:

(1) **Tubular Steel Posts** - Tubular steel posts, braces and appurtenances shall conform to the requirements of AASHTO M 181. Tubular posts shall be fitted with a snug-fitting, galvanized metal cap.

(2) **Other Shapes** - Metal posts and braces, other than tubular shape, for barbed wire and woven wire fences, shall conform to AASHTO M 281 (ASTM A 702), except that galvanizing may conform to the requirements of AASHTO M 111 (ASTM A 123). The posts and braces may be either galvanized or painted, as elected. Wire fasteners shall meet the coating requirements of ASTM A 641/A 641M, Class 1.

(3) **Fence Stays, Brace Guys, and Wire Loops** - Metal fence stays, brace guy wires, wire loops for gateways and other miscellaneous wire used in barbed and woven wire fences shall be furnished with Class 1 coating as required by ASTM A 641. Either 9 1/2 gauge or 10 gauge wire is acceptable for fence stays.

(d) **Concrete In Footings** - Concrete for footings shall conform to Section 00440.

(e) **Grounding Rod** - 5/8 inch by 8 foot, nonrusting, copper covered steel rod with a bronze grounding wire clamp.

(f) **Grounding Wire** - AWG 4/0 Solid Copper or No. 6 bare aluminum wire with clamps.
03010.60 Fence Gates:

(a) General - Tubular steel gate frames shall conform to AASHTO M 181. Fabric in gates used with chain link fence shall be chain link of the same gauge and conforming to applicable requirements of 03010.30. Fabric in gates used with woven wire fence shall be woven wire fabric conforming to 03010.20 or chain link fabric conforming to the applicable requirements of 03010.30, except that the zinc coating may be either Class C or Class D.

(b) Hardware - All fence and gate hardware shall conform to the requirements of AASHTO M 181, except that the thickness of galvanizing shall be according to AASHTO M 232 (ASTM A 153).

03010.75 Protective Fence Materials, On and Off Structures:

(a) Resin Bonded Anchor System - The resin bonded anchor system used to install the fence post anchor rods in the concrete bridge rail shall be from the CPL and be installed according to the manufacturer's recommendation.

(b) Posts - Modify posts to attach to the structure as shown.

(c) Steel Plates, Angles, and Bolts - Steel plates, angles, and bolts shall meet the applicable requirements of Section 02530 and galvanized according to 02530.70.

(d) Chain Link Fabric, Ties, and Tension Wire - Chain link fabric, ties, and tension wire shall conform to the requirements of 03010.30.

(e) Pickets - Pickets shall meet the requirements of 03010.30.

03010.80 Acceptance - Acceptance of fencing materials will be according to 00165.35 and this Section.
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