CITY OF PORTLAND

STANDARD
CONSTRUCTION
SPECIFICATIONS

Published
November 2007

Copies of this book may be purchased from:
City of Portland
Development Services Center
1900 SW 4th Avenue
Portland, Oregon 97201
Telephone: 503-823-7660
http://www.portlandonline.com/bds/index.cfm?c=36663
ACKNOWLEDGEMENT

The following people worked diligently to update the City of Portland Standard Construction Specifications. A list of the committee members is shown below. In addition, the committee members extend a "thank you" to the many City employees who provided technical support and expert review of the draft Standards.

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Introduction


To aid users of the Standard Construction Specifications on where changes were made, a vertical bar has been placed on the left margin. The enclosed disk allows the user to view the exact change, whether a word, sentence or an entire paragraph in blue. Blue wording in Part 00100 means language differs from the 1987 Division 1A (as revised January 2006). For Parts 00200 and beyond, blue changes refer to content that differs from the ODOT 2002 Standards Specifications for Construction.

Note that most of the major changes in the Standard Specifications technical sections occur in Parts 00400 and 01100. Part 00400 contains new Sections dealing with pipe bursting and vegetated stormwater facilities. Section 00405 has been modified extensively to address both Environmental Services and Water Bureau construction practices. The Sections In Part 01100 dealing with water mains have been revised and expanded to reflect Water Bureau procedures.

The City of Portland intends to update these Standard Construction Specifications on a regular basis.
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Section 00110 - Organization, Conventions, Abbreviations and Definitions

Organization

00110.00 Organization of Standard Specifications - This publication is comprised of Part 00100 "General Requirements," which deals with the solicitation process and contractual relationships, and Parts 00200 and beyond, 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, Supplemental Specifications (if any), or future expansion of the Standard Specifications.

Conventions

00110.05 Conventions Used Throughout the Specifications Include:

(a) Grammar - Part 00100 of the Supplemental Specifications is written in the indicative mood, in which the subject is expressed. Parts 00200 and beyond of the Standard Specifications are generally written in the imperative mood, in which the subject is implied. Therefore, throughout Parts 00200 and beyond, 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 City and/or the Engineer.

(4) The following words, or words of equivalent meaning, refer to the actions of the City and/or the Engineer, unless otherwise stated: "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 City and/or the Engineer.

(6) 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 and beyond, 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.

(1) 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.

(2) 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 and/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.

(3) 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**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAN</td>
<td>American Association of Nurserymen</td>
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<tr>
<td>AAR</td>
<td>Association of American Railroads</td>
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<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
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<tr>
<td>ABC</td>
<td>Associated Builders and Contractors, Inc.</td>
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<tr>
<td>AC</td>
<td>Asphalt Concrete</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
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<tr>
<td>ACWS</td>
<td>Asphalt Concrete Wearing Surface</td>
</tr>
<tr>
<td>ADA</td>
<td>Americans with Disabilities Act</td>
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<tr>
<td>AGA</td>
<td>American Gas Association</td>
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<tr>
<td>AGC</td>
<td>Associated General Contractors of America</td>
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<tr>
<td>AIA</td>
<td>American Institute of Architects</td>
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<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
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<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
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<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>APA</td>
<td>American Plywood Association</td>
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<td>APWA</td>
<td>American Public Works Association</td>
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<tr>
<td>ARA</td>
<td>American Railway Association</td>
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<tr>
<td>AREA</td>
<td>American Railway Engineering Association</td>
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<td>ASCE</td>
<td>American Society of Civil Engineers</td>
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<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<td>ATPB</td>
<td>Asphalt-Treated Permeable Base</td>
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<td>AWG</td>
<td>American Wire Gauge</td>
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<tr>
<td>AWPA</td>
<td>American Wood Preservers Association</td>
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<td>AWS</td>
<td>American Welding Society</td>
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<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>BES</td>
<td>Bureau of Environmental Services</td>
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<tr>
<td>CABO</td>
<td>Council of American Building Officials</td>
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<td>CAgT</td>
<td>Certified Aggregate Technician</td>
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<td>CAT-I</td>
<td>Certified Asphalt Technician I</td>
</tr>
<tr>
<td>CAT-II</td>
<td>Certified Asphalt Technician II</td>
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<td>CBM</td>
<td>Certified Ballast Manufacturers</td>
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<td>CCD</td>
<td>Construction Change Directive</td>
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<td>CCO</td>
<td>Contract Change Order</td>
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<td>CCT</td>
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<tr>
<td>CDT</td>
<td>Certified Density Technician</td>
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<tr>
<td>CEBT</td>
<td>Certified Embankment and Base Technician</td>
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<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
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<td>CMDT</td>
<td>Certified Mixture Design Technician</td>
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<td>CPF</td>
<td>Composite Pay Factor</td>
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<td>CRSI</td>
<td>Concrete Reinforced Steel Institute</td>
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<td>CPL</td>
<td>Construction Products List</td>
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<tr>
<td>CS</td>
<td>Commercial Standard, Commodity Standards Division, U.S. Department of Commerce</td>
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<td>CSI</td>
<td>Construction Standards Institute</td>
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<td>CSTT</td>
<td>Concrete Strength Testing Technician</td>
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<td>D1.1</td>
<td>Structural Welding Code - Steel, American Welding Society, current edition</td>
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<td>D1.5</td>
<td>Bridge Welding Code, American Welding Society, current edition</td>
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<td>DBE</td>
<td>Disadvantaged Business Enterprise</td>
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<td>DEQ</td>
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<td>DHS</td>
<td>Oregon Department of Human Services</td>
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<td>DOGAMI</td>
<td>Department of Geology and Mineral Industries, State of Oregon</td>
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<td>DSL</td>
<td>Division of State Lands, State of Oregon</td>
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<td>EAC</td>
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<td>EPA</td>
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<td>ESCP</td>
<td>Erosion and Sediment Control Plan</td>
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<tr>
<td>FHWA</td>
<td>Federal Highway Administration, U.S. Department of Transportation</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>FSS</td>
<td>Federal Specifications and Standards, General Services Administration</td>
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<td>GSA</td>
<td>General Services Administration</td>
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<td>HMAC</td>
<td>Hot Mixed Asphalt Concrete</td>
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<tr>
<td>ICEA</td>
<td>Insulated Cable Engineers Association (formerly IPCEA)</td>
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<tr>
<td>IES</td>
<td>Illuminating Engineering Society</td>
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<td>IMSA</td>
<td>International Municipal Signal Association</td>
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<td>ISO</td>
<td>International Standards Organization</td>
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<td>ITE</td>
<td>Institute of Traffic Engineers</td>
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<tr>
<td>JMF</td>
<td>Job Mix Formula</td>
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<td>MDFT</td>
<td>Mil Dry Film Thickness</td>
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<td>MFTP</td>
<td>Manual of Field Test Procedures (ODOT)</td>
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<td>MIL</td>
<td>Military Specifications</td>
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<td>MSS</td>
<td>Manufacturers Standard Specifications</td>
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<td>MSC</td>
<td>Minor Structure Concrete</td>
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<td>MUTCD</td>
<td>Manual of Uniform Traffic Control Devices for Streets and Highways, FHWA, US Department of Transportation</td>
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<td>NACE</td>
<td>National Association of Corrosion Engineers</td>
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<td>NEC</td>
<td>National Electrical Code</td>
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<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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<td>NIST</td>
<td>National Institute of Standards and Technology</td>
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<td>NLMA</td>
<td>National Lumber Manufacturer's Association</td>
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<td>NMFS</td>
<td>National Marine Fisheries Services, a part of the National Oceanic and Atmospheric Administration</td>
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<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
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<td>NPS</td>
<td>Nominal Pipe Size (dimensionless)</td>
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<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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<td>Oregon Administrative Rules</td>
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<td>OD</td>
<td>Outside Diameter</td>
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<td>ODFW</td>
<td>Oregon Department of Fish and Wildlife</td>
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<td>ODF</td>
<td>Oregon Department of Forestry</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
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<td>OR-OSHA</td>
<td>Oregon Occupational Safety and Health Administration</td>
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<td>ORS</td>
<td>Oregon Revised Statutes</td>
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<td>OSHA</td>
<td>Occupational Safety and Health Administration (Federal)</td>
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<td>PCA</td>
<td>Portland Cement Association</td>
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<td>PCI</td>
<td>Precast/Prestressed Concrete Institute</td>
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<td>PCP</td>
<td>Pollution Control Plan</td>
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<td>PDOT</td>
<td>Portland Office of Transportation</td>
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<td>PF</td>
<td>Pay Factor of a constituent</td>
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<tr>
<td>PLS</td>
<td>Professional Land Surveyor</td>
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<td>PMBB</td>
<td>Plant Mixed Bituminous Base</td>
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<td>PTI</td>
<td>Post-Tensioning Institute</td>
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<td>PUC</td>
<td>Public Utility Commission</td>
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<td>PWB</td>
<td>Portland Water Bureau</td>
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<tr>
<td>QA</td>
<td>Quality Assurance</td>
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<td>QC</td>
<td>Quality Control</td>
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<tr>
<td>QCT</td>
<td>Quality Control Technician</td>
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<td>QL</td>
<td>Quality Level</td>
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<tr>
<td>RAP</td>
<td>Reclaimed Asphalt Concrete Pavement</td>
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<td>REA</td>
<td>Rural Electrification Administration, U.S. Department of Agriculture</td>
</tr>
<tr>
<td>RMA</td>
<td>Radio Manufacturers Association or Rubber Manufacturers Association</td>
</tr>
<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
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<tr>
<td>SI</td>
<td>International System of Units (Système Internationale)</td>
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<tr>
<td>SRCM</td>
<td>Soil and Rock Classification Manual (ODOT)</td>
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<td>SSPC</td>
<td>Steel Structures Painting Council</td>
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<tr>
<td>T</td>
<td>Tolerances, AASHTO Test Method</td>
</tr>
<tr>
<td>TM</td>
<td>Test Method (ODOT)</td>
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<tr>
<td>TV</td>
<td>Target Value</td>
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<tr>
<td>UBC</td>
<td>Uniform Building Code (as adopted by the State of Oregon)</td>
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<tr>
<td>UFC</td>
<td>Uniform Fire Code</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters' Laboratories, Inc.</td>
</tr>
<tr>
<td>UMC</td>
<td>Uniform Mechanical Code</td>
</tr>
<tr>
<td>UPC</td>
<td>Uniform Plumbing Code (as adopted by the State of Oregon)</td>
</tr>
</tbody>
</table>
Definitions

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

Act of God - An Act of God is a phenomenon of nature of catastrophic proportions or intensity, such as an earthquake, flood, cloudburst, tornado, or hurricane.

Addenda - 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.

Aggregate – Fracture 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 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, the Proposal, 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.

**Bid Schedule** - The list of Pay Items, their units of measurement, and estimated quantities. (When a Contract is awarded, the Bid Schedule becomes the Schedule of Items.)

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

**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, Maintenance, Parks and Recreation, Purchases, Office of Planning and Development Review (OPDR), Traffic Management, Transportation Engineering and Development, Water Works, and General Services.

**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, twenty-four 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 order issued by the Engineer to the Contractor modifying work required by the Contract and establishing the basis of payment for the modified work. |
| **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 strict 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 affect 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 Pay Items - A specific unit of work for which a price or basis of payment is provided in 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, as modified by any authorized Change Order.

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 - 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.

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 Concrete - A mixture of Emulsified Asphalt and graded Aggregate.

Emulsified Asphalt - Emulsified asphalt cement.

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 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 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.

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

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

**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.

**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’s Representative** - An employee acting on behalf of 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))

**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.

**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, and/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 (Contract Item)** - A specific unit of Work for which a price is provided in the Contract.

**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 companies, joint stock companies and associations.

**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.

**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.

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

**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.

**Purchasing Agent** - The Director of the Bureau of Purchases or the Director’s designated representative.

**Purchasing 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.

**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 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** - 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 referenced by the solicitation document are included in the solicitation document.

**Special Provisions or Special Specifications** - 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(l).

**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 Plans and Drawings** - Standard details 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.

Surety - The 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 - The short ton of 2000 pounds avoirdupois.

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.

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 expressed 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 in writing of the Project 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.
Assignment of Claim Relief - The Bidder shall sign a form provided in the Bid Documents assigning 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.
Section 00130 - Award and Execution of Contract

Provisions and Requirements

00130.10 Award of Contract - The Owner's Purchasing 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.
Section 00140 - Scope of Work

Provisions and Requirements

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 pursuant to a CCD shall be made pursuant to 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.
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) above. 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 govern any increases in the scope of the Work required as a result of environmental or natural resources laws enacted 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 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:

- A description of existing Contract requirements for performing the Work and the proposed change;

- The Contract items of Work affected by the proposed change, including any quantity variation caused by the proposed change;
• Pay Items affected by the proposed change including any quantity variations;

• 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

• 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.

(b) Unless the Contract specifically provides for payment for this item, the Owner will make no separate or additional payment for final trimming and cleanup.
Section 00150 - Control of Work

Provisions and Requirements

00150.00 Authority of the Owner's Representative:

(a) The Work shall be performed to the complete satisfaction of the Owner's Representative.

(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 00180.70(a).

(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 Inspectors' 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

(4) Special Provisions

(5) Supplemental Specifications

(6) Plans

(7) Information furnished by written notes and/or schedules on drawings

(8) Large Scale Drawings over small scale drawings

(9) Information provided by lines on drawings

(10) Standard Plans

(11) Standard Specifications

(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 and/or staked every 25 feet and at corners with stakes and/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.
(6) Traffic Signal and Street Lighting Staking:

- **Poles** - Signal and Light poles with 2 points each with cut/fill to sidewalk finish grade.
- **Controllers** - Offsets to control cabinets with cut/fill to sidewalk finish grade.

(7) Structure Staking:

- **Piling** - Set stakes with offsets to locate center of each pile.
- **Abutments/Pier Caps** - Set stakes and benchmark to locate centerline of abutments or pile caps.
- **Retaining Walls** - Set stakes and benchmark to locate wall control line.
- **Bridge Decks** - Calculate and provide finish deck grades.

(8) Water line and appurtenances shall be staked.

The Contractor shall be responsible for supplementing as needed and/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.

(c) 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.

(d) 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 three (3) City business days of the Survey department's receipt of the request. If an area requested is not ready for staking within the three (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.

(e) All elevations shown on the Plans are City of Portland datum. This datum plane has its zero elevation set equivalent to a minus 1.375 feet below mean sea level as set by the U.S. Coast and Geodetic Survey 1947 adjustment.
00150.20 Inspection:

(a) Inspection by the Owner - 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.

(b) Inspection Facilities - 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 five business 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 six (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 with 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.
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 strict accordance with the Contract Documents;
5. The means and methods of construction; and
6. Conforming to all the requirements of the Contract

The Owner's Representative will have 14 days to review any Submittals, unless a different time is established elsewhere. The Owner's Representative will review the Submittals and return them to the Contractor stamped with one of the following notations:

1. “NO EXCEPTIONS TAKEN” If the Submittal is marked, “NO EXCEPTIONS TAKEN,” this means that the Contractor immediately can 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 suggested 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 schedule 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 seven copies of Working Drawings for steel Structures and six 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 that 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 time frames set forth in each Section of the Specifications that requires such approval.

00150.40 Cooperation and Superintendence by the Contractor:

(a) The Contractor, or a representative authorized to act on the Contractor's behalf, shall supervise the progress and coordination of the work and be continually available in the event that the Owner needs to communicate with the Contractor about the Work. Contractor shall have only one authorized representative and shall inform Owner if that representative should change.
(b) 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.

(c) 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 to perform the Work in accordance with the law, statutes, ordinances, or building Codes nor does it relieve the Contractor from obtaining all required Permits.

00150.50 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 utilities are responsible for relocation.

(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 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) above, Contractor shall also give Notice to Owner of any intended excavation it may have at least 48 hours 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.

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 them to allow them to perform their separate work, including, but not limited to, the introduction and storage of materials and equipment.

(c) The Contractor promptly shall 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, separate 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) above constitutes Contractor’s acceptance of the other Contractor’s work and constitutes a conclusive waiver of any later Claim for additional compensation or Contract Time as a result of the other Contractor’s 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 below.

(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 the overweigh 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 Representative, 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 shall fully warrant all work for at least two (2) full years from Substantial Completion of the Project, regardless of the length of manufacturers’ or installers’ warranties.

(b) In addition to any other warranties that are required, the Contractor shall make all necessary repairs and replacements to remedy any and all defects, breaks, or failures of the Work occurring within two (2) years following the date of Substantial Completion by the City Council 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.

(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 thereon if caused by the Contractor’s work and if the damage or remedy occurs during the warranty period.

(e) If the Contractor performs warranty work, the warranty work also shall have a two (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 ten 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 two-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 the 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 PDOT 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 PDOT'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.

00160.60 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.

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 Engineer.

**(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 Engineer may reject any Materials that appear to be defective (00150.80). 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 Engineer has approved their use. The Engineer 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 test results and 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.

(f) 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.

(g) 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.
00165.03 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 Engineer, 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.

00165.04 Costs of Testing - Contractor shall provide and pay for all quality control testing of materials on PDOT projects, except Permit Engineering, unless otherwise indicated in the Special Provisions. PDOT Permit Engineering, BES and PWB will provide and pay for all quality control testing of Materials on their projects unless otherwise indicated in the Special Provisions. The Owner will pay the cost of the first source-review tests on unprocessed Aggregates when requested by the Contractor. Thereafter, additional source-review tests performed at the Contractor's request shall be paid by the Contractor.

On joint projects, the Contractor shall be responsible for providing and paying for quality control testing of materials as shown in the Special Provisions.

Provisions and Requirements

00165.10 Materials Acceptance Guides - Unless otherwise specified elsewhere in the Contract, Materials will be accepted according to the following guides:

(a) 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 - 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. 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:

- ODOT;
- WAQTC;
- AASHTO;
- ASTM;
- AWWA;
- NSF
- Other recognized national organizations, such as ANSI, AWPA, IMSA, and UL; and
- Industry standards in the location where the Work is being performed.

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:

- Special Provisions;
- MFTP;
- Supplemental Specifications; and
- Standard Specifications.

00165.30 Field-Tested Materials:

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

- Furnish Materials of the quality specified in the Contract;
- 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

- Perform other testing as required by the Contract.

(b) Types of Tests - The types of tests and testing methods generally required by PDOT 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:

- Statistically, according to 00165.40, to determine "Pay Factors" for produced Aggregate;

- Statistically, according to 00165.40, to determine "Composite Pay Factors" for mixtures; or

- Other methods determined by the Engineer.

If acceptance testing reveals that the Contractor's data is incorrect, the Owner will perform additional testing to determine whether the Materials meet Specifications. 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.

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:

- Be from the manufacturer verifying that the Material furnished has been sampled and tested and the test results meet the Specifications

- Include, or be accompanied by, a copy of the specified test results (ODOT, AASHTO, ASTM, AWWA, NSF, UL or other)

- Identify the testing agency and the representative responsible for the test results

- Permit positive determination that Material delivered to the Project is the same Material covered by the test results

- Be delivered to the Engineer with the shipment of the material

(b) Quality Compliance Certificate - The Certificate from the manufacturer shall:
Verify that the Material meets the Specifications, and identify by number the specified test methods used (ODOT, AASHTO, ASTM, AWWA, NSF, UL, or other)

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

Be delivered to the Engineer 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 - These consist of lists of proposed Equipment and Materials, such as:

• Shop drawings
• Material lists
• Equipment lists
• Catalog description sheets
• Manufacturer's brochures

Submit these lists to the Engineer for review of conformance with the Specifications.

(d) Certificate of Origin of Steel Materials - When specified, complete ODOT Form 734-2126 as required for Federal-aid projects.

Materials will be subject to acceptance testing if the Engineer so elects. The Engineer 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 Engineer 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:

- The percentage of each constituent of the Materials meeting Specifications;
- The Pay Factor for each constituent; and
- 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 ($\bar{X}$) for each constituent:

$$\bar{X} = \frac{\sum X}{n}$$

Where $\sum X$ = summation of sample test values
$n$ = total number of samples

2. Compute standard deviation (sd) for each constituent:

$$sd = \sqrt{\frac{\sum X^2 - n\bar{X}^2}{n-1}}$$

Where $\sum X^2$ = summation of the squares of each sample test value
$\bar{X}^2$ = square of the lot arithmetic mean

3. Compute the upper quality index ($Q_U$) for each constituent:

$$Q_U = \frac{USL - \bar{X}}{sd}$$

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

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

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.

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.

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

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

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<th>Pu or Pl, Percent Within Limits For Positive Values of QU or QL</th>
<th>n = 3</th>
<th>n = 4</th>
<th>n = 5</th>
<th>n = 6</th>
<th>N = 7</th>
<th>n = 8</th>
<th>n = 9</th>
<th>n = 10 to n = 11</th>
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<td>2.23</td>
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**NOTE:** For negative values of QU or QL, Pu or Pl is equal to 100 minus the table value for Pu or Pl. If the value of QU or QL does not correspond exactly to a figure in the table, use the next higher figure.
### Table 00165-1

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

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**NOTE:** For negative values of \(Q_U\) or \(Q_L\), \(P_U\) or \(P_L\) is equal to 100 minus the table value for \(P_U\) or \(P_L\). 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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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.
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**NOTE:** If the computed QUALITY LEVEL does not correspond exactly to a figure in the table, use the next lower value.
00165.50 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) A Lot-in-Progress - The Contractor shall shut down production when any of the following occurs:

- The CPF for a lot-in-progress drops below 1.0000, and the Contractor is taking no corrective action;
- The CPF is less than 0.7500; or
- 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.

(2) 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:

- Determine if the Owner or its agents can sample and test;
- Estimate the cost to the Contractor for the testing service; and
- 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** - 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.
Stored Materials:

- Shall be readily accessible for inspection;
- May be stored on approved parts of the Right-of-Way; and
- 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 - 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:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Place of Fabrication</th>
<th>Reduction in Payment</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>All of State of Oregon, and those portions of adjacent states within 50 airline miles of the Oregon border</td>
<td>$0</td>
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<tr>
<td>2</td>
<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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<tr>
<td>3</td>
<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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<tr>
<td>4</td>
<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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</tbody>
</table>
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.

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:

- Structural steel fabrication;
- Prestressed concrete members;
- Precast concrete;
- Signs;
- Preservative treatment of wood products;
- Epoxy coating of reinforcing steel; and
- 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:

(a) The Oregon Legislature has determined that Bid Documents for a public contract for a public improvement shall make specific reference to federal, state and local agencies that have enacted ordinances or regulations dealing with the prevention of environmental pollution and the preservation of natural resources that affect the performance of the Contract. The agencies include, but may not be limited to the following:

(1) Federal Agencies:

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

   b. Army, Department of the:
      1. Engineers, Corps of

   c. Commerce, Department of
      1. National Oceanic and Atmospheric Administration
      2. National Marine Fisheries Service

   d. Homeland Security, Department of:
      1. US Coast Guard

   e. Interior, Department of:
      1. Heritage, Conservation and Recreation Service
      2. Indian Affairs, Bureau of
      3. Land Management, Bureau of
      4. Reclamation, Bureau of
      5. Surface Mining, Reclamation and Enforcement, Office of
f. US Fish and Wildlife Service

g. Labor, Department of:
   1. Occupational Safety and Health Administration
   2. Mine Safety and Health Administration

h. Transportation, Department of:
   1. Federal Highway Administration

(2) Oregon Tribal Governments:
   a. Warm Springs, Confederated Tribes of

(3) State of Oregon Agencies:

   a. Agriculture, Department of
      1. Natural Resources Division
      2. Soil and Water Conservation Division

   b. Consumer and Business Services, Department of
      1. Insurance Division
      2. Oregon Occupational Safety and Health Division

   c. Energy, Department of

   d. Environmental Quality, Department of

   e. Fish and Wildlife, Department of

   f. Forestry, Department of

   g. Geology and Mineral Industries, Department of

   h. Human Resources, Department of

   i. Insurance and Finance, Department of

   j. Oregon Occupational Safety and Health Division

   k. Labor and Industries, Bureau of

   l. Land Conservation and Development Department

   m. State Lands, Division of

   n. Water Resources Department
(4) Local Agencies:

a. City Council

b. County Courts

c. County Commissioners

d. Metro

e. Planning Commissions

f. Port Districts

g. Public and Private Utilities:
   1. County Service Districts
   2. Fire Protection Districts
   3. Irrigation Districts
   4. Lighting Districts
   5. Metropolitan Service Districts
   6. Sanitary Districts
   7. Water Districts

h. TriMet

00170.02 Permits, Licenses, and Taxes:

(a) The Contractor shall, without additional expense to the Owner, be responsible for obtaining any necessary fees, 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.

Provisions and Requirements

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 (JSA) - 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 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 obligation 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 (SSSHP) - 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 Sections 00220 and 00225.

(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 number 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 existing 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, and 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 SSHP for review to the Owner's Representative. The Owner's Representative will review 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 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 SSHP. Continued acceptance of the SSHP 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 SSHP 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 SSHP.

(r) **Cost** - The Contractor shall include the cost of development, implementation, and maintenance of the SSHP in its Bid, and therefore it is included in the Contract Amount. However, this work is incidental to the other items of Work and is not identified as a separate bid item for which payment is made nor should it be included as separate payment item any Contract that uses a schedule of values.

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.
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 will 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:

The Contractor shall provide the City Auditor certificates of insurance and additional insured endorsements signed by the insurance carrier showing that the coverage required by the Contract Documents with Insurance Services Office (ISO) form numbers to identify the specific coverage that has been obtained and the effective dates of the insurance policies. 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.

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.

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.

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 Longshoremens' 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 **two** 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 two 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 two (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;

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 keep 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:

(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 not 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 percent 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 percent 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.

00170.79 **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 it causes 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 caused by vandals shall be covered by Contractor's insurance. 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 if caused by third persons, such as vandals.

(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 under 00170.80.

(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 more specifically in Section 01030. If conditions are such that seeding cannot be done, provide temporary erosion control measures as set forth in Section 00280 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 five (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 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.

00170.85 **Responsibility for Defective Work** - The Contractor shall make good any defective Work, Materials or Equipment incorporated into the Work, in accordance with the provisions of Section 00150.

(a) **Latent Defects** - The Contractor shall remain liable for all latent defects resulting from causes other than fraud or gross mistakes that amount to fraud until the expiration of the Performance Bond, warranty security as provided in 00150.96(g), or warranty period, whichever expires last. The Contractor shall remain liable for all latent defects resulting from fraud or gross mistakes that amount to fraud regardless of when those latent defects may be discovered, and regardless of whether such discovery occurs outside any applicable Performance Bond, warranty security, or warranty period.
(b) **Warranties** - For those Pay Items with Specifications referencing this 00170.85(b) warranty, the Contractor warrants that all Work, including Changed Work, Additional Work, Incidental Work, On-Site Work, and Extra Work, and Materials and Equipment incorporated into the Work, shall meet the technical and performance Specifications required under the Contract, from the date and for the period of time identified in each applicable Specification or elsewhere in the Contract. The Contractor shall be responsible for making good the Work and for all repairs of damage to other improvements, natural and artificial structures, systems, equipment, and vegetation caused by, or resulting in whole or in part from, defects in warranted Materials, Equipment, and workmanship. The Contractor shall be responsible for all costs associated with site cleanup and remediation caused by, or resulting in whole or in part from, defects in warranted Materials, Equipment, or workmanship. This warranty provision shall survive expiration or termination 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. See 00330.41(e) and Section 00335.

00170.95 **Overtime Work:**

(a) The Contractor shall obtain approval of 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 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(a) above. 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.

(f) When the work is substantially complete, regardless of whether Owner takes possession of or occupies all or a portion of the Work, the Contractor and Owner shall prepare a list of items, known as a “punch list,” that remain to be completed or corrected. The Contractor remains responsible to complete the work in accordance with the Contract Documents regardless of whether an item is omitted from the punch list.

(1) The Contractor is required to proceed promptly to complete the items on the punch list and any other items that may be discovered to be incomplete or incorrect regardless of whether they are on the punch list or not. If the Contractor fails to complete the punch list within 30 days or such other time as the Owner's Representative may allow, the Owner may terminate any further services of the Contractor under the Contract, complete the punch list items remaining to be completed or corrected with the Owner's own forces or by hiring another Contractor to perform the punch list work, or charge the Contractor $100 per day in liquidated damages until the Contractor completes the punch list items in accordance with the Contract Documents. Costs of performing the punch list work by Owner shall be deducted from any payments otherwise due the Contractor.

(2) Contractor shall notify Owner when the punch list work is complete and Final Payment shall be made in accordance with 00195.90. After receipt of that Notice, Owner will inspect the work to determine if the punch list is complete as provided in 00195.90(b).

(3) 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.

(4) 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.

(g) 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.
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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 seven 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.
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 Purchasing Agent 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. However, 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 those documents required by Section 00180.42;

(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.

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.
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.

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.

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.

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.

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 seven (7) Calendar Days of the request.

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.

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 two (2) weeks' work will be submitted at that time with particular attention given to the next week's schedule. If the two-week schedule deviates more than one (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.
00180.42 Preconstruction Conference:

(a) Before meeting with the Owner’s Representative for the pre-construction 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 pre-construction conference.

(b) After the contract is awarded, but before any work is performed, meet with the Owner’s Representative for a pre-construction conference at a time mutually agreed upon. Submit the following at the pre-construction 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 two 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)); and


(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 00180.80(c) have occurred.

(1) Examples of excusable delays include:

   a. Act of God, which means a singular, unexpected and irregular visitation of a force of nature such as fire or flood;

   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 if by written order of the Owner's Representative and the suspension is not because of Contractor's failure or neglect; or

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 twenty-five percent 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 00180.80(e) below.

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 know-how 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.
(a) **Time is of the essence of this Contract** - The time allowed to complete the Work will be stated in the Proposal and/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.

2. 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.

3. 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.

4. 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.

5. 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.

00180.85 **Suspension of Work:**

(a) The Owner has the authority to suspend all, or part of, the work of the Contractor as provided below.

1. 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.
(2) 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.

(3) 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(a)(2) above.

(4) 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.

(5) Work shall resume as soon as possible after the Contractor receives written Notice that the Owner has canceled the suspension of work. The Contractor is deemed to have received the Notice if it is mailed or sent by facsimile transmission to it.

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 seven 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 four 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 seven 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;

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) above, 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.
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 from 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) Lengths and Dimensions - Lengths and dimensions will be measured horizontally and vertically, at least to the nearest 0.1 foot, unless otherwise specified in the Contract. Measurements will be limited to the dimensions shown or specified, or as directed by the Engineer.

(b) Area - Areas will be determined by measuring width and length to the nearest 0.1 foot and computed to the nearest 0.1 square foot or 0.1 square yard as appropriate unless otherwise specified in the Contract.

(c) Weight - Weight will be determined on Contractor-provided scales as required by 00190.20 unless otherwise allowed by the Specifications. Weight 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 Engineer.

No payment will be made for quantities in excess of the supplier weight, materials that have been lost, wasted for otherwise not incorporated into the Work, or for additional hauling costs resulting from the act of checking weight.

**Volume**

Volume will be measured at least to the nearest 0.1 cubic yard unless otherwise specified in the Contract.

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 TM321).

**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 gage, 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.

**Lump Sum**

Lump sum, when used, means the Work described shall be completed and accepted without measurement unless changes are ordered in writing by the Engineer. 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.

**Time**

Time will be measured to the nearest 0.5 hour unless otherwise specified.

**Contractor to Provide Vehicle Weigh Scales:**

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:

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 six months thereafter; and
4. When the Engineer 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 Engineer 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 Engineer. 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 three 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 Engineer, 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:

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 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.

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 Contractor 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.
00195.20(c)

(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 00199.30.

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.

   (1) Pursuant to ORS 279C.845(7), the Owner will retain 25 percent 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.
(2) Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent 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.

(e) 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 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 substitute its own Estimate if it believes the Contractor’s submission is incorrect. Thereafter, Owner will pay Contractor an advance payment based on the approved estimate. Owner may withhold money from the advance for any of the reasons specified in 00195.50(m) below.

(3) The “mid-month” or advance payment will be taken into account and deducted from any amount otherwise due the Contractor on the next monthly 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 substituted an 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 three 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 $1500 or less, or if there is a chance that the advance payment might exceed the remaining amounts due the Contractor under the Contract.

(7) Owner is not required to pay for any portion of the Work that is disputed or which would otherwise not be eligible for payment pursuant to a monthly progress payment.

(8) Because the payment is an advance on the progress payment, no interest is due on the advance payment until the time when interest would be due under the progress payment.

(9) Within seven 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.

(10) Upon request from Owner, Contractor shall inform Owner of the portion of any advance payment owed to any of its Subcontractors.

(11) Nothing in 00195.50(f) 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.

(f) In addition to the advance payment, Contractor shall also receive a monthly progress payment as described in more detail in 00195.50(g) through 00195.50(q). To receive a monthly progress payment, 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.

(g) 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 seven 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, which is the earlier date.

(h) 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 Owner as an advance payment as explained in 00195.50(e) and 00195.50(f) above.

(i) 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 and/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 six 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 six months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Owner.

(j) 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.

(k) 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 owner, shall be permitted by ORS 279C.560.

(l) Progress payments on Local Improvement District (LID) Contracts shall be made in accordance with the state law, the Contract Documents and City Code.

(m) 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 remains 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;
The Contractor was exceeding the limits of Work Specified in 00405.41(b) or other work limits specified by the Contract; or

The Contractor owes liquidated damages to the Owner.

The Contractor is not entitled to interest on money purposely withheld for any of the reasons specified in 00195.50(m) above.

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.

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 $1,000, unless approved in advance by the Owner's Representative.

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).

Final Payment:

The Contractor shall notify the Owner's Representative in writing when it considers that all the work required by the Contract Documents is 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.
(b) Within 15 days of receipt of the Notice, the Owner’s Representative will either preliminarily accept the Work or notify the Contractor of work yet to be performed on the Contract. This work may consist of items on the punch list that have not been completed or corrected, or other items that have come to Owner’s attention. If the Work is preliminarily accepted as complete, the Owner will notify the Contractor and prepare a Certificate of Completion. If the Owner’s Representative does not accept the Work as complete after receipt of the Notice, the Contractor shall complete or correct the items remaining and then again notify the Owner that Work is complete.

(1) The Contractor is required to proceed promptly to complete the 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, and charge the Contractor liquidated damages in the sum of $100 per day. Costs of performing the punch list work shall be deducted from any payments otherwise due the Contractor.

(2) If 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 one inspection of the work is required because remaining portions of the Work are incomplete.

(c) If the Contractor disagrees with the Owner’s conclusion that the Work is not 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.

(d) 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.

(e) 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.

(f) 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.
(1) 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.

(2) If the work under the Contract is designated as one 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) The Owner may deduct against the Final Payment, as provided in 00195.50(d), additional retainage in the amount of 25 percent of amounts earned which will be withheld and released in accordance with ORS 279C.845(7) when the Contractor fails to file certified statements as required by law.

(g) Acceptance of the Work will not occur until the Contractor provides the Notice referenced in 00195.90(a) above, prepares and submits the Acknowledgement Form referenced in 00195.90(h) below, 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.
Section 00196 - Payment for Extra Work

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 may be executed in advance of when agreement between the Owner and Contractor is reached or they may be executed after the work has been performed when the Owner has authorized work to be performed on a Force Account 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.
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 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. See 00197.20(h).

(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 materials furnished from that source on contract items or the current 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:

\[
\text{Hourly Rate} = \frac{\text{Monthly Base Rate} \times \text{Rate Adjustment Factor} + \text{Hourly Operating Rate}}{176 \text{ hours/month}}
\]

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. The terms used above are defined below:
(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 - 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. 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 subcontractor 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:

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<thead>
<tr>
<th>Subsection</th>
<th>Percent</th>
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<tbody>
<tr>
<td>00197.10 Material</td>
<td>15</td>
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<tr>
<td>00197.20 Equipment</td>
<td>0</td>
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<tr>
<td>00197.30 Labor</td>
<td>20</td>
</tr>
<tr>
<td>00197.20(l) Outside Rental</td>
<td>5</td>
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</tbody>
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(b) The allowances shown in 00197.80(a) shall also apply to force account work performed by a Subcontractor. When work is performed by a Subcontractor on a force account basis or other basis agreed to by the Owner’s Representative, the Owner shall pay an additional five percent allowance for both overhead and profit to the Contractor. Regardless of the number of tiers of Subcontractors, this supplemental markup will be applied only one time.
When changed work includes both additions and reductions to the Work, the allowances provided in 00197.80(a) and 00197.80(b) shall apply to the net difference between the cost of the added work and the estimated value of the deleted work. However, when the cost of the added work is less than the estimated value of the deleted work, the allowances will not be applied.

The allowances permitted by 00197.80(a), 00197.80(b), and 00197.80(c), when paid to the Contractor, will be complete compensation for overhead, profit, and all other force account work costs that were incurred by the Contractor or by other forces that the Contractor furnished. No other reimbursement, compensation, or payment will be made.

Billings:

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.

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.

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, any subsequent 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) below.
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) above 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.

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.

(2) 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.
(1) 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.

(2) 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.

(3) 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 merit, 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 one 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 one-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.
PART 00200 - TEMPORARY FEATURES AND APPURtenances

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 for work on the Project
- Perform other work and operations or incur costs as necessary before beginning work on the Project

Measurement

00210.80 Lump Sum Basis - There will be no measurement of work performed under this section.

Payment

00210.90 Lump Sum Basis - Payment for the item "Mobilization" will be the Contract lump sum amount.

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 for 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 preclude progress payments otherwise provided by the Contract.

00210.91 Incidental Basis - When the Contract Schedule of Items or the Special Provisions do not indicate payment for mobilization, mobilization will be considered incidental to the work and no separate or additional payment will be made.
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 to property, injury to persons, loss, expense, inconvenience, and delay caused by or resulting from any act, omission, or neglect of the Contractor, the Contractor's subcontractors and suppliers, or their employees while performing the work

- Conduct work at all times so that there is the least possible interference with or hazard to the traveling public and residents affected by the Project

- Do not perform work which would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time

- Do not stop or hold vehicles more than 20 minutes, or block driveways, intersections or connections for more than 2 hours unless otherwise authorized in writing

- Submit proposed methods and lane closure times in each instance to the Engineer for approval with ample time to allow the traveling public to be notified through the news media

- Obtain the Engineer's approval before closing any lanes or streets

- 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

- Park construction equipment and vehicles and stockpile material at least 30 feet from the traveled way if this is not possible, protect the equipment, vehicles, and stockpiled material with barriers or other satisfactory means

- Provide and maintain in a safe condition 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, bikeways, sidewalks and footpaths

- Provide protection from work areas
• Allow emergency vehicles, incident response units and transit vehicles immediate passage at all times

• Notify the Engineer a minimum of 7 days in advance for any adjustments to existing traffic signals, signs or other traffic control devices

• When it is necessary to limit on-street parking, notify Parking Control at 503-823-PARK, at least 7 days in advance of the parking limitation. Provide 48-hour public notification prior to limiting on-street parking. In metered area, obtain permit(s) to restrict parking in areas where parked vehicles conflict with the execution of the Work

• Notify Tri-Met at least 48 hours in advance of any bus stop closures

• When construction requires the closure of a sidewalk, notify the Engineer in writing, at least 7 days in advance of the closure. Do not close the sidewalk without written approval. Provide 48 hour public notification prior to closing the sidewalk

• Notify the Engineer in writing of all affected emergency services, school districts, and US Postal Service at least 7 days prior to street closure

00220.03 Abbreviations:

ABA - Architectural Barriers Act

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 pilot cars and/or flaggers

• Apply a fine spray of water to the surface. The Engineer will determine the rate of application

• Broom 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 on the plans or ordered.

(c) Driveways - While working on subgrade and other construction, provide adequate access to businesses, residences, intersections and connections as required by 00220.02, and as follows:
• Replace and maintain temporary aggregate 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

(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 the plans.

• 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 above the striped panel of a Type II barricade placed across the sidewalk, facing pedestrians approaching the work area. To the maximum extent feasible, the alternate circulation path shall be provided on the same side of the street as the disrupted route.

• Alternate routes shall comply with the Accessible Routes guidelines found in "ADA and ABA Accessibility Guidelines for Buildings and Facilities". This document prescribes all ADA related design criteria, including the qualities of an acceptable surface.

• Barricades and channelizing devices 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 two weeks or more, and if required, place ramps, barrels, and other protective measures to delineate the route.

• Provide additional traffic control measures to meet the accessibility requirements in Part 6 of the 2003 MUTCD to match the existing facility as a minimum.

(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) Business/Residential Access and Delineation - When construction requires the closure of a driveway, contact the property’s point of contact 14 days in advance of construction. Contractor shall 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.

(h) 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.

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 surfacings during construction is as follows:

(1) Contractor Responsibility - Do the following at Contractor's expense:

• Keep surfaces being used by public traffic, pedestrians and bicycles free of dirt, mud, gravel and other harmful materials. The surface includes sidewalks, bike paths, bike lanes, roadway shoulders or the outside 6 feet of the roadway.

• Repair damage to surfaces caused by the Contractor's operations

• Maintain any detour or stage construction surfacings not constructed as specified or directed

(2) City Responsibility - The City will be responsible to do the following at City expense:

• Maintain surfacings and shoulders in existence 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

- Sand icy pavements and remove the sand residue
- Remove snow from traveled ways as required to accommodate public traffic

This work may be performed by City forces, or, if directed, by the Contractor 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:

- 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 do the following:

- 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 winter seasonal conditions, or any cause not included in (b)(1) above, 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) 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 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) Damage/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 bear all additional costs caused by the presence of traffic.

**Measurement**

00220.80  **Measurement** - There will be no measurement of work performed under this Section.

**Payment**

00220.90  **Payment** - No 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.
Section 00225 - Work Zone Traffic Control

Description

00225.00 Scope - This work consists of providing temporary traffic control measures and furnishing, installing, moving, operating, maintaining, inspecting, and removing traffic control devices throughout the Project Area according to the standard drawings, the traffic control plan for the Project, these Specifications, or as directed.

00225.01 Abbreviations, Definitions, and Standards:

(a) Abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
</tr>
<tr>
<td>NCHRP</td>
<td>National Cooperative Highway Research Program</td>
</tr>
<tr>
<td>NHS</td>
<td>National Highway System</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>TOD</td>
<td>Tourist-Oriented Directional</td>
</tr>
<tr>
<td>PCMS</td>
<td>Portable Changeable Message Sign</td>
</tr>
<tr>
<td>PROM</td>
<td>Programmable Read Only Module</td>
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</tbody>
</table>

(b) Definitions:

Traffic Control Devices (TCD) - Signs, signals, markings, and other devices placed on or adjacent to a road to regulate, warn, or guide traffic.

Traffic Control Measures (TCM) - Elements of the TCP including, but not limited to, TCD, personnel, materials and equipment used to control traffic through a work zone.

Traffic Control Plan (TCP) - A written and drawn plan for handling traffic on a specific roadway through a work zone.

Work Zone - An area within highway construction, maintenance, or utility work activities.
(c) Standards - Use and follow the Oregon Department of Transportation's "Sign Policy and Guidelines for the State Highway System," the "Manual on Uniform Control Devices (MUTCD)," and these Specifications and Special Provisions in designing, applying, installing, maintaining, inspecting and removing traffic control devices.

Do not use the Oregon Department's "Short Term Traffic Control Handbook." Do not use the "Traffic Control on State Highways for Short Term Work Zones" guideline except when directed by the Engineer for mobile pavement marking operations.

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.

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 TCD 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) Extended Traffic Queues - When extended traffic queues develop during flagging operations, protect traffic by providing advance flagger(s) and signing according to the "Extended Traffic Queues Detail" shown on ODOT Standard Drawing TM710. The advance flagger is required when the sight distance for oncoming traffic to the end of the queue is less than 675 feet or when traffic queues extend beyond the initial work area warning signs.

Monitor the length of traffic queues and install an additional set of advance flagger signs if traffic queues extend beyond the first set of advance flagger signs. Advance flagger signs include the "BE PREPARED TO STOP" (MUTCD W20-7b) and the Flagger Symbol (MUTCD W20-7a) signs.

Relocate the initial advance warning sign so it is the first sign visible to incoming traffic.
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 any other laws which apply.

00225.05 Contractor’s Traffic Control Plan - Submit the following in writing five days before the pre-construction conference for approval:

- Proposed TCP showing all TCM and quantities of all TCD
- Proposed order and duration of the TCM
- 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
- A detailed temporary striping plan, if required
- A designated haul route, if required

TCP revisions may be subject to a Contract change order.

00225.06 Routing Traffic Over Surfacings - When allowed by the TCP, control traffic being routed over newly constructed surfacings as follows:

(a) Aggregates - When directed, control traffic over aggregate surfacings 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 according to 00747.61(b).

(d) Oil Mats/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 - Use new or like-new TCD for all installations unless otherwise specified. Provide test results and quality compliance certificates, equipment lists and drawings when specified. Acceptance will be by the CPL, test results and quality compliance certificates, equipment lists, drawings and testing as necessary to assure compliance with the Specifications. After TCD have been accepted in place on the Project, inspect and maintain the condition of the devices.

Use Category I, Category II, and Category III TCD's conforming to the NCHRP Report 350. Category I devices are low-weight devices including, but not limited to, conical markers, tubular markers, plastic drums, and delineators. Category II devices include, but are not limited to, barricades and sign supports. Category III devices include, but are not limited to, impact attenuators, end treatments, and concrete barriers.

All work zone TCD on the NHS, except for Category IV trailer mounted devices, are required to comply with the NCHRP 350 report and be crashworthy. Category IV trailer mounted devices are currently exempt from the NCHRP 350 guidelines and do not require crash testing.

00225.11 Temporary Signing - Use temporary signs meeting the requirements of the "Acceptable" category shown in the American Traffic Safety Services Association (ATSSA) "Quality Standards For Work Zone Traffic Control Devices" handbook and the following:

(a) Signs - Use materials and fabricate signs conforming to Section 00940 and the following:

(1) Size and Shape - Use standard size and shape signs conforming to the current edition of the MUTCD and "Sign Policy and Guidelines for the State Highway System" unless otherwise specified or ordered. Double-face signs will not be allowed except for flagger "STOP/SLOW" sign paddles.

(2) Type - Use Type "O4" signs, unless otherwise indicated in this Section or in the TCP. In addition to Section 00940, fabricate these signs on one of the following materials:

- New sheet aluminum sign blanks
- 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
- Extruded aluminum panels

(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) Retroreflective Sheeting (Prismatic Lens) - Use Type "B" sheeting that is Fluorescent Orange (Wide Angle, Prismatic) only on signs that are specifically indicated as using this sheeting in 00225.02 or as shown. The sheeting shall meet the photometric properties of 02910.31.

(5) Roll-up Signs - Use roll-up signs with fluorescent orange roll-up sheeting from the CPL.

(6) Light-Weight Sign Substrate - Use light-weight sign substrates from the CPL.

(b) Sign Supports:

(1) Wood Sign Posts - Provide wood sign posts in the sizes and quantities determined from ODOT Standard Drawing TM670 and according to 02110.40 except preservative treatment is not required.

(2) Portable Sign Supports - Use portable sign supports from the CPL and conforming to the following:

- Conform to ODOT Standard Drawing TM775
- Be attached securely to the top of the concrete barrier
- Not project laterally from the surface of the barrier in such a way to create an unsafe condition

(3) Concrete Barrier Sign Supports - Barrier rail sign supports shall:

- Conform to ODOT Standard Drawing TM775
- Be attached securely to the top of the concrete barrier
- Not project laterally from the surface of the barrier in such a way to create an unsafe condition

(4) Temporary Sign Supports - Fabricate TSS according to ODOT Standard Drawing TM775 and according to 02110.40 except preservative treatment is not required.

(5) Square Tube Sign Supports - Provide and use square tube sign supports from the CPL and ODOT Standard Drawing TM681. To determine proper steel post size, gauge, and number of posts for a given sign size, refer to manufacturer specifications.

(c) Sign Covers:

(1) Temporary Signs - Sign covers for temporary signs shall be:

- One-piece plywood or 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:

• Orange or 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
• Visible the full width of the traveled way and shoulders 1,200 feet from the flashers

• 110/120 V flashers conforming to the flash rate, illuminated period and temperature requirements of the current edition of ODOT’s Standard Specifications for Microcomputer Signal Controller or 12 V, rechargeable, battery-operated flashers that:
  • Provide a constant flash rate of one flash per second plus or minus 10%
  • Provide an illuminated period of each flash of 30% plus or minus 10% of each flash cycle
  • Operate one 50W, 12 V incandescent lamp

(f) Sign Flag Boards - Use sign flag boards conforming to 02910.10 and ODOT Standard Drawing TM204.

00225.12 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing - Temporary barricades, guardrail, barrier, attenuators, pedestrian fencing, and accessories shall conform to the following:

(a) Barricades - Use barricades from the CPL and conforming to ODOT Standard Drawing TM750.

(b) Guardrail - Use guardrail conforming to Section 00810 except posts may be untreated. Use guardrail terminals from the CPL and ODOT Standard Drawings RD420 and RD425.

Use guardrail materials may be reused provided:

• Timber posts are structurally sound 6" x 8", or 8" x 8", at least 6 feet long, and free from damage which would affect their strength
• Rail members meet the requirements of 00810.15(b)

• Guardrail hardware is in good condition and conforms to the design for new materials

(c) Concrete Barrier - Use pin-and loop concrete barrier conforming to ODOT Standard Drawing RD500, dated 2002 (three ASTM A 36 M loops, 32 inch height) and the applicable requirements of Section 00820 or use tall concrete barrier conforming to ODOT Standard Drawing RD545, (two ASTM A 36 M perforated C-shapes, 42 1/2 inch height) and the applicable requirements of Section 00820.

Provide concrete barrier that is in "Acceptable" condition, without cracks, chips, spalls, corroded loops of C-shape connectors. Immediately repair any concrete barrier segment 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 expense to the City.

Salvaged pin-and loop concrete barrier that conforms to this section may be used when acceptable to the Engineer.

Use Concrete barrier with the same cross section, height, and loop configuration within individual runs.

The concrete barrier shall have functioning scuppers.

(d) Impact Attenuators - Use temporary impact attenuators from the CPL and conforming to ODOT Standard Drawing TM755 or TM760.

(e) Barrier and Guardrail Mounted Reflectors - Use temporary concrete barrier and temporary guardrail reflectors from the CPL.

(f) Glare Shields - Use minimum 24 inch high temporary glare shields from the CPL.

(g) Temporary Pedestrian Fencing - Use temporary pedestrian work zone delineation fencing from the CPL.

00225.13 Temporary Traffic Delineation - Temporary traffic delineation items and accessories shall conform to the following:

(a) Tubular Markers - Use tubular markers from the CPL.

(b) Conical Markers - Use conical markers 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. Provide drums with Type "OO" encapsulated lens reflective sheeting.

(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.
(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** - Materials for temporary illumination shall conform to Sections 00960, 00970, and 02920.

00225.15 **Temporary Traffic Signals** - Materials for temporary traffic signals shall conform to Sections 00960, 00990, 02920 and the following:

(a) **General** - Used materials are permitted except if noted on the plans. Do not use permanent signal equipment as part of the temporary signal installation.

(b) **Cable and Wire** - Use all new cable and wire

(c) **Wood Poles** - Poles shall be able to support the dead load of the equipment shown and withstand a wind load of 90 mph.

(d) **Traffic Signal Control Devices** - Use new, or like-new, Model 170 controllers and cabinets. Cabinets shall meet the minimum requirements of 02920.40. Repair all damage before delivery to the Project. Maintain a minimum of 2 feet and a maximum of 6 feet of clearance between the bottom of a pole mounted temporary controller and the ground beneath it, except when work next to the pole is affecting this clearance.

The controller program, PROM and monitor will be furnished by the City.

When the temporary signal is removed, return the PROM and monitor to the City.

00225.16 **Temporary Electric Signs** - Provide electrical signs conforming to the following:

(a) **Sequential Arrow Signs** - Use trailer mounted Type "C" sequential arrow signs from the CPL.

(b) **Portable Changeable Message Signs** - Use trailer mounted PCMS's from the CPL.
00225.17 Temporary illumination for Nighttime Flaggers - Use temporary illumination equipment conforming to the following:

- Provide an illuminated area of at least 40 feet diameter at ground level
- Provide portable illumination equivalent to a 200 W to 250 W high pressure sodium luminaire.
- Provide shielding to prevent the illumination from adversely affecting traffic.

00225.18 Temporary Pedestrian Walkways - Materials for temporary walks shall be constructed using Douglas Fir-Larch No. 2 without knots 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” x 8” except for the hand railing which shall be a minimum of 2” x 4” with 4” x 4” posts. Apply a non-skid material, with a minimum friction coefficient of 0.6, to the walking surfaces.

Submit a design for the proposed walks for review before construction begins.

Equipment

00225.20 General - Use new or like-new equipment for all temporary items under this Section unless otherwise specified. Acceptance will be by testing that the Engineer determines necessary to assure compliance with the Specifications.

00225.27 Flaggers - Equip flaggers as follows:

- Clothing to cover the complete body except head, neck, and arms below the point of the shoulders
- An orange, yellow, strong yellow green or fluorescent versions of these colors retroreflective vest. The retroreflective material shall be orange, yellow, white, silver, strong yellow green, or a fluorescent version of one of these colors, and shall be visible at a minimum distance of 1,000 feet. The vest shall be designed to identify the wearer as a person and be visible through the full range of body motions.
- An fluorescent yellow-green, orange, yellow, or bright white hardhat or baseball style cap. Wear hardhats when there is danger of falling or flying object or electrical shock or burns.
- High visible "STOP/SLOW" sign paddles conforming to the MUTCD and fabricated using encapsulated lens reflective sheeting or brighter, or flashing "STOP/SLOW" sign paddles from the CPL.
- Use a "STOP/SLOW" paddle for advance flagging. Cover the "STOP" face of the "STOP/SLOW" paddle during flagging operations.
- Portable, self contained two-way radio and repeaters, as required, with a range suitable for communications throughout the Project limits.
• Illuminated stand area of high visibility at night.

**00225.28 Traffic Control Supervisor (TCS)** - Equip TCS as follows:

• Clothing, vest, 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 that is visible for 360°, or other approved non-strobe device

**00225.29 Pilot Cars** - Provide pilot cars with the following features:

• Be no smaller than a compact pickup truck

• Have four wheels

• Be identified with a "PILOT CAR FOLLOW ME" (MUTCD G20-4) sign mounted in a conspicuous location on the rear of the vehicle

• Equipped with a roof or post mounted rotating amber light that is visible for 360°, or other approved non-strobe device

• Equipped with two-way radio with a range suitable for the Project

**Labor**

**00225.30 General** - Observe all laws concerning construction safety and health 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 drivers 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 three 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 (TCS) - When the bid schedule does not include an item for a TCS, appoint a trained person on the jobsite during 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

• Has the authority to assign and control flagging operations

• Files his/her name and phone number with the Engineer and local police

When the bid schedule includes an item for a TCS, designate an individual or individuals to perform the TCS duties for the Project. Do not designate the Project superintendent as the TCS. The TCS shall personally perform all of the duties of the TCS.

The TCS shall possess a current official Oregon Department of Transportation (ODOT) TCS card. A TCS with a current card from another State Department of Transportation or from the American Traffic Safety Services Association may obtain an ODOT TCS card upon completion of ODOT's one-day Recertification Class.

The TCS's duties include:

• 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

• Inspecting TCD for proper location, installation, message, cleanliness, and effect on the traveling public. When the TCS is on duty, inspect TCD during each work shift except check post-mounted signs once a week. Inspect traffic control devices left in place for 24-hours or more at least once during non-working hours. Check for effectiveness in both daylight and darkness.

• Reviewing and inspecting nighttime lighting and its effect on the traveling public

• Preparing and signing a daily traffic control report. Submit to the Engineer no later than the end of the next working day include in the report such items as:

  • When sign and TCD are installed and removed
• Locations of signs and TCD
• Revisions to the TCP
• 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
• Ensuring that corrections are made to the TCP when not functioning as required. 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
• Overseeing all requirements of the Contract to ensure the convenience, safety and orderly movement of vehicular, bicycle, and pedestrian traffic
• Having the latest adopted editions of the documents listed in 00225.01 and applicable standards and Specifications available on the Project at all times
• Attending all Project meetings where TCM is discussed
• Providing supervision over all TCM on a 24-hour per day basis

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 shall report to the Project site within 45 minutes after notification. 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 TCS shall not act as a flagger except in an emergency.

00225.34 Law Enforcement Officer - In place of a properly equipped flagger, a uniformed law enforcement officer may be used to control traffic. If so, the provisions of 00225.27 will not apply, except the illuminated stand area will be required.
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 by the Engineer. When work on the Project requires temporary signing at locations not shown on the plans, provide signing according to the MUTCD and "Sign Policy and Guidelines for the State Highway System."

Install temporary signs according to 00940.47.

Provide all temporary signing according to the plan and the following:

(a) Orange Construction Speed Zone Signing - In areas where the existing posted speed is basic rule maximum speed (65/55 mph), cover Type "W1" speed zone signs with a non-transparent weather and windproof cover if the speed shown is higher than the speed shown on orange construction speed signs. Uncover them when the orange construction speed signs are removed or covered. When there is no work on the Project or when directed, cover or remove the orange construction speed signs and restore the original Type "W1" speed zone signs. 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.

In areas where the existing posted speed is less than basic rule maximum, do not cover the existing white speed signs when orange construction speed signs are in use.

(b) Sign Supports:

(1) Wood Sign Posts - Except as provided in the following (2) through (4), mount all temporary signs on wood sign posts as shown and according to ODOT Standard Drawing TM676.

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:

- Signs are needed at a single location for no more than 48 consecutive hours
- Support is positioned so the lowest point of the sign is at least 1 foot above the roadway surface
- Flags are installed 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 only with roll-up signs from CPL

(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
- Position the TSS behind other channelization devices
- When TSS, as shown on ODOT Standard Drawing TM775, are not in use, move the sign support outside the clear zone or cover and delineate them with Type III barricades.

(5) **Square Tube Sign Supports** - Square tube sign supports may be used as a substitute for wood sign posts. Install square tube sign supports according to ODOT Standard Drawing TM670 and TM681.

(c) **Sign Flag Boards and Sign Flags** - Install two sign flag boards, according to TM204, above "ROAD WORK NEXT XX MILES" and "BRIDGE\ROAD WORK AHEAD" post mounted signs. Install at least two sign flags above all signs mounted on portable sign supports. The flags are in addition to specified amber flashers, if any. Mount flags so both the entire sign and amber flashers are visible.

(d) **Amber Flasher** - Use either 110/120 V Flashers or 12 V rechargeable flashers.

(e) **Roll-up Signs** - Roll-up signs may be used at a single location for no more than 48 consecutive hours.
(f) Inappropriate Temporary Signs - Ensure that all temporary signs are properly used in the work zone by doing the following:

- Remove from the road all temporary signs which are no longer needed
- Fold, turn, cover, or remove the signs so that the message is not visible to any traffic
- Cover or remove sign flag boards
- Remove or roll and completely cover flags with an opaque, black, reflective sheath
- Turn off or remove amber flashers
- Remove portable signs and supports from the road at the end of the shift when the condition is no longer in effect

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 and supports, 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>
</tr>
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<tbody>
<tr>
<td>65</td>
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</tr>
<tr>
<td>55</td>
<td>16:1</td>
</tr>
<tr>
<td>50</td>
<td>14:1</td>
</tr>
<tr>
<td>45</td>
<td>13:1</td>
</tr>
<tr>
<td>40</td>
<td>11:1</td>
</tr>
</tbody>
</table>
(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 according to the appropriate ODOT Standard Drawing TM755 or TM760
- 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 according to the appropriate ODOT Standard Drawing TM755 or TM760
- Use attenuators designed for the original pre-construction posted speed
- For narrow site systems, pin the first two barrier sections to the asphalt concrete pavement or attach the first two barrier sections to the concrete pavement as shown

(e) **Reflectors** - Install reflectors on temporary concrete barrier and temporary guardrail when shown or specified, as follows:

- Space **no further apart than 50** foot centers on tangents and 25 foot centers on curves. Closer spacing may be required as directed.
- Use same type for each run of barrier or guardrail
- Bracket-mount to the top of guardrail posts and concrete barrier
- Use yellow when installed on the left side of traffic
- Use white when installed on the right side of traffic
- Position to face oncoming traffic

(f) **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 expense 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.

**Temporary Pedestrian Fencing** - Install temporary pedestrian work zone delineation fencing according to Section 00270.

**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 or as directed.

(e) **Pavement Markers** - Unless shown on the plans, install pavement markers as follows:

- Three single makers 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 the Contractor's expense. Remove the markers from the top lift of pavement within five days after the Contractor is notified of the placement of permanent striping 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 on the plans according to Section 00860. Establish alignment with control points no further apart than 50 feet on tangent and 25 feet 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 temporary carry traffic
- When temporary striping is determined as not practical

(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 Removable and Non-removable Tape** - Install removable and non-removable tape as shown or as directed.

(g) **Striping** - Before opening roadways to traffic, unless otherwise permitted, apply temporary painted stripes on pavement base courses and pavement markers on the wearing surface at locations designated. Immediately remove all unacceptable striping and replace with acceptable striping at no additional compensation.

For temporary striping on new bridge deck surfaces, use temporary removable tape.

(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 strip 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, as directed.

(3) **Layout** - Provide TCM, personnel, equipment and material to layout the temporary striping as shown or directed.
(h) Stripe Removal and Durable Stripe Removal - Remove striping by sandblasting, hydroblasting, or steel shot blasting so the pavement surface is not damaged. Remove durable striping by steel shot blasting, grinding the pavement surface to a depth no greater than 1/4 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.

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 striping can be applied. Remove all remaining striping and pavement markers from the wearing course after the permanent striping has been applied, as directed.

Coordinate all removal work with the construction activity. Remove striping and pavement markers during the same day(s) the traffic shift is accomplished unless otherwise approved.

(i) 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 ODOT Standard Drawing TM570, except do not exceed 50 feet on tangent or 25 feet on curves.
- Patrol daily and restore them to their 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 strip has been painted and new delineators are in place
- Between traffic and the abrupt edge
- Place delineation immediately

00225.44 Temporary Illumination - Construct and remove temporary illumination according to the plans, Sections 00950, 00960, 00970, 02920, and this subsection of the Special Provisions.

Install temporary illumination in a manner that does not shine the light directly into approaching traffic.

00225.45 Temporary Traffic Signals - Construct and remove temporary traffic signals according to the plans, Sections 00950, 00960, 00990, and 02920 and the following:

(a) 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.
(b) **Power Service** - Be responsible for utility coordination, hook-up, and power consumption.

(c) **Wood Poles** - Backguy wood poles so that they are vertical with all dead loads applied.

(d) **Suspension of Heads** - Adapt signal mounting hardware as needed for mounting on wood poles. When tether wires are shown, tether all signals and signs suspended from messenger cables.

(e) **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.

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.

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 75 seconds
  - Use no more than two displays within any message cycle
  - Separate two 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.
(c) Temporary Power Source - Arrange for, provide, and pay for all electrical power.

00225.47 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 the "STOP/SLOW" sign paddle.

Position flaggers, as directed, at locations where traffic can enter the highway within the limits of the work zone. Direct vehicles entering the highway to follow the pilot car line.

Provide continuous illumination as required or until the Engineer determines flagging is no longer required.

00225.48 Traffic Control Supervisor (TCS) - 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 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 Standards for Work Zone Traffic Control Devices." The ATSSA publication is available for review at the Project Manager's office. Using the above criteria, the Engineer will make regular documented inspections during the Contract and when changing stages or restarting work after extended shutdown periods. Except for electrical devices, replace all TCD that are in "marginal" or "unacceptable" condition with equal devices, in new or like new 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 the Contractor's expense except as in 00225.90(a).

The above inspections and subsequent replacement of devices does not relieve the Contractor of the responsibility to evaluate, maintain and repair of replace TCD, or to 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 the effectiveness of the installations at frequent intervals, both in daylight and darkness, by actual travel and inspection

• 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 Existing TCD - Maintain existing TCD as follows:

(a) Signs and Other Existing TCD - Maintain existing guide signs, warning signs, regulatory signs, and other existing TCD, the same as temporary signs and devices are maintained.

(b) Signals, Illumination, and Sign Illumination - Maintain existing signals, illumination, and sign illumination after adjusting or working on them until accepted.

Routine maintenance of electrical items 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.

00225.62 Impact Attenuators and Portable Electrical Signs - Maintain or replace materials and equipment as follows:

(a) 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 four hours of discovery of or of being notified of the damage.

When temporary 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.

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.

(b) 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 on the Project site repair equipment and parts 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  **Temporary Illumination for Nighttime Flaggers**  - Maintain and use the required temporary illumination equipment according to the manufacturer's recommendation and as required.

When the temporary illumination equipment is in use, have on the Project site, the following:

- Two extra lamps for the temporary luminaire system
- Repair equipment and parts recommended by the manufacturer or have an acceptable backup temporary luminaire

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  **General**  - 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 measures will be limited to the following, unless otherwise specified:

- Quantities necessary to complete the Project based on the Schedule of Items
- Additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone
  - The replacement of TCD and TCM damaged by public traffic and replaced by the Contractor
- The quantities approved in contract change orders

(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** - The quantity of temporary signs will be measured upon delivery to the Project. The quantities will be limited to those in the approved TCP. 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, per each.

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00225.81(a)

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00225.82 **Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing** - Quantities for 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, per each.

(b) **Guardrail and Concrete Barrier:**

(1) **Guardrail** - Quantities of temporary guardrail will be the length in feet of each type complete and in place as specified, measured 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 connection will be measured on a unit basis, per each.

(3) **Concrete Barrier** - Quantities of temporary concrete barrier and moving temporary concrete barrier will be the length in feet, measured by one of the following methods:

   a. **Count Method** - 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 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 from center to center of the glare shield blades, as installed on concrete barrier for each run.

**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, per each.

Measurement for flexible pavement markers includes flexible oiling markers and flexible overlay markers.

(b) **Temporary Removable and Non-Removable Tape** - Temporary tape will be measured as follows:

- **Removable and Non-Removable Tape** - Temporary removable and temporary non-removable tape will be determined by measuring the actual length of the 4 inch wide tape in place, as accepted.

- **Non Reflective Tape** - Temporary non-reflective tape will be determined by measuring the actual length of the 6 inch wide tape in place, as accepted.

(c) **Striping** - Painted temporary striping on pavement base courses will be determined by measuring the actual length of 4 inch wide stripe in place as accepted.

Skip intervals will not be included in the measurement.

The quantity of temporary striping will be the length 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 Durable Stripe Removal** - Stripe removal and durable stripe removal will be determined by measuring the overall length of 4 inch line removed. The quantity of stripe removal and durable strip removal will be the computed length of lines removed based on a nominal width of 4 inches. For computations, the width of a line is defined as 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. If the plans call for, or the Engineer requires, removal of standard 8 inch or 12 inch wide stripes, the computed length 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.

(e) **Striping and Stripe Removal Mobilization** - No separate measurement will be made 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 this work.
00225.85 Temporary Traffic Signals - No measurement of quantities will be made for this work.

00225.86 Temporary Electrical Signs - Quantities for temporary electrical signs will be determined as follows:

(a) Sequential Arrow Signs - Sequential arrow signs will be measured on a unit basis, per each by actual count where the devices are initially installed on the Project.

(b) Portable Changeable Message Signs - Portable changeable message signs will be measured on a unit basis, per each by actual count where the devices are initially installed on the Project.

00225.87 Flaggers - The quantity for flaggers will be measured by the actual number of hours flagging stations are staffed.

No measurement will be made for the temporary illumination required for nighttime flagger operations.

No measurement will made for flagging performed by the TCS.

00225.88 Traffic Control Supervisor (TCS) - The quantity for the TCS will be measured by the number of authorized 24-hour days regardless of the number of people used. An authorized 24-hour day will be any day or portion of a day authorized by the Engineer when any of the following is required:

- construction operations require a TCS during normal working hours
- TCS performs routine inspection of TCD during non-work hours
- TCS is called to respond to a traffic related issue during non-work hours

00225.89 Pilot Cars and Temporary 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 by 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 General – 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 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(b). All TCD damaged by public traffic and replaced by the Contractor, except temporary signing and temporary electrical signs will be paid for at the Contract price for the pay items listed in the 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 - Payment for the item "Temporary Protection and Direction of Traffic" will be made at the Contract lump sum amount 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
- Furnishing, placing, replacing, maintaining, moving and removing tubular and/or conical markers
- Removing existing raised and recessed pavement markers
- Furnishing, placing, replacing, maintaining, moving and removing tubular and/or conical markers used to delineate the pavement edge because of edge line obliteration
- Furnishing, installing, maintaining, moving, and removing pedestrian work zone delineation fencing
- Moving temporary impact attenuators of any type to and from Contractor's stockpile areas
- Providing, surfacing, maintaining, removing, and restoring the alternate pedestrian route

(b) Method "B" - Lump Sum Basis - Payment for the item "Temporary Work Zone Traffic Control, Complete" will be made at the Contract lump sum amount and will be 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 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 pay items for temporary signing and appurtenances will be as follows:

<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) will be payment in full for signs, regardless of type. No separate or additional payment will be made for flags, sign flag boards, or posts and other supports.

Item (b) will be payment in full for the flashers.
00225.92 **Temporary Barricades, Guardrail, Barrier, and Attenuators** - The pay items for temporary barricades, guardrail, barrier, and attenuators will be follows:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Temporary Barricades, Type_................................................ Each</td>
<td></td>
</tr>
<tr>
<td>(b) Temporary Guardrail, Type__Reflectorized................................ Foot</td>
<td></td>
</tr>
<tr>
<td>(c) Temporary Guardrail Terminals,.............................................. Each</td>
<td></td>
</tr>
<tr>
<td>(d) Temporary Guardrail Transition............................................... Each</td>
<td></td>
</tr>
<tr>
<td>(e) Temporary Bridge Connections................................................. Each</td>
<td></td>
</tr>
<tr>
<td>(f) Temporary Concrete Barrier, Reflectorized................................ Foot</td>
<td></td>
</tr>
<tr>
<td>(g) Moving Temporary Concrete Barrier .......................................... Foot</td>
<td></td>
</tr>
<tr>
<td>(h) Temporary Impact Attenuator,.................................................. Each</td>
<td></td>
</tr>
<tr>
<td>(i) Moving Temporary Impact Attenuators........................................ Each</td>
<td></td>
</tr>
<tr>
<td>(j) Temporary Glare Shields.......................................................... Foot</td>
<td></td>
</tr>
<tr>
<td>(k) Moving Temporary Glare Shields............................................... Foot</td>
<td></td>
</tr>
<tr>
<td>(l) Temporary Concrete Barrier, Tall, Reflectorized........................ Foot</td>
<td></td>
</tr>
<tr>
<td>(m) Temporary Concrete Barrier Walkways......................................... Foot</td>
<td></td>
</tr>
</tbody>
</table>

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) will be payment in full for each device, regardless of size or type. No separate or additional payment will be made for providing temporary pedestrian ramps or ramping materials.

Item (f) will payment in full for the barrier. Item (f) includes tall concrete barrier.

Item (g) will payment in full for moving temporary concrete barriers from one location of actual use to another, including removing and replacing reflectors on the barriers, as necessary.

In item (h), the type of attenuator, if applicable, will be inserted in the blank. No separate payment will be made for temporary impact attenuator replacements, replacement modules, cartridges, components, or replacement parts.

Item (i) will be payment in full for each move of the device from one location of actual use to another, regardless of size or type.

Item (j) will be payment in full for the devices installed on the concrete barrier.

Item (k) will be payment in full for moving the devices from one location on the concrete barrier to another.

Item (l) will be payment in full for the barrier.

Item (m) will be payment in full for the walkway, railings, non-skid surface, and wooden transitions. No separate payment will be made for adjusting walkways as needed during construction.
When pedestrian fencing is installed, the work will be paid for according to Section 00270.

**00225.93 Temporary Traffic Delineation** - The pay items for temporary traffic delineation will be as follows:

<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 Non-Removable Tape</td>
<td>Foot</td>
</tr>
<tr>
<td>(h) Temporary Striping</td>
<td>Foot</td>
</tr>
<tr>
<td>(i) Stripe Removal</td>
<td>Foot</td>
</tr>
<tr>
<td>(j) Durable Stripe Removal</td>
<td>Foot</td>
</tr>
<tr>
<td>(k) Striping and Stripe Removal</td>
<td>Each</td>
</tr>
<tr>
<td>(l) Temporary Non-Reflective Tape</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Item (a) will be payment in full for furnishing and installing the complete assembly of each device in its initial location and for removing the device from the surface.

Item (b) will be payment in full for furnishing new or refurbished devices to replace damaged or missing devices.

Items (c) and (d) will be payment in full for the devices.

Item (e) will payment in full for temporary pavement markers having either one or two reflective faces.

Item (f) includes removing flexible pavement marker covers.

Item (l) will be payment in full for each time the Contractor mobilizes as required for striping, stripe removal or durable stripe removal.

Payment for items (g), (h), (i), (j), (k), and (l) performed beyond the quantity shown in the 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.

**00225.94 Temporary Illumination** - The item "Temporary Illumination," will be made at the Contract lump sum amount, and will be payment in full for all required materials called for by the plans and Specifications and for minor adjustments not requiring disassembly.
00225.95  **Temporary Traffic Signals** - The item "Temporary Traffic Signal Installation," will be made at the Contract lump sum amount and will be payment in full for all required materials called for by the plans and Specifications and for minor adjustments not requiring disassembly.

00225.96  **Temporary Electrical Signs** - The pay items for electrical signs will be as follows:

<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) will be payment in full for furnishing, operating, moving, and removing the signs and supports. No payment will be made for removing and replacing damaged signs.

00225.97  **Flaggers** - The item "Flaggers" includes all necessary equipment, special apparel, flagging equipment, two-way radios, and illumination for night use.

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 "Flaggers" performed beyond the quantity shown in the 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 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.

00225.98  **Traffic Control Supervisor** - The item "Traffic Control Supervisor" will be paid for at the Contract unit price per day. Payment includes vehicle and equipment.

00225.99  **Pilot Cars** - The item "Pilot Cars" 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 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 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:

Agency - A city, county, state organization, special district or political subdivision, as applicable, which is impacted by the Contract with the Contractor.

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 - Provide materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbed Wire</td>
<td>03010.10</td>
</tr>
<tr>
<td>Chain Link Fabric</td>
<td>03010.30</td>
</tr>
<tr>
<td>Commercial Grade Concrete</td>
<td>00440</td>
</tr>
<tr>
<td>Concrete Barrier</td>
<td>00225.12(c)</td>
</tr>
<tr>
<td>Fence Gates</td>
<td>03010.60</td>
</tr>
<tr>
<td>Fence Posts, Braces, and Appurtenances</td>
<td>02110.30, 03010.50</td>
</tr>
<tr>
<td>Gabion Wire Mesh Fabric</td>
<td>03010.70(i)</td>
</tr>
<tr>
<td>Pickets</td>
<td>03010.31</td>
</tr>
<tr>
<td>Wood Fence Posts and Braces</td>
<td>02110.30</td>
</tr>
<tr>
<td>Woven Wire Fabric</td>
<td>03010.20</td>
</tr>
</tbody>
</table>

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.

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.

00270.43 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.
Maintenance

**00270.60 General** - Maintain temporary fences and appurtenances in good condition. Keep the fences in place until they are no longer needed.

**00270.61 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

**00270.70 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

**00270.80 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.

**00270.81 Gates** - The quantities of temporary gates will be measured on a unit basis per each by actual count regardless of size or type.

**00270.82 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**

**00270.90 General** - The accepted quantities of temporary fences and temporary gates 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>
</tbody>
</table>

In items (a) and (b) the type of fence will be inserted in the blank.

Payment will be payment in full for furnishing, placing, maintaining, and removing all materials, performing all necessary earthwork, and for furnishing all equipment, labor, and Incidentals necessary to complete the work as specified.
Section 00275 - Temporary Plating

Description

00275.00 Scope - This work consists of furnishing, installing, maintaining, and removing temporary plating as shown or directed.

Materials

00275.10 Material - Provide material meeting the requirements of 02530.10 in grade A-36 or better.

00275.11 Plating Coating - Coating shall be an Acrylic Modified Alkyd Aggregate Coating. The plate coating shall be suitable for steel traffic plates and applied in accordance with the manufacturer's instructions. Use Number 222 series FLOOR-GRIP Alkyd Deck Coating, manufactured by Farwest Paint Manufacturing or approved equal. Paint shall be lead free Orange #229 or similar color.

Construction

00275.40 General - Backfill, place temporary fencing around, or place plating over all trenches when not performing work or as directed.

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 and 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 HS-21-44 load configuration.

<table>
<thead>
<tr>
<th>Plate Thickness</th>
<th>Trench Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<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.
**00275.43 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

**00275.44 Anti-skid Coating Application** - Apply a coating to temporary plates as an anti-skid surface treatment to help prevent slipping by cyclists and pedestrians when required.

**Maintenance**

**00275.60 General** - Maintain temporary plating in good condition. Re-align any plates that have been moved by traffic. Re-apply any missing anti-skid coating.

**Measurement**

**00275.80 Measurement** - There will be no separate measurement of temporary plating.

Advance warning signs will be measured according to Section 00225.

Temporary fencing will be measured according to Section 00270.

**Payment**

**00275.90 Payment** - There will be no separate payment for temporary plating, as the cost will be included in the payment for the particular items of work using temporary plating.

Payment for advance warning signs will be according to Section 00225.

Payment for temporary fencing will be according to Section 00270.
Section 00280 - Erosion and Sediment Control

Description

00280.00 Scope - This work consists of installing, maintaining, and removing temporary erosion and sediment control devices such as berms, dikes, swales, check dams, sediment traps, sediment basins, matting, mulching, slope drains, sediment fences, sediment barriers, construction accesses, and other structural or nonstructural erosion and sediment control devices. Typical work areas include medians, interchanges, cut and fill slopes, areas disturbed by Project construction, material sources, and disposal sites.

The work described in these Specifications and shown on the plans is the Erosion and Sediment Control Plan (ESCP) and is the minimum requirement for wet weather site conditions.

Coordinate all temporary erosion control features with all permanent erosion control features, if applicable, to the extent practicable to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

00280.01 National Pollutant Discharge Elimination System - The City's ESCP's are developed to comply with Federal, State, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) General Construction Permit for erosion prevention and sediment control for on-site construction activities. A copy of the Permit is available from the City. Erosion and sediment control features, other than those shown on the plans, may be required depending on the Contractor's methods of operation and schedule.

00280.02 City Controlled Lands Erosion and Sediment Control Plan - For work on all City-controlled lands, submit signed copies of the following for review and approval ten days before the preconstruction conference:

- A Contractor developed ESCP that incorporates the City's ESCP and all proposed modifications to it
- Implementation schedules for the ESCP

The Contractor may submit the ESCP that is included in the Project plans. To assist in the preparation or modification of the ESCP, refer to the City's Erosion and Sediment Control Manual revised as of March 1, 2000 along with Title 10 of the City Code.

For each phase of the scheduled work indicate on the ESCP how the proposed erosion and sediment control devices will divert flows, store flows, limit runoff from exposed areas, stabilize exposed soil, and filter sediment.

Include the following information in the implementation schedules, if applicable:

- A list of emergency on site stockpiled materials
- Clearing and grubbing for perimeter controls
- Installing perimeter controls
• Construction phasing
• Clearing and grubbing, grading, and trenching for activities other than perimeter controls
• Grading related to the Project
• Temporary stabilizing exposed soil surfaces
• Final grading, landscaping, and stabilization
• Work on or at bridges and other watercourse structures
• Isolating work area from surface water during in-water work
• Installing and removing utilities
• Work required in wetlands
• Monitoring rainfall
• Inspecting controls
• Installing, maintaining, monitoring, and removing temporary controls
• Installing and maintaining permanent controls
• Disposing of waste materials
• Haul road and borrow pit controls
• Additional controls for wet season work and temporary work suspensions

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 may be on-site or retained by the City.

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 than 24 hours after implementation.

00280.03 Non-City Controlled Lands Erosion and Sediment Control Plan - For work on all non-City controlled lands, submit signed copies of the following for review ten days before the preconstruction conference:

• A Contractor developed ESCP
- A description of the methods to be used for the ESCP

Describe the following:

- Clearing and grubbing
- Installing perimeter controls
- Construction phasing
- Grading
- Temporary stabilizing exposed soil surfaces
- Final grading, landscaping, and stabilization
- Inspecting controls
- Installing, maintaining, monitoring, and removing temporary controls
- Installing and maintaining permanent controls
- Disposing of waste materials
- Haul road and borrow pit controls
- Additional control for wet season work and temporary work suspensions
- Methods of diverting flows, storing flows, limiting runoff from exposed areas, stabilizing exposed soil, and filtering sediment

The ESCP and methods of operation shall be prepared by an individual who is knowledgeable in erosion and sediment control.

Also, furnish the following:

- Signed, written 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 and use of the property.

- Copies of permits or proof that permits are not required from all pertinent federal, State, county, city, and local agencies.

If the Contractor’s operations require work on non-City controlled lands that were 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 review.
00280.04 **Erosion and Sediment Control Manager (ESCM)** - Designate and provide a representative, experienced in all disciplines of construction, as the Erosion and Sediment Control Manager (ESCM). The ESCM is responsible for assuring the duties described in 00280.61 are done and has the authority to immediately mobilize necessary personnel to correct and modify erosion prevention and sediment control devices as required. Provide the ESCM's name and working phone number ten days before the preconstruction conference. Provide written changes in the appointment of this individual during the term of the Contract.

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**

00280.10 **General** - Provide materials meeting the following requirements. The Contractor may submit a request for proposed alternate materials by following the requirements of 00140.70.

(a) **Biofilter Bags** - Provide minimum size 18" x 6" x 30" plastic mesh bags with 1/2 inch openings filled with approximately 45 pounds of clean, 100% recycled wood-product waste.

(b) **Check Dams** - Provide check dam material meeting the following requirements:

- **Aggregate** - Aggregate with maximum size between 4 inches and 2 inches meeting the requirements of 00330.16.
- **Straw Bales** - Standard rectangular straw bales meeting the requirements of 00280.10(n).
- **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.10(a).
- **Sand Bags** - Sand bags meeting the requirements of 00280.10(l).
- **Stakes** - Stakes meeting the requirements of 00280.10(n).
- **Prefabricated** - Prefabricated check dam system meeting the manufacturer's recommendations.

(c) **Construction Entrances** - Provide construction entrance material meeting the following requirements:

- **Aggregate** - Aggregate with a maximum size between 4 inches and 2 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).
(d) **Diversion Dike/Swale** - Provide diversion dike/swale material meeting the following requirements:

- **Aggregate** - Aggregate with maximum size between 4 inches and 1 inch meeting the requirements of 00330.16.

- **Seeding** - Temporary seeding meeting the requirements of 01030.13.

(e) **Temporary Drainage Curbs** - Provide temporary drainage curb material as follows:

- **Type 1** - Concrete drainage curb meeting the requirements of 00480.11.

- **Type 2** - Asphalt concrete drainage curb meeting the requirements of 00480.12.

- **Type 3** - Sand bags meeting the requirements of 00280.10(l).

(f) **Dust Control** - For dust control, use water at an application rate determined by the Engineer or use liquid stabilizer emulsion or dry powder tackifier according to the following:

- **Liquid Stabilizer Emulsion** - Provide a tackifier base material of liquid and polyvinyl acetate polymers with emulsion resins containing not less than 55% total solids by weight. Do not use tackifiers that contain polyacrylates or polyvinyl acrylics.

- **Dry Powder Tackifier** - Provide a 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 remulsifiable and consists of a processed organic adhesive derivative of one of the following:

  - Gumbinder derived from guar (Cyamopsis tetragonoloba)
  - Gumbinder derived from plantian (Plantago insularis)

Use nontoxic dust control materials that do not have an adverse effect on soil structure or establishment and growth of vegetation.

(g) **Flow Spreader** - Provide aggregate for flow spreaders with a maximum size between 6 inches and 3 inches meeting the requirements of 00330.16.

(h) **Inlet Protection** - Provide inlet protection materials meeting the following requirements:

- **Wire Mesh** - Provide wire mesh materials as follows:

  - **Type 1 Inlet Protection** - Wire mesh meeting the requirements of 00280.10(o).

  - **Type 2 Inlet Protection** - 19 gage steel-wire mesh with 3/8" x 3/8" 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 4 inches and 1 inch meeting the requirements of 00330.16.

- **Stakes** - Stakes meeting the following requirements:
  - **Type 1 Inlet Protection** - Use commercial grade metal posts with a weight of at least 1.35 pounds/foot.
  - **Type 4 Inlet Protection** - Use minimum 1" x 2" x 18" wooden posts.

- **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.10(a).

- **Prefabricated Filter Inserts** - Provide prefabricated filter inserts manufactured specifically for collecting sediment in drainage inlets and listed on the CPL. Include handles and/or fasteners sufficient to keep the insert from falling into the inlet during maintenance and removal of the insert from the inlet.

- **Concrete Masonry Units** - Provide nominal 8" x 8" x 16", 29 pound concrete building blocks with two 5 1/2" x 5 1/2" openings and 1 inch minimum outer wall thickness.

- **Sod** - Provide grass sod grown on agricultural land that is cultivated specifically for turf sod meeting the following requirements:
  - Free of weeds, diseases, nematodes, and insects
  - Mature and not less than 10 months old
  - 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

- **Reinforcing Steel** - Provide commercial grade reinforcing steel.

(i) **Matting** - Provide matting material that conforms to the Texas DOT/TTI Hydraulics and Erosion Control Laboratory requirements and 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/square foot.

• **Type F** - Flexible channel liner for shear stress from 0 to 4 pounds/square foot.

• **Type G** - Flexible channel liner for shear stress from 0 to 6 pounds/square foot.

• **Type H** - Flexible channel liner for shear stress from 0 to 8 pounds/square foot.

Provide check slot material and fasteners as follows:

• **Check Slot:**
  
  • **Channel Application** - Compacted class 50 riprap meeting the requirements of Section 00390.

  • **Slope Application** - Compacted native material.

• **Fasteners** - Use U-shaped wire staples or heavy duty pins as follows:
  
  • **Staples** - 14 gage 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.

Provide the manufacturer’s material and installation specifications to the City prior to installation.

**(j) Temporary Mulch** - Provide mulch material conforming to 01030.15(b) and tackifier material conforming to 001030.16.

**(k) Plastic Sheeting** - Provide plastic sheeting slope protection, anchoring system, and toe protection according to the following:

• **Plastic Sheeting** - Minimum 6 mil thick polyethylene plastic sheeting.

• **Anchoring System** - Anchor system consisting of 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 1.35 pounds/foot.

• **Rock** - Class 50 riprap conforming to Section 00390.

**(l) Sand Bags** - Provide 24" x 12" x 6" durable, weather-resistant, tightly woven bags sufficient to prevent leakage of filler material. Fill bags with at least 75 pounds of firmly packed fine pcc aggregate 3/8" - 0 or round 3/8" - 3/16" pea gravel.
Temporary Scour Holes - Provide class 100 riprap for temporary scour holes conforming to Section 00390.

Sediment Barriers - Provide sediment barriers and sediment barrier materials meeting the following requirements:

- **Straw Bales** - Provide standard 45-65 pound rectangular straw bales that are wire-bound or string-tied. Straw material shall meet the requirements of 01030.15(b).

- **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.10(a).

- **Wattles** - Provide wattles 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/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/foot (plus or minus 10%)
  - Made from 85% high density polyethylene, 14% ethyl vinyl acetate, and 1% color for UV inhibition

- **Sand Bags** - Sand bags meeting the requirements of 00280.10(l).

- **Brush Barrier** - Provide 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).

- **Filter Berm and Rock Filter** - Provide 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" documentation according to 02320.10(c).

- **Prefabricated Barrier System** - Provide prefabricated barriers manufactured specifically for temporarily obstructing the flow of sediment-laden water and listed on the CPL.

- **Stakes** - Provide the following size stakes:
  - Biofilter Bags - Use minimum 1" x 2" x 18" wood posts
  - Brush Barrier - Use minimum 1" x 2" x 18" wood posts
  - Straw Bales - Use minimum 1 1/2" x 1 1/2" x 36" wood posts
- Wattle - Use minimum 1" x 1" x 24" wood posts

(o) 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:
  - **Supported Sediment Fence** - Commercial grade metal posts with a weight of at least 1.35 pounds/foot.
  - **Unsupported Sediment Fence** - 1 1/2" x 1 1/2" x 48" minimum wooden posts.

- **Wire Mesh** - Galvanized wire mesh with 2x2 - W0.5xW0.5 or 4x2 - W0.5xW0.5 openings or horizontal and vertical self supporting, prior to fastening to posts, mesh with a minimum tensile strength of 70 ksi meeting the requirements of ASTM A 82.

(p) Sediment Mat - Provide sediment mats from the CPL.

(q) Temporary Sediment Trap - Provide the following materials for sediment traps:

- **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 00641.

- **Aggregate** - Aggregate with maximum size between 6 inches and 3 inches meeting the requirements of 00330.16.

(r) Temporary Slope Drains - Provide either plastic pipe meeting the requirements of Section 02410 or metal pipe meeting the requirements of Section 02420. If the contributing area is not established, use 12 inch diameter.

(s) Slope Berms - Provide earthwork materials for slope berms according to 00330.41 or stone embankment material with the maximum size between 4 inches and 1 inch meeting the requirements of 00330.16.

(t) Tire Wash Facility - Provide the following materials for tire wash facilities:

- **Aggregate** - 1 1/2" - 0, 1" - 0, or 3/4" - 0 aggregate base material meeting the requirements of Section 00641.

- **Reinforcing Steel** - Reinforcing steel meeting the requirements of 02510.10.

- **Geotextile** - Subgrade geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).

- **Concrete** - Commercial grade concrete meeting the requirements of Section 00440.
(u) **Chemical Soil Stabilization** - Provide a liquid stabilizing emulsion meeting the requirements of 00280.10(f).

(v) **Coir Filter Fabric** - Made of rope fashioned from coconut husk fibers that is either woven or unwoven.

(w) **Temporary Signing** - Use temporary signing conforming to 00225.11 for Erosion Concerns? signs.

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**Construction**

00280.40 **Installation** - Install erosion and sediment control devices as shown and according to the 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.

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 interceptor ditches, berms in fill areas, and sediment fences or straw bales along the banks of existing streams and toes of slopes. Install all appropriate perimeter controls before beginning major site grubbing operation.

Install all erosion and sediment control features for soil disturbing activities that are within 300 feet horizontal distance of the two-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 May 30. Before working during the wet season and before temporary work suspension for winter, meet with the City to review and update the ESCP and to develop a schedule to ensure that appropriate controls are implemented and maintained during the wet season work and work suspension periods.
During 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 - 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 seven days of exposure.

(b) Temporary Stabilization - Protect from erosion the surface area of exposed soils caused by construction activities. Temporary stabilize exposed soil surfaces not at finish grade at all times and soil surfaces at finish grade when working outside the permanent seeding dates. Provide the following until permanent stabilization measures are implemented:

- Schedule temporary stabilization on an 14 day basis, or more frequent, if needed or directed

- Implement at a minimum, appropriate temporary stabilization measures according to the schedule. Temporary stabilization includes, chemical soil tackifiers, temporary seeding, temporary mulching, erosion control matting, plastic sheeting, preparing seed bed, fertilizing, watering, and adding soil amendments.

- Document implemented measures on the ESCP

Active work areas scheduled for re-disturbance before the next scheduled temporary stabilization period may be left un-stabilized if approved by the City.

(c) Permanent Stabilization - Permanently stabilize exposed soil surfaces at finished grade. Permanent stabilization methods include, but are not limited to, seeding, mulching, riprap protection, and bio-engineered slope stabilization. Permanent stabilization includes stabilization of temporary structures such as detours, stockpiles, 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 that have been seeded and are not sufficiently stabilized by an established stand of vegetation according to 01030.60, or the soil surface is not protected with sufficient temporary stabilization measures by November 1 of each year, do the following:

- Take measures necessary to redirect the flows 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 to be stabilized, prior to re-grading, are too steep or lack access for effective straw mulch application, apply, upon approval, other effective measures such as chemical soil stabilizers.

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 erosion will be a problem and if construction permits, construct permanent erosion control features immediately after clearing and grubbing and grading operations are complete. If permanent erosion control features cannot be constructed furnish and install temporary erosion control features.

00280.43 Area Preparation - Prepare areas according to 01040.48(d).

Track all fill slopes at finished grades 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.

00280.46 Application - Install erosion and sediment control devices as shown and according to the following:

(a) Biofilter Bags - Place and arrange biofilter bags as shown or directed.

(b) Check Dams - Construct check dams as shown or as directed.

   Type 1: Aggregate - Place aggregate in the ditch section with the center low point below the outside edge.

   Type 2: Straw Bales - Place aggregate in ditch section and extend check dam with straw bales sufficient to direct flow over aggregate weir.
**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: Pre-fabricated Check Dam System** - Install pre-fabricated check dam systems according to the plans, Special Provisions, and the manufacturer’s recommendations. Field fabricated systems are not allowed.

**(c) Construction Entrances** - Construct construction entrances at each access point between the construction site and all public or private roads or other paved surfaces.

When construction entrances are in use and mud and dirt tracking is 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.

**(d) Diversion Dike/Swale** - 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 MFTP.

Immediately after completing constructing diversion dikes and swales place temporary seed and mulch according to Section 01030, or place erosion matting and seed as directed.

**(e) Temporary Drainage Curbs** - Construct temporary drainage curbs as shown or directed.

**(f) Dust Control** - Apply appropriate dust (wind erosion) control according to the following:

- **Water** - Apply water according to Section 00340.

- **Liquid Stabilizer Emulsions** - Dilute the liquid stabilizer emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at a rate of 865 gallons/acre unless the manufacturer recommends a greater rate of application.

- **Dry Powder Tackifier** - Apply at a rate of 140 pounds/acre unless the manufacturer recommends a greater rate of application.

**(g) Flow Spreader** - A flow spreader is a 12 inch to 18 inch high berm of aggregate that is at a uniform grade throughout its length. Place the flow spreader to receive channeled runoff so that the water is uniformly dispersed along the length of the spreader. Discharge water into a stabilized area at non-erosive velocities.
(h) **Inlet Protection** - Construct inlet protection that directs flows through the control and into the inlet. Select materials from alternatives shown on the plans or Special Provisions.

**Type 1** - Install supported sediment fence around the perimeter of the inlet according to 00280.46(n).

**Type 2** - 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** - Install pre-fabricated inserts according to the plans, Special Provisions, and manufacturer’s recommendations. Field fabricated inserts are not allowed.

**Type 4** - Install biofilter bags according to the plans.

**Type 5** - 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** - Within 36 hours of harvest, install sod around the perimeter of the inlet.

(i) **Matting** - Ensure that the matting is installed according to the plans, these Specifications, or the manufacturer’s recommendations, whichever is more stringent.

(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 over the same area where matting is required according to one of the following:

a. **Seeding Prior to Mat Installation** - Apply according to Section 01030. This method is preferred.

b. **Seeding After Mat Installation** - This method is allowed only if specified in the Special Provisions or approved. Apply according to Section 01030 at double the application rate for seed.

c. **Single Application - Mat and Seed**:

   - **Hydraulically Applied Mat** - Apply seed at double the rate specified in Section 01030. Thoroughly mix seed, fertilizer, and mat material.

   - **Manually Applied (Pre-seeded) Mat** - Pre-seed the mat at double the rate specified with the seed mix specified in Section 01030.

(3) **Mat 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.
(j) Temporary Mulch - Evenly apply dry mulch and tackifier material according to these Specifications. 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 the Contractor’s expense. Tack mulch material in place mechanically or with hydraulically applied tackifier to form a cohesive surface cover that is resistant to displacement by wind and water.

(1) Dry Mulch - Apply straw mulch on slopes 1V:1.5H 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/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:

a. Hydraulically Applied Tacking Agents:

   • Liquid Stabilizer Emulsions - Dilute liquid stabilizer with water at a ratio of 30:1 then apply at a rate of 29 gallons/acre unless the manufacture recommends a greater rate of application.

   • Dry Powder Tackifier - Apply at 80 pounds/acre with 1,940 pounds of hydromulch fiber unless the manufacturer recommends a greater rate of application.

b. Mechanical Methods - Straw mulch may be mechanically tackified using a crimping disk or sheep's-foot roller.

   • Crimping disc - A heavy disk with flat, scalloped discs approximately 1/4 inch thick, having dull edges and spaced no more than 9 inches apart.

   • 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 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.

(k) Plastic Sheeting - Place plastic sheeting on disturbed, temporary slopes 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 soils with plastic sheeting and secure it tightly in place 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 maintain cover during reasonably expected conditions in the area. Direct water away from areas above the plastic sheeting to prevent erosion from undermining the plastic sheeting.

Control drainage from areas covered by the plastic sheeting so that the discharge occurs onto the toe protection.

(l) Temporary Scour Holes - Construct temporary scour holes at the outfall ends of temporary slope drains or as shown.

(m) Sediment Barriers:

- **Type 1: Straw Bales** - Place and arrange straw bales as shown or directed.
- **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 and arrange brush barriers as shown or directed. Place woody debris or topsoil strippings 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: Pre-fabricated Barrier System** - Install pre-fabricated barrier systems according to the plans, Special Provisions, and manufacturer’s recommendations. Field fabricated systems are not allowed.

(n) 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 silt 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 silt fence system according to the plans, Special Provisions, and manufacturer’s recommendations. Connect end of rolls as shown.

**o) 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.

**p) 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.

**q) 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.

**r) Temporary Stabilization** - Surfaces which require temporary stabilization include, but are not limited to:

• Exposed soil surfaces not at finished grade

• Exposed soil surfaces at finished grade when outside permanent seeding dates

• Stockpiles of exposed soils

Temporary stabilization methods include chemical soil stabilization, permanent seeding with temporary mulching, temporary mulching, matting, bark mulch and other temporary cover and stabilization measures. Prepare soil surfaces as specified for the appropriate method used.

If seed of any kind is applied and has not achieved 70% density of the surrounding existing grass areas prior to the end of the permanent seeding dates, then apply additional temporary stabilization measures, other than seeding.

**s) Slope Berm** - Construct an 18 inch minimum high berm of compacted material at the top of embankments during construction to direct water away from exposed slopes.

**t) 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.

**u) Chemical Soil Stabilization** - Hydraulically apply a liquid stabilization emulsion chemical soil stabilizer at the following rates unless the manufacturer recommends a greater rate of application:

• **Long Term Control of Exposed Soil Surfaces** - 35 gallons/acre. Dilute the emulsion with water at the rate of one part emulsion to 20 parts water.
• **Steep Slopes with Raveling Small Rock** - 45 gallons/acre. Dilute the emulsion with water at the rate of one part emulsion to 10 parts water.

**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.

**Maintenance**

**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 the Contractor's expense.

**00280.61 Erosion and Sediment Control Manager** - The ESCM's duties include:

- Manage and ensure proper implementation of the ESCP
- Accompany the City's representative to the field to review the ESCP before beginning construction activities
- Monitor rainfall on and in the vicinity of the Project site
- Monitor receiving streams in the vicinity of the Project site
- Weekly inspect erosion and sediment control features on active construction sites
- Every two weeks inspect erosion and sediment control features on inactive sites
- Inspect erosion and sediment control features on all inactive and active 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 the control devices or to install additional control devices during working and non-working hours
- Record actions taken to clean up significant amounts of sediment
- Complete the Erosion Control Monitoring form
- Update the ESCP monthly and within 24 hours after changes are implemented
- Prepare a contingency plan in preparation for emergencies and the rainy season
Accompany the City’s representative on inspections and, if requested, on inspections made by the regulating agency representatives.

**00280.62 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 the Contractor expense.

**00280.63 Monitoring** - Monitoring consists of the following:

(a) **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.

(b) **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.

(c) **Monitoring Form** - Complete the Erosion Control Monitoring form after each inspection, observation of the receiving stream erosion control facility modification, or maintenance action. Submit the forms to the City weekly for active sites and every two weeks for inactive sites.

**00280.64 Sediment Removal** - Remove sediment and upgrade or repair the devices as needed as soon as practicable, but not later than two 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 50%. Do not flush sediment into the inserts or other forms of inlet protection for the drainage system unless directed.

(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 two 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 all federal, state, and local laws and ordinances. Do not flush sediment-laden water into drainage systems.

**Measurement**

**00280.80 Lump Sum Basis** - No separate measurement will be made for lump sum items.

**00280.81 Unit Basis** - Unit basis items will be measured on a unit basis, per each, by actual count of each device or location where the device is constructed or placed and accepted.

**00280.82 Length Basis** - Length basis items will be measured by the foot along the line and grade of the item or device constructed or placed and accepted.

- 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.
00280.83 **Area Basis** - Area basis items will be measured on the ground surface by the foot, and computed to the square foot or acre unit as applicable.

00280.85 **Limitations** - The quantities of emergency materials listed in 00280.48 of the Special Provisions are included in the pay item quantities listed in bid schedule.

**Payment**

00280.90 **General** - The accepted quantities of erosion and sediment control devices will be paid for at the Contract unit price per unit of measure for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion Control</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Check Dams</td>
<td>Each</td>
</tr>
<tr>
<td>Construction Entrances</td>
<td>Each</td>
</tr>
<tr>
<td>Inlet Protection</td>
<td>Each</td>
</tr>
<tr>
<td>Temporary Scour Holes</td>
<td>Each</td>
</tr>
<tr>
<td>Temporary Sediment Traps</td>
<td>Each</td>
</tr>
<tr>
<td>Tire Wash Facility</td>
<td>Each</td>
</tr>
<tr>
<td>Biofilter Bags</td>
<td>Each or Foot</td>
</tr>
<tr>
<td>Sand Bags</td>
<td>Each or Foot</td>
</tr>
<tr>
<td>Sediment Barrier</td>
<td>Each or Foot</td>
</tr>
<tr>
<td>Diversion Dike/Swale</td>
<td>Foot</td>
</tr>
<tr>
<td>Temporary Drainage Curbs</td>
<td>Foot</td>
</tr>
<tr>
<td>Flow Spreader</td>
<td>Foot</td>
</tr>
<tr>
<td>Sediment Fence, Supported</td>
<td>Foot</td>
</tr>
<tr>
<td>Sediment Fence, Unsupported</td>
<td>Foot</td>
</tr>
<tr>
<td>Temporary Slope Drains</td>
<td>Foot</td>
</tr>
<tr>
<td>Plastic Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Sediment Mat</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Chemical Soil Stabilization</td>
<td>Square Foot or Acre</td>
</tr>
<tr>
<td>Matting</td>
<td>Square Foot or Acre</td>
</tr>
<tr>
<td>Temporary Mulching</td>
<td>Square Foot or Acre</td>
</tr>
</tbody>
</table>

"Erosion Control" includes the following:

- 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 all disturbed ground and work areas
Erosion control signs

If "Erosion Control" is not listed as a pay item, it is Incidental work for which no separate payment will be made.

Emergency materials that are incorporated into the Project will be paid for under the appropriate pay item.

"Plastic Sheeting" includes the costs for protecting exposed slopes with plastic sheets, anchoring devices, and toe protection maintenance.

"Matting" includes the costs for preparing the slope surface and stabilizing exposed soil with erosion mat material.

Biofilter bags and sand bags used in constructing check dams or sediment barriers will not be separately paid for. Biofilter bags and sediment fence used in constructing inlet protection will not be separately paid for. Payment for these items will be included in payment made for the items "Check Dams", "Sediment Barriers", and "Inlet Protection" as applicable.

No separate or additional payment will be made for the following:

- 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

Payment will be payment in full for furnishing and placing all materials, performing all work, and furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

00280.91 Lump Sum Progress Payments - The amount paid for lump sum items 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:

- 50% upon initial installation of erosion items
- An additional 25% when 50% of the original Contract amount earned
- The remaining 25% when the Project is completed and all temporary erosion control devices are removed from the Project site
Section 00290 - Environmental Protection

Description

00290.00 Scope - This Section describes the Contractor’s duties and obligations with respect to protection of the 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.

The following federal, State and local agencies are 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:

Federal Agencies:

Agriculture, Department of
   Forest Service
   Natural Resources Conservation Services

Army, Department of
   National Marine Fisheries Service

Defense, Department of

Energy, Department of

Federal Energy Regulatory Commission

Health and Human Services, Department of

Housing and Urban Development, Department of

Interior, Department of
   Heritage, Conservation, and Recreation Service
   Bureau of Indian Affairs
   Bureau of Land Management
   Bureau of Mines
   Bureau of Reclamation
   Geological Survey
   Minerals Management Services
   Office of Surface Mining, Reclamation, and Enforcement
   U.S. Fish and Wildlife Service

Labor, Department of
   Mine Safety and Health Administration
   Occupational Safety and Health Administration
Transportation, Department of
Coast Guard
Federal Highway Administration

Water Resources Council

State of Oregon Agencies:

Administrative Services, Department of

Agriculture, Department of
Natural Resources Division
Soil and Water Conservation District

Columbia River Gorge Commission

Consumer and Business Services, Department of
Insurance Division
Oregon Occupational Safety and Health Division

Energy, Office of Transportation

Environmental Quality, Department of

Fish and Wildlife, Department of

Geology and Mineral Industries, Department of

Human Resources, Department of

Labor and Industries, Bureau of

Land Conservation and Development Department

Parks and Recreation, Department of

State Lands, Division of

Water Resources Department

Local Agencies:

City Councils

County Courts

County Commissioners, Board of

Design Commissions
Historical Preservation Commissions
Planning Commissions
Port Districts
Special Districts

Oregon Tribal Governments

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 any additional requirements or Laws imposed by any agency or governmental unit having authority to enforce the Endangered Species Act (ESA) and other Laws.

No Condition of the Contract releases the Contractor from any responsibility or requirement under any environmental or other Law.

00290.20 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:

- Hazardous substances (as defined in ORS 465.200)
- Oil and hazardous materials (as defined in OAR 340-108-0002)
- Hazardous waste (as defined in 40 CFR 261 and OAR 340-101-0033)
- Solid waste (as defined in 40 CFR 258, ORS 459 and OAR 340)

For the purposes of this Section, the term "hazardous substances" includes oil and hazardous materials. Additional requirements, if any, concerning hazardous materials on the Project will be included in the Special Provisions.

(a) Hazardous Substance Registration - Register all hazardous substance storage with the Oregon State Fire Marshal, as required by OAR 837-085 to -090, and provide copies of that registration to the Engineer within 14 days of registration.

(b) Worker Right-to-Know Documentation - Have on the Project Site Material Safety Data Sheets (MSDS) for all hazardous substances stored or used on-site, readily available to employees and inspectors at all times. Comply with all federal and State Laws for employee right-to-know in association with the use and storage of hazardous substances on-site.

(c) Fuel Storage - Any fuel to be stored on-site shall be stored in compliance the Uniform Fire Code, NFPA standards, and all other applicable Laws.
If above-ground fuel storage will exceed 660 gallons per container or 1,320 gallons aggregate, develop and submit for approval 10 days before the pre-construction conference, a spill prevention control and countermeasures (SPCC) plan, signed and stamped by a professional engineer, in accordance with 40 CFR 112. The SPCC plan requirement is in addition to the PCP requirement described in 00290.30(b). Employees shall be trained as specified in 40 CFR 112 and the SPCC plan. Maintain a copy of the SPCC plan on-site at all times during construction activities, readily available to employees and inspectors.

(d) Solid Waste Disposal:

(1) General - Prepare a hazardous waste determination for all waste generated at the Project Site, in accordance with 40 CFR 262.11 and OAR 340-102-0011. Determine whether the waste is classified as hazardous waste, as defined in 40 CFR 261 and OAR 340-101-0033, as follows:

- Determine whether the waste is excluded from regulation under 40 CFR 261.4
- Determine whether the waste is listed in Subpart D of 40 CFR 261.4
- Determine whether the waste meets the characteristics set forth in Subpart C of 40 CFR 261.4
- Determine whether the waste is otherwise excluded as a hazardous waste in 40 CFR 261, 264, 265, 266, 268, or 273.
- Determine whether the waste is an "Additional" hazardous waste pursuant to OAR 340-101-0033.

For waste classified as hazardous, follow the procedures set forth in 00290.20(e).

Except as provided in (d)(2) below, dispose of non-hazardous solid waste generated at the Project Site at a permitted landfill, in accordance with 40 CFR 258, ORS 459.205 through 459.350, OAR 340-093, and all other applicable Laws. Exceptions to this requirement are noted below:

(2) Inert Material - Handle inert material, as defined in OAR 340-093-0030, according to 00330.41. Inert materials include weathered, consolidated asphalt paving, concrete (including embedded re-bar), clean soil, rock and brick.

(e) Hazardous Waste Management - 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.

(f) Hazardous Substance Transportation - All employees involved in the transportation or preparation for transportation of hazardous substances and hazardous wastes must have received training under the provisions of 49 CFR 100 through 185, in addition to having all necessary permits and licenses for hazardous substance/waste transportation. All hazardous waste must be shipped under a hazardous waste manifest. All hazardous
substance and hazardous waste shipments shall be appropriately packaged and labeled, and the vehicles placarded in accordance with 49 CFR 100 through 185. Submit copies of the completed manifests and documentation to the Engineer within 14 days of the hazardous substance/waste leaving the site.

(g) **Used Oil** - Store used oil in compliance with 00290.20(c), 00290.30 and all other applicable Laws. Used oil may be transported off-site for recycling or for use as fuel as set forth in 40 CFR 261 and 279, and OAR 340-111. The used oil transporter must be registered with the DEQ for this activity unless the Contractor self-transports less than 55 gallons at any time to a used oil collection center within the State.

(h) **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 incident.

The Engineer will attempt to resolve the unanticipated situation expeditiously according to 00140.40. Delays to work due to the discovery of unexpected contamination will be considered for exclusion from Contract time according to 00180.60(d)(1).

(i) **Spills and Releases** - In the event of a spill or release of hazardous substance or hazardous waste, do the following:

- Immediately commence response actions as set forth in the PCP, SPCC and/or Contingency Plan, as appropriate. If any of the provisions set forth in these plans conflict, the actions providing the greatest protection of public health and safety and the environment shall be implemented.
- Immediately notify the Engineer and provide written notification within 24 hours, setting forth a description of the incident.
- If the quantity released exceeds the minimum for a reportable quantity pursuant to 40 CFR 302.4 or OAR 340-108-0010, immediately notify DEQ via the Oregon Emergency Response System (OERS). OERS can be reached at 1-800-452-0311 or (503) 378-4124.
- If the release impacts or threatens to impact any surface water body, or exceeds the quantity listed in 40 CFR 302.4 and OAR 340-108-0010(1)(d), immediately notify the EPA and the USCG through the National Response Center. The National Response Center can be reached at 1-800-424-8802.
- Conduct cleanup of the released material in compliance with OAR 340-108 and all other applicable Laws.
• Provide a written spill report to the Engineer within 48 hours of completing initial cleanup activities. If spill cleanup is not completed within seven days, provide an interim spill report to the Engineer within seven days of the incident. Include, at a minimum, the type of material and quantity released, a description of how the release occurred, containment and cleanup methods employed, disposal location for cleanup materials (include disposal receipts), any EPA, DEQ, OERS and/or Oregon State Fire Marshal incident identification numbers issued and a description of how similar incidents will be prevented in the future.

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/or generated on the Project Site including, but not limited to, 29 CFR 1910, ORS 654, and OAR 437. If any of these requirements are in conflict, the more stringent requirements shall apply.

00290.30 Pollution Control - Prevent, control and abate pollution of the environment as required by the Contract and all applicable Laws. Perform changes or alterations of work required by new or amended environmental pollution Laws, not contemplated at the time of bid submittal, according to 00140.50 and ORS 279.318.

(a) Water Pollution Control Measures - Prevent, control and abate pollution of state waters as required by the Contract and local, state and federal regulations and requirements. Be fully informed of the NPDES Storm Water General Conditions, and conduct construction operations accordingly. Meet or exceed the DEQ requirements for the NPDES General Permit 1200-CA. A copy of the permit is available from the Engineer. Maintain a copy of the General Conditions at the Project Site. The criminal penalty for the conviction of a violation of this permit is a fine of not more than $25,000 and each calendar day of violation constitutes a separate offense. DEQ may also impose civil penalties up to $10,000 per calendar day for violation of the terms or conditions of the General Conditions.

(1) Minimum Required Measures - As a minimum, take the following measures:

• Allow no pollutant of any kind (e.g., petroleum products or fresh concrete) to come in contact with an active flowing stream.

• 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 Subsection 00290.20(i).

• Dispose of material waste according to 00290.20(d) and (e). Do not bury, dump or discharge material wastes or unused materials at the Project Site, except as provided in 0310.43.

• Limit water leakage from trucks carrying saturated soils to less than 1 gallon per hour before allowing them to leave the Project Site.

• Comply with the erosion and sediment control requirements of Section 00280.

• Protect potable water system from contamination.
Additional measures applicable to the Project will be included in the Special Provisions.

Any penalties assessed against the City because of the Contractor’s willful or negligent violation of the terms of the General Conditions will be withheld from the progress or final payments according to 00195.50(m).

(2) Permitted Work Areas - Work within permitted work areas shall be performed only within the permitted in-water work period(s), unless otherwise approved. Equipment shall not enter the permitted work area except as allowed in permits issued for the Project.

(b) Pollution Control Plan (PCP) - Develop and submit a PCP to prevent point-source pollution related to Contractor operations for approval 10 days before the pre-construction conference. Maintain a copy of the PCP on the Project Site at all times during construction activities, readily available to employees and inspectors. Ensure that all employees comply with the provisions of the PCP. The PCP shall satisfy all pertinent requirements of all applicable Laws including, but not limited to, the requirements of the Uniform Fire Code and National Fire Protection Association (NFPA) Standards, and shall include the following:

- Methods for confining, removing, and disposing of excess concrete, cement and other mortars.
- Measures for containing fluids and debris from washout facilities.
- Identify hazardous products or materials to be used. Include how they will be handled, monitored, inventoried, and stored as well as spill prevention practices to be followed.
- A spill containment and control plan that includes: notification procedures; specific clean up and disposal instructions for different products; quick response containment and clean up measures which will be available on site; proposed methods for disposal of spilled materials; and employee training for spill containment.
- Measures to be used to reduce and recycle hazardous and non-hazardous waste generated from the Project, including types of materials, estimated quantity, storage methods, and disposal methods.
- Vehicle and equipment maintenance procedures and associated pollution prevention practices.
- Off-site vehicle tracking and dust prevention measures.
- A map showing the locations of proposed hazardous substance storage, spill response equipment, communications equipment, fire suppression equipment and the on-site copy of the PCP.

A "Pollution Control Plan Contractor Packet" is available upon request.
(c) **Air Pollution Control Measures** - Control or abate air pollution to safeguard the State’s air resources in compliance with ORS 468 and 468A, OAR 340-014 and 340-200 through -268, and all other applicable Laws.

(d) **Noise Control** - Comply with ORS 467, OAR 340-035, all other applicable Laws and the following construction noise abatement measures:

- Perform no construction within 1,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 10:00 p.m. and 6:00 a.m. on other days, without the approval of the Engineer.

- Use equipment with sound control devices no less effective than those provided on the original equipment. Equipment with unmuffled exhausts is prohibited.

- Use equipment complying with pertinent equipment noise standards of the EPA.

- Perform no pile driving or blasting operations within 3,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 8:00 p.m. and 8:00 a.m. on other days, without the approval of the Engineer.

- Mitigate the noise from rock crushing or screening operations performed within 3,000 feet of any occupied dwelling by placing material stockpiles between the operation and the affected dwelling, or by other means approved by the Engineer.

Should a specific noise impact complaint occur during the construction of the Project, one or more of the following noise mitigation measures may be required at the Contractor’s expense, 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.

- **The Contractor’s attention is directed to City of Portland Ordinance No. 159276 which describes noise control regulations. Comply with the applicable noise control requirements of the ordinance for Project work.**
Protection of Fish, Wildlife, and Plants:

(a) General - Comply with the Laws of the Oregon Department of Fish and Wildlife, National Marine Fisheries Service and U.S. Fish and Wildlife Service, and the rules and practices developed through the Oregon Plan for Salmon and Watersheds. Conduct operations to avoid any hazard to the safety and propagation of fish and shellfish in waters of the state.

(b) Prohibited Operations - Except where authorized by the Contract and by permit, do not:

- Blast underwater
- Use water jetting
- Release petroleum products or chemicals in the water
- Disturb spawning beds
- Obstruct stream channels
- Cause silting or sedimentation of water
- Use treated timbers within the permitted work area
- Impede adult and juvenile fish passage, including intermittent streams

The permitted work area, if any, will be defined by Special Provision for the Project.

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.

Protection of Wetlands:

(a) General - Comply with, and require that all the Contractor's employees, agents, and subcontractors comply with the Clean Water Act Section 404 (33 U.S.C. 1344); Federal Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. 403 et seq.); Oregon Removal-Fill law (ORS 196.800 -.990); Oregon Removal and Filling in Scenic Waterways law (ORS 390.805 -.925), and other applicable Laws governing preservation of wetland resources. For the purposes of this Section, "wetland" or "wetlands" will be understood to include wetlands as defined in 00110.20, as well as other jurisdictional waters of the U.S. and/or the State.

(b) Identification of Wetlands - Wetlands known to be on the Project Site will be shown on the Plans. Wetlands to be permanently filled or excavated, or that will be temporarily impacted, will be identified. Wetlands to be protected will be shown as "no work zones". Further information may be provided in the Special Provisions.
Comply with Clean Water Act Section 404 permits issued by the U.S. Army Corps of Engineers, and Fill/Removal permits issued by DSL, which allow specified quantities of fill and excavation only within specifically identified areas of wetlands.

**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:

- Immediately discontinue operations or move to another area of the Project Site or material source.
- Protect the cultural resource from disturbance or damage
- Notify the Engineer

The Engineer will:

- Arrange for immediate investigation
- Arrange for disposition of the cultural resources. The Engineer may direct the Contractor to perform salvage operations as Extra Work
- Notify the Contractor when to begin or resume construction operations in the affected area

**00290.51 Protection of Sensitive Cultural Sites** - Act in compliance with, and require that all the Contractor's employees, agents, and subcontractors on the Project Site for any purpose 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 such sites, are determined in accordance with the Laws including, but not limited to, the National Historic Preservation Act (NHPA) of 1966, Section 106, codified in 36 CFR Part 800 (Protection of Historic Properties), 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) and ORS 390.235 to 390.240 (Archaeological Sites and Historical Material). If sensitive cultural sites are known to be on the Project, further information will be provided in the Special Provisions.
Every effort has been made to identify all sensitive cultural sites on the Project. There are no known sensitive cultural sites on this project however, if the Contractor finds a previously undiscovered sensitive cultural site, immediately cease all activities at that site, follow procedures under Section 00290.50 (Protection of Cultural Resources), and notify the Engineer. If the Contractor inadvertently disturbs unknown sensitive cultural sites, but immediately ceases all activities and follows the procedures of 00290.50, the Owner, 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 Owner 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 00180.60(d)(1).

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 General - There will be no separate measurement of work performed under this Section.

Payment

00290.90 Lump Sum Basis - The Contractor’s Pollution Control Plan, submitted according to 00290.30(b), will be paid for at the Contract lump sum amount for the pay item "Pollution Control Plan". Payment also includes all work, materials, equipment, labor and incidentals required to comply with the Pollution Control Plan and these Specifications, if not covered by other Pay Items in the Schedule of Items.

00290.91 Contractor Responsible for Fines Resulting from Violations - If the City incurs any fine as a result of the Contractor’s violation of any permit condition or requirement, the cost of such fine will be withheld from amounts due the Contractor.
Section 00291 – Contaminated Media

Description

00291.00 **Scope** – This work includes 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:**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<tr>
<td>CIH</td>
<td>Certified Industrial Hygienist</td>
</tr>
<tr>
<td>CMDP</td>
<td>Contaminated Media Disposal Plan</td>
</tr>
<tr>
<td>CMMZ</td>
<td>Contaminated Media Management Zone</td>
</tr>
<tr>
<td>CPR</td>
<td>Cardiopulmonary Resuscitation</td>
</tr>
<tr>
<td>HASP</td>
<td>Health and Safety Plan</td>
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<tr>
<td>PCB</td>
<td>Polychlorinated biphenyl</td>
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<tr>
<td>RCRA</td>
<td>Resource, Conservation, and Recovery Act</td>
</tr>
<tr>
<td>UST</td>
<td>Underground Storage Tanks</td>
</tr>
</tbody>
</table>
(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, judgement, 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.
**00291.04 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 the following informational submittals and documentation prior to commencing work within the Contaminated Media areas. These submittals do not require any action by the City and will not be returned.

- 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 CIH that prepared the HASP, and Contractor’s 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 storm water 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, certified by a CIH in good standing.
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.

Revise the HASP plan as needed whenever new information about Contaminated Media or other potential site hazards is obtained. The Contractor's CIH or 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:

- CIH
- Contractor's 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) **Confined Space Procedures** - Procedures for confined spaces shall be developed in accordance with all applicable federal, state and local statutes, rules, regulations and ordinances.

(k) **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.

(l) **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.

(m) **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.

(n) **Training Requirements** - Define appropriate levels of training and training procedures to promote a safe working environment in accordance with the HASP.

(o) **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 contaminated media storage areas as identified in plans or Special Provisions

On-site hauling routes, entrance and exit locations, standby areas, etc.

Decontamination and best house keeping practices

Refer to any Contaminated Media stations listed in the special provisions and on the construction plans. The approximate zones of any known Contaminated Media have been identified and are shown in the Environmental Report. Horizontal lengths are based on linear distance along the proposed construction area and the full width of the construction zone.

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 or disposed of and/or 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 General - Provide materials meeting the following requirements:

Plastic Sheeting ................................................00280.10(k)
Straw Bales .......................................................00280.10(n)

00291.11 Truck Liners - Provide 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 dispose of contaminated media. Training shall include, but not be limited to, 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. Training is required for all personnel who come in contact with, or operate equipment that handles contaminated media.

00291.31 Certified Industrial Hygienist - Submit certificates demonstrating a CIH meets the requirements stated below for oversight of all work relating to hazardous substances or Contaminated Media:
(a) Qualifications for CIH:

(1) Certification - Has been certified by the American Board of Industrial Hygiene (ABIH) as a CIH in good standing.

(2) Experience - A minimum of 3-years experience in hazardous substance or hazardous waste site remediation or related work.

(3) Training - Completion of 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.

(4) Regulation - Has demonstrated knowledge of federal, state and local occupational health and safety regulations.

(b) Responsibilities:

(1) Certifying - Certify the Contractor’s HASP, any task specified HASP, and all additions and/or modifications thereto unless the Engineer and the Contractor agree that such additions or modifications may be made by the Contractor’s Safety Representative.

(2) Assistance - Be accessible to the Contractor’s Safety Representative and assist in the identification and evaluation of potential hazards, develop appropriate procedures for addressing known or suspected conditions or activities that may pose routine occupational hazards or immediate danger to the life or health of Contractor personnel, Division personnel, or the public.

(c) Authority:

• Suspension of Activities - Suspend field activities if health and safety of Contractor personnel, Project personnel, or the public is endangered.

• Suspension of Individuals - Suspend individual(s) from field activities due to infractions of the HASP.

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 CIH or Contractor’s 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 HazMat 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 pre-construction 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, and a brief description of the Contaminated Media (i.e., soil, water, debris). 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 or Oregon State-Only 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.

With 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 below:

00291.42 Known or Anticipated Contaminated Media – Any known or anticipated contaminated media will be 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 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 soil.
- Control surface water runoff, to minimize entry or collection of water in excavations.
• 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 soil in a manner that prevents commingling of contaminated and uncontaminated soil. Minimize movement of excavation equipment over or through contaminated soil to prevent movement of contaminated soil into areas where no contaminated soil 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 soil.

• Select a location for contaminated soil stockpile. Supply drop box or sheeting and hay bales. Stockpile soil in covered drop box or on 10-mil plastic sheeting bermed by hay bales. Contaminated soil storage area will be capable of holding 80-100 cubic yards of soil. Cover contaminated soil stockpile with plastic sheeting and maintain, as necessary, until removed.

• Loading areas for contaminated soil will be located in the CMMZ.

• Load contaminated soil into trucks or approved containers in a manner that prevents spilling or tracking of contaminated soil 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 collect surface soil samples from area to confirm that contaminated soil 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 transportation.

Ensure that all drivers of vehicles transporting contaminated media or hazardous 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
- 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/or disposal manifests shall be provided by Engineer (disposal/treatment facility requires driver to have copies of permit and/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 compliance 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 storm water 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/or 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.

00291.46 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.
00291.47 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.

00291.48 Treatment of Contaminated Media – Unless approved, contaminated soil 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. Contaminated construction dewatering effluent determined to contain soluble forms of hazardous materials shall not be discharged directly into the City’s sanitary 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. Options will range from holding for a period of 24-48 hours in an open container to allow dissipation of volatile organics, to treatment with a mobile stripping unit.

Suspended solid settling tanks shall provide continuous flow-through treatment. Suspended solid settling tanks shall have an instantaneous capacity of no less than 20,000 gallons. Each treatment tank brought onto the construction site shall be used until effluent exceeds Batch Discharge Permit concentration limits. Additional tanks shall not be installed unless effluent standards from (all) existing tanks are exceeded, or unless authorized. Multiple tanks may be installed in tandem until final unit effluent meets Batch Discharge Permit concentration limits. Total volume of construction dewatering effluent actually treated per tank, and total residence time in the treatment system (tandem tanks) will vary depending upon influent concentrations.

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 sanitary sewer line requires an Industrial Batch Discharge 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 sanitary sewer system is permissible, provide all labor, equipment and materials necessary to complete the work.

- Concentration of effluent from the settling tank shall not exceed 1700 pounds per day of solids.

- Transport contaminated sludge from the pre-treatment 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 is 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 General - The estimated quantities of Contaminated Media to dispose at approved disposal facilities will be indicated in the Special Provisions.

00291.81 Contaminated Media – Contaminated Media disposal, except liquid, will be measured in the truck by the ton or cubic yard at the disposal site.

00291.82 Contaminated Groundwater Disposal – Contaminated groundwater disposal will be measured in 1,000 gallon units (M-Gallon).

00291.83 Stockpile Berm - No measurement of quantities will be made for this work.

00291.84 Decontamination of Equipment – No measurement of quantities will be made for this work.

00291.85 Truck Liners – Liners will be measured on a unit basis, per each. Reusable liners will only be measured once regardless of how many times liner is used.
## Payment

### General

The accepted quantities of work will be paid as follows:

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<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</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/CMDF 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 Section 00330 and/or 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 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 shall be paid according to Section 00196.

- Payment will be payment in full for furnishing and placing all materials including 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. Provisions for removing bridges, including payment, are given in Section 00501.

00310.01 Area 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 designated on the plans or stated in the Special Provisions.

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:

| Track | The parallel rails of a railroad |
| Tie | One of the transverse supports to which railroad rails are fastened to keep them in line. |

Construction

00310.40 Restrictions on Removal Work - In those areas where guard rail, 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
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.

Do not remove sidewalk corners until any historic dates and/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 have a dimension in excess of 15 inches. The broken concrete and masonry shall not have 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:

(a) Burnable Material - Burning is not allowed. Dispose of burnable material according to 00310.43(d).

(b) Concrete and Masonry - Concrete and masonry, when not salvaged, may be used to fill basements or be buried in embankments on the Project 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

(c) Disposal on City-Owned Lands - Do not dispose of materials on City-owned or City-controlled lands except when shown on the plans, specified or permitted in writing. If permitted, place the materials only at specified locations, as directed.

(d) Other Disposal - All other materials not covered in 00310.43(a), (b), and (c) become the property of the Contractor at the place of origin. Dispose of at own expense.

Subject to local zoning codes and the requirements of 00280.03, materials 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 any disposal of material. Do not place these materials in a location visible from a public highway, road, or street, unless the site is zoned and licensed for landfill.

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 cost to the City.

Measurement

00310.80 Lump Sum Basis - If the Special Provisions or Contract bid schedule items indicate that payment for part or all of the removal work is to be done on a lump sum basis, there will be no measurement of removal work. The estimated quantities of man-made material removals will be listed in the Special Provisions.

00310.81 Separate Item Basis - If the Special Provisions or Contract bid schedule items indicate a unit basis of payment, measurement of quantities will be made as follows:

- Length and Area - The length or area of the structure or item actually removed, measured along the line and grade of the structure or item for each continuous structure or item removed. Measurement will be limited to the neat lines shown on the plans or as directed.

- Each - Items will be measured on a unit basis, per each, by actual count of units removed.

00310.82 Temporary Precast Concrete Barrier - No separate measurement will be made for barriers used for temporary protection in median and guardrail areas according to 00310.40.

Payment

00310.90 Lump Sum Basis - The accepted quantities of removal work done on a lump sum basis will be paid for as follows:

<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) applies to all removal work done on a lump sum basis, except as covered under pay items given in the form of (b).

Items in the form of (b) will have the specific kind or description of removal work inserted in the blank.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
**00310.91 Separate Unit Basis** - The accepted quantities of removal work done on a unit 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 Existing 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.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

**00310.92 Temporary Precast Concrete Barrier** - No separate or additional payment will be made for barriers used for temporary protection where guard rail, median rail or concrete barriers have been removed. Providing protection will be incidental to the work.
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 10 feet 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:

(a) 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

(b) 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
(c) **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 30 feet from the edge of the traveled way, but this distance may vary depending on design speed, horizontal alignment and side slope requirements.

**Construction**

00320.40 **Clearing Operations:**

(a) **Clearing 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:

- 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 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. Provide and place orange plastic fencing, as specified in 00270.11, around the critical root zones of marked trees or tree groups as 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 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.

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 by one or more of the following methods:

(a) Burning - Not allowed.

(b) Chipping - Woody matter may be disposed of by chipping and spreading the chips uniformly over selected areas, as directed, in loose layers. Wood chips shall be no more than 3 inches in any dimension.

(c) Burying:

(1) Required Conditions - Stumps may be buried in the areas specified by 00320.42(c)(2) if, in the opinion of the Engineer, all the following requirements are met:

- Future construction in the burial area is not anticipated
- Burial would not interfere with highway drainage, existing waterways, groundwater or areas subject to erosion
- Roots extending from stumps are removed
• Stumps are buried with at least 4 feet cover and 3 feet clear of adjacent stumps in any direction. The contour of the cover over the stumps is blended into the existing terrain.

• All disturbed areas are seeded and mulched according to Section 01030.

(2) Burial Areas - Stumps may be buried in the following areas if all the requirements of 00320.42(c-1) are met:

• Under embankments outside of a 2V:1H slope line projected from the edge of the subgrade shoulder.

• Under random fills used to correct drainage of low spots.

• Between toes of embankment slopes and highway right-of-way lines.

• Between interchange ramp toes of embankment slopes.

Do not bury stumps in areas to be planted or anywhere else on the Project unless permitted.

(d) Other Disposal Methods - Dispose of all other material or debris, not disposed of according to 00320.42(a), (b), or (c), according to 00310.43(d).

00320.43 Backfilling Holes - Except in areas to be excavated, backfill holes remaining after grubbing operations according to 00330.45. Backfill will be measured for payment according to 00330.82 if there is an embankment measure basis pay item for earthwork and that material is used for backfilling.

Measurement

00320.80 Measurement - Work covered under this Section will be measured for payment by one of the following methods:

• Lump Sum Basis - Under this method, no measurement will be made.

• Area Basis - Under this method, clearing and grubbing will be the ground surface, limited to the areas shown on the plans or directed, measured by the foot and converted to the acre.
## Payment

**00320.90 Payment** - Payment for the clearing, grubbing, disposal, and cleanup work specified to be done will be made at the Contract lump sum amount or the Contract unit price per acre 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.

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.

**00320.91 Incidental Basis** - When neither the Special Provisions or the Schedule of Items indicate separate payment for the work under this Section, perform the work as Incidental work for which no separate 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 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", provide 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 - 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, 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 (AASHTO T 11) will be performed on the sampled material. The amount of material passing the No. 200 sieve shall not exceed 5% 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:

- CEBT (Certified Embankment and Base Technician)
- CDT (Certified Density Technician)
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 Contractor's expense.

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 Contractor's expense.

(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 Contractor's expense.

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. The types of materials to be selected and their uses shall be 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 (a)(4) become the property of the Contractor at the point of excavation. Unless otherwise specifically permitted and subject to the requirements of 00280.03, dispose of waste materials outside and beyond the limits of the Project and City controlled property, shaped to drain, contoured, trimmed, and seeded in a manner satisfactory to the Engineer. Do not dispose of any materials on any wetland, either public or private or within 300 feet of any river or stream. Dispose on private property according to 00310.43(d).

(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 fillings, 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 according to 00330.00, approach roadways, road connections, or other items, as required, to provide a complete Project.

(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 Schedule of Items or covered in the Special Provisions, perform blasting as follows:

1. **Methods** - Do not use tunnel blasting methods. Use blasting methods that:
   - Do not shatter or loosen the backslopes
   - Produce smooth specified slopes
   - Satisfactorily loosen the rock for excavation

2. **Safety** - Be responsible for the storage of explosives, their use, and the results of all blasting operations according to 00170.94.

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 seven 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 **Embarkment, 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 and/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 Surfacing** - 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 and/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 Contractor's expense.

(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 permitted 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 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 three 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) **Embarkment 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 (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, and 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 Contractor expense, unless provided for in the Special Provisions
- Construct specification embankments at least five pipe diameters each direction from the pipe centerline and to a height equal to the following:
  - For pipes less than 48 inch inside nominal diameter, to the outside top of pipe elevation
  - For 48 inch to 72 inch inside nominal diameter pipes, 48 inches high
  - 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 permitted, 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 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 sheeps-foot 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 permitted, 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 must 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, each compacted layer will be observed for deflection or reaction under moving loaded equipment to verify that no soft or pumping areas remain in any layer or foundation soil. Correct any such areas.

(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 four 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
• sheepsfoot 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 five 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

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 (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
- Contractors method and manner of operations
- Contractors 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 plus of minus 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
Measurement

00330.80 General - Quantities of earthwork measured for payment will:

- Be volumes, cubic yard, 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.

- Be the volume, cubic yard, of materials handled and placed in the work as required by Contract provisions and as directed

- Not include material handled, removed, placed, or used contrary to Specifications or directions

- Not include rehandling and reshaping of materials previously excavated, except where called for in the Specifications, plans, or Contract change orders

- Not include excavation for forms to construct curbs, gutters, walks and like structures unless specified

- Not include the volume of any free water or liquid

- Be only for those pay items listed in 00330.93 and 00330.94 that are actually included as an item in the Schedule of Items. All other earthwork, including cutbank rounding, foundation benching, and constructing outer portions of embankment with suitable material for slope stabilization will be considered Incidental to the work and will not be separately measured.

The hauling, moving, or transporting of earthwork materials is considered Incidental to the work and no measurement will be made.

The removal of excess moisture according to 00330.42(b) is considered Incidental to the work and no measurement will be made.

The retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a) is considered Incidental to the work and no measurement will be made.

Materials subexcavated from beneath footings as required by 00330.42(c)(8) will be measured for payment according to 00510.82. Granular structure backfill will be measured according to 00510.86.

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:

- The volumes of abandoned pipe and miscellaneous matter within excavation limits
- The volumes of materials removed below subgrade in roadbed excavations according to 00330.41(a)(9) and 00330.91(e)
- The volumes of 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 Embankment 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 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, if included in the Schedule of Items as a Contract item, 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) are considered to be Incidental to the embankment and will not be separately measured.

If an excavation basis pay item is included in the Contract and selected materials are obtained from the excavation for use as "Extra for Selected ______ Material", measurement will be made for both pay items.

**Payment**

00330.90 **General** - Payment for earthwork performed under this section will be made at the Contract price per unit of measurement for each pay item that appears in the Schedule of Items. The pay quantities for each pay item will be as determined under 00330.80, 00330.81, and 00330.82.

Payment will be payment in full for all equipment, labor, and incidentals necessary to complete all Contract work specified for performance under this section, except that:

- Watering of materials performed according to 00330.46 will be measured and paid for as specified in Section 00340
- Slide removal and repair work determined under 00330.49(d)(2) to be City responsibility will be measured and paid for as Extra Work under Section 00196

Work that is required to be done under these Specifications that does not appear as a separately listed pay item in the Schedule of Items is considered to be Incidental, including cutbank rounding, foundation benching, removal of excess moisture, and retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a). The cost of this work is included in the Contract unit price for one or another of the pay items listed in the Schedule of Items.

Materials subexcavated from beneath footings as required by 00330.42(c)(8) will be paid for according to 00510.91. Granular structure backfill will be paid for according to 00510.96.

Unless a pay item is included in Section 00335, all blasting done according 00330.41(e) will be considered Incidental with no separate or additional payment being made for this work.
Kinds of Pay Excavation - The kinds of pay excavation on a Project will be indicated by the pay 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) Structure Excavation:

- Limited to the lines, grades, and cross sections shown on the plans or established
- For the construction of foundations and substructures for bridges, grade separation structures, retaining walls, rigid frame structures and other major structures see Section 00510

(c) 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

(d) 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

(e) 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.
(f) 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 - Payment will be included in the payment made for one or more affected pay items without measurement of the following Incidental earthwork:

(a) Removal Excavation:

- 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

(b) Rounding Cutbanks:

- Blend tops of cutbanks with adjacent ground according to 00330.41(a)(11)
- If shown on the plans

(c) Overbreak - Incidental, except on excavation basis earthwork and the Engineer determines that overbreak was unavoidable.

(d) Foundation Benching - According to 00330.42(a)(7).

(e) Below Grade in Rock - 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.

(f) Forms Excavation - As required for forms to construct curbs, gutters, walks, and like structures, unless specified.

(g) Smoothing and Maintenance Excavation - Smooth and maintain foundations, roadbeds, and haul roads.

(h) Rehandling Excavation - Rehandling and reshaping of materials previously excavated, except where called for in the Specifications, plans, or where directed.
00330.93 **Excavation Basis Payment** - When listed in the Schedule of Items, the following pay items will be paid for on the excavation basis:

<table>
<thead>
<tr>
<th>Pay Item Description</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>

Payment will be payment in full for excavating, selecting, handling, hauling, placing, and compacting the materials as specified.

00330.94 **Embankment Basis Payment** - When listed in the Schedule of Items the following pay items will be paid for on the embankment basis:

<table>
<thead>
<tr>
<th>Pay Item Description</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>

Payment for item (a) will be payment in full for excavating, selecting, handling, hauling, placing, and compacting of the materials as specified and all other costs incurred in furnishing required embankment materials.

Payment for item (b) will be payment in full for furnishing, selecting, handling, hauling, placing, and compacting the material as specified.

In item (c) above the type of material will be inserted in the blank.

Payment for item (c) will be payment in full for any and all additional costs involved in preserving, sorting, stockpiling, and handling of the specified selected materials as described in 00330.41(a)(1) and (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 Schedule of Items, there will be no extra payment for any additional costs involved in the preserving, sorting and handling of selected materials. These costs will be considered Incidental to the work and included in one or another of the listed pay items.

There will be no separate payment for cutbank rounding, foundation benching, and removing boulders from the clear zone. However, earthwork materials obtained from such excavations and incorporated into specified embankments will be paid for at the Contract unit price for the applicable pay item, if any.

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/or aggregate backfill to the lines and grades as shown or directed.

Materials

00331.10 General - Provide materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Base</td>
<td>02630</td>
</tr>
<tr>
<td>Aggregate Subbase</td>
<td>00641.10(c)</td>
</tr>
<tr>
<td>Stone Embankment</td>
<td>00330.16</td>
</tr>
<tr>
<td>Subgrade Geotextiles, Level B</td>
<td>02320</td>
</tr>
<tr>
<td>Water</td>
<td>00340</td>
</tr>
</tbody>
</table>

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 00641.

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 General - Subgrade stabilization will be measured by the square yard of subgrade surface area stabilized to the full depth. The depth of stabilization will be indicated on the plans. The surface area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than indicated on the plans, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Excavation, geotextile, backfill material, and water will not be separately measured.
Payment

00331.90  General - The accepted quantity 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 all materials, 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. These items will be included in the subgrade stabilization item.
Section 00332 - Surfacing Stabilization

Description

00332.00 Scope - This work consists of excavating and disposing of unstable surfacing materials and subgrade and placing subgrade geotextiles, stone embankment, aggregate subbase or base material, and EAC or HMAC to the lines and grades shown or directed.

Materials

00332.10 General - Provide materials meeting the following requirements:

- Aggregate Base ........................................................................... 02630
- Aggregate Subbase ...................................................................... 00641.10(c)
- EAC ............................................................................................. 00735
- HMAC .......................................................................................... 00744
- Stone Embankment ..................................................................... 00330.16
- Subgrade Geotextiles, Level B ..................................................... 02320
- Water ........................................................................................... 00340

00332.16 Acceptance of Backfill - The backfill material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00332.20 General - Provide all equipment necessary to perform the work according to Sections 00330, 00340, 00350, 00641, 00735, and 00744.

Construction

00332.40 Excavation - Excavate unstable material to the lines and grades as shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00332.41 Geotextile - Place geotextile as shown.

00332.42 Backfill - Place the backfill 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

00332.80 General - Surfacing stabilization will be measured by the square yard of surfacing area stabilized to the full depth. The depth of stabilization will be indicated on the plans. The surfacing area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than indicated on the plans, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.
Excavation, geotextile, stone embankment, aggregate, and water will not be separately measured. EAC and HMAC used will be measured according to 00735.80 or 00744.80 or 00747.80 as applicable.

Payment

00332.90 General - The accepted quantity of surfacing stabilization will be paid for at the Contract unit price per square yard for the item "_____ inch Surfacing Stabilization". The depth of stabilization will be inserted in the blank.

Payment will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, geotextile, stone embankment, aggregate, or water. These items are included in the surfacing stabilization item. EAC and HMAC will be paid for according to 00735.90 or 00744.90 or 00747.90.
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:

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 - Controlled blasting in which the detonation along the specified excavation backslope is at least 25 milliseconds before the detonation of any production holes.

- Trim (Cushion) Blasting - Controlled blasting in which the detonation along the specified excavation backslope is performed to trim the slope after the main excavation has been performed.

Production Blasting - Fragmentation blasting in the main excavation area, usually using more widely spaced drill holes than controlled blast holes.

Buffer Row - The first row of production holes immediately adjacent to and drilled on a plane parallel to the controlled blast line.

Construction

00335.40 Blasting Methods:

(a) General - Use methods in making excavations that do not shatter or loosen the backslopes and result in smooth specified slopes. This includes:

- Controlled Blasting - Use on the entire length of cut section in rock or cemented materials which have backslopes of 1V:1.33H or steeper, even if the main excavation can be ripped.

- Production Blasting - Avoid as far as practical. Use only if necessary to loosen rock not affecting backslopes.

(b) Safety and Flyrock Control - Use techniques that effectively control flyrock. Following every blast, observe the entire blast area for a minimum of five minutes before reentering or commencing work in the area.

Be responsible for the storage of explosives, their use, and the results of all blasting operations according to 00170.94.
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 - Make a preblast survey of the nearby buildings, structures and utilities which may potentially be at risk from blasting damage. Before beginning blasting operations, certify to the Engineer in writing that the preblast survey has been completed.

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 Plan - Provide a separate blasting plan for each cut that requires blasting. Submit the blasting plan(s) to the Engineer not less than 14 calendar days before beginning drilling and blasting operations. 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(s) in writing to the Engineer for review before implementation. Submittal of blasting plan(s) is for quality control and record keeping purposes.

Review of the blasting plan(s) by the Engineer does not relieve the Contractor of full responsibility for the accuracy and adequacy of the plan and the resulting safety when implemented in the field.

Each blasting plan shall contain the full details of the drilling and blasting patterns, controls 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 and depth 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
(e) Blasting Test Section(s) - Demonstrate the adequacy of each proposed blasting plan by means of test shot(s) in each cut before beginning full scale blasting. 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. Do not drill ahead of the test blast area, except as provided in 00335.41(a)(6), until the test section has been evaluated.

If the results of the test shot(s) are unacceptable revise the methods, techniques and procedures at the Contractor's expense so that the results achieved will be acceptable. No further drilling and blasting will be permitted 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.

(f) Blasting According To Plan - After the blasting plan has been reviewed and test sections have demonstrated acceptable results, perform all controlled and production blasting according to the plan which produced acceptable results. Notify the Engineer when any changes in conditions or results are observed.

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°, 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 the Contractor's expense. Drill new presplit holes with the proper spacing. Rejected holes will not be measured for payment.

(4) Control the drilling operations to insure 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 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 permitted 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 permitted 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 especially 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.

(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.

(10) The detonating of 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 there is production blasting, the detonation of trim blasting holes shall be at least 25 milliseconds after the detonation of any production holes.

00335.42 Production Blasting - Do not drill the buffer row of production blast holes closer than 6 feet to the controlled blast line. Where necessary to minimize damage to the rock backslope, load this row of holes lighter than other production 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 rock on the cut face that is loose or overhanging by scaling during or upon completion of the excavation of each lift. Drilling of the next lift will not be allowed 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 General - The quantities of controlled blast holes will be measured on the length basis by dividing the cut slope surface area by the 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 Schedule of Items have been computed from a theoretical plan length using a 30 inch hole spacing. The actual quantities measured for payment will depend on field conditions and results from blasting test sections.

Payment

00335.90 General - Payment for controlled blast holes 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>Controlled Blast Holes</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for all materials, equipment, labor, and incidentals necessary to drill the controlled blast holes as specified.

No separate or additional payment will be made for the costs involved in blasting, scaling or loosening materials for excavation. The work will be Incidental to the kind of excavation involved.
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 - Provide 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 the "Water Laws of Oregon," which are administered by the Water Resources Department, and specifically Chapter 537 covering the appropriation of water. There will be no separate payment for obtaining permits, water rights or any other costs involved to comply with these laws.

Most adjudicated water is limited to agricultural uses, so 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 permitted 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 Watering - 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.
Additives in Water - Quantities of additives combined with water for watering purposes will be determined separately from the water and will be measured in gallons.

Payment

General - 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</td>
<td>M-gallon</td>
</tr>
<tr>
<td>(b) _______ in Watering</td>
<td>M-gallon</td>
</tr>
</tbody>
</table>

Payment for item (a) will be payment in full for furnishing and developing the water supply, hauling and applying the water, and for all materials, equipment, labor and incidentals required or used in performing the watering work as specified, except for furnishing, combining and mixing additives with the water when required.

In item (b), the name of the additive will be inserted, with a separate pay item provided for each additive.

Payment for item (b) will be payment in full for 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).

Quantity Variations - Payment for watering pay items performed beyond 25% of the quantity shown in the 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.

Incidental Basis - When neither the Special Provisions or Schedule of Items indicate separate payment for the work under this section, perform the work as Incidental work for which no separate payment will be made.
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 and/or as a separator under embankments.

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.

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.

Geotextile - A permeable geosynthetic comprised solely of textiles.

Nonwoven Geotextile - A textile produced by bonding and/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/or separator behind or beneath riprap, buttresses, inlays, shear keys and/or erosion control applications.

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 and/or reinforcement on subgrades and in other material separation applications.

**Ultraviolet (UV) Rays** - Direct radiation from the sun during daylight hours, even on cloudy days.

**Ultraviolet Stability** - The ability of a geosynthetic to resist deterioration when exposed to UV radiation.

**Materials**

00350.10 **General** - Provide materials conforming to Section 02320.

**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 two rows of lock-type stitching, Type 401, to make the seams, as shown. The two 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 ½</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 three 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 five 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>Onto Geotextile Material</th>
<th>Onto an Aggregate Cushion Blanket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 200 pounds</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>200 pounds or less</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 gallon/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 and/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 sub-grade, remove all foreign matter and sharp, protruding or loose material that could penetrate or otherwise damage the geomembrane, and compact the sub-grade 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 three 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

00350.80 Square Unit Basis - Each geosynthetic installation will be measured along the lines and grades of the surface area actually covered according to the plans or as required, except for drainage applications.

The number of square yards of drainage geotextile will be 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.

No separate measurement will be made for constructing laps, seams, joints, or patches unless more than the specified lap is ordered, in which case the added lap width will be measured.

Payment

00350.90 Square Unit Basis - The accepted quantities for geosynthetics 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) 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>
</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 all equipment, labor, and incidentals necessary to complete the work. No separate 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 - The sand drainage blanket material shall conform to the following gradation limits determined by AASHTO T 11/T 27:

<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 - The granular drainage blanket material shall be clean, free draining, durable crushed or uncrushed rock, conforming to 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 permitted.

Labor

00360.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT (Certified Embankment and Base Technician)
- CAgT (Certified Aggregate Technician)
- CDT (Certified Density Technician)

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

**00360.90 General** - The accepted quantities of sand and granular drainage blankets will be paid for as follows:

<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>

Payment for items (a) and (b) will be payment in full for furnishing, hauling, handling, placing and compacting the materials including all equipment, labor, and incidentals necessary to complete the work as specified.
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:

Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

Filter Blanket - A layer of graded granular material placed between the area prepared for it and the riprap.

Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.

Loose Riprap - Specified classes of graded rock placed on prepared slope, riprap geotextile or filter blanket, as specified.

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.

Grouted Riprap - Loose riprap with all or part of the spaces filled with Portland cement mortar.

Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.

Materials

00390.10 Riprap Geotextile - Riprap geotextile shall meet the requirements of 02320.

00390.11 Riprap Requirements:

(a) General - Rock for loose riprap shall:

- Meet the test requirements of 00390.11(b)

- Be angular in shape. Thickness of a single rock shall not be less than one-third 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** - The rock shall conform to 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&quot; - 1 1/2&quot; and</td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot; - 3/4&quot; 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</th>
<th>Class</th>
<th>Class</th>
<th>Class</th>
<th>Class</th>
<th>Percent (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>100</td>
<td>200</td>
<td>700</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Weight of Rock (pounds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 - 30</td>
<td>100 - 60</td>
<td>200 - 140</td>
<td>700 - 500</td>
<td>2000 - 1400</td>
<td>20.0</td>
</tr>
<tr>
<td>30 - 15</td>
<td>60 - 25</td>
<td>140 - 80</td>
<td>500 - 200</td>
<td>1400 - 700</td>
<td>30.0</td>
</tr>
<tr>
<td>15 - 2</td>
<td>25 - 2</td>
<td>80 - 8</td>
<td>200 - 20</td>
<td>700 - 40</td>
<td>40.0</td>
</tr>
<tr>
<td>2 - 0</td>
<td>2 - 0</td>
<td>8 - 0</td>
<td>20 - 0</td>
<td>40 - 0</td>
<td>10.0 - 0</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** - Rock for grouted riprap shall conform to the requirements of 00390.11, and the Portland cement grout shall conform to the requirements of 02080.40.
00390.13 **Filter Blanket** - Filter blanket material shall conform to 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 (b), key the riprap into place by slapping the surface with a piece of armor plating (approximately 4’ x 5’ 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 (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.

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 Filter Blanket - The quantities of filter blanket will be measured on the area basis of the finished surface within the neat lines shown or directed.

00390.81 Riprap Backing - The quantities of riprap backing, will be measured on the area basis of finished geotextile or filter blanket surface, within the neat lines shown or directed.

00390.82 Riprap - The quantities of riprap will be measured on the volume in place basis or on the weight basis as given by the appropriate pay item in the Schedule of Items.

When measurement of riprap is given on the volume in place basis 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 cubic yard, vehicle measure, is equivalent to cubic yard in place.

00390.83 Riprap Basins - The quantities of riprap basins will be measured on a unit basis per each by actual count of basins constructed and accepted.

Payment

00390.90 General - The accepted quantities, measured according to 00390.80 through 00390.83, 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 Blanket</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>

Riprap geotextile will be separately paid for under Section 00350, except when included in item (b).

In items (c), (d) and (e), the class of riprap will be inserted in the blank, with a separate pay item being provided for each class.

No separate or additional payment will be made for the grout in item (d).

Payment will be payment in full for furnishing all material, equipment, labor and incidentals necessary to complete the work as specified.
PART 00400 - DRAINAGE AND SEWERS

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 require drilling and blasting or other approved splitting and breaking methods or increasing a trench width more than 18-inches greater than the width of the preceding 10 feet of trench. Classify as Common Excavation any piece of boulder 1 cubic yard or less in volume that can be mechanically removed without drilling and blasting, breaking, splitting, or increasing a trench width less than the width previously specified.

Common Excavation - The removal of all material not classified as boulder, concrete or rock excavation.

Concrete Excavation - The removal of pieces of concrete larger than 1 cubic yard in volume that require drilling and blasting or other approved splitting and breaking methods or increasing a trench width more than 18-inches greater 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. Classify as Common Excavation any piece of concrete 1 cubic yard or less in volume that can be mechanically removed without drilling and blasting, breaking, splitting, or increasing a trench width less than the width previously specified.

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 purposes of investigating underground conditions and to identify 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 by using 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 is 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 - Provide 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) and/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" or less use Controlled Low-Strength Material 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 gravel or crushed rock meeting the requirements of Section 00641. Material shall be free from organic material, with maximum particle size not exceeding 3 inches, (1 inch in pipe zone).
(c) Class C Backfill - Use clean sand with no particle size larger than 1/4 inch.

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>
</tbody>
</table>

Sand Equivalent 50 min. 50 min. 50 min.

When using sand as imported granular trench backfill material, material shall be able to stand on a minimum 60° 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 also be free from organic material. Acceptability of grading will be determined according to requirements of ASTM D 2487.

(e) Class E Backfill - Use Controlled Low-Strength Material (CLSM) 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 (Certified Embankment and Base Technician)
- CAgT (Certified Aggregate Technician)
- CDT (Certified Density Technician)

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(h).

(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 accomplished 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 expense 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** - Remove all excavated material from the site unless otherwise directed.
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 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 such a manner that will cause a minimum of inconvenience to the public. Provide unobstructed access to all fire hydrants, water valves, and meters, and leave clearance to enable free flow of storm water 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
- 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 as defined in this Section 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 and 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.

00405.44 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. Conform to applicable provisions for concrete encasement in Part 00400.

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) Flexible Pipe Bedding - Unless otherwise specified, bed flexible sewer pipe in 3/4" - 0" crushed rock 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 smoothly 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 percent 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 percent 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 percent of Standard Proctor maximum density in paved areas and in street right-of-ways or 90 percent 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.
- 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 material. 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, one (1) successful test for the entire backfill depth and three 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 00405.45.

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 percent 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, saw-cut the pavement along each edge of the area to be removed. In any case, a jack hammer shall not be used to remove asphaltic pavement if there is concrete pavement underneath.

Saw cut portland cement concrete pavement to a minimum of 75% of total depth. Saw curbs and sidewalks to a minimum depth of four (4) inches. Subsequent removal may be accomplished by using a jackhammer or other approved method. Full depth cut by pavement saw can be done at option of Contractor, but 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 saw-cutting, follow lines parallel to the pipe centerline. All slurry developed during the saw cutting 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 saw cut alignment to change at an angle greater than 60°, make a minimum 24 inch transition saw cut. If there is damaged or undermined surfacing at the transition point, make the transition saw cut beyond the damaged or undermined surfacing. Make the transition saw cut angle half the angle change in the direction of the pipeline or connecting line.

If the asphalt surfacing is to be overlaid, the second saw cut will only be required to firm subgrade.
A second saw cut 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. Saw cut, 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 six-months or less. Plans to discharge wastewater for a duration exceeding six-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 the City of Portland Bureau of Environmental Services (BES) before discharging any wastewater into a public sewer, public sump or body of surface water. Do not begin discharge until the BES and/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 and/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 pre-treatment 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 pre-treatment 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 nature, 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 five (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 and/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 four 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 one (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 seven 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 frequently 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 three 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, for example DEQ or EPA, requests this information.
Pre-treat 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 from 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) Trench Excavation, Bedding and Backfill for Inlet Lead Pipe - There will be no separate measurement for trench excavation, bedding, pipe zone, and backfill for storm sewer inlet lead pipe. These items will be considered incidental to the pay item for storm sewer inlet lead pipe.

(f) Exploratory Excavation - Exploratory excavation will be measured on a volume basis.

(g) Pothole Excavation - Pothole excavation will be measured on an each basis for each location shown or specifically directed.

00405.81 Saw Cutting - Saw cutting 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(a).

00405.83 **Trench Protection** - Shoring, mobile trench shields, over-break and other trench protection measures will be considered incidental work.

(a) **Shoring, Sheeting and Bracing** - When the item “Engineered Shoring” is not included in the 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 Schedule of Items, measurement will be made on a lump sum basis.

(b) **Dewatering** - When the item “Dewatering” is not included in the 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 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 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 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.

**Extra Work Basis** - When not listed in the 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 will be made for pipe zone material under Pipe Zone Material - Water Pipe.

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) **Other 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 of 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 01040.
## Payment

**General** - 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) Rock Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(b) Boulder Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(c) Concrete Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(d) Exploratory Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(e) Pothole Excavation</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Trench Excavation and Native Backfill</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(g) Trench Excavation</td>
<td>Foot or Cubic Yard</td>
</tr>
<tr>
<td>(h) Trench Foundation Stabilization</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(i) Trench Backfill</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(j) CLSM Backfill</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>(k) Engineered Shoring</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(l) Dewatering</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(m) Construction-Generated Wastewater Discharge</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(n) Water Pipe Zone Bedding and Backfill</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing, placing and compacting all materials, and providing all equipment, labor and incidentals necessary to complete the work.

Item (a) includes any additional excavation required for installation of manholes, inlets, pipe or other structures in rock. Other than as provided in 00405.82(a), such additional excavation is considered incidental to the work and no separate or additional payment will be made.

Item (c) includes any additional excavation required for installation of manholes, inlets, pipe, or other structures in concrete. Other than as provided in 00405.82(b), such additional excavation is considered incidental to the work and no separate or additional payment will be made.

Item (d) 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 (e), 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 (h) includes removal of unsuitable material and replacement as necessary to provide a stable foundation for the pipe.

Item (k) includes all costs for designing, providing, constructing, maintaining, and removing the shoring system.

Item (m) 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.

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 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 saw cutting 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 Descriptive Terms:

(a) 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.

(b) 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.

(c) 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.

1) 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.

2) 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.

(d) 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.

(e) 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 providing its own permanent ground support.

(f) 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.

(g) Direct-Jacked Pipe - Pipe installed by boring and jacking that serves either as a casing and/or carrier pipe.

(h) 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.

(i) Jacking - All methods by which a casing or direct-jacked pipe is pushed into place behind or ahead of an excavation face.
(j) **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.

(k) **Muck** – All material of whatever nature that is excavated, removed, and disposed of during the course of a tunneling or boring and jacking operation.

(l) **Permitter** - The owner of land, or other facilities with prior rights, under which a conduit is to be tunneled, bored or jacked.

(m) **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.

(n) **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.

(o) **Tunneling** - All methods by which an underground opening is first excavated before lining materials and/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 or Carrier Pipe 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 and/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:
For Sewer and Stormwater Pipe use this table as a minimum for 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 inches per ASTM A 53 Grade B or ASTM A 252 Grade 2</td>
</tr>
<tr>
<td>24-36</td>
<td>0.313 inches 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>

For all Domestic Water Pipe use this table as a minimum for casing wall thickness:

This chart is for smooth steel casing pipes with a minimum yield strength of 35,000 psi:

<table>
<thead>
<tr>
<th>Diameter in Inches</th>
<th>Smooth Steel Pipe Minimum Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>0.375 inches per ASTM A 53 Grade B or ASTM A 252 Grade 2</td>
</tr>
<tr>
<td>12-48</td>
<td>0.625 inches per ASTM A 53 Grade B or ASTM A 252 Grade 2</td>
</tr>
<tr>
<td>Larger than 48</td>
<td>Casing pipes larger than 48 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 and/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. Every ten linear feet along the centerline provide a set of liner plates with a minimum of one nipple at the crown and one nipple on each side 60° above invert for lubricant injection and/or pressure grouting.

(c) Injection Nipples - Equip casing with nipples for lubricant injection and pressure grouting on 10-foot centers located at the crown and on each side 60°.

00406.13 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-guage 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 four 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 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 openings on either side 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 and or directed.

**Equipment**

00406.20 Excavating Equipment for Unmanned Boring and Jacking - The boring head for such operations shall be designed to securely 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 for jacking 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 Guidance Equipment - Use a laser and target system or other approved methods to continuously monitor line and grade during manned boring or tunneling operations. For unmanned boring, check line and grade at intervals proposed in accepted submittal. Calibrate laser equipment before the beginning of each operation and check laser at the beginning of each shift during the operation. Maintain laser equipment and keep it in good working condition at all times. Mount laser 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 at all times 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 five 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 and/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 providing 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. Provide an estimate of anticipated jacking thrust and show analysis and all assumptions upon which the estimate is based.

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 and/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 providing 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** - Submit details of annular and backfill space grouting methods to be used including equipment and placement, sequence of operations, schedule, pumping procedures, grout mix, plug and insertion points, and method of monitoring and controlling grout pressure for each of the required grouting 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 condition 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 planned.
- 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 and/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 and/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 and/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 one-half inch for line and one-quarter 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 any 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 data 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 two 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) Continuous Jacking Operations - Once commenced, perform boring and jacking operations continuously 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 and/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 and/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 pertinent 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 General:
(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 bid 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 neutral axis, or from center to center of manholes, inlets, other structures, or portals as applicable.

Payment

00406.90 General - 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:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Tunneling</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Boring and Jacking</td>
<td>Lump Sum</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 all equipment, labor, materials and incidentals necessary to complete the work as specified.

00406.92 Separate Unit Basis - The accepted quantities of tunneling or boring and jacking work done on a unit basis 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) Tunneling</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Boring and Jacking</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Tees, ____ inch</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Wyes, ____ inch</td>
<td>Each</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

For items (c) and (d), the nominal size will be inserted in the blank.

Payment will be payment in full 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 Schedule of Items indicate separate payment for tees and wyes under this section, perform work as incidental work for which no separate payment will be made.

(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.
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.

00412.01  Abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>CD</td>
<td>Compact Disc</td>
</tr>
<tr>
<td>DVD</td>
<td>Digital Video Disc</td>
</tr>
<tr>
<td>HDPE</td>
<td>High Density Polyethylene</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
</tr>
<tr>
<td>VHS</td>
<td>Video Home System</td>
</tr>
</tbody>
</table>

Materials

00412.10  Pipe - Provide 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
- DR: Minimum 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. All materials provided shall be fully in accordance with the requirements of the reference specifications specified above.
- Verify with the pipe manufacturer all connection details.
- Submit detail drawings and a written description of the construction procedure and sequence including its locations to bypass insertion and receiving bypass sewage flow of the host sewer and service 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 - Protect existing and new facilities including utilities, road pavement, and private property from damage by forces generated by the pipe bursting equipment. All existing facilities damaged as a result of the pipe bursting operation shall be the responsibility of the Contractor.

Use only those tools designed and approved by the pipe manufacturer or supplier and the Engineer, for assembly of pipe and fittings and ensure proper installation. The heater plate shall be equipped with suitable thermometers or pyrometers to measure the temperature of plate surfaces and to assure uniform heating.

Post-TV inspect the installed pipe after existing services have been reconnected and manhole reconnection and sealing procedure work has been completed. 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 locate all sewer service connections using CCTV prior to the start of any pipe bursting operation and pipe insertion. 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. Any pipe segment, which has cuts in the pipe wall exceeding 10 percent of the wall thickness, shall be cut out and removed from the site at the Contractor's expense. The pipe shall be stored so that it is not unduly deformed axially or circumferentially to hinder pipe installation. 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.

00412.44 **Preinstallation CCTV Inspection** - TV inspect the sewers with a color CCTV tilt-head type camera recorded in VHS, DVD, or CD format before pipe bursting to assess the existing conditions and to locate all active sewer service connections. Provide the original tape to the Engineer for review. The television camera used for the inspection shall be specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100 percent humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing a clear and sharp picture quality to the satisfaction of the Engineer. The camera shall be equipped with a 1 inch diameter steel ball extended in front of the camera for visual depth interpretation along the entire length of the pipe section.

**(a) Cleaning** - Assure that the sewer pipe is sufficiently clean and free of obstructions so as not to prohibit pipe bursting operations. After cleaning, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled. Perform CCTV inspection as soon as possible after cleaning the pipe.

**(b) Camera** - The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer’s condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire pipe run, set up equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire manhole section, the inspection shall be considered complete.

**(c) Communication** - When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to ensure good communications between members of the crew.
(d) Measurement – Provide accurate distance measurements. Measurement for location of defects shall be aboveground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer.

(e) Inspection Logs - Television Inspection Logs: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. Provide one copy of all pre and post inspection TV logs and recordings. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, all connections, pipe material and size, and broken pipe will be noted.

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, it 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.

00412.47 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 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, and/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.

00412.48 Pipe Installation - Excavate, expose, and isolate all sewer service connections prior to the start of any pipe bursting operation and pipe insertion. The existing service connections may be encased in mortar, concrete, or reinforced concrete. There will be no additional compensation.

Install the pipe by utilizing a constant tension system with a static, hydraulic or pneumatic bursting device that breaks away the existing pipe. The advancement of the bursting mole head with a “chain” shall be prohibited. 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 and/or the installation process put any undue stress on the existing surface. 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 Television Inspection - After completion of the pipe installation, service reconnections, finish work at the manholes and final cleaning, the sewer shall be televised with a color CCTV tilt-head camera recorded in VHS, DVD, or CD format. The original shall be provided to the Engineer.

Measurement

00412.80 General - The quantity of the pipe replaced by pipe bursting will be measured on a linear foot basis, for each pipe size or 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.

Unless specifically set out in the pay items above and by special provisions, all required work, including, but not limited to, surface restoration for pits, CCTV inspection (pre and post) pipe cleaning (pre and post), sag elimination, point repairs, leak testing and acceptance testing are considered parts of or incidental to the installation of the HDPE pipe and no payment will be made.

Payment

00412.90 General - The accepted quantities will be paid for at the contract unit price for one or all of the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) HDPE Pipe-burst Installation. ___ Inch. .................................. Foot</td>
<td></td>
</tr>
<tr>
<td>(b) Service connections .......................................................... Each</td>
<td></td>
</tr>
</tbody>
</table>

Item (a) the nominal size of the new HDPE pipe will be inserted in the blank.

Item (b) includes all required work to excavate for, backfill, and install service connections.

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified.

Resurfacing work will be paid for according to Section 00495.
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, 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 on all sides by curbing between the existing curb and a new curb.

Stormwater Planter - A stormwater facility with a relatively flat landscaped reservoir used to collect, filter, infiltrate and convey stormwater. Plantings are surrounded on all sides by curbing between the sidewalk area and the roadway curbing or in easement areas.

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 - Materials shall meet the following requirements:

- Check Dam Aggregate ......................................................00430.11
- Coir Filter Fabric ............................................................00280.10(v)
- Commercial Grade Concrete .................................................00440
- Curbs ......................................................................................00759
- Geomembrane Liner ..............................................................00350
- Granular Drain Backfill Material ........................................00430.11
- Granular Drainage Blanket ................................................00360.11
- Inlets .......................................................................................00470
- Mulches .............................................................................01040.20
- Pea Gravel .......................................................... 01040.20(e)
- Plantings .................................................................................01040
- Plastic Sheeting ........................................................... 00280.10(k)
- Seeding ..................................................................................01030
- Soil Testing ............................................................................01040.13
- Stormwater Facility Topsoil ............................................. 01040.14(d)

00415.13 Soil Testing - Perform soil testing according the 01040.13.
Construction

00415.40 General – Construct the planters or swales as shown or as directed. The planter or swale bottoms shall be constructed at the indicated slope and without ruts or other surface imperfections capable of channeling water flows. If the planters or swales are used for erosion and sediment control measures during construction, all accumulated sediments shall be removed and the facility restored as directed.

Install City provided markers, identifying the stormwater facility, in the fresh concrete as directed.

00415.41 Stormwater Facilities:

(a) Soil Placement - After construction of the concrete elements, place drain rock and pea gravel. If no drain rock or pea gravel is specified, excavate native soil to the bottom of the stormwater facility topsoil and rototill exposed subgrade. Place stormwater facility topsoil in two equal lifts. Rototill the first lift. Topsoil shall not be placed when the ground or soil is frozen, excessively wet or in a condition detrimental to the work. Bring grading conflicts to the Engineer prior to proceeding with the work.

Install soil in a manner that ensures adequate infiltration. Lifts should not be compacted, but rather placed in a manner to reduce excessive erosion or settlement. Lifts may be lightly watered to encourage natural compaction or, if necessary, rolled with a water-filled landscape roller. Slightly overfill the facility above the proposed finished grade to accommodate natural settlement. After completion of finished grading, soil compaction shall not exceed 75% maximum density according to 00330.43(b).

(b) Grading - Grade slopes in a uniform manner as shown or directed. Round any abrupt changes in the surfaces. Feather grades gradually to meeting 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.

(c) Existing and Proposed Utility Services – Wherever existing utility service trenches are encountered during excavation and construction of the rock trench, provide a watertight seal along the trench wall whenever granular material is present in the exposed portion of the service trench. The seal shall be by means of a native soil, imported clay or bentonite plug as approved. Remove the granular material at least 6” into the rock trench wall and firmly pack the resulting space with native soil, imported clay, or bentonite as directed.
Maintenance

00415.60 Stormwater Facility Establishment - The stormwater facilities shall have damages repaired according to good horticultural practice under prevailing conditions. Prior to an operational facility being turned over to the City for maintenance, clean the stormwater facilities as necessary during the 2-year warranty period and perform a final clean-out at the end of the warranty period. Then, a final inspection will be completed to determine if any warranty work needs to occur. During the warranty period, the stormwater facilities are to be inspected at least every 6 months or more often as sediment and/or debris accumulation warrants.

Measurement

00415.80 Area Basis – Measurement for stormwater facilities will be on the area basis. The limits of measurement will be the edge of curb, 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.

00415.81 Stormwater Facility Establishment Work - No separate measurement will be made for stormwater facility establishment work.

Payment

00415.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for one or more of 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, equipment, labor and incidentals necessary to complete the respective facilities in place as specified, including working around existing utilities.

Payment for inlet piping, curb cuts with concrete pads, inlets, roadway curbing associated with the stormwater facilities, and soil testing will be according to Sections 00445, 00470, 00759 and 01040.

00415.91 Stormwater Facility Establishment Work - There will be no separate payment for performing required establishment of the stormwater facilities.
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 geotextile.

00430.01 Descriptive Terms - 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 General - Use materials meeting the requirements of the following:

Geotextile .................................................................................02320
Perforated Concrete Pipe.......................................................02410.10
Perforated Corrugated Aluminum Alloy Pipe ...................02420.50
Perforated Corrugated Polyethylene Pipe..........................02410.60
Perforated Corrugated Steel Pipe...........................................02420.30
Perforated Polyvinyl Chloride Pipe.................................02410.70
Commercial Grade Concrete .............................................00440.00
Protective Coatings ............................................................02420.20
Special Filter Materials.........................................................02610.10
Granular Drain Backfill Material - Granular drain backfill material shall be 1 1/2" - 3/4", 1 1/4" - 3/4", or 3/4" - 1/2" crushed or uncrushed rock or gravel meeting 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>100</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>-</td>
<td>90 - 100</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

General - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install pipes in paved areas according to Section 00405.

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.

Laying Pipe - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

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.

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.

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.

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 - Geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

Measurement

00430.80 Trench Excavation and Backfill - There will be no separate measurement for trench excavation and backfill.

00430.81 Geotextiles - There will be no separate measurement for geotextiles.

00430.82 Installation Under Pavement - Extra for pipe installed under pavement will be measured according to Section 00495.

00430.83 Drain Pipe - Quantities of subsurface drain pipes of the various kinds, types and sizes will be measured according to Section 00445.

00430.84 Special Sections - Quantities of special sections will be measured according to Section 00445.

00430.85 Special Filter Material and Granular Drain Backfill Material - There will be no separate measurement for special filter material and granular drain backfill material.

00430.86 Subsurface Drain Outlet - Subsurface drain outlets will be measured for payment on a unit basis, per each, by actual count of connections made as specified.

Payment

00430.90 Trench Excavation and Backfill - There will be no separate payment for trench excavation and backfill.

00430.91 Geotextile - There will be no separate payment for geotextile.

00430.92 Installation Under Pavement - Extra for installation of pipe under pavement will be paid for according to Section 00495.

00430.93 Drain Pipe - The accepted quantities of subsurface drain pipe will be paid for at the Contract unit price per foot for the following pay item:

(a) ___________ Inch Drain Pipe

The nominal diameter of pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing the pipe including all materials, equipment, labor and Incidentals necessary to complete the work as specified.
00430.94  **Special Filter Material and Granular Drain Backfill Material** - There will be no separate payment for special filter material or granular drain backfill material. Payment will be included in payment for the item "Inch Drain Pipe".

00430.95  **Subsurface Drain Outlet** - The accepted quantities of subsurface drain outlets will be paid for at the Contract unit price per each for the item "Subsurface Drain Outlets". Payment will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work, including:

- Furnishing and installing pipe
- Connecting pipe to inlets
- Excavating and disposing of excess material
Section 00440 - Commercial Grade Concrete

Description

00440.00 Scope - This work consists of furnishing, placing and finishing commercial grade concrete (CGC).

Materials

00440.10 General - Proportioning, mixture, and acceptance of materials for CGC shall comply with 00440.11, 00440.12, 00440.13 and 00440.14. Use materials meeting the following requirements:

- Bonding agents ..................................................................................02070
- Chemical admixtures ........................................................................02040
- Concrete materials ..........................................................................02001.30 and 02001.50
- Curing materials ................................................................................02050
- Fly ash .............................................................................................02030.10
- Grout ..................................................................................................02080

00440.11 Proportioning of CGC Mixture - Before using any CGC on the Project, furnish in writing to the Engineer, the proportions by weight of the following materials, when used:

- Air entraining admixtures
- Cement
- Each size of aggregate
- Fly ash
- Other admixtures
- Water

00440.12 Tolerance and Limits of CGC Mixtures - Provide a workable mixture of CGC that is uniform in composition and consistency, and has the following characteristics:

- Minimum Cement Content - Furnish CGC mixtures which have at least the minimum cement or (cement + fly ash) contents shown in 02001.30, Table 02001-1.

- Entrained Air - Furnish CGC mixtures that have entrained air contents according to the provisions of 02001.50 and Table 02001-2.

- Slump - Do not allow slump to exceed 5 inches, except as noted in Table 02001-3.

- Compressive Strength - Unless otherwise noted, CGC shall attain a 28-day compressive strength of at least 3,000 psi.
- **Temperature** - Mix CGC at a temperature between 50 °F and 90 °F.

**00440.13 Field-Mixed Concrete** - Work items listed in 00440.14(a) may be either commercially mixed or field-mixed.

**00440.14 Acceptance Sampling and Testing:**

(a) **General** - Acceptance sampling and testing will be based on samples obtained at the site of placement before any pumping, unless provided otherwise. The QCT shall perform all required sampling and testing.

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>
</tbody>
</table>

(b) **Batch Weights** - Send a batch ticket with each load recording and attesting to the source, day, time of batch(es), size of load and quantity of individual constituents in the load. A batch 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 the tolerances and limits of 02001.50, Tables 02001-2 and 02001-3.

(d) **Hardened CGC** - Acceptance of the hardened CGC will be according to the provisions of 00540.17(c). 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 *(Concrete Strength Testing Technician)*
- QCT *(Quality Control Technician)*
Construction

00440.40 General:

(a) Mixing - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mass.

(b) Placing - Place CGC according to 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.
- For sign supports, signal supports, and luminaire supports, place concrete according to 00540.48(a).

(c) Forms - Provide forms for CGC using the best common practice. Place to the lines and grades called for or as directed.

- For sign supports, signal supports, and luminaire supports, remove forms and perform subsequent loading according to Table 00540-1.

(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 five 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 seven calendar days.

Curing compounds may be used if not applied to the 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</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>00480</td>
<td>drainage curbs</td>
<td>1</td>
<td>1</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>1</td>
<td>1</td>
</tr>
</tbody>
</table>

¹ Use Type 2 except when the Engineer requires Type 1 or 1-D.

Application rate shall not be less than 1 gallon per 150 square feet.
00440.41 **General Surface Finish** - Give the concrete surfaces a general surface finish, in accordance with 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 Contractor's expense. 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** - There will be no separate measurement of CGC.

**Payment**

00440.90 **Payment** - There will be no separate payment for CGC, as the cost will be included in payment for the particular items of work using CGC.
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 is highly flowable lean concrete mix; a mixture of fly ash, cement, fine aggregates, water and admixtures, if necessary.

Materials

00442.10 General - Materials shall meet the requirements of the following Part 02000 Sections of the Standard Specifications as well as modifications given in the Special Provisions:

- Admixtures ............................................................... 02040
- Fly ash ................................................................. 02030.10
- Portland cement .................................................... 02010.10

00442.11 Fine Aggregates - Fine aggregates shall be 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 90 - 195 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 General - The quantities of CLSM will be measured as specified for the application where CLSM is used.

Payment

00442.90 General - Payment for CLSM will be as specified for the application where CLSM is used.
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 installation.

00445.01 Definitions and Descriptive Terms - 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 - Concrete, ductile iron, PVC, or HDPE pipe |
| 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 - Ductile iron |
| 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; as well as driveways, curbs, gutters, walks, walls and other similar structures. |
| Pipe - All pipe, regardless of kind, size, shape or use |
| Plain - Unreinforced concrete |
| PVC - Polyvinyl Chloride |
| Rigid Pipe - Pipes, other than potable water pipes, constructed of concrete and clay. |
| Sanitary and Storm Sewer Pipe - Concrete, PVC, solid wall HDPE or ductile iron pipe |
**SDR (Standard Dimensional Ratio)** - The pipe’s minimum outside diameter divided by its wall thickness

**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.

**00445.11 Materials** - Use materials meeting the requirements of the following:

- 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 than the pipe.

2. **Fittings for Pressure HDPE Pipe** - All HDPE fittings used in pressure pipeline applications shall be pressure rated the same 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 the pipe.
(j) **Service Lateral 2”x4” 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.”

### Labor

00445.30 **General** - Perform all pipe fusion using an operator that has been certified to be trained and competent by the supplier or manufacturer of the pipe.

(a) **Welder Qualifications for Fusing HDPE Pipe** - The operator shall have a minimum of two years experience in fusing those sizes of pipe shown. A representative of the supplier shall field review and approve the procedure used for first four (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 one-half 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 three 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 the pipe.

Only personnel possessing the qualifications and certifications specified below 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.

All fused joints on gravity pipelines do not require electronic data recording, unless directed. All 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 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, and/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 manufactures 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, have excessive joint gap, or damaged.

### (g) Service Lateral 2"x4" Markers

- Install 2"x4" 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 to 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 CCTV inspection, deflection, 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.

Hydrostatic 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.

(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.

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 being 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 limit 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 capable of resisting the applied internal pressure and securely braced. 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 0.0625 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.

3. 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.

4. After the test pressure is reached, allow at least two minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

5. After the temperature stabilization period, disconnect the air supply.

6. 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 backpressure 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:

\( K = \) the sum of the computations \((0.011 \ d^2 L)\) for each size of pipe and its length in the section
\( C = \) the sum of the computations \((0.0003882 \ dL)\) for each size of pipe and its length in the section, except that the minimum value for \( C \) shall be 1
\( d = \) inside diameter of the pipe in inches
\( L = \) 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.

(1) 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 0.0625 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 than the average backpressure 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 “Vj” in cubic inches. (Minimum Time = T * Vj)
TIME PER UNIT VOLUME TABLE

<table>
<thead>
<tr>
<th>Pipe Inside Diameter (Inches)</th>
<th>Time per Unit Volume (Sec. per Cu. Inc.)</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 passing a 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.

00445.74 Television Inspection of Sanitary and Storm Sewers - Complete a closed circuit television (CCTV) inspection of all finished sewers and submit documentation of inspection to the Engineer.

(a) Personnel Qualifications - Perform CCTV inspection work with experienced personnel trained in recognizing and locating sewer breaks, obstacles, and other defects, and service laterals using remote closed circuit video equipment.

(b) Notice and Access - Inform the Engineer a minimum of 48 hours before beginning CCTV inspection. Clean the sewer thoroughly before any video inspection. Assure the Engineer the sewer is ready for inspection, and do not proceed with CCTV work without verbal consent from the Engineer. Allow the Engineer access to the CCTV truck at all times to observe the CCTV monitor and all other operations.

(c) Recording Format, Storage Box and Labeling - Record using high-quality color VHS format magnetic tapes, CD or DVD. Submit videotapes, CD, or DVD in a snap-top type, 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-installation or final inspection video. Label both the videotapes, CD or DVD and the boxes.
(d) **Camera and Lighting** - Use a color video camera capable of 360° pan and tilt, capable of operating in 100% humidity conditions, and equipped with high-intensity lighting that is appropriate for the sewer pipe size and material type.

Under good conditions (no fog in the sewer), the lighting and camera quality shall provide a clear, in-focus color picture of the entire inside periphery of the sewer up to three pipe diameter lengths away. The lighting shall provide uniform light, 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 CCTV monitor.

(e) **Footage Meter** - Videotape shall have an information banner that displays a footage meter showing the distance, in tenths of feet, the camera has moved from its starting point. Any other information displayed in the banner area shall not obstruct the forward camera view.

(f) **Narrative and Extent of Inspection** - Provide a running narrative description by camera operators recorded on each video inspection tape. 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.

Move camera through the line in either direction at a moderate and uniform rate, stopping when necessary to permit proper documentation of the sewer's condition. Inspect all joints, lateral connection(s), and any other noteworthy features within the sewer. Stop the camera at each location to fully inspect, document and describe in the narrative each inspected feature. The maximum rate of travel shall be 30 feet per minute when recording.

(g) **Continuity, Image and Audio** - Record continuously in color from the beginning to the end of each sewer run. The sewer image shall be free of visual distortions and appear level. The audio portion of the composite videotape shall be sufficiently free from electrical interference and background noise to provide complete clarity of the narrative description.

(h) **Reference Ball** - The video camera shall have a 1-inch steel reference ball mounted in front of the camera approximately one foot from the camera lens. Suspend the ball using a chain that allows it to serve as a depth reference when traveling and so it maintains continuous contact with the pipe invert. The reference ball shall be clearly visible at all times yet be positioned so as not to obstruct more than 10% of the forward camera view. Stop the reference ball at every wide joint to allow for comparison of the ball diameter to the joint width.

(i) **Disposition of Report** - Deliver the CCTV inspection tape of each sewer run to the Engineer no later than 48-hours after such work is completed. All accepted videotape(s), operator log(s), and any related information become the property of the City.

(j) **Deficiencies** - The Engineer has the sole responsibility to review each delivered tape and note any deficiencies. The Engineer will issue a written notice to correct any identified deficiencies. Correct any identified deficiencies within 48 hours after receiving notification. Re-perform the CCTV inspection of the sewer and submit the new videotape for review and acceptance.
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 deficient in CCTV inspection. Internal pipe repairs are not acceptable. Re-rounding of pipe is not an approved repair method.

(c) Visible Infiltration of Groundwater - Following a successful hydrostatic or air test, visible infiltration of ground water 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 General - 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, by actual count of units in place.

(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.

(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"x4" Markers** – Service lateral 2"x4" markers will be measured according to Section 00446.

00445.84 **Television Inspection** - The quantities of television inspection will be measured by the foot. Measure pipes with sloped ends to the top of the sloped sections.

00445.85 **Acceptance Testing** - No measurement will be made of required air, hydrostatic and deflection acceptance testing.

00445.86 **Installation Under Pavement** - Pipe installed under pavement will be measured according to 00445.81. Trench resurfacing will be measured according to Section 00495.

00445.88 **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.

00445.89 **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 provided in the plans).

Payment for trench excavation, bedding, pipe zone material, trench backfill and acceptance testing for pipes 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.

**00445.91 Pipes and Appurtenances** - The accepted quantities will be paid for at the Contract price per unit of measurement for each of the pay items listed in the Proposal. Payment will be payment in full for furnishing and placing all materials, equipment, labor and Incidental necessary to complete the work as specified.

(a) **Pipes** - Payment for pipes will be made at the Contract unit price per foot for the following item:

___ inch ______ Pipe, _____ Class

The nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank. The appropriate Class, SDR, DR, and/or applicable ASTM specification will be inserted in the third blank.

Payment for pipes will be made at the unit price per linear foot and will include full compensation for all pipe, including bedding, pipe zone, backfilling, compacting, joint materials, joining, collars, fittings, field closures and all labor, equipment and incidentals necessary to complete the work in place.

Payment for perforated pipe will be full compensation for trench excavation, special filter material and filter fabric, if specified, pipe bedding, trench backfill, and all other work to complete the installation of the perforated pipe complete in-place. All work shall be in accordance to Section 00430.
(b) Appurtenances - The following items, when in the Schedule of Items, will be paid for at the Contract price for the unit of measure specified:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pipe Tees, _____ inch</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Pipe Wyes, _____ 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 Yards</td>
</tr>
</tbody>
</table>

Payment for items (a) through (h) will be by actual count for units installed, and will include payment for pipe plugs, stoppers and other fittings required to accomplish the work.

For items (a) and (b) the nominal size will be inserted in the blank.

Payment for a service lateral connection to a new manhole will made under item (a) for a tee of the same inside diameter as the service lateral.

Payment for service lateral 2”x4” 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 Schedule of Items for "Reinforcement in Blocks" the cost will be considered Incidental with payment for reinforcement included in the item "Concrete in Blocks".

00445.94 Television Inspection – Payment for television inspection will be made at the Contract unit price per foot for the item “TV Pipe Inspection”. Payment will be payment in full for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

00445.95 Acceptance Testing - All work and material involved in testing, including TV 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.

00445.98 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 Incidentals 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.

**00445.99 Incidental Basis** - When neither the Special Provisions nor 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 section covers the work necessary to provide facilities for electronic location and visual identification of sewers (ELVIS).

Materials

00446.10 Electronic Locating Materials – Use materials conforming to 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. 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 cannot be removed by normal handling or upon burial.

The width of the tape shall be 6 inches. Tape 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. Connectors shall 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 two terminals, one for ground wire and one for tracer wire, when only one 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 Standard Drawings and Section 00445.

(c) **Manholes and Inlets** – Use materials conforming to 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”x4” Markers - Use new, pressure-treated 2” X 4” 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:

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 markers 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 linear feet on sewers with a straight horizontal alignment.

- Install marker balls at a minimum spacing of 25 lineal feet directly above sewer mains 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, property line or other end of lateral location, as directed.

- Install marker balls directly above every alignment change along sewer mains and service laterals.

- Install marker balls directly above manholes for manholes with buried covers.

(b) Tracer Wire and Terminal Appurtenances - Install tracer wire 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 two 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 by Engineer. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed by Engineer.

(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”x4” Markers** – Extend tracer wire in one continuous piece directly up service lateral 2”x4” markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2”x4” 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 location approved by Engineer.

(c) **Tracer Wire Locate Boxes** - Install tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed by the Engineer.
(d) Service Lateral Plastic or Copper Markers - Install plastic or copper markers in the concrete curb directly over the centerline of the service lateral, as shown or directed by the Engineer. 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 by the Engineer and according to paragraph (b) above.

(e) Service Lateral 2”x4” Markers – Place a 2”x4” marker at the end of each new service lateral not connected to a building sewer. Omit markers only as approval. 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.

Measurement

00446.80 General – There will be no separate measurement of work performed under this Section.

Payment

00446.90 General – There will be no separate payment for facilities for electronic location and visual identification of sewers as these will be considered incidental to the appropriate pipe Pay Item.
Section 00470 - Manholes, Catch Basins and Inlets

Description

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 precast, as shown or specified. Concrete inlets and siphon boxes may be either cast-in-place or precast.

Materials

00470.10 General - Use materials meeting the following requirements:

| Aggregate Base .............................................................. 00640.10 |
| Commercial grade concrete ......................................... 00440 |
| Couplings .................................................................. 02410.60 |
| Geotextile .................................................................. 02320 |
| Grout ........................................................................ 02080 |
| High density polyethylene (HDPE) Pipe ..................... 02410.60 |
| Joint material ........................................................... 02440.40, 02440.50, 02440.60 |
| Metal frames, grates, covers, and ladders ................. 02450.30 |
| Nonreinforced concrete pipe ................................... 02410.10 |
| Polyvinyl chloride (PVC) pipe, Schedule 40 ............. 02410.70 |
| Polyvinyl chloride pipe (PVC), ASTM 3034 .......... 2410.70 |
| Precast concrete manholes, catch basins and inlets .... 02450.10, 02450.20 |
| Reinforcement ........................................................... 02510.10, 02510.40 |
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. Prior to delivery of precast manhole sections to the job site, yard permeability tests maybe 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/C 497M.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

- 48 inches
- 60 inches
- 72 inches
- 84 inches
- 96 inches
- 108 inches
- 120 inches
- 132 inches
- 144 inches

Heights of sections shall be multiples of 12 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 6 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 1/2" - #4 clean round gravel. 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 ¾" – 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** - 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.
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. Conform welding to the ANSI ASW D1.1. 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.

**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** - For cast-in-place bases, 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.

For precast bases, carefully place the base section on the prepared bedding so as to be 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.

Conform finish grade of manhole covers to finish 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. Non-shrink grout is allowed on manhole grade rings above the cone.

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 and sumps 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 lb. 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. Extensions 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. Inlet depth shall be a minimum of 30 inches and a maximum of 48 inches from finish grade unless otherwise shown or approved.

(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. 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 & 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 encountering unstable or caving soil strata 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 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. The Engineer will adjust final location of each sump and sedimentation manhole.

(b) Spacing - When constructing two 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 pre-construction 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 polyvinyl chloride (PVC) plastic pipe for basin drains. Place and compact backfill without damaging pipe or inlet.

**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:**

(a) **General** - 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:

(1) **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, if not present, 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 and/or gravel to sumps and sedimentation manholes shall not be permitted.

(2) 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).

(3) 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 and/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 lb. load applied through a 1-inch thick by 9-inch ASTM A36 steel plate on a ¼-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 two 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.

- c. If either of the tested specimens of a designated lot fails to pass the test, then test five additional specimens from the same lot selected by the Engineer.

- d. If the five 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 five 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.

**00470.73 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>
</tr>
</thead>
<tbody>
<tr>
<td>8 or less</td>
<td>11</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>20</td>
<td>23</td>
<td>26</td>
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<td>58</td>
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<td>32</td>
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<td>59</td>
<td>65</td>
<td>73</td>
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<td>30</td>
<td>35</td>
<td>42</td>
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<td>72</td>
<td>79</td>
<td>89</td>
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<tr>
<td>24</td>
<td>33</td>
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<td>105</td>
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<td>42</td>
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<td>69</td>
<td>81</td>
<td>91</td>
<td>101</td>
<td>113</td>
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<tr>
<td>30</td>
<td>42</td>
<td>45</td>
<td>53</td>
<td>63</td>
<td>74</td>
<td>87</td>
<td>98</td>
<td>108</td>
<td>121</td>
</tr>
</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 General - 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, per each by actual count. Required earthwork not covered as trench or ditch excavation, pipe connections, sump, backfill, aggregate base backfill and drain tile is considered incidental to the pertinent structure and no separate measurement will be made.

No measurement will be made for the removal and replacement of pavement base rock, asphalt concrete pavement or portland cement concrete pavement around the sump necessary to complete the installation.

No separate measurement will be made for manhole pipe stubouts.
No separate measurement will be made for manhole steps. Steps are considered incidental to manholes.

No separate measurement will be made for inlet and catch basin frames and grates. Frames and grates are considered incidental to inlets and catch basins.

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 or manhole inside drop assembly over 8 feet deep will be from 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 per each by actual count.

00470.84 Manhole Testing - No separate measurement will be made for acceptance testing of sewer manholes.

Payment

00470.90 General - The accepted quantities will be paid for at the Contract unit price for one or more of the following items:

<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>
</tr>
<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>
</tr>
<tr>
<td>(l) Catch Basins, _____</td>
<td>Each</td>
</tr>
<tr>
<td>(m) Inside Drop Assembly, _____ inch, 0-8 Ft Depth</td>
<td>Each</td>
</tr>
<tr>
<td>(n) Inside Drop Assembly, _____ inch, Deeper than 8 Ft</td>
<td>Foot</td>
</tr>
<tr>
<td>(o) Sump Manhole, 30 Ft Depth</td>
<td>Each</td>
</tr>
<tr>
<td>(p) Sump Capacity Test</td>
<td>Each</td>
</tr>
<tr>
<td>(q) Watertight Manhole Frame and Cover</td>
<td>Each</td>
</tr>
<tr>
<td>(r) Abandoned Sump Manhole</td>
<td>Each</td>
</tr>
</tbody>
</table>
In items (a), (b), (m) and (n) 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 (o), an adjustment, plus or minus, will be made if the sump manhole is not built to 30 feet. The adjustment will be calculated by dividing the sump manhole bid price by 30 feet to determine the cost per foot for adjustment.

Item (p) includes any stand-by time required for the sump capacity test and evaluation shall be considered incidental to this pay item.

Item (q) will be the additional cost above providing a standard manhole frame and cover.

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified.

There will be no separate payment for performing required acceptance testing.

Resurfacing work will be paid for according to Section 00495.

Manhole pipe stubouts will be paid for according to Section 00445.
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 General - Use materials meeting the requirements of the following:

- Emulsified Asphalt .......................................................... 00730.11
- Epoxy Bonding Agent ....................................................... 02070.10
- Preformed Expansion Joint Filler .................................... 02440.10

00480.11 Commercial Grade Concrete - Furnish commercial grade concrete CGC according to Section 00440. Provide combined coarse and fine aggregates conforming to the following gradation limits when tested according to AASHTO T 27, unless otherwise approved:

<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>75 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>50 -75</td>
</tr>
<tr>
<td>No. 16</td>
<td>20 - 40</td>
</tr>
<tr>
<td>No. 30</td>
<td>12 -23</td>
</tr>
<tr>
<td>No. 50</td>
<td>5 -15</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

00480.12 Asphalt Concrete - Use a dense graded asphalt concrete mixture conforming to Section 00744 Level 2, 1 inch or 3/4 inch Dense. The mixture may be varied when conditions require, if approved by the Engineer.

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 and 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 one-third 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 **Length Basis** - 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**

00480.90 **Length Basis** - The accepted quantities of drainage curbs 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, 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, sumps, inlets, boxes and other similar structures, and removing and disposing of pipe, manholes and catch basins.

**00490.02 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 General** - Materials used shall be either existing materials in a condition suitable for reuse and meeting current design, or new materials that meet the following:

- Commercial grade concrete ...................................................00440
- Joint materials ..........................................................02440.40, 02440.50, 02440.60
- Metal frames, covers, grates and ladders .........................02450.30
- Precast concrete sections ................................02450.10, 02450.20
- Reinforcement.................................................................02510.10

**00490.11 High Early Strength Concrete** - Use high early strength concrete conforming to the requirements of commercial grade concrete and containing 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, and/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. The 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) Diversion of flow shall be maintained during working hours and returned 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 watertight.

(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 expense 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.
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).

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

Manholes over Existing Sewers:

(a) General – Construct manholes in accordance with 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.

(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.
**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.

**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.

**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.

**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.

**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.

**Service Line Connections to Existing Sanitary Sewers and Facilities:**

**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 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.

**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.

**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.
00490.44  **Filling Abandoned Pipes, Manholes and Catch Basins:**

**(a) General** - Fill all existing manholes, sumps 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 3 feet below finish grade. Remove manhole or inlet frame and cover and plug all abandoned pipes with permanent plugs. For pipes greater than 12 inches in diameter, fill with CLSM or sand as directed. Cover in-place pea gravel with two mats of non-woven filter fabric, extended at least 1 foot beyond the outside walls of manhole, sump, or basin. When in landscaped or unimproved roadway sections, backfill with approved materials meeting the requirements of 00330.13. Place topsoil meeting the requirements of 00330.11 for the last one foot of backfill.

**(b) Permanent Plugs** - Provide permanent plugs where sumps, manholes, inlets, pipes and other sewer appurtenances are removed or abandoned. Also provide plugs where shown on the Plans. Clean the interior surfaces of all pipes to be cutoff or abandoned, as approved. Construct a concrete plug in the end of all pipes 18-inches or less in diameter. The minimum length of concrete plug shall be 8-inches. 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. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage.

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:
   - Do not reduce the manhole cone height to a point such that the inside diameter exceeds 25 3/4 inches
   - Do not allow the manhole form casting to rest on a manhole step.  
   - 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.
   - 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 become the property of the Contractor.

(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 all 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.

00490.47 **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. Welding shall conform to the requirements of current version of ANSI / AWS D1.1.
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 Unit Basis – 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, per each by actual count.

00490.81 Incidental Basis – There will be no separate measurement for abandoning pipes in place, sewer appurtenances, permanent plugs 12 inches or smaller, or removal and disposal of existing structures and pipe.

00490.82 Lump Sum Basis - Measurement for flow diversion required during sewer construction will be paid on a lump sum basis under Proposal Item “Diversion of Flow”.

Payment

00490.90 Unit Basis – The accepted quantities will be paid for at the Contract unit price per each for the following items:

(a) Minor Adjustment of Manholes
(b) Major Adjustment of Manholes
(c) Adjusting Sumps
(d) Adjusting Inlets
(e) Adjusting Boxes
(f) Adjusting Catch Basins
(g) Manholes over Existing Sewers
(h) Connections to Existing Structures
(i) Filling Abandoned Structures
(j) Existing Pipe Connection to New Manhole
(k) Reconstruct Manhole Base
(l) Permanent Plugs
(m) Bicycle Protection for Existing Grates

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 (g) applies to manholes that are installed over existing sewers and includes all incidentals required to complete the work as specified.

Item (i) 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 (j), any existing pipe that needs to be replaced in order to connect to a new manhole will be paid under Section 00445.

Item (l) applies to plugs larger than 12 inches.

Payment will be payment in full for furnishing and placing all materials including all equipment, labor and incidentals necessary to complete the work as specified.

Earthwork, backfill, protective coatings, replacement of sump backfill, base drains, aggregate bases, pavements, connections, structure abandonment, structure filling and other miscellaneous work will be considered incidental to the work with no separate payment being made.

00490.91 Lump Sum Basis - Payment will be made at the Contract lump sum amount for the item "Diversion of Flow". Payment will be payment in full for furnishing all material, equipment, labor and incidentals necessary to complete the work as specified.
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 General - Provide trench resurfacing materials that match existing material removed from pipe trenches, or meeting the following:

- Aggregate........................................................................00640
- Asphalt prime coat ..........................................................00705
- Asphalt seal and cover coat ............................................00710
- Concrete paving..............................................................00756
- Concrete sidewalks, curbs and driveway.........................00759
- Control Low Strength Materials (CLSM) .........................00442
- Hot Mixed Asphalt Concrete (HMAC) .........................00744
- Rock surfacing .............................................................00640
- Topsoil, planting and seeding ......................................01040

00495.11 Edge Sealing Tack Coat - Provide emulsified asphalt tack coat material for sealing edges of asphalt concrete pavement according to 00730.11.

00495.12 Edge Sealing Sand - Sand used for edge sealing shall be clean sand with no visible sign of silts or organic materials. Use reasonably well graded, from maximum size to dust, sand with 100% passing the No. 10 sieve.

00495.13 Temporary Surfacing Material - Use HMAC or products on the CPL.

00495.14 Temporary Plating - Temporary plating shall conform to Section 00275.

Construction

00495.40 General - The following construction requirements are for resurfacing trenches in various locations. Refer to Section 00405 for trench surface removal requirements.

(a) Hot Mixed Asphalt Concrete (HMAC) Paving - Place HMAC 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 1 inch 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. HMAC paving may be used if approved.
(c) **Asphalt Prime Coat** - Apply asphalt prime coat according to Section 00705.

(d) **Asphalt Seal and Cover Coat** - Apply asphalt seal and cover coat according 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) **Control 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 the HMAC.

**00495.41 Temporary Surfacing** - Construct temporary surfacing with a minimum of 2 inches of material or as shown.

### Measurement

**00495.80 Area Basis** - Measurement for trench resurfacing will be 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:

<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 Section 00406.

Payment

00495.90 General - The accepted quantities of trench resurfacing will be paid at the Contract unit price per square yard for the following:

<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>
</tbody>
</table>

Item (b) includes the cost to remove and dispose of the temporary surfacing when no longer needed.

Payment will be payment in full for furnishing, placing and compacting all materials as specified or as directed and providing all equipment, labor, and incidentals necessary to complete the work.

Any replacement of disturbed landscape items other than topsoil is considered incidental to the work and no separate or additional payment will be made.

When the pipe is installed under pavement by tunneling, jacking, or boring methods, the work will be paid for according to Section 00406.

00495.92 Incidental Basis - When neither the Special Provisions nor the Schedule of Items indicates separate payment for trench resurfacing or other work under this Section, perform the work as incidental work for which no separate payment will be made.
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 00310.

Measurement

00501.80 Measurement - No measurement will be made for work under this Section.

Payment

00501.90 Payment - Payment for the work will be made at the lump sum amount for the Contract item "Bridge Removal Work".
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(m)(1) except as modified by this subsection.

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 allowable and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit five sets (nine sets if railroad approval is required) of the plans, and three copies (five copies if railroad approval is required) of the calculations, summary, and checklist.

The Engineer will provide a list of construction concerns at least two 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.
00510.04 Shoring Plans, Calculations and Construction Inspection - Submit stamped shoring plans and design calculations according to 00150.35(m) except as modified by this subsection.

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 allowable and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit five sets (nine sets if railroad approval is required) of the plans, and three copies (five copies if railroad approval is required) of the calculations, summary, and checklist.

The Engineer will provide a list of construction concerns at least two 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

00510.10 Selected General Backfill - Provide soil selected from roadbed, ditch, trench or structure excavations according to 00330.13.

00510.11 Selected Granular Backfill - Provide granular material selected from roadbed, ditch, trench or structure excavations according to 00330.14.
00510.12  **Granular Wall Backfill** - Provide granular wall backfill material of crushed or uncrushed rock, or combinations meeting the following gradation limits as determined by AASHTO T 27 and T 11:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0 - 80</td>
</tr>
<tr>
<td>No. 40</td>
<td>0 - 40</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 6</td>
</tr>
</tbody>
</table>

The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T90.

00510.13  **Granular Structure Backfill** - Provide granular structure backfill of crushed, durable, rock material meeting the following gradation limits as determined by AASHTO T 27:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>50 - 80</td>
</tr>
<tr>
<td>No. 4</td>
<td>35 - 70</td>
</tr>
<tr>
<td>No. 40</td>
<td>15 - 35</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 15</td>
</tr>
</tbody>
</table>

The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T90.

00510.15  **Quality Control** - Provide quality control according to Section 00165.

**Labor**

00510.30  **Quality Control Personnel** - Provide certified technicians in the following fields:

- CEBT (Certified Embankment and Base Technician)
- CDT (Certified Density Technician)

**Construction**

00510.40  **Clearing, Grubbing and Removal Work** - In the absence of pay items under Sections 00310 and 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 330.41(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 for all structure excavation requiring blasting according to Section 00335. Backfill and repair as directed, at no cost to the City, any excavation, shattered rock, void, fault, or unstable condition caused by the Contractor outside the limits of structure excavation. Backfill and repair of voids, faults or unstable condition not caused by the Contractor or covered elsewhere in the Specifications will be paid for according to Section 00196.

Consider the elevations of the bottoms of footings or foundations shown as approximate only. The Engineer may order, in writing, changes in elevations of footings necessary to secure a satisfactory foundation.

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 sub-excavated 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 permitted, 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 permitted 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 seven calendar days and test cylinders show the concrete strength to be 100% of design strength according to 00540.16(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 00540.16(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.
If open excavations are made within paved areas that are to be preserved, perform the aggregate base and pavement replacement work according to Section 00445.

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 selected granular backfill at all weepholes if granular wall backfill is not specified or directed.

(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.

Measurement

00510.80 Clearing, Grubbing, Removal and Clean-up - If there is no pay item for clearing, grubbing, removal and cleanup work, the work will be considered incidental to other pay item work.

00510.81 Shoring, Cribbing and Cofferdams - Shoring, cribbing and cofferdams will be paid for on a lump sum basis and no measurement will be made for this work.

00510.82 Structure Excavation (Volume Basis) - Structure excavation will be measured for payment by the cubic yard, in original position (position before excavating).
No measurement 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.

Regardless of the depths and widths to which excavations are made, the pay quantities will be limited to the neat lines shown, or if not shown, will be limited to the following:

(a) Lower Limit - The elevations shown for the bottoms of structure footings or bases, including bedding, if any.

(b) Upper Limits - The following:

(1) Within Embankments - The upper limit will be the planes of the new embankment at the elevation specified or established.

(2) Within Roadbed or Channel Change Excavations - The upper limit will be the planes of the bottoms and side slopes of the excavations.

(3) All Other Cases - The upper limit will be the ground surface immediately before starting the excavation.

(c) Horizontal Limits - 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 pay limits will be the actual excavation made.

00510.83 Structure Excavation (Lump Sum Basis) - The estimated quantity of structure excavation to be paid for on the lump sum basis will be stated in the Special Provisions.

00510.84 Structure Excavation Below Elevations Shown - Structure excavation below elevations shown will be measured according to 00510.93 or 00510.94 as applicable. Pay limits will be from the bottom limit described in 00510.82(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 for computing pay quantities will be vertical extensions of the pay limits established according to 00510.82(c).

00510.85 Bedding - There will be no measurement of bedding.

00510.86 Granular Wall/Structure Backfill - The pay quantities of granular wall backfill and granular structure backfill will be the number of cubic yard of the material used in backfilling as determined by cross section measurement of the materials in place. The pay quantities will be limited to the quantities placed according to the plans and specifications or as directed. In backfilling excavated areas, the pay quantities will be limited to the pay limits of the excavation for the part of excavated areas backfilled with the specified granular backfill material.
00510.87 Unauthorized Excavation - No measurement will be made of 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 such unauthorized excavations with concrete or other material acceptable to the Engineer according to 00510.46 at no expense to the City.

00510.88 Water Not a Pay Quantity - Water removed from excavations and water used in compaction or other items of work will not be measured for payment.

Payment

00510.90 Shoring, Cribbing and Cofferdams - Payment for shoring, cribbing, cofferdams, pumping, preparing foundations, removal, and other similar work, including incidental clearing, grubbing and cleaning up, will be made at the Contract lump sum for the pay item "Shoring, Cribbing and Cofferdams". Payment will be payment in full for furnishing, placing and maintaining all materials, equipment, labor and incidentals necessary for shoring, cribbing, and cofferdams required to complete the excavations, construction and backfill shown.

If the Engineer orders excavations extended below the elevation shown on the plans, 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>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>

No separate or additional payment will be made for any pumping. This work is incidental to the pay item "Shoring, Cribbing and Cofferdams".

If the Schedule of Items does not contain a pay item "Shoring, Cribbing and Cofferdams", this work will be incidental, and no separate payment will be made for any required shoring, cribbing, or cofferdam work.

00510.92 Structure Excavation (Volume Basis) - The accepted quantities of structure excavation will be paid for at the Contract unit price per cubic yard for the pay item "Structure Excavation," which will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work. This includes backfilling and compacting to the elevation specified or as directed, except for granular wall backfill or granular structure backfill.

00510.93 Structure Excavation (Lump Sum Basis) - Payment for structure excavation measured on the lump sum basis described in 00510.83 will be made at the Contract lump sum amount for the item "Structure Excavation". The lump sum payment will be in effect unless plan changes are ordered. Payment for quantities involved in plan changes will be made according to 00510.94 and 00190.10(e) based on the limits described in 00510.82.
Payment for structure excavation at the lump sum amount, plus or minus adjustments, if any, will be payment in full for all materials, equipment, labor and incidentals required to complete the structure excavation work as shown or directed. This includes backfilling and compacting to the elevations specified or as directed, except for granular wall backfill or granular structure backfill.

00510.94 Structure Excavation Below Elevations Shown

(a) Volume Basis - If the Engineer requires excavation below the elevations shown, payment to extend the excavations will be made as follows:

- For excavation 3 feet below elevations shown, payment will be made at the Contract unit price per cubic yard for the pay item "Structure Excavation".

- For excavation more than 3 feet below elevations shown, payment will be at the Contract unit price per cubic yard for the pay item "Structure Excavation Below Elevations Shown", or if no such pay item is in the Schedule of Items, payment will be determined according to Section 00196.

(b) Lump Sum Basis - If the Engineer requires excavation below the elevations shown, payment to extend the excavations will be made as follows:

- For excavation 3 feet below elevations shown, payment will be based on a theoretical unit price determined according to 00190.10(e).

- For excavation more than 3 feet below elevations shown, payment will be determined according to Section 00196.

00510.95 Bedding - There will be no separate payment for bedding.

00510.96 Granular Wall/Structure Backfill - The accepted quantities of granular wall backfill and granular structure backfill will be paid for at the Contract unit price per cubic yard for the pay items "Granular Wall Backfill" or "Granular Structure Backfill", as applicable. Payment will be payment in full for furnishing, hauling, placing and compacting the materials as specified.
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 or 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 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 any laboratory test results 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

00512.11 General - Use materials meeting the following requirements:

(a) Reinforcement - Use reinforcement complying with Sections 00530 and 02510.

(b) Concrete - Provide structural concrete according to Section 00540 except that in drilled shafts where the specified clear distance between the reinforcement bars is less than 2 1/2 inches, the maximum aggregate size shall be 3/4 inch.

00512.12 Concrete Mix Design - Design the drilled shaft concrete mix for minimum segregation. Use a pre-approved mix design that meets the following slump requirements:

- 7 inches ± 1 inch - all conditions except placed under a drilling fluid
- 8 inches ± 1 inch - placed under drilling fluid

Mix a trial batch and take test cylinders for one seven-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 gallon/cubic yard. Retarding or water-reducing agents may be used to maintain specified slump ranges and to facilitate temporary casing extraction. To allow for concrete placement prior to temporary casing extraction, it is recommended that the concrete mix have a slump loss characteristic such that a minimum slump of 4 inches remains four hours after batching. Admixtures may be used if tested and certified in the mix design and if approved.

00512.13 Steel Casing - Use temporary casing conforming to ASTM A252 or ASTM A36. Use permanent casing conforming to ASTM A36 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 - Use drilling slurry conforming to one of the following:

(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 API * 13B-1, Section 1</td>
<td>64 - 75 lb/ft³</td>
</tr>
<tr>
<td>Viscosity</td>
<td>Marsh Funnel and Cup API * 13B-1, Section 2.2</td>
<td>26 - 50 sec/qt</td>
</tr>
<tr>
<td>pH</td>
<td>Glass Electrode, pH Meter, or pH Paper</td>
<td>8 - 11</td>
</tr>
<tr>
<td>Sand Content</td>
<td>Sand API * 13B-1, Section 5</td>
<td>4.0 % max.</td>
</tr>
</tbody>
</table>

*American Petroleum Institute

Maintain slurry temperature at 40 °F or more during testing.

(b) Synthetic Slurries - Use synthetic slurries according to the manufacturer’s recommendations, the Contractor’s quality control plan and the Special Provisions. The sand content of synthetic slurry shall be less than 2.0 percent (API 13B-1, Section 5) prior to final cleaning and immediately prior to concrete placement. The following synthetic slurries may be used:

- Slurry Pro CDP; manufactured by KB International LLC, 735 Broad Street, Suite 216, Chattanooga, TN 37402
- Super Mud; manufactured by PDS Company, 8140 East Rosecrans Avenue, Paramount, CA 90723
- ShorePac GCV; manufactured by CETCO, 1500 West Shure Drive, Arlington Heights, IL 60004
Approval of the above products applies to the liquid product only. Other synthetic slurry products may be used if approved in writing by the Engineer.

(c) Water Slurry - Water, with or without site soils, 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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density Mud Weight (Density)</td>
<td>API 13B-1, Section 1</td>
<td>70 lb/ft³ max.</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>

00512.18 Grout - After completion of the crosshole sonic logging tests, fill the access tubes with portland cement grout conforming to 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.

Labor

00512.30 Personnel Qualifications - Use personnel experienced in drilled shaft construction to perform the work. Experience shall be relevant to anticipated subsurface materials, water conditions, shaft size and special construction techniques required. Prior to 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:

- Submit a list of at least three projects successfully completed in the last five years, which used drilled shaft construction. Include a brief description and reference for each project listed.
- Provide the names and detail the experience of the on-site supervisors and drill operators for the Project. On-site supervisors shall have at least two years experience in drilled shaft construction, and drill operators shall have at least one year experience.

The Engineer will respond within 21 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 field personnel to the Engineer, who will have a further 21 days to respond. Additional costs resulting from the suspension of work will be the Contractor’s responsibility, and no adjustment in Contract Time resulting from the suspension of work will be allowed.
Construction

00512.40 Drilled Shaft Installation Plan - At least 21 days prior to beginning shaft construction, submit the following according to 00150.35:

(a) Unstamped submittals:

- 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 mixing, 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 synthetic drilling slurries, if their use is proposed. In the quality control plan, include property requirements, required tests and test methods to ensure the synthetic slurry performs as intended. Submit to the Engineer the name and current phone number of the synthetic slurry manufacturer’s representative who will provide technical assistance during construction.

- Reinforcing steel shop drawings and details of reinforcement placement, including bracing, centering and lifting methods and the method for supporting the reinforcement on the bottom of the shaft excavation. Include details for ensuring the reinforcing cage position is maintained during construction. Include details for attaching the crosshole sonic logging 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/or 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, including casing dimensions.

• CSL testing company performing the CSL testing work, including documentation demonstrating that the company, and company personnel, meet 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.

Do not begin drilled shaft construction work until all drilled shaft submittals have been approved.

(b) Stamped Submittals - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Any modifications to the dimensions 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(m)(1).

(c) Drilled Shaft Inspection Reports - During construction, provide the Engineer with a summary report for each drilled shaft, detailing the actual location, alignment, elevations and dimensions of the shafts.

A blank form of the "Drilled Shaft Inspection Report" is included in the Special Provisions or is available from the Engineer.

00512.41 Testing - Furnish materials and work, including engineering analysis and redesign, needed to correct unacceptable drilled shafts, with no additional compensation. Do not begin repair operations before remedial procedures or designs, submitted according to 00512.40, are approved.
If directed, drill a core hole in any questionable quality shaft to explore the shaft condition. Use a coring method that provided complete core recovery and minimizes abrasion and erosion of the core (e.g., double or triple tube core barrels). If a defect is confirmed, as determined by the Engineer, all coring and excavation costs associated with identifying the defect will be at the Contractor's expense and no time extension will be granted. If no defect is encountered, and the CSL tubes were satisfactorily installed according to ASTM D 6760 and accepted, the City will pay for all coring and excavation costs and grant an appropriate time extension, if required, according to Section 00190 and 00195. If it is determined by the Engineer that the CSL tubes were not installed properly and debonding or other deficiencies are the cause of the defects detected by CSL testing or revealed by excavation, all coring, excavation, and all other evaluation costs will be at the Contractors expense and no time extensions will be granted. Fill all core holes with grout after the evaluation process is completed, the shaft is accepted, and is approved by the Engineer.

00512.43 **Construction Tolerances** - Excavate drilled shafts as accurately as possible at the locations shown and within specified tolerances. The following construction tolerances apply to drilled shafts unless otherwise stated:

- **Horizontal position (at the plan elevation of the top of shaft)** - Within 3 inches of the location shown

- **Top elevation** - Plus 1 inch or minus 3 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

- **Bells** - Excavated to the minimum bearing area and height shown on the plans. Actual diameter may not exceed three times the specified shaft diameter. If approved, all other plan dimensions shown for the bells may be varied to accommodate equipment.

- **Top of Steel Reinforcement** - No more than 6 inches above or 3 inches below plan top-of steel reinforcement elevation.

Select excavation equipment and design methods so that the completed shaft excavation has a planar bottom.

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.

00512.44 **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.
Dispose of materials removed from the shaft excavations according to the applicable federal, state and local regulations for disposal of excavated materials.

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.

**Clean-out** - Use appropriate means, such as a cleanout bucket 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 skin 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.

Determine the drilled shaft dimensions and alignment with approved methods. Measure final shaft depths with a suitable weighted tape or other approved method after final cleaning. The drilled shaft excavation may be extended if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing capacity or differ from those anticipated in the design of the drilled shafts.

If caving occurs during any construction procedure, stop the construction operation, notify the Engineer, and stabilize the shaft excavation by approved methods.

Where the acceleration coefficient used for seismic design of the structure is less than or equal to 0.09, 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.

If approved, a larger diameter casing than the shaft diameter shown may be used.
(c) **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.

(d) **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.

(e) **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.

All in-hole drilling slurry shall meet the required Specifications prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

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.

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.

(f) **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 two sets of slurry tests per eight-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.
**00512.46 Reinforcing Steel** - Furnish and place reinforcing steel 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. After the Engineer has approved the final shaft tip elevation and immediately before placing the concrete, assemble the reinforcing cage and place it in the shaft excavation as a complete unit. 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. 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.

(c) 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.

**00512.48 Concrete** - Furnish and place concrete according to the following:

(a) Concrete Placement - If the drilled shaft excavation cannot be pumped free of seepage water at the time of concrete placement, place the concrete under water 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.

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 only with a concrete pump and hose or through a tremie hopper and pipe. Use hose or pipe having watertight joints and an inside diameter not less than 8 inches for pipe or 4 inches for hose. 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. Allow free fall of concrete only in a dry excavation when approved.

If concrete is placed under water, dispose of all displaced water in an approved manner. 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. 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.

Place concrete continuously until concrete discharged 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. Should a delay in concrete placement occur 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. Allow a maximum of 60 minutes between concrete placements. Use no concrete older than 90 minutes from batch time. In addition to the above, use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Allow the exposed top of concrete to cure a minimum of seven days by covering with wet burlap overlain with plastic sheets. Keep the burlap wet during the concrete cure.

If caving occurs during concrete placement, the shaft will be rejected. Submit a repair plan to the Engineer for approval according to 00512.40.

(b) Casing Removal - If a temporary casing is used during drilled shaft construction, do not start casing removal until the level of fresh concrete within the casing has reached a depth of 10 feet. 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 permitted to facilitate extraction. Extract the casing so that concrete cast against the surrounding material develops the designed shaft skin friction. Check the elevation of the top of the reinforcing cage and the elevation of the top surface of the shaft concrete before and after temporary casing extraction. Any upward or downward movement of the reinforcing cage or any large downward movement of the surface of the concrete during casing extraction may be cause for rejection of the shaft. Casing that cannot be extracted during or immediately after the concrete placement operation may also be cause for rejection of the shaft. Submit a repair plan (or a structural evaluation for temporary casing not extracted from the shaft excavation) for all rejected shafts to the Engineer for approval according to 00512.40.

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.
00512.49  **Scheduling and Restrictions** - Schedule drilling and concrete placement so that each drilled shaft is cast immediately after drilling operations are complete. After the first drilled shaft on the Project has been accepted, make no significant change in construction methods, equipment or materials used in the construction of subsequent shafts, unless approved by the Engineer. Do not proceed with additional shafts until the first drilled shaft has been approved. Drilling may commence on a subsequent shaft at an approved location, provided that the concrete placement operation on the previously drilled shaft is in progress and there are sufficient workers present to complete all required operations.

For 24 hours after completion of concrete placement in a newly-constructed shaft, including withdrawal of casing if applicable, do not, within 15 feet of the shaft:

- Excavate adjacent shafts
- Construct footings
- Apply equipment wheel loads
- Introduce vibrations with a velocity greater than 1/4 inch per second

00512.50  **Testing and Acceptance** - Should the Engineer have 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.

The Engineer will have final authority to accept or reject each drilled shaft (based on CSL test results, if applicable).

**Measurement**

00512.80  **Furnish Drilling Equipment** - There will be no separate measurement of the work performed under this pay item.

00512.81  **Drilled Shafts** - Drilled shafts will be measured on the length basis by the vertical excavated length from the bottom of the shaft to the top of the shaft or to the mudline if under water as shown. If directed to excavate drilled shafts below the elevations shown on the plans, the drilled shaft will be measured from the revised bottom of shaft.

00512.82  **Permanent Casing** - Permanent casing installed in drilled shafts will be measured on the length basis.

00512.83  **Concrete** - Concrete for drilled shafts will be measured on the lump sum basis for the concrete required to complete the shaft from the bottom of the excavation to the top of shaft elevation shown on the plans.

00512.84  **Reinforcement** - Reinforcement for drilled shafts will not be measured separately.
00512.85 **CSL Test Access Tubes** - CSL access tubes will be measured on the length basis, by the number of feet of tubes installed in the shafts. Grout used to fill the access tubes after the completion of CSL testing will not be measured, as it will be considered Incidental to the bid item "CSL Test Access Tubes".

**Payment**

00512.90 **General** - The accepted quantities of drilled shafts will be paid for at the Contract unit price for one or another of the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Furnish Drilling Equipment</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Drilled Shaft Concrete</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Drilled Shaft Reinforcement</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) CSL Test Access Tubes</td>
<td>Foot</td>
</tr>
<tr>
<td>(e) Drilled Shafts, ____ Diameter</td>
<td>Foot</td>
</tr>
<tr>
<td>(f) Permanent Shaft Casings</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment for item (a) will be full and complete payment for 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. Payment of 60% of the amount bid for this item will be made when all drilling equipment is on the job, assembled and ready to excavate the shafts. Payment for the remaining 40% of the bid amount will be made when all shafts have been excavated and all shaft concrete has been placed and accepted.

Payment for item (b) will be payment in full for concrete and for equipment, labor, and incidentals required to complete the shafts as specified. If directed to excavate drilled shafts below elevations shown, additional concrete required will be paid for according to 00195.20. If a larger diameter casing than the shaft diameter shown is used at the Contractor’s option, no additional compensation will be allowed for concrete required to fill the oversized excavation.

Payment for item (c) includes payment for all reinforcement within the drilled shaft plus reinforcement shown on the plans which is to be embedded in the shaft and extends above the top of the drilled shaft. This includes the continuous vertical and spiral reinforcement extending from the bottom of the shaft to the elevation shown. Bracing, centering devices and support for the bottom of the reinforcement cage will be considered incidental to lump sum pay item "Drilled Shaft Reinforcement". Payment will be payment in full for furnishing, fabricating and placing all reinforcement in the shafts as specified. If directed to excavate drilled shaft below elevations shown on the plans, additional reinforcement required will be paid for according to 00195.20.

Payment for item (d) will be payment in full for furnishing and installing all access tubes in the shafts as shown or specified and filling the tubes with grout after completion of CSL testing. If directed to excavate drilled shaft below elevations shown on the plans, additional CSL access tubing required will be paid for according to 00195.20.
For item (e), the diameter will be inserted in the blank. Payment will include payment for excavating the shafts and disposing of the excavated material; for furnishing, placing, splicing and removing temporary shaft casing and forms; and for furnishing all materials, equipment, labor and incidentals necessary to complete the work. Additional payment for length below the shaft tip elevation shown will be provided at the Contract price if drilling was at the direction of the Engineer.

Payment for the item (f) will be made at the Contract unit price per foot for the length of casing furnished and installed in the drilled shafts.
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 - Provide materials meeting the following requirements:

- Preservative treatment of timber ........................................... 02190
- Reinforced pile tip............................................................. 02520.10
- Reinforced pre-stressed concrete piles ............................ 02520.20
- 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 value specified, and to extend into the cap or footing as shown. The Contractor may, at no cost to the City, drive test piles, make borings, or perform other investigations the Contractor considers necessary. The "Engineer's Estimated Length" listed in the Special Provisions will be used only for comparison of bids.

00520.12 Pile Order List - Furnish pre-stressed 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 without additional compensation.

00520.13 Test Piles - When test piles are required, the production pile lengths shown or specified are for bidding purposes 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 one-third 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 six 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.

(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 load capacity equals or exceeds the required ultimate pile bearing capacity. After driving piles with a vibratory hammer, verify pile capacity (see 00520.42) by driving them with an impact hammer of suitable energy. Do not use vibratory hammers to drive test piles or when pre-boring or jetting.

(c) Driving Components:

   (1) Pile Cushion - Protect the heads of pre-stressed concrete piles with a pile cushion made of wood or other approved material.

      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. Replace the pile cushion if, during the driving, the cushion is either compressed to less than one-half 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. A blank form is included in the Special Provisions or 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.
If the Contractor chooses to submit more than one pile hammer for approval, the proposed pile hammers must be prioritized for evaluation. When it is determined that a proposed pile hammer is acceptable, the remaining lower priority pile hammers will not be evaluated. After initial pile hammer approval has been recommended, the Contractor will be charged $500 for each additional pile hammer submittal that requires a wave equation analysis for evaluation.

During pile-driving operations, no changes to the approved equipment will be permitted 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 seven 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 seven 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 ultimate pile bearing capacity shown.

<table>
<thead>
<tr>
<th>Ultimate Capacity (Kips)</th>
<th>Minimum Field Energy (Foot-pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 180</td>
<td>7,500</td>
</tr>
<tr>
<td>&gt; 180 and ≤ 300</td>
<td>14,500</td>
</tr>
<tr>
<td>&gt; 300 and ≤ 360</td>
<td>18,000</td>
</tr>
<tr>
<td>&gt; 360 and ≤ 420</td>
<td>23,000</td>
</tr>
<tr>
<td>&gt; 420 and ≤ 480</td>
<td>28,500</td>
</tr>
<tr>
<td>&gt; 480 and ≤ 540</td>
<td>34,500</td>
</tr>
<tr>
<td>over 540</td>
<td>WAVE EQ required</td>
</tr>
</tbody>
</table>

1 Using 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 bearing, do not use the hammer until repaired to the Engineer's satisfaction.

The required number of hammer blows indicated by the Gates equation at the ultimate pile bearing capacity shall be at a rate between 3 and 15 blows per inch.

(3) Special Evaluation Method - If specified, the method used to evaluate the driving equipment will be based on wave equation analysis. The criteria will be the required number of hammer blows per blows per inch and the pile stresses at the required ultimate pile bearing capacity.

The required number of hammer blows indicated by the wave equation at the ultimate pile bearing capacity shall be at a rate between 3 and 15 blows per blows per inch.
If the wave equation analysis shows an inability to drive the pile(s) to the required ultimate pile bearing capacity with an acceptable blow count or that pile damage will occur, change the proposed driving equipment until the wave equation analysis indicates the piles can be driven as specified. Submit changes proposed for review according to 00520.20(d)(1). Make approved changes at no additional compensation.

The pile stresses indicated by the wave equation at the ultimate pile bearing capacity shall not be greater than the stress at the point of impending damage to the pile. This point for the different types of piles is:

- **Steel Piles** - A compressive driving stress of 90% of the pile material's yield point.

- **Pre-stressed Concrete Piles:**
  - A tensile stress of \((3 \sqrt{f_c}')\) + effective pre-stress
  - A compressive stress of \((0.85 \sqrt{f_c}')\) - effective pre-stress

  where \(f_c'\) = concrete compressive strength

- **Timber Piles** - A compressive driving stress of three times the allowable static design stress shown.

### 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 at the Contractor's expense before concrete for the foundation is placed.

(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 ultimate pile bearing capacity 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 cap. 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, pre-bore or jet holes, or use other approved methods as necessary to attain the required penetration.

(d) **Preboring** - Use auguring, wet-rotary drilling or other methods of pre-boring only when specified or with written approval. When permitted, pre-bore holes at pile locations and to the depths shown or directed. Make pre-bored 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 permitted unless otherwise approved.

Perform pre-boring 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 pre-boring has disturbed the load bearing capacities of previously installed piles, restore those piles that have been disturbed to conditions meeting the requirements of this Specification by re-driving or by other acceptable methods. The Contractor shall be responsible for the costs of any necessary remedial measures unless the pre-boring 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, pre-boring 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 pre-boring 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.

(e) **Jetting** - Jetting may only be used when permitted 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.

(f) **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 shall be at the Contractor's expense.
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 permitted.

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 bear 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. Re-drive to the required penetration and resistance, at Contractor's cost, all piles that have risen more than 1/2 inch. Continue readings until the Engineer determines that such checking is no longer required. If pipe piles which have been filled with concrete subsequently heave, re-drive 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 re-driven (See 00520.42(d)). If the tops of test piles reach plan grade without attaining the required bearing capacity, splice them and drive until the required bearing 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 seven calendar days after completion of all test pile driving specified in the Contract.
00520.42 Ultimate Pile Bearing Capacity:

(a) General - Drive piles with approved pile driving equipment to the lengths necessary to attain the required penetration and ultimate pile bearing capacity. 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 required number of hammer blows per 1 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.

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) Gates Equation - Unless otherwise specified, the Engineer will determine ultimate pile bearing capacity of the driven pile by the Gates equation:

\[ R_u = 1.60 \left( \sqrt[6]{E} \right) \log(10N) - 100 \]

where:
- \( R_u \) = Ultimate pile bearing capacity (kips).
- \( E \) = Hammer energy (foot-pounds) at the ram stroke observed in the field.
- \( W \times H \) = Weight (pounds) of striking parts of hammer.
- \( H \) = Height of fall (feet) of the ram measured during pile driving in the field.
- \( \log(10N) \) = 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

\[
N = 10 \left[ \frac{R_u + 100}{1.60 \sqrt[6]{E}} - 1 \right]
\]

or \( N = 10 \) to the power in brackets.

The 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 when the above equation is applied, the Engineer may order the Contractor, at the Contractor's expense, to verify the bearing values obtained by the use of a different hammer.
(c) Wave Equation Analysis - If specified, the Engineer will determine ultimate pile bearing capacity based on wave equation analysis.

(d) Set Period and Re-driving - If piles do not attain the required bearing capacity when driven to the specified length, and if permitted 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 two piles in each bent or on one 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 re-driving. Warm up the hammer before re-driving begins by applying at least 20 blows to another pile. Re-driving shall consist of driving the pile to the required bearing with a maximum of 15 blows. If the specified hammer blow count is not attained on re-driving, the Engineer may direct the Contractor to drive all of the remaining pile length and repeat the set period and re-driving procedure. Splice those piles driven to plan grade that do not attain the hammer blow count required, and drive until the required bearing is attained. If the required bearing capacity is attained for each pile that is re-driven, then the remaining piles in that bent will be considered satisfactory when driven to at least the same penetration and resistance as the re-driven piles.

(e) Jetted Piles - The ultimate pile bearing capacity 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 capacity. For piles that are jetted at the Contractor's request and do not attain the required ultimate pile capacity at the ordered length, splice, as required, and drive with a specified impact pile hammer until the required ultimate pile bearing capacity is achieved according to appropriate criteria in 00520.42. Regardless of City approval, bear all costs of splicing and driving piles beyond the order length if jetting is requested by the Contractor.

(f) Followers - The required ultimate pile bearing capacity 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 ultimate bearing capacity 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 ultimate pile bearing capacity at the specified length, splice them as required, at the Contractor's expense, and drive with a specified impact pile hammer until the required ultimate pile bearing capacity 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 ultimate pile bearing capacity 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 ultimate pile bearing capacity 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 - Provide and install reinforced pile tips of the type and dimensions shown and specified. Provide steel pile tips from cast steel according to AASHTO M103.

(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 working drawings submitted according to 00150.35(m)(2) and approved by the Engineer.

(g) Welding - Weld pile splices, pile tips, pile anchors, and other welded attachments to steel piles according to ANSI/AWS D1.1 "Structural Welding Code - Steel".

   (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 in accordance with 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 A36 and A252 Grade 1 and 2 may be treated as pre-qualified base metals under Group 1. ASTM A252 Grade 3 will not be considered a pre-qualified 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 Department. If the additional NDT does not identify defects warranting rejection, the Department will bear 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 00310.43. 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 1/4 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 pre-stressed concrete piles according to the Special Provisions and Section 00550.

(b) Lifting, Storage and Transportation - Lift, store and transport pre-stressed concrete piles according to 00550.51.

(c) Strength before Driving - Do not drive pre-cast, pre-stressed concrete piles until the conditions of 00550.20(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. Pre-stressed 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 pre-stressed concrete piles to pre-stressed 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 pre-stressed concrete piles at the elevations shown or directed. All cut-off lengths become the property of the Contractor. Dispose of according to 00310.43. Take care to prevent spalling of the concrete below the footing or pile cap. Repair any damage to the piles at the Contractor's expense.

(f) Finishing - Finish all exposed pre-stressed concrete pile surfaces to 1 foot below ground surface according to 00550.49.

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 permitted.

(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 boltholes. 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 expense to the City.
(c) **Strapping** - Strap timber piles with at least three 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 00310.43.

(f) **Capping** - Cover timber pile heads not encased in concrete with alternate layers of hot asphalt and loosely woven fabric, using four applications of asphalt and three 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 seven complete turns of commercial corrosion resistant wire (13.5 gage 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 at Contractor's expense:

- 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 bearing capacity is proved by load tests performed by the Contractor. If such tests indicate inadequate capacity, take corrective measures, such as the use of damaged piles at reduced capacity, 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 Furnish Equipment for Driving Piles** - There will be no measurement for the work performed under this subsection.

**00520.81 Furnish Steel, Prestressed Concrete and Timber Piles** - Furnishing steel, pre-stressed concrete and timber piles will be measured on the length basis, per meter (foot), measured to the nearest meter (foot). 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.

(a) **Steel Piles** - The quantity of steel piles will be the length of each pile remaining in the completed work, from the pile tip to the cutoff plane.

(b) **Prestressed Concrete and Timber Piles** - The quantity of pre-stressed 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.

**00520.82 Drive Piles** - Driving steel, pre-stressed concrete and timber piles will be measured on the unit basis, per pile.

If pre-boring or jetting of piles is requested by the Contractor, it will not be measured, but will be considered incidental to the pay item "Drive ____ Piles".

If pre-boring is specified or directed, it will be measured on the length basis, to the nearest foot.

If jetting is specified or directed, it will be measured on the unit basis, for each pile driven with the aid of jetting.

**00520.83 Reinforced Pile Tips** - Reinforced pile tips will be measured on the unit basis, per each, for tips specified and installed on piles and accepted for payment.

**00520.84 Load Tests** - Load tests to be will be measured on the unit basis, per each, for the number of specified load tests completed and accepted, except that load tests made at the option of the Contractor will not be included in the quantity measured for payment.

**00520.85 Furnish Test Piles** - Test piles, including test piles remaining in the completed work, will be measured on the length basis for the total length shown, specified or approved, measured according to 00520.81.

**00520.86 Drive Test Piles** - Driving test piles, including test piles remaining in the completed work, will be measured on the unit basis, per each, for the total number of piles driven as shown, specified or approved. All test piles will be driven under 00520.41(h).
00520.87 Pile Splices:

(a) Steel Piles - No measurement will be made for splices to steel piles within the estimated lengths as listed in 00520.11 of the Special Provisions, as these splices will be considered incidental and included in the unit price for the pay item "Furnish ____ (Test) 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 paid at the Contract unit price for the item "_______ Steel Pile Splices". Only one splice will be paid for per pile.

(b) Pre-stressed Concrete Piles and Timber Piles - No measurement will be made for splices shown or specified, as such splices are considered incidental and included in the unit price for the pay item "Furnish ____ (Test) Piles". Other splices required to complete the work will be considered Extra Work and shall be performed according to Section 00196.

Payment

00520.90 General - Payment at the Contract price per unit of measurement for the applicable pay item in 00520.91 will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work.

Payment for driving piles will include payment for cutting off piles, treating and capping pile heads, attaching anchor brackets, lugs or other attachments, and finishing concrete piles. Payment for splices required to drive piles to the specified length will be considered incidental to pay items 00520.91(b) and (d). Payment for pre-boring, jetting, larger hammers, or 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. Payment for steel pile splices required to increase pile length beyond the estimated length will be paid under 00520.91(i)). No additional payment will be made for work needed to drive piles to minimum tip elevation as shown or specified.

00520.91 Pay Items - Quantities accepted for payment will be paid for at the applicable Contract price per unit of measurement for each of the following pay items in the Schedule of 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) Pile Load Test (static)</td>
<td>........................Each</td>
</tr>
<tr>
<td>(g) Pile Load Test (dynamic)</td>
<td>........................Each</td>
</tr>
<tr>
<td>(h) Reinforced Pile Tips</td>
<td>........................Each</td>
</tr>
<tr>
<td>(i) _____ Steel Pile Splices</td>
<td>........................Each</td>
</tr>
</tbody>
</table>
Payment for Item (a) will be made at the lump sum price bid for this item as follows:

- 75% of the amount bid will be paid when the equipment for driving piles is furnished and is satisfactorily driving piles
- The remaining 25% will be paid when the work of driving piles is complete and equipment has been moved from the site

The lump sum price bid will include the cost of furnishing all materials, equipment and labor necessary for transporting, erecting, maintaining, replacing any ordered equipment, dismantling and removing the entire pile driving equipment. 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 (i) the type and size of pile will be inserted in the blank.

Payment for items (c) and (e) includes payment for any expense involved in driving piles which have not attained the required bearing and are required to stand for a "set period".

Payment of item (h) includes payment for attaching the tips to the piles.

00520.92 Test Piles - Test piles furnished and driven will only be paid for under items (d) and (e) above.

00520.93 Welding Inspection - Welding inspection performed according to 00520.43(g)(2) will be at the Contractor's expense.
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 - Provide materials meeting the following requirements:

- Dowels
- Epoxy coating
- Galvanized coating
- Mechanical splices
- Reinforcement bar
- Welded wire fabric
- Wire

00530.11 Order Lists and Bending Diagrams - Before ordering material, submit all order lists according to 00150.37 and bending diagrams according to 00150.35(m)(2) for review. Do not order material until such lists and bending diagrams have been reviewed. The review of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expense incidental to the revision of material furnished according to such lists and diagrams to make it comply with the design drawings shall be borne by the Contractor.

Order lists and bending diagrams for reinforcement affected by stressing system in pre-stressing 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 Concrete Reinforcing Steel Institute's "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, shall be classified as reinforcement.

Standard steel pipe attached to or used in conjunction with bridge deck drains or catch basins shall be classified as reinforcement.
Labor

00530.30 Mechanical Splice Installers - Provide qualified mechanical splice installers to construct mechanical splices. To become qualified, each mechanical splice installer shall provide three completed mechanical splice samples of each type, size, and lot, at Contractor's expense, to be installed on the Project 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 two equal lengths of straight reinforcing bar so the total length of the assembled splice sample is at least 48 inches.
- Mark each splice sample sleeve with the heat treatment lot number.

All splice samples shall 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 - Protect reinforcement at all times from damage. When placed in the work, it shall be free from dirt, detrimental rust or scale, paint, oil and other foreign substances.

00530.41 Placing and Fastening - Place all reinforcement within the tolerances recommended in the Concrete Reinforcing Steel Institute's "Manual of Standard Practice" unless otherwise specified.

(a) Fabric - If fabric reinforcement is shipped in rolls, straighten it into flat sheets before placing.

(b) Ties - 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.
- Tie all other bars at all intersections except where spacing is less than 1 foot in each direction; in that case tie alternate intersections.
- Use non-metallic-coated ties to tie coated reinforcement to coated reinforcement or uncoated reinforcement.
- Pre-cast concrete blocks shall have wire ties.
• Pre-cast concrete blocks that support coated reinforcement shall have nonmetallic coated ties.

(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, pre-cast concrete blocks, ties, hangers, or other approved supports.

• Separate layers of bars with pre-cast concrete blocks or by other suitable devices.

• Use pre-cast 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 when the legs of the chair will be on an exposed surface.

• Legs of chairs shall be turned up a minimum of 1/8 inch.

• Remove all pre-cast girder lifting devices prior to placing concrete deck reinforcement.

• Bridge deck clearances shall 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 permitted, unless shown otherwise:

• Splice bars No. 36 (No. 11) and smaller by lapping, or with an approved mechanical splice

• Splice bars No. 43 (No. 14) 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 three ties per splice.

The length of lapped splices for coated reinforcement shall be longer than for uncoated reinforcement as shown.

(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.

Mechanical butt-spliced reinforcing bars shall 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 imbedded 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 Contractor's expense. All sample splices will be tested by the City at no cost to the Contractor.

b. **Samples** - All samples shall meet the requirements of 02510.20 and this subsection.

c. **Testing** - Construct test splices in the presence of the Engineer. Construct test splices with two equal lengths of straight reinforcing bar so that the total length of the assembled sample is not less than 48 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; after which 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 the Contractor's expense.

Coat mechanical splices of epoxy coated reinforcing bars after installation, according to AASHTO M 284 for patching damaged epoxy coatings.

Where pre-coating is required, pre-coat splices with an approved coating.

Following installation on projects within 25 miles, by air, 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.

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.

00530.45  Substitutions  - Substitute different size bars only if approved.

00530.48  Protect Epoxy Coated Rebar  - Inspect coated bars before placement for damage to coating. Patch all visual defects in the coating with a pre-qualified 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 - 3 inches, or as recommended by the manufacturer, into the undamaged coated areas. Apply patching material to a thickness greater than 8 mils. Cover coated bars with an opaque material during storage, to protect them from exposure to sunlight and saline mist. Clean bars exposed to saline mist with a high pressure washer 1,500 pounds/square inch pressure, with a fan pattern, 4.5 gallons/minute capacity just prior to placing concrete. Move bars to or from storage carefully, according to 02510.11(c) to minimize damage to the coating. Total exposure time, while in storage or in place, is not to exceed two months.

Clean visual damage found after placement as specified above. Keep repairs to installed bars to a minimum.
Measurement

00530.80 General - Reinforcement will be measured either on a weight basis or on a lump sum basis. The Special Provisions will state the basis of measurement for payment applicable to the particular parts of work under the Contract.

00530.81 Weight Basis - When measured on a weight basis, reinforcement incorporated in the concrete will be measured in pounds, 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 .................. 0.2833 pounds/cubic feet
- Copper .................. 0.32 pounds/cubic feet
- Cast Iron.................. 0.26 pounds/cubic feet

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, the following table will be used:

<table>
<thead>
<tr>
<th>Designation Number</th>
<th>Diameter (inch)</th>
<th>Weight (lb/in²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.375</td>
<td>0.376</td>
</tr>
<tr>
<td>4</td>
<td>0.500</td>
<td>0.668</td>
</tr>
<tr>
<td>5</td>
<td>0.625</td>
<td>1.043</td>
</tr>
<tr>
<td>6</td>
<td>0.750</td>
<td>1.502</td>
</tr>
<tr>
<td>7</td>
<td>0.875</td>
<td>20.44</td>
</tr>
<tr>
<td>8</td>
<td>1.000</td>
<td>2.670</td>
</tr>
<tr>
<td>9</td>
<td>1.128</td>
<td>3.400</td>
</tr>
<tr>
<td>10</td>
<td>1.270</td>
<td>4.303</td>
</tr>
<tr>
<td>11</td>
<td>1.410</td>
<td>5.313</td>
</tr>
<tr>
<td>14</td>
<td>1.690</td>
<td>7.650</td>
</tr>
<tr>
<td>18</td>
<td>2.260</td>
<td>13.600</td>
</tr>
</tbody>
</table>

The weight of reinforcement in pre-stressed beams, slabs, piles and other items where the reinforcement is included in the Contract price for the item will not be included in the pay quantities.

No allowance will be made for clips, wire, separators, wire chairs and other material used in fastening the reinforcing in place. 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.
00530.82 Lump Sum Basis - The lump sum basis of measurement will be in effect without further measurement unless plan changes are ordered. The Special Provisions will show an estimate of quantities for the sole purpose of providing a basis for adjustment of payment in the event changes in the work are ordered. Estimated quantities shown are approximate only and it is the Contractor’s responsibility to determine the actual quantities required.

The estimate shown in the Special Provisions is made on a reasonable interpretation of the plans. The of reinforcement in pre-stressed beams, slabs, piles and other items where the reinforcement is included in the Contract price for the item will not be included. If no changes are made in the work, payment will be made at the lump sum Contract price.

If changes are ordered, the adjustment will apply only to those quantities involved in the plan changes and will be as determined by the Engineer.

Payment

00530.90 General - Payment for reinforcement measured on the weight basis according to 00530.81 or on the lump sum basis according to 00530.82 will be made at the applicable Contract price for one of the pay items listed below as given in the Schedule of Items. Payment for reinforcement will be made when the reinforcement is incorporated into the concrete. Payment for quantities involved in plan changes will be made according to 00195.20.

<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>

Payment for item (a) will be payment in full for furnishing, fabricating and placing uncoated reinforcement as specified.

Payment for item (b) will be payment in full for furnishing and placing epoxy coated reinforcement as specified.
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 and/or reinforcement using a resin bonded anchor system as shown.

Materials

00535.10 Materials - Provide anchor bolts conforming to AASHTO M 314 or reinforcing steel conforming to ASTM A 615/A 615M as shown. The following ASTM specifications may be substituted for AASHTO M 314:

<table>
<thead>
<tr>
<th>AASHTO M 314</th>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 36</td>
<td>A 307 or F 1554</td>
</tr>
<tr>
<td>Grade 55</td>
<td>F 1554</td>
</tr>
<tr>
<td>Grade 105</td>
<td>A 193 (Grade B7), A 449 or F 1554</td>
</tr>
</tbody>
</table>

Provide a polyester, vinylester, or epoxy resin bonding system from the CPL that will sustain not less than the pullout force given on the plans. See Table 00535-1 when pullout force is not given on the plans. Provide the resin in proper proportions to be mixed easily.

<table>
<thead>
<tr>
<th>TABLE 00535-1</th>
<th>Minimum Pullout Force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anchor Bolts</td>
</tr>
<tr>
<td></td>
<td>Grade 36</td>
</tr>
<tr>
<td>Dia. (inch)</td>
<td>Force (Pounds)</td>
</tr>
<tr>
<td>1/2</td>
<td>7,400</td>
</tr>
<tr>
<td>5/8</td>
<td>11,700</td>
</tr>
<tr>
<td>3/4</td>
<td>17,300</td>
</tr>
<tr>
<td>7/8</td>
<td>24,000</td>
</tr>
<tr>
<td>1</td>
<td>31,700</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unless shown otherwise, anchors larger than 1 inch in diameter will not be installed 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 420 (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

Unless shown otherwise on the plans, galvanize all anchors which have any portion of the anchor exposed. Galvanize according to ASTM A 153/A 153M or ASTM B 695, Class 50. When within 50 miles of the Pacific Ocean, galvanize according to ASTM A 153/A 153M only. Unless otherwise shown on the plans, anchors that become completely encased in concrete will not require galvanizing.

Provide thread lengths as shown. If thread lengths are not shown on the plans 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. Do not use epoxy resin unless ambient air temperature is at least 50 °F. 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 an air hammer with 9 pounds force, or a carbide bit rotary hammer with two 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 four 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 must 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 separate measurement will be made for resin-bonded anchor systems.

Payment

**00535.90 Payment** - No separate payment will be made for resin-bonded anchor systems. This work is incidental to the item(s) which the anchor system fastens.
Section 00540 - Concrete Bridges

Description

00540.00 Scope - This work consists of furnishing, placing, and finishing portland cement concrete, hereafter referred to as concrete, for bridges according to these Specifications and in close conformity to the lines, grades and dimensions shown or established.

00540.01 Abbreviations:

ASTV - Actual Strength Test Value - See 00540.17(c)(2).

00540.02 Definitions:

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.

Post-Tensioned - Tensioning of pre-stressing 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

00540.03 Deck Pre-placement Conferences:

(a) Supervisory Personnel - The Contractor's supervisory personnel, concrete supplier, and any subcontractors who are to be involved in the concrete work shall meet with the Engineer for a conference at a mutually agreed time approximately three weeks in advance of placing concrete for bridge decks. At this conference, present and discuss all phases of the concrete deck placement work.

(b) Placement Crew - Hold a second pre-placement conference at the job site one-half hour before the first placement begins to discuss placement duties and procedures. It shall be attended by the Engineer and the Contractor's entire placement crew.
Materials

00540.10 General - Materials shall meet the following requirements:

- Blended hydraulic cement ............................................................. 02010.20
- Chemicals admixtures ........................................................................ 02040
- Coarse aggregate .............................................................................. 02690
- Concrete coating ........................................................................... 02210.30
- Curing materials ................................................................................. 02050
- Epoxy and non-epoxy bonding agents ............................................... 02070
- Epoxy and non-epoxy grouts ............................................................. 02080
- Epoxy cement .................................................................................... 02060
- Fine aggregate ................................................................................... 02690
- Fly ash ........................................................................................... 02030.10
- Portland cement ............................................................................ 02010.10
- Poured joint fillers .......................................................................... 02440.30
- Preformed expansion joint filler ..................................................... 02440.10
- Structural concrete ............................................................................. 02001
- Water .................................................................................................. 02020
- Ground granulated blast furnace slag (GGBFS) ........................... 02030.40
- Latex (formulated) ......................................................................... 02030.30
- Silica fume..................................................................................... 02030.20

00540.11 Classes of Concrete - Provide concrete conforming to 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. Unless otherwise specified, use Class 25 (3600).

00540.13 Concrete Mix Designs - Prepare and submit either new mix designs or current mix designs for each class of concrete required, according to Section 02001. The Engineer will review the mix design for compliance with the Specifications.

00540.14 Concrete Mix Tolerances and Limits - Provide a workable concrete mixture, uniform in composition and consistency and conforming to the properties and limits of 02001.30 and 02001.50.

00540.15 Form Materials - Forms shall be wood, plywood, metal or other suitable material. Forms for round concrete columns shall be metal or other approved material that produces a smooth and true surface free from fins, joints and other irregularities. Plywood shall be minimum 5/8 inch nominal thickness.

00540.16 Quality Control - Provide quality control according to Section 00165 and the following:

- 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 the placement of the load. Correct the load or, if the load cannot be corrected, 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. 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.

• Reject plastic concrete that is outside of the specified limits.

00540.17 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance will be based on the Contractor’s quality control testing, if verified, according to Section 00165. Blend aggregates 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 the plastic concrete will be based on the tests performed by the Contractor’s QCT, according to the tolerances and limits of Table 02001-1 and 02001.50.

(c) Hardened Concrete - Cast and cure the test specimens according to AASHTO T 23 in 6" x 12" or 4" x 8", 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 three cylinders tested. If the compressive strength of a single test specimen varies by more than 10% from the average of the other two specimens, that compressive strength value will be discarded. The average compressive strength test of the two 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 $f'_c$ but at least 85% of $f'_c$, the Engineer will review the results to determine if the concrete represented by the cylinders shall be removed. Concrete that has an ASTV of less than 85% of the specified strength shall be removed unless otherwise authorized, in writing, by the Engineer. If the concrete is removed, the cost of removal, replacement and all related work shall be the Contractor’s responsibility. If the concrete is allowed to remain in place, it will be subject 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 three 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.

**Equipment**

00540.20 **Batch Plant** - Provide a batch plant adequate to handle materials within specified proportions and tolerances. Make provisions to measure components of the mix at the batch plant. The batch plant shall comply with the following:

(a) **Storage Bins** - Storage bins shall:

- Have adequate, separate compartments for cement, fly ash, fine aggregate and each separate size of coarse aggregate
- Be tight and ample to prevent spilling from one bin to another
- Discharge freely and provide positive control of the quantities in each batch

(b) **Weigh Hoppers** - Provide scales for weighing aggregates and cement in weigh hoppers that are:

- Either beam, springless dial or electronic load-cell type
- Accurate within 0.5% under operating conditions throughout the range of use
- Tested and certified according to 00190.20
- Able to independently weigh cement, fly ash and each separate size of aggregate

(c) **Water and Admixture Dispensers** - Provide equipment for dispensing water and admixtures that:

- Has separate feeds
- Measures each quantity of material within 0.5% and shows the quantity in gallons or pounds
• Injects each material at the proper time in the mixing process to ensure thorough and complete mixing throughout each batch of concrete

• Automatically cuts off the water supply at the specified amount of water

• Is calibrated by the Contractor and witnessed by the Engineer before use on the Project

(d) **Automatically Controlled Batches** - Automatically controlled batches shall have automatically interlocked mechanisms that provide:

• Positive, separate weighing and discharging of cement, fly ash and each separate size of aggregate

• Interlocking between weigh hoppers to prevent any part of the batch from being discharged until each separate hopper has been filled with the correct proportion

• Simultaneous discharge of all hoppers

00540.21 **Mixers** - Mix concrete in a batch plant mixer or revolving-drum type truck mixer. If hauling concrete, deliver concrete mixed in a batch plant mixer to the jobsite in a truck mixer.

Mixers shall be equipped with a metal plate, or plates, on which the manufacturer has marked the mixing speed of the drum and the maximum mixing capacity.

(a) **Batch Plant Mixers** - Batch plant mixers shall:

• Meet the requirements in 00540.20

• Be a revolving-drum type. Other types may be used with the Engineer’s written permission

• Be equipped with mechanical means for recording the number of revolutions for each batch and automatically preventing the discharge of the mixer until the materials have been mixed the specified minimum time

(b) **Truck Mixers** - Truck mixers shall use a watertight revolving drum, constructed and maintained within tolerances of the manufacturer’s specifications, and equipped with:

• A tank for carrying mixing water

• A device to measure the quantity of mixing water added

• A device to indicate the number of drum revolutions
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 - The discharge line of the pump shall be steel or rubber pipe and shall have 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&quot;</td>
<td>4</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>5</td>
</tr>
</tbody>
</table>

(b) Chutes - Use steel or steel-lined chutes. Where steep slopes are required, the chutes shall be equipped with baffles or shall be in short lengths that reverse the direction of movement.

(c) Pipes or Trunks - Pipes, other than tremie seal pipe, shall be rubber or steel, and trunks shall be plastic.

(d) Tremie Seal Pipe - The tremie seal pipe shall:

- Be 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, be the flange-and-gasket type and be waterproof

- Have means to close the discharge end

- Be supported to permit free movement of the discharge end throughout the seal

- Be equipped with a device to permit rapid lowering when necessary to retard or stop the flow of concrete

00540.23 Vibrators - Vibrators shall be:

- An internal type unless other methods are approved by the Engineer

- Capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute

- In working condition to meet manufacturer's rating

- Fitted with a manufactured rubber sleeve head to minimize damage to epoxy coated reinforcement
00540.24 **Deck Finishing Machine** - The deck finishing machine shall be:

- 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 or other approved device 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.

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 80 microns, according to the nozzle manufacturer's recommendation.

**Labor**

00540.30 **Quality Control Personnel** - Provide the following certified technicians:

(a) **Certified Aggregate Technician (CAgT)** - Provide a CAgT who shall:

- Perform sampling and testing of aggregates during production
- 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.
(b) Quality Control Technician (QCT) - Provide a QCT certified for all classes of concrete and for trial batches when required. The QCT shall:

- Attend pre-placement meetings for bridge deck pours
- Be at the concrete placement site when placement is in progress
- Have a copy of the mix design on site and available during concrete placements
- Check each batch ticket on arrival at the jobsite for the correct mix design for the placement
- Sample and test the concrete for ambient air and fresh concrete temperatures, slump, air content, density, water/cementitious ratio, yield, and cementitious content as required and according to the tests listed in the MFTP, and at such times as requested by the Engineer to validate compliance with the Specifications
- Notify the Contractor and the Engineer immediately when the concrete is not in compliance with the Specifications

In addition, on projects that have more than 100 cubic yards of structural concrete and on projects that have any high performance concrete, the QCT shall:

- Be in direct contact with the CCT by telephone, radio or other means necessary to convey important mix information
- Notify the CCT of loads rejected by the Contractor and the reason for rejection
- Notify the CCT immediately whenever the density of the fresh concrete varies from the mix design target by more than 3 pounds per cubic foot
- Notify the CCT immediately whenever the water-cementitious ratio varies from the mix design target by more than plus or minus 0.03

(c) Concrete Control Technician (CCT) - Provide a certified CCT to prepare new mix designs and to make adjustments in current mix designs for all structural concrete. During placement of all structural concrete, provide a certified CCT, as required in Table 02001-1, who is authorized to control the production of the concrete.

On projects that have more than 100 cubic yards of structural concrete and on projects that have any high performance concrete, the CCT shall:

- 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 due to variations in aggregate moistures. Moisture testing may be by an alternate method if approved by the Engineer.
- Visually inspect the coarse aggregate for changes in moisture content throughout the day. Perform necessary testing for total moisture, and make adjustments if necessary.
Monitor the mix properties and performance of the compressive strength tests throughout the duration of the Project

Make recommendations or adjustments to maintain a satisfactory over-design \( f'c_r \)

Perform an analysis and make adjustments if necessary whenever the density (unit weight) of the fresh concrete varies from the mix design by more than plus or minus 3 pounds per cubic foot. Submit a written analysis along with any recommendations to the Engineer by noon of the following workday.

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-cement ratio varies from the mix design target by more than plus or minus 0.03 and submit to the Engineer by noon of the following workday

(d) Contractor’s Additional Quality Control Duties - Provide and designate an individual who shall 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.

(e) Concrete Strength Testing (CSTT) - Provide a CSTT, to perform the duties outlined in the MFTP.

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

- Support 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:

- Horizontal dimension of formed members: minus 1/2 inch to plus 2 inches
b. Horizontal dimension of unformed members cast against soil:
   - 2 feet or less: minus 1/2 inch to plus 3 inches
   - Greater than 2 foot and less than 6 feet: minus 1/2 inch to plus 6 inches
   - Over 6 feet: minus 1/2 inch to plus 12 inches

c. Vertical dimension (thickness): minus 5%

(4) **Relative Alignment** - Footing side and top surfaces may slope with respect to the specified plane at a rate not to exceed in 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: plus 0, 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 inch
   c. On ramps, sidewalks and intersections, in any direction, the gap below a 12 foot unleveled straightedge resting on high spots shall not exceed 1/4 inch.
   d. Bridge decks: See 00540.54.

(4) **Cross-Sectional Dimensions**:
   - Bridge slabs and decks vertical dimension (thickness): minus 1/8" 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(m)(1), except as modified below.

The falsework designer shall also prepare a Falsework Design Summary and complete 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/or derivations for design formulas
- Documentation for computer generated calculations

The Falsework Design Checklist is included in the Special Provisions.

Submit five sets (nine sets if railroad approval is required) of the plans and three copies (five 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.
Design loads shall be the maximum loadings. Deflections used on manufactured devices and assemblies shall 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,

- Design the posts using a minimum section modulus, about each axis, of:
  - 12.2 in$^3$ for structural steel
  - 244 in$^3$ for timber
- Increase the vertical post load 150%. If the load on the falsework will be increased by load transfer due to pre-stressing, increase the vertical post load by the additional load due to pre-stressing 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. Do not place concrete that will be supported by the falsework before the falsework design engineer of record, accompanied by the Engineer, field inspects that portion of the falsework proposed for use. Do not use the inspected portion until all construction concerns have been addressed, and the Engineer agrees in writing that the falsework will serve the intended use. Do not use this portion of falsework until the falsework design engineer furnishes the Engineer a written statement that it conforms to the design and will serve the intended use. Within two days of notice of the falsework design engineer's pending inspection, the Engineer will provide a list of construction concerns.

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.

Sand jacks, when used, shall consist of a metal piston and metal frame filled with compacted, clean, dry sand. The annular space between the top bearing plate or piston and the frame shall not exceed 1/4 inch.

Use barriers to protect falsework from damage from adjacent traffic. Make provisions to prevent damage by debris in streams.

Upon completion and before acceptance, 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 one and one-half times the least horizontal dimension of the blocking or wedges, whichever is smaller. Post, shim pack and wedging assemblies supporting beams shall be limited to six faying (interface or contact) surfaces. Adjacent beam support assemblies shall not have a difference of more than two faying surfaces. Timber blocks loaded perpendicular to the grain shall be 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.

Stay in place forms are not allowed in bridge deck construction joints.

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, its placement shall be 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, construction joints shall have a roughened surface. Do not smooth or trowel aggregate into the cement paste. Minimum deviation from a plane surface shall be 1/4 inch and the maximum deviation from a plane surface shall be equal to the maximum size of aggregate in the specified class of concrete.

Within 24 hours after placing concrete, clean the joint surface and reinforcing steel 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. Excavation and backfill shall be according to Section 00510.

00540.45 **Construction of Forms** - Forms shall:

- Be mortar-tight and sufficiently rigid to conform to the specified dimensions without appreciable distortion, warping or opening of joints
- Provide a 3/4 inch chamfer on all exposed concrete edges unless otherwise noted
- Provide a smooth concrete surface unless otherwise specified
• Be constructed so portions may be removed without disturbing forms that are to remain

• Be treated with a release agent that is not detrimental to the concrete

• Be cleaned of dirt, sawdust, excess water and other foreign material before placing concrete in the forms

• Be saturated with water immediately before placing the concrete and kept damp during placement

• Be retightened before depositing new concrete on or against concrete which has hardened

On structures 25 miles or less, by air, 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, the depth shall be at least 1 inch.

Install embedded conduit with 2 inches clearance from 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 steel bridge deck forms are not permitted.

(a) Footings - When footings are not founded in firm rock, concrete may be placed without forms if the excavation does not exceed 1 foot outside the footing dimensions.

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 according to 00540.52.

00540.46 Handling, Measuring and Batching of Materials:

(a) Aggregates - Stockpile and remove aggregate from stockpiles in a manner that minimizes segregation. Do not stockpile aggregates from different sources and of different gradings together. Do not use aggregates that become segregated or mixed with earth or foreign material. Thaw frozen aggregates or aggregates containing frozen lumps before use.

(b) Batching - Weigh the fine aggregate, each separated size of coarse aggregate, cement and fly ash separately into the hoppers in the respective amounts set by the mix design. Provide a device to indicate positively that the full amount of cement and fly ash was discharged into the batch box or container. Measure water either by volume or by weight.

Conduct batching so that the individual weights of each material required are within the following tolerances:

- Admixtures.................................................................................± 3%
- Aggregates..............................................................................± 2%
- Cement....................................................................................± 1%
- Fly ash....................................................................................± 1%
- Water......................................................................................± 1%
- Silica fume..............................................................................± 15%

00540.47 Mixing and Transporting Concrete:

(a) Mixing Concrete - Mix concrete in equipment conforming to 00540.21.

(1) Batch Plant Mixer - Remove the entire contents of the mix from the drum before materials for a succeeding batch are placed in it. Simultaneously deposit the materials composing a batch in the mixer. Do not charge a mixer in excess of its rated capacity.

Mix concrete for a period of not less than one and one-half minutes after all materials, including water, are in the mixer. During the period of mixing, operate the mixer at a design speed of not less than 14 or more than 20 revolutions per minute.

Put a sufficient excess of cement, sand, and water in the first batch of concrete materials placed in the clean mixer to coat the inside of the drum without reducing the required mortar content of the mix.

(2) Truck Mixers - Before placing materials for the concrete in the mixer, empty the drum of water, and reset the drum revolution counter to zero or record the counter number on the batch ticket. The total revolutions on any load shall not exceed 300.
The concrete in the truck mixer shall not exceed the rated mixing capacity stated in 00540.21.

Measure materials deposited in the mixer according to 00540.20.

Begin mixing as soon as the cement has been added to the aggregates in the mixer. Continue mixing, before leaving the batch plant, for not less than 70 nor more than 100 revolutions of the drum at the rate stated in 00540.21. When silica fume, in densified powder form, is added to high performance concrete, mix the batch with between 150 and 175 revolutions at the mixing speed specified by the manufacturer before leaving the batch plant.

Top off the water tank of each truck before leaving the loading site.

If water or additives are added at the jobsite, mix the concrete an additional 40 or more revolutions of the drum, but do not exceed 300 revolutions total on any load.

(3) Partial Mixing at the Batch Plant - When a batch plant mixer is used for partial mixing of concrete, the mixing time in the stationary mixer shall be no more than 30 seconds. After transfer to a truck mixer, continue further mixing at the designated mixing speed for 60 revolutions.

(4) On-Site Mixers - Mixing at the site shall conform to the requirements for mixing at a batch plant.

(b) Transporting Concrete - The truck mixer shall turn continuously at the rate specified by the mixer manufacturer. The maximum volume of concrete transported in a truck mixer shall not exceed the manufacturer's specified rating.

(c) Delivery - The batch plant capacity and delivery vehicles shall ensure continuous delivery of concrete during placement. The rate of delivery shall be such that the interval between the end of one load and the start of the next load should not exceed 20 minutes for all placements except seal and deck placements. See 00540.48 for seal and deck placements.

If the requirements of 00540.47(c) are not followed, the Engineer may order a bulkhead installed, or concrete in the affected placement removed.

(d) Cleaning - Concrete truck cleaning shall be performed in a manner approved that does not damage the work area or surrounding area in conformance with the approved ESCP in Section 00280. Cleaning waste shall be contained and removed from the work area.

00540.48 Handling and Placing Concrete:

(a) General - Do not place concrete under water or in flowing water. Place specified seal concrete under water according to 00540.48(e). Place concrete:

- In the sequence shown or as approved
• In its final position in the forms within one and one-half 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 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
  • To produce a dense, homogeneous concrete, which is free of voids and rock pockets

• Through pumps, chutes or trunks conforming to 00540.22, when placement requires dropping concrete more than 5 feet. The bottom of pump hose, chutes, pipes or trunks shall be as close to final placement position as practicable

• In layers not more than 18 inches thick, except for seal concrete placement, and those shown differently on the plans. 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 approval of:

• The extent of the excavation and the bearing material in a foundation

• The quality of the piling, if used, in the footing

• The adequacy of the falsework and forms

• The placement of 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.

(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 for a pumpable mix.

(c) Vibrating Concrete - Except for seal and drilled shat concrete, thoroughly consolidate fresh concrete according to the following:

• Vibrate concrete internally using mechanical vibrating equipment

• For concrete placements which exceed 50 cubic yards per hour use a minimum of two vibrators
• For deck placement use a minimum of two vibrators. Provide an extra vibrator for emergency use.

• For deck placements which exceed 30 cubic yards per hour, use a minimum of three vibrators. 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(e) 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 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.

Stop placement for walls, abutments, columns at the bottoms of caps, crossbeams, girders and other vertical members with significant section changes where concrete shrinkage and settlement could cause cracking at the intersection.

Delay placement for the superstructure until the column forms have been stripped sufficiently to determine the character of the column concrete. The superstructure load shall not be carried by the bents or piers until the concrete has been in place and has attained the strength specified in 00540.52.

Deposit and vibrate concrete for beams and girders in layers of less than 18 inches.

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 and allow the concrete to attain its full shrinkage and settlement before continuing placement. If the beams or girders are over 4 feet in height, the delay shall be not less than that specified in 00540.52. Likewise, delay concrete placements at the intersections of any structural members where concrete shrinkage and settlement could cause cracking.

(g) **Bridge Decks** - Finish bridge decks to elevations established. Use deck finishing machines conforming to 00540.24 and set to run on the skew of the bent lines. Place the screed rails outside the finishing area. Extend the rails beyond both ends of the scheduled placement length for a distance that allows the finishing machine to reach all of the 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 on the plans will be plus or minus 1/4 inch. Make necessary corrections before beginning the placement.

Furnish at least two transverse work bridges, not counting the finishing machine.

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
- Delivers 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
- Provides a rate of producing and placing concrete 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 breakdowns, late concrete deliveries, or other delays occur lasting longer than 20 minutes, the Engineer may order construction of a bulkhead at an approved location unless further placement is started within 10 minutes. 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. Otherwise, do not construct bulkheads except where shown.

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 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 seven calendar days after placement, unless a specified enclosure and heat are used or insulated forms are approved and used.

(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 seven 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.

Temperature of the concrete shall be 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. The temperature of concrete produced with heated aggregate, heated water, or both shall 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 with a means of maintaining curing moisture.
Maintain the air temperature in the enclosure between 60 °F and 80 °F for a period of seven days after placing concrete.

c. **Insulated Forms** - Where practicable, insulated forms, capable of maintaining the surface of the concrete at not less than 50 °F for a period of seven days, may be used instead of enclosures and heating. If forms are insulated, protect exposed horizontal surfaces with a similar layer of the 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 0.20 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).
To estimate evaporation rate:
- Enter the chart at the appropriate air temperature. Move vertically to the relative humidity.
- Move right to the concrete temperature.
- Move down to the wind velocity.
- Move horizontally to read the approximate evaporation rate.
- 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 00540.54. 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 - Texture deck roadway surface with markings 1/8 inch to 3/16 inch deep, randomly spaced from 1/2 inch to 1 1/4 inch apart, as approved, using one of the following:

- A steel-tined tool with 1/8 inch wide tines
- A finned float, having a single row of fins, that produces grooves approximately 3/16 inch wide
- A saw that cuts grooves 0.1 inch wide. Grooving must be done after the curing duration and before the roadway is opened to traffic. Continuously remove residue from the sawing operation while grooving.

Perform the texturing operation at such time and in such a manner that the desired texture will be achieved with minimal displacement of the larger aggregate particles.

Avoid overlaps of the texturing. Make the texturing transverse to the roadway centerline and full width of the roadway except for strips 16 inches wide along curb faces, which shall be troweled smooth.

If texturing is unacceptable, use a diamond saw to correct deficiencies.

(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. The surface shall not vary more than 1/8 inch under a 12 foot straightedge. 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 seven 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 clean presoaked wet burlap or an approved wet or dry material. Do not allow water to puddle or pond on top of the concrete.
Do not interrupt curing for more than one hour during the curing period.

If temperature falls below 35 °F during the seven-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:

1. Provide wind breaks, fog spray 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 0.15 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.

2. 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, texturing and until the evaporation reducer compound has been applied. The purpose of fogging is to keep the concrete cool and prevent uneven shrinkage in the concrete before the cure is applied. Do not allow larger water droplets that drip from nozzles to fall onto the freshly finished plastic concrete.

3. Apply an evaporation reducer compound from the CPL immediately after the texturing operation. Apply the reducer with a pressurized mechanical power sprayer that will produce a fine and uniform spray at a rate of 250 square feet/gallon. Re-agitate the mixed material immediately before and during application. Wash away any reducer that comes into contact with hardened concrete surfaces. Avoid finishing concrete surface after placement of reducer.

4. Cover the concrete with a single layer of clean initial covering immediately after finishing, texturing, and applying an evaporation reducer. The initial covering shall be one continuous piece, 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. All overlaps shall be a minimum of 6 inches.

   - Non-woven, needle punched polypropylene fabric curing blanket from the CPL. Place wet or dry. Fabric shall be wetted by fogging within 15 minutes of fabric placement. All overlaps shall be a minimum of 12 inches.

5. Provide soaker hoses for additional soaking of the initial covering. Place over the full width of the concrete placement, at a maximum of 10 feet intervals. Periodically, as needed, operate the soaker hoses to re-saturate the initial covering. Other methods of re-saturating the initial cover may be submitted to the Engineer for review and approval.
(6) Place a layer of 4 mil polyethylene film over the initial covering and soaker hoses. The polyethylene film shall be clear or white 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 during the curing period.

(7) 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. The cylinders will be tested at the Contractor's expense at a recognized testing laboratory. Cure cylinders under conditions which are equivalent to the most unfavorable field conditions for the portions of the concrete which the cylinders represent.

The Contractor may remove forms and falsework or place subsequent loads when both conditions of Table 00540-1 are met.

Table 00540-1

<table>
<thead>
<tr>
<th>Form and Falsework Removal For:</th>
<th>Percent of Specified Strength</th>
<th>Counting Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side form for footings, walls, abutments, caps, traffic and pedestrian barriers, and any other side forms not supporting the concrete weight</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Columns</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Cantilevered bridge deck sidewalks</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Bridge decks supported on steel beams or precast, prestressed concrete members; top slabs of concrete box culverts</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>Crossbeams, caps, box girders, T-beam girders, and flat slab superstructures (^2)</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>Arches (^2)</td>
<td>80</td>
<td>7</td>
</tr>
</tbody>
</table>
### Part 2:

<table>
<thead>
<tr>
<th>Subsequent Loading of:</th>
<th>Percent of Specified Strength</th>
<th>Counting Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings for signal, luminaire and sign supports</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>Footings</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</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Bottom slabs of box girders</td>
<td>66</td>
<td>5</td>
</tr>
<tr>
<td>Members and falsework designed integrally to carry the additional loads</td>
<td>100</td>
<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 four 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 requirements 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 Section 00310.
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 25 miles or less by air from the Pacific Ocean.
   - Remove rock pockets and unsound concrete.
   - Fill holes and depressions with 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: 1/2 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.
Thoroughly saturate the surface with water and coat it, while damp, with a coating material conforming to 02210.30(c). Apply a minimum of two coats of coating material. 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.

(c) Class 2 Surface Finish (Ground, Floated 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. 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, thoroughly saturate the surface with water and coat it as in (b) above.

00540.54 Final Acceptance of Bridge Deck Surface - The finished bridge deck roadway surface work, when tested longitudinally and transversely with a 12 foot straightedge, shall not vary from the testing edge by more than 1/8 inch at any point. Furnish the 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 General - Concrete will be measured on either the lump sum or the volume basis, as indicated in the Schedule of Items. No deductions will be made for the volume of pile heads, metal reinforcement, scoring, chamfer strips or structural steel embedded in the concrete. Any work item covered by a pay item will be measured according to that item unless otherwise specified. There will be no separate measurement of extra concrete required where forms are omitted.

00540.81 Lump Sum Basis - Measurement will be according to 00190.10(f).

The estimated quantity of concrete for each structure will be listed in the Special Provisions. If the Engineer orders changes from the work shown, only those quantities involved in the ordered changes will be adjusted.

The concrete quantity indicated 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 estimated quantity of concrete.

There will be no separate measurement of additional concrete placed in deck buildups on top of beams to achieve the desired deck elevations.
**Volume Basis** - Measurement will include only the volume within the neat lines of the structure as shown or as revised.

**Payment**

**General** - Payment for structural concrete at the lump sum amount or at the Contract unit price will be payment in full for all materials, equipment, falsework, forms, bracing, labor, fogging, surface finish, evaporation reducer compounds, curing, joint filler, admixtures and other similar items, and all other items of expense required to complete the concrete work shown, with the exception of reinforcing steel, metal expansion joints or other metal incorporated in the work.

The cost of forms, falsework, shoring, cribbing, and similar appurtenances will be paid according to 00195.50(a-1). Supply portland cement and/or fly ash used in excess of the minimum specified at no additional cost to the City.

There will be no additional payment for extra concrete required to fill footings cast directly against rock or soil.

**Lump Sum Basis** - Payment will be for the item "Structural Concrete, Class ____" according to 00540.81. Lump sum payment for all concrete of each class required will be in effect, unless plan changes are ordered. Payment for quantities adjusted by plan changes will be according to 00195.20.

**Volume Basis** - Payment will be made at the Contract unit price per cubic yard for the item "Structural Concrete, Class ____" according to 00540.82. The class of concrete or type of structure in which it is placed will be inserted in the blank.
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 General** - Use materials meeting the requirements of Sections 00530 and 02001, modified as follows:

- Furnish Class 4350 concrete for the end panel.
- Use granular structure backfill meeting the requirements of 00520.13.
- Use Class V reinforced concrete pipe meeting the requirements of 02410.20 or ASTM A 53 (Grade B) galvanized steel pipe (1/4 inch minimum wall thickness) when pipes are shown under the end panels on the plans. Hot-dip galvanize steel pipe according to ASTM A 123/A 123M.

**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 (Certified Embankment and Base Technician)
- CDT (Certified Density Technician)
- CSTT (Concrete Strength Testing Technician)

Construction

**00545.40 General** - Perform work according to Sections 00530 and 00540 except as modified by this Section.

**00545.41 Earthwork** - Remove pavement and subgrade according to Sections 00310 and 00330.

**00545.42 Surface Finish** - For end panels with an asphalt concrete wearing surface, a finishing machine and roadway texturing are not required.

**00545.43 Curing** - Cure concrete according to 00540.51(a).
**00545.44  Expansion Joints** - Construct expansion joints at the bridge end of panels as shown, in accordance with 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 panel 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 panel are cast.

- Place asphaltic plug joints at the bridge ends a minimum of 14 days after the end panels are cast and after final paving is complete.

Saw cut the 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 saw cut 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 saw cut 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 bridge end panels in the transverse and/or diagonal direction, as well as longitudinally, as directed.

**00545.47  Bridge Rails** - Construct bridge rails on the bridge end panels as shown and according to Section 00587.

**Measurement**

**00545.80  General** - The area of reinforced concrete bridge end panels will be the number of square yards complete in place as specified and accepted. The area will be determined by surface measurement of the width and length of each separately constructed reinforced panel. Measurement will be to the nearest 0.1 foot and the area will be calculated to the nearest full square yard for each bridge.

Extra thickness of panel as shown at the panel ends will not be measured.

There will be no measurement for pipes placed under the end panel for future utilities.

Bridge rails on the bridge end panels will be measured according to 00587.80.
Payment

00545.90 General - Payment for all material, equipment, labor and incidentals required to construct the reinforced concrete bridge end panels will be made at the Contract unit price per square yard for the item "Reinforced Concrete Bridge End Panels".

Payment for saw cutting and filling the cut(s) is considered incidental and will be included in payment for the item "Reinforced Concrete Bridge End Panels".

Payment for curbs or rails placed on the end panels will be included in the Contract price for the item(s) under Section 00587.

Payment for expansion joints at the panel ends will be made at the Contract unit price per meter for the appropriate item joint seal pay item.

Furnishing and placing pipe under the end panels for future utilities, including all materials, equipment and labor is considered incidental, and will be included in payment for the item "Reinforced Concrete Bridge End Panels".

Bridge rails on the bridge end panels will be paid for according to 00587.90.

There will be no separate or additional payment for extra thickness of panels as shown at the panel ends. No additional payment will be made for required stage construction, including splices.
Section 00550 - Precast Prestressed Concrete Members

Description

00550.00 Scope - This work consists of the manufacture, storage and transportation of beams, slabs, piling or other structural concrete members, prestressed by pretensioning, and the installation of all precast prestressed members except piling, which shall be driven according to Section 00520. Precast prestressed concrete members will be referred to as members.

00550.02 Design - Essential elements of design and section dimensions for members are as shown. Current design specifications in use will be furnished by the City upon request. Submit working drawings, stressing calculations, and detensioning sequence for all members for approval according to 00150.35(m)(2), 00550.42 and 00550.51.

00550.03 Alternate Designs - The Contractor may propose another type of prestressing system or different member dimensions provided the following requirements are met:

- Submit stamped design calculations, working drawings, and specifications for all modified members according to 00150.35(m)(1) for review before member manufacture. Review will be made within 14 calendar days after all the required information has been submitted.

- The member has a load capacity the same as or greater than the City design criteria.

- Member dimensions are increased no more than 1 inch, 2 inch for bulb width, from the dimensions shown.

- No materials or members may be incorporated into the work until the proposal has been reviewed.

- Structural changes required to accommodate the alternate prestressing system or section approved are made at no additional cost to the City.

00550.04 Member Tolerances:

(a) General - Any member not fabricated within the dimensional tolerances recommended in the PCI "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products" and specified below may be rejected. Acceptance or rejection will depend on how a defect outside these tolerances will affect the structure's strength, rideability and appearance.

(b) Twist - The relative twist of member bearing surfaces between member ends shall be less than or equal to 1/16 inch/foot of bearing width measured at right angles to the centerline of the member.
00550.06  **Fabricator Certification and Qualification** - Plants producing precast prestressed concrete bridge members shall be appropriately certified under the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program. Certification in Bridge Group B3 or Bridge Group B4 is mandatory for the fabrication of prestressed straight strand bridge members, including piling. Certification in Bridge Group B4 is mandatory for the fabrication of prestressed draped strand bridge members.

**Materials**

00550.11  **General** - Use materials for members meeting the following requirements of Part 02000:

- Backer rod ................................................................. 02440.14
- Blended hydraulic cement ............................................. 02010.20
- Chemical admixtures .................................................... 02040
- Coarse aggregate ....................................................... 02690.20
- Concrete coating ....................................................... 02210.30
- Deformed bar reinforcement ......................................... 02510.10
- Epoxy and non-epoxy grouts ........................................ 02080
- Epoxy coating ............................................................ 02510.11
- Fine aggregate ........................................................... 02690.30
- Fly ash ...................................................................... 02030.10
- Keyway grout .............................................................. 02080.30
- Microsilica admixture .................................................. 02030.20
- Portland cement .......................................................... 02010.10
- Poured joint filler .......................................................... 02440.30
- Prestressing reinforcement .......................................... 02515
- Tie rods ..................................................................... 02560.30
- Water ......................................................................... 02020

00550.13  **Concrete Mix Design** - Prepare and submit either new mix designs according to 00550.13(b) and (e) or current mix designs according to 00550.13(c) and (f) for each class of concrete required. The Engineer will review the mix designs for compliance with the Specifications.

(a) **Proportioning of Concrete Mix** - The proportions for each mix design shall be determined by a CCT (see 00550.30 and 00550.15(a)). This shall include the proportions by weight of cement, water, aggregates, air-entraining agent and any other materials or admixtures to be used in the mix.

Design each concrete mix by the volumetric method as outlined in ACI 211.1 to meet the limits in 00550.14.

1. **Fly Ash** - Fly ash may be used in concrete to replace up to 20% of the cement.

2. **Blended Hydraulic Cement** - A blended hydraulic cement may be used instead of fly ash and cement provided that fly ash does not exceed 20% of the cementitious content.
(3) Chemical Admixtures - Use only admixtures from the CPL. Determine the quantity of each chemical admixture to be used in the concrete mix by trial batches before it is used in concrete produced for incorporation into the Project. This quantity may be adjusted by actual field use to obtain the qualities indicated in 00550.14. Add the chemical admixture to the concrete mix according to the manufacturer’s recommendations.

Use a water-reducing chemical admixture in all concrete.

Obtain entrained air in the concrete by the use of an air-entraining admixture.

(b) New Mix Designs - New mix designs are those which have not been used previously or do not meet the requirements of (c) for current mix designs. Make at least one trial batch for each proposed new mix design using the same materials including admixtures that will be used in the Project. Prepare and test the trial batch by casting, curing and testing cylinders for compressive strength. The Engineer may witness the preparation and testing.

(1) Plastic Concrete - Test the slump, density and air content and compute the water-cement ratio and yield for each trial batch. Slump, air content and water-cement ratio must be within specification limits and be representative of what will actually be used on the job for the trial batch to be valid.

(2) Strength Tests - Cast at least three test cylinders for each mix design according to AASHTO T 23 and cure cylinders according to 00550.16(d). Test at 28 days according to AASHTO T 22.

(3) Required Strength - The average 28-day strength of the trial batch cylinders shall exceed one of the following:

- Required Strength = Specified Strength x 1.15
- Required Strength = Specified Strength + 1.28S

Where S = Standard Deviation of 28-day cylinder strengths from a similar class (plus or minus 1,000 psi) mix design produced at the same plant. There shall be at least 10 sets of 28-day cylinders from this similar class mix design to use this option.

(c) Current Mix Designs - Propose the use of a current mix design which has been used in any previous project, public or private, within one year before actual date of use in this Project. The mix design shall meet the tolerances and limits in 00550.14 and the average of all 28-day strength tests must exceed the required strength determined from the following equation:

- Required Strength = Specified Strength + 1.28S

Where S = Standard deviation of 28-day cylinder strengths

If these requirements are not met, submit a new mix design according to 00550.13(b).
(d) Review of Mix Designs - Submit each proposed mix design to the Engineer with the information listed in 00550.13(e) or 00550.13(f). Do not proceed with concrete placement using the mix design until the Engineer has determined that it complies with the Specifications. Review of concrete mixes will not relieve the Contractor of responsibility to provide concrete conforming to the Specifications.

(e) Required Submittals for New Mix Designs - Submit the following information:

- A unique number to identify the mix design
- Mix Design Proportions - The weight per cubic yard and absolute volume of cement, fly ash, aggregates (SSD) and mix water. Indicate dosage rates of chemical admixtures.
- Materials - Identify the source of the aggregates by ODOT source number and report specific gravities, absorptions, density of coarse aggregate and fineness modulus of sand used in mix calculations. Identify type and brand of cement, fly ash, admixtures and water sources to be used.
- Reports on Plastic Concrete - Report on slump, density, air content, yield and water-cement ratio of the trial batch or batches representing this mix design.
- Compressive Strength Tests Results - Report on 28-day cylinders’ compressive strength test results for the trial batch or batches representing this mix design.
- Strength Analysis - Analyze 28-day cylinders’ compressive strengths according to 00550.13(b).

(f) Required Submittals for Current Mix Designs - If the current mix design has not been used on City projects, submit the information required for new mix designs (field tests may substitute for trial batches). If the current mix design has received a favorable review by ODOT on a previous project within the past one year only the following information is required.

1) Mix Design Identification - Identify in writing the mix design proposed for use by its unique number and ODOT number.

2) Adjustments - If mix proportions have been adjusted since the design was originally reviewed, provide the adjusted mix proportions and the reasons for the adjustments. Also note changes in cement or admixture brands.

(g) Adjusting Mix Proportions - After a mix design has been reviewed and accepted, submit any proposed adjustment to mix proportions for review. Significant changes, including any changes in cement or fly ash content, may require new trial batches at the discretion of the Engineer.

(h) Contractor 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 the Contractor's expense. Costs of City personnel monitoring or performing check tests will be paid by the City.
00550.14 Concrete Mixture Tolerances and Limits - Provide a workable concrete mixture, uniform in composition and consistency, having the following properties or limits:

<table>
<thead>
<tr>
<th>Material or Property</th>
<th>Condition When Applicable</th>
<th>Tolerances/Limits</th>
<th>Specifications or Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrained Air Members with cast-in-place deck</td>
<td>Not Required</td>
<td>N/A</td>
<td>AASHTO T 152</td>
</tr>
<tr>
<td>All other members</td>
<td>4.0% - 7.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Temperature</td>
<td>Time of Placing</td>
<td>50 °F min 90 °F max</td>
<td>ASTM C 1064</td>
</tr>
<tr>
<td>Slump</td>
<td>Time of Placing</td>
<td>5&quot; max (^1)</td>
<td>AASHTO T 119</td>
</tr>
</tbody>
</table>

\(^1\) If a high range water reducer is approved and used, increase slump to 7 inch maximum

<table>
<thead>
<tr>
<th>Concrete Class (^1)</th>
<th>Minimum Cement Content (^2) (lbs/yd)</th>
<th>Maximum Water/Cement Ratio (^3) With Air</th>
<th>No Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500</td>
<td>660</td>
<td>0.40</td>
<td>0.44</td>
</tr>
<tr>
<td>6000</td>
<td>660</td>
<td>0.40</td>
<td>0.42</td>
</tr>
<tr>
<td>7000</td>
<td>660</td>
<td>0.40</td>
<td>0.42</td>
</tr>
</tbody>
</table>

\(^1\) Designates the minimum specified strength psi at 28 days
\(^2\) Includes fly ash when used
\(^3\) If fly ash is used, water/(cement + fly ash) ratio

00550.15 Quality Control:

(a) Quality Control - Provide for quality control according to Section 00165. Perform required sampling and testing according to 00550.15(b), (c), (d), and (e).

(b) Aggregates - Stockpile each size of aggregate separately. The Certified Aggregate Technician (CAgT) shall take samples and perform the following tests on each size aggregate:
(1) Required Tests:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Aggregates</th>
<th>Start of Production</th>
<th>One per 5 Sublots¹</th>
<th>One per Sublot²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Rodded Density</td>
<td>AASHATO T 19</td>
<td>Coarse</td>
<td>X (at least annually)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk Specific Gravity and Absorption</td>
<td>AASHTO T 84</td>
<td>Fine</td>
<td>X (at least annually)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Particles</td>
<td>ODOT TM 225</td>
<td>Coarse</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Elongated Pieces³</td>
<td>ODOT TM 229</td>
<td>Coarse</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fineness Modulus²</td>
<td>ODOT TM 771</td>
<td>Fine</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sand Equivalent²</td>
<td>AASHTO T176</td>
<td>Fine</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sieve Analysis²</td>
<td>AASHTO T 27</td>
<td>All</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

¹ Sublot: 1500 tons
² Perform at least three tests per project
³ Aggregates only

(2) Split Samples - Provide split samples to the Engineer.

(3) Engineer Testing - The Engineer may perform any of the above testing under (b)(1) and additional tests such as lightweight pieces, soundness, degradation, abrasion and organic impurities. The test results will be provided to the Contractor.

(4) Removal of Failing Material - Immediately perform a second test from Contractor's portion of split sample whenever a test result, other than sieve analysis and sand equivalent, does not meet specification. If the second test result does not meet specification remove all failing material from the stockpile and make the appropriate operational adjustments before continuing production. Refer to 00550.16(a)(2) relative to non-specification aggregate gradation and sand equivalent.

(5) Preproduced Aggregate - Compliance of aggregates produced and stockpiled before the award date of the Contract will be determined by (a) or (b) following:

a. Submit continuing production records meeting the requirements of 00550.15(b)(1) through (b)(4).
b. Sample according to AASHTO T 2 and furnish records of testing for the entire stockpile for the tests required in 00550.15(b)(1) except change the sampling frequency schedule to:

- "Start of Production" means "One Set of Tests per Stockpile."
- "One per five Sublots" means "One Set of Tests per 5000 cubic yards."
- "One per Sublot" means "One Set of Tests per 1000 cubic yards," with a minimum of three sets of tests per project.
- One stockpile sample shall be required for each set of tests required above.

(c) Plastic Concrete - Sample and test the plastic concrete, by the QCT, according to the following tests:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Concrete Specimens in the Field</td>
<td>AASHTO T23</td>
</tr>
<tr>
<td>Sampling Fresh Concrete</td>
<td>AASHTO T 141</td>
</tr>
<tr>
<td>Slump</td>
<td>AASHTO T 119</td>
</tr>
<tr>
<td>Cement Content/Density</td>
<td>AASHTO T 121</td>
</tr>
<tr>
<td>Air Content</td>
<td>AASHTO T 152</td>
</tr>
<tr>
<td>Water-cement Ratio</td>
<td>ODOT TM 729</td>
</tr>
<tr>
<td>Concrete Temperature</td>
<td>ASTM C 1064</td>
</tr>
</tbody>
</table>

(d) Mix Control and Documentation - CCT's Duties:

(1) Before Batching - Before batching is started and at any time there is a visible change in the moisture content of the aggregate:

- Test fine aggregate for total moisture content, initially according to AASHTO T 255. Subsequent testing may be by an alternate method approved by the Engineer.
- Visually inspect the coarse aggregates for moisture content.
- Calculate the amount of free water present in the aggregate and adjust the batch proportions accordingly.
- Calculate the total allowable amount of water, including liquid admixtures and free water in the aggregates, for each batch; determine the amount of water added during batching; determine the allowable maximum amount of water that can be added after batching; and record these on the ticket.
(2) Batching:

- Make sure all water is removed from the hauling equipment before each loading.
- Send a ticket with each load on which the Contractor's batch person records and attests to the ODOT mix design number, day, time of batch(es), size of load and quantity of individual constituents in the load.
- Reject the load if the materials in any load are outside the specified limits of the mix proportions.
- Require the hauling equipment driver to record and initial on the ticket the amounts of water added in transit and at the jobsite.

(e) Other Sampling and Testing Procedures - As a minimum, test the mix temperature, air content and slump, by the QCT, on the first load for each bed, when there is a visible change in the mix, and when a set of cylinders is obtained.

Stop placement of the load if the results of any test are outside the specification limits. Correct the load as approved, or reject it and do not incorporate it into the work. Test subsequent loads and correct if outside 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 specified frequency when the test results from two successive loads meet the specification limits.

00550.16 Acceptance of Concrete - Acceptance of concrete will be determined by the Engineer according to (a) through (d).

(a) Aggregate - Acceptance of aggregate will be based on the Contractor's quality control testing as required in Section 00165 and 00550.15(b).

(1) Aggregate Gradation and Sand Equivalent - A stockpile contains specification aggregate gradation and sand equivalent when the Quality Level (QL) for each sieve size and sand equivalent calculated according to 00165.40 is equal to or greater than the QL indicated in Table 00165-2 for a Pay Factor of 1.00. Each required sample represents a sublot. When the QL indicated in Table 00165-2 yields a Pay Factor of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation and Sand Equivalent - Stockpiled aggregates that contain non-specification aggregate gradation and sand equivalent will be rejected unless 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 QL for each constituent is equal to or greater than the QL in Table 00165-2 for a 1.00 PF.

(3) Verification Testing - Compliance will be verified by check tests and other tests performed by the Engineer. If check tests of the Contractor's tests are not within the allowable tolerances given in the City's standard procedures, immediately work with the Engineer to resolve the difference in an attempt to avoid having this material rejected for not meeting the Specification. Material not meeting the Specifications based on tests performed by the Engineer will be rejected.
(4) **Materials on Hand** - Payment for stockpiled materials on hand will not be allowed.

(b) **Plastic Concrete** - Acceptance of the plastic concrete will be based on tests performed by the QCT according to 00550.15(c). The Engineer may:

1. Reject any non-specification material not already rejected by the Contractor according to 00165.50 and, if necessary, suspend operations according to 00180.70.

2. Assess any non-specification material incorporated in the work and determine the appropriate price reduction, or order its removal from the work according to 00150.80(g).

(c) **Manufacture** - Prestressed concrete members will be inspected during fabrication for compliance with the Specifications.

(d) **Hardened Concrete**:

1. **General** - Acceptance of hardened concrete will be based on analysis of 28-day compression strength tests of cylinders cast and cured by the Contractor’s QCT and tested by the City.

2. **Sampling and Testing** - Obtain a sample from a delivery vehicle, selected at random, during placement of each bed. Test the sample for temperature, slump, density and air content and cast at least three cylinders for testing at 28 days by the City. Initial curing of the acceptance cylinders shall be in a manner similar to the members they represent. In lieu of curing with the members, 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 per AASHTO T 23.

3. **Strength Test Value** - The average of the 28-day compressive strength tests of the three cylinders will constitute the Actual Strength Test Value (ASTV).

   If the compressive strength of any cylinder in a set is more than 10% lower than the average strength of the remaining cylinders in the set, that cylinder strength value will be discarded, and the average of the remaining cylinders will comprise the ASTV.

4. **Low Strength Procedures** - Any set of concrete cylinders that has an ASTV less than the specified design strength for the class of concrete shown will be reviewed by the Engineer to determine if the member is acceptable. Concrete that has an ASTV less than 85% of the specified design strength will not be accepted. The cost of removal, replacement, and all related work shall be the Contractor's responsibility.

   If found to be acceptable, concrete represented by cylinders that have an ASTV less than the specified design strength for the class of concrete shown will be subject to a price adjustment according to 00150.80(g).
Equipment

00550.20 Batch Plant - Provide a batch plant conforming to the requirements of 00540.20.

00550.21 Mixers - Mix concrete in mixers conforming to the requirements of 00540.21.

00550.23 Hauling Equipment - Transport concrete in hauling equipment conforming to AASHTO M 157, paragraph 11.6 or section 12.

00550.24 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.

Recalibration will be required annually or at any time it appears to the Engineer that the equipment is producing erratic results.

00550.25 Vibrators - Vibrators shall be:

- An internal or an external type
- In working condition to meet manufacturer’s rating

Internal vibrators shall be fitted with a resilient covering to minimize damage to epoxy coated reinforcement.

Labor

00550.30 Quality Control Personnel - Provide a Concrete Control Technician (CCT), a Quality Control Technician (QCT), and Certified Aggregate Technician (CAgT), each certified by an accredited organization. A list of the accredited organizations may be obtained from the Engineer. If there are none, the City will certify qualified technicians.

Certification is required before the technicians are allowed to work on the project. Allow at least 14 days for the certification process to be completed by the City if there are no accredited certification organizations.

(a) CCT’s Duties - The CCT is responsible to:

- Develop the concrete mix designs for the project
- Instruct the plant control personnel how to adjust the batch proportions of the ingredients required to maintain the proper water-cement ratio, cement content, air content and aggregate proportions to produce the specified concrete.
- Perform the duties required by 00550.15(d)
- Be present at the plant to supervise control or adjustment of the mix when concrete is placed
(b) **QCT's Duties** - The QCT is responsible to:

- Be at the placement bed when placement is in progress
- Sample and test the concrete as required by 00550.15(c) and (e)
- Reject concrete not complying with the Specifications
- Notify the CCT of rejected loads and the reason for rejection

(c) **CAgT's Duties** - The CAgT is responsible to sample and test aggregates as required by 00550.15(b).

**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.

Retighten forms before depositing new concrete on or against hardened concrete.

If using a release agent, treat forms with an agent that is not detrimental to the concrete and is kept off of strands and reinforcement.

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, who shall supervise the work and assist the Engineer.
- Hold the prestressing elements accurately in position and stress by jacks that meet the requirements of 00550.24.
- Determine the force induced in these elements by measurement of elongation and, independently, by direct measurement of force using a pressure gauge dynamometer and/or load cell. If the difference in force determination, for the two methods, exceeds 5%, determine the cause and correct it.
- Check strand elongation on the first and last strands, and on at least 10% of the other strands in the bed.
• Keep a record of 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 Handling, Measuring, and Batching of Materials - Handle, measure and batch concrete materials according to 00540.46.

00550.44 Mixing Concrete - Mix the concrete at a batch plant or in a truck mixer as follows:

• Charge a new batch into an empty drum.

• Do not intermix batches.

• Keep the skip and the throats of drums free of accumulations.

• Do not re-temper concrete by adding water.

• Use a mixing time for batch plant mixers of 60 seconds for mixers of 1 cubic yard capacity or less. Increase mixing time by 15 seconds for each cubic yard, or fraction, of increased capacity. For truck mixers use 70 to 100 revolutions at a mixing speed recommended by the manufacturer of truck mixer.

• Mixing time may also be established by uniformity tests according to procedures in AASHTO M 157, Annex A1, Concrete Uniformity Requirements.

00550.45 Handling and Placing Concrete:

(a) General - Handle and place concrete so that the produced members are uniform and monolithic, free from cold joints.

In preparation for placing the concrete, prepare the 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.

Do not deposit concrete in the forms until the Engineer has inspected and approved the placement of reinforcement, conduit, anchorages and prestressing steel.

Handle and place concrete close to its final position, without segregation of the materials or displacement of the reinforcement.

(b) Consolidation of Concrete - Consolidate the 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.

00550.46  Concreting in Hot or Cold Weather - Produce and place concrete within the temperature range specified in 00550.14. 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, steel or appurtenances when the temperature of these facilities is below 40 °F. Provide steam, heat or other means to maintain their temperature at 50 °F minimum.

• Form temperature shall be below 100 °F before concrete placement.

00550.47  Curing - Cure members with low-pressure steam or radiant heat inside a suitable enclosure to contain the live 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.

• The curing temperature within the enclosure shall not exceed 160 °F. During the initial application of live steam or radiant heat, the temperature within the enclosure shall not increase at a rate exceeding 40 °F per hour.

(2) Measuring Concrete Temperature:

• Embed a thermocouple 6 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.

• The concrete temperature shall not exceed 190 °F. During the initial application of live steam or radiant heat, the concrete temperature shall not increase at a rate exceeding 80 °F per hour.

Throughout the setting and curing periods, keep any unformed surface continually moist by fogging, covering with moist burlap or by covering with an impermeable cover.
(b) Curing with Low-Pressure Steam:

- Make the initial application of steam after initial set of concrete as determined by 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 to prevent loss of moisture and to provide moisture for proper hydration of cement.
- 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, or closer if necessary, to keep the units being cured completely and uniformly surrounded with live 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. Pipes, blankets or heating elements shall not be in contact with concrete, form surfaces, or test cylinders.

00550.48 Release of Prestress - Do not transfer bond stress to the concrete, or release end anchors, until the concrete has attained a compressive strength of at least the minimum 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.

Detension the strands immediately following the curing period while the concrete is still warm and moist.

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 T 23. Retain at least two cylinders to test, for verification of the release strength, when the Engineer arrives at the plant.

The Contractor may use independent testing laboratories by obtaining prior approval or may use on-site testing apparatus if it has been calibrated against the City approved standard. Recalibration will be required annually or at any time that it appears that the apparatus is producing erratic or unsatisfactory results.

00550.49 Surface Finish - Apply the specified finish to each surface as shown or specified.

Where no finish is shown or specified, provide a general surface finish except on the tops of members. Surfaces to receive a Class 1 surface finish (ground and coated) shall receive that finish when in final position and shall be finished to a point 1 foot below finished ground line. Provide a uniform surface finish on the exposed surfaces of piling.
Provide a roadway finish on the tops of members, except piling. After the concrete has been struck to grade and cross section, float if necessary, 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. Avoid overlaps of the texturing. Make markings transverse to the roadway centerline and full member width.

(a) General Surface Finish - Apply general surface finish as a final finish or preparatory to a higher class finish.

Remove strands in members, except piling and 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.

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, uniform texture, lines, and appearance.

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 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 two coats of coating material. The second coat may be applied at any time after the previous coat, when touched lightly, 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 help achieve a uniform surface.

00550.50 Exposed Reinforcement - When a member is removed from the casting bed, clean projecting reinforcement and protect it from dirt, oil, grease, rust, corrosives and damage until concrete is cast around it.

00550.51 Lifting, Storage and Transportation - Working drawing review of member details by the Engineer will not include review of lifting, storage and transporting details. Lifting, storage and transporting the members is the sole responsibility of the Contractor subject to the following requirements:
(a) Lifting:

- Lift members so as to prevent damage.
- Lift members, except piling, at support points less than 24 inches from the member ends.
- Lift piles so as to protect them from fractures by impact and undue bending stresses. Do not handle or stress any pile until test cylinders reach a strength of at least 3,600 psi. Handle so the stress in the reinforcement is not more than 12,000 psi. Make an allowance of twice the calculated load for impact and shock effects. Lift piles with bridles or slings not more than 20 feet apart nor more than 10 feet from pile ends. Take care to avoid damaging the surface of any pile. When storing, support piles at the same lift support points.
- 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 seven calendar days after casting, not less than seven days after all concrete patching and repairing is complete, and after 28-day compressive strengths have been achieved.

- Extra 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.
- These 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 beams only.
- The stress from the 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.
- Pretensioned strands shall require the forming of a hole in the beam at each end of the debonded length, so the strand can be cut for detensioning. These holes shall be free draining and patched after detensioning. The detensioned strands may be left in place.
- Post-tensioned 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 depth. The detensioned strands may be left in place.
• Submit for review stamped calculations, according to 00150.35(m)(1), that predict the effect of the temporary strands on initial and long term beam camber.

Payment for this work is included in payment for the applicable pay item.

Damaged members will be rejected and shall be replaced by the Contractor or repaired to the Engineer's satisfaction at the Contractor's expense.

00550.52 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 a 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 on the plans. A nil gap is defined as a gap when the number of spaces between the protrusions of direct tension indicator in which the 0.005 inch feeler gage is refused at each tie rod equals or exceeds 2, 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.

00550.53 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 from 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 beams), 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 before grouting as shown.

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 the grout for the period of time indicated by the manufacturer or 72 hours, whichever is greater.

00550.54 Poured Joint Filler for Integral Deck Members with Asphalt Concrete 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 the exposed keyway walls. After keyway grout is fully cured, dry surfaces to be sealed immediately before installing the 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.
00550.55 Differential Camber Correction for Integral Deck Members with No Asphalt Concrete 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, at the Contractor's expense, by either patching with an epoxy or non-epoxy grout deck patching material from the CPL, or other approved method. Before patching, clean the area by sandblasting. Water cure the patch for the period of time indicated by the manufacturer or 72 hours, whichever is greater. If patching is used, slope it away from the joint on a 1V:6H slope or flatter.

Measurement

00550.80 General - The quantity measured will be the sum of the horizontal lengths shown on the plans for each type and size of member completed, installed and accepted. Each member includes the reinforcement, prestressing steel, enclosures for post-tensioning steel, anchorages, plates, nuts, and all other material contained within the member. Field measurement of each member length will not be required. The quantity for payment will be the theoretical horizontal length shown in the plans, unless changes are ordered in writing by the Engineer. The theoretical horizontal lengths are shown to the nearest 0.1 foot, and are added together for a total for each member type which is then rounded to the nearest foot.

Piling will be measured according to Section 00520.

The Schedule of Items will list each member type with the corresponding total sum of each member type, measured from out-to-out along centerline of each member to the nearest horizontal foot. Furnish members with the appropriate lengths as shown on the plans.
Payment

**00550.90 General** - Payment at the Contract price per unit of measurement for the applicable pay items, according to 00550.91, will be payment in full for all materials, equipment, labor and incidentals necessary to complete work as specified, including the following work:

- Furnishing, hauling, 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 Pay Items** - Accepted pay quantities, determined according to 00550.80, will be paid for at the applicable Contract price per unit of measurement for each of the following pay items in the Schedule of Items.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Precast Prestressed Beams</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Precast Prestressed Slabs</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Precast Prestressed Box Beams</td>
<td>Foot</td>
</tr>
</tbody>
</table>

In item (a) above, the type and depth of beam will be inserted.

In item (b) above, the slab depth will be inserted.

In item (c) above, the beam depth will be inserted.

**00550.92 Piling** - Prestressed concrete piling will be paid for according to Section 00520.

**00550.93 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 post-tensioning method will be referred to as member.

Provide a person, skilled in the use of the system of stressing to be used, who shall supervise the work and assist the Engineer.

00555.03 Anchoring Devices Design - Secure all post-tensioned stressing steel at the ends by means of approved permanent type anchoring devices. Design anchoring devices to have concrete directly under the plate or assembly with bearing compressive stress not exceeding 3,000 psi.

Anchoring devices shall be capable of developing 95% of the ultimate tensile strength of the tendon without measurable permanent distortion of the assembly and without concrete failure in the test block. Measurable permanent distortion of the anchorage is defined as a distortion across the face of the assembly of 0.01 inch or more, using the original plane as a reference, when measured after release of the test loading. Concrete cracking in the local anchor zone of the anchorage will be acceptable if there are:

- No visible concrete cracks with a test load of 40% of tendon ultimate tensile strength
- No concrete cracks exceeding 0.005 inch width with a test load of 70% of tendon ultimate tensile strength
- No concrete cracks exceeding 0.015 inch width after loading to 95% of tendon ultimate tensile strength, and after releasing the test load

Assure all parts of the anchoring device have at least 2 inches of concrete cover unless a greater cover is shown.

Submit a certified test report for each size and type of anchoring device showing that the device meets 00555.40(b) and the above requirements. The certification shall include a statement that the design, materials and manufacture of the anchorage has not changed since testing. The concrete strength test block dimensions and amount of reinforcing must not be greater than proposed for the Project.

Should the Contractor elect to furnish an anchoring device of a type which is sufficiently large, and which is used in conjunction with a steel grillage embedded in the concrete that effectively distributes the compressive stresses to the concrete, the steel distribution plates or assemblies may be omitted, subject to the above testing requirements.

Anchoring devices which are currently approved for use by the California Department of Transportation may be approved without testing provided that similarity of product and application is verified.
Materials

00555.10 General - The materials for stressing shall meet the following requirements:

- Anchorages .......................................................... 02530 and 02540
- Couplings ............................................................. 02515.60
- Seven-Wire Strand Epoxy Coated Reinforcement .......... 02525.40
- Tendon duct .......................................................... 02515.50

00555.11 Stressing Steel - Provide 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

00555.12 Tendon Grout - For grouting post tensioning ducts, provide a commercial, pre-packaged, thixotropic tendon grout according to 02080.50. Label each grout bag with application, date of manufacture, lot number, and mixing and pumping instructions. Use commercial, pre-packaged thixotropic grout, within six months of the manufacture date.

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 pre-packaged 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 in the project at least 48 hours before grouting.

Perform the following tests:

(a) Flow Cone - Determine the efflux time at 0 quiescent time according to ASTM C939 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 for a one quart discharge.

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 for a one quart discharge.

(b) Bleeding - Determine wick induced bleeding according to ASTM C 940 as modified by Post Tensioning Institute (PTI) guide specifications except limit the maximum allowable bleed to 0.0% at three 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 two 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's personnel with City-furnished load cells. Make certification 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 thixotropic grout.

- Accessory equipment which will accurately measure solids and liquids to be batched

- An easily accessible screen before the grout pump with clear openings of 1/8 inch maximum size
• A grout pump capable of producing a pressure of 75 psi, with a pressure gauge reading from 0 - 300 psi, and with a relief valve that will limit grouting pressures to less than 200 psi.

Provide a secondary holding and agitating tank of approximately the same volume as the primary holding and agitating tank. Paddle style mixers are acceptable for secondary holding and agitating tank. Paddle style mixers are not to be used in place of high speed, high shear mechanical grout mixers.

• 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

00555.30 Labor - Provide an American Bridge Institute (ASBI) certified grouting technician to supervise, inspect, and document the entire grouting operation.

Construction

00555.40 Required Submittals:

(a) Working Drawings and Calculations - Submit stamped working drawings and calculations for post-tensioning systems to the Engineer for review according to 00150.35(m)(1).

(b) Review of Methods - Submit for review complete details of the materials, equipment, method and sequence proposed for the stressing operations, including:

• Additions or rearrangement of reinforcing steel or changes in member dimensions from that shown
• Working stresses, anchoring stresses and all other data pertaining to the stressing operation
• Complete specifications and details of the ducts, stressing steel including arrangement and alignment, and the anchoring devices
• Pressure grouting materials and equipment

Furnish the reinforcement bar supplier a copy of the reviewed stressing operation details.

Do not cast any member to be stressed before shop details 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 the 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 comparable 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 in the forms, 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 or other results of corrosion at any time will be rejected. If rust spots can be removed by rubbing or scraping with the fingernail, or if light streaks of rust remain, the steel is acceptable if pitting is not present.

(b) **Working Force and Stress** - Consider working force and working stress as the force and stress remaining in the stressing steel after all losses, including elastic compression, creep and shrinkage of concrete, creep of steel, losses in stressing steel due to sequence of stressing, friction and take up of anchorages, and all other losses peculiar to the stressing method or system have taken place or have been provided for.
Tension stressing steel by means of hydraulic jacks so the force in the stressing steel is not less than the value shown.

Unless otherwise specified or shown:

- The working stress in the stressing steel shall not exceed 80% of the yield point stress \( (f_y) \) of the stressing steel.

- The temporary tensile stress (jacking stress) in the stressing steel shall not exceed 75% the ultimate strength of stressing steel \( (f'_s) \).

- The initial stress after anchor set shall not exceed 70% of \( f'_s \).

Assume the loss in stress in stressing steel due to creep and shrinkage of concrete, creep of steel and sequence of stressing to be 25,000 psi unless otherwise specified.

Estimate friction loss using the following formula:

\[
T_o = T_x e^{(K \lambda + \mu \alpha)}
\]

Where:

- \( T_o \) = Stressing steel stress at jacking end.
- \( T_x \) = Stressing steel stress at any point \( x \).
- \( e \) = Base of Napierian logarithms.
- \( K \) = Friction wobble coefficient.
- \( \lambda \) = Length of stressing steel from jacking end to point \( x \).
- \( \mu \) = Friction curvature coefficient.
- \( \alpha \) = Total angular change of stressing steel profile, in radians, from jacking end to point \( x \).

Use coefficients \( K \) and \( \mu \) as shown or approved.

(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 four 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 shall in no way relieve the Contractor of full responsibility for successfully constructing the members.

(d) Procedures - Tension stressing tendons by jacking at each end of the tendon unless otherwise noted.

(1) Continuous Post-tensioned Members - Such jacking of both ends need not be done simultaneously. Subject to prior written approval, bent cap tendons may be tensioned by jacking from one end only.
(2) **Simple Span Post-tensioned Members** - If jacking from one end only is allowed, then half of the stressing steel in each member shall be tensioned from one end of the span and the other half from the opposite end, unless otherwise permitted in writing.

(e) **Measuring Pre-stressing 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 pre-stressing force by both of the following methods:

1. **Measurement of Strand Elongation** - Determine required elongation from average load-elongation curves for pre-stressing 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.

(f) **Stressing Steel Alignment** - Provide horizontal and vertical alignment as follows:

1. **Horizontal Alignment** - The horizontal center of gravity of the stressing steel is the centerline of each girder stem within a tolerance of ± 1/2 inch.

2. **Vertical Alignment** - The vertical center of gravity of the stressing steel is the profile shown within a tolerance of ± 3/8 inch.

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. 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 with 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** - Coat anchor heads and prestressing strand ends with an epoxy bonding agent from the CPL after post tensioning stressing operations and before post tensioning duct grouting. Cut post tensioning strands 1 inch beyond wedges after stressing operations. Prepare post tensioning blockouts according to 00540.43 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 wash out a partially grouted tendon.

Maintain a water-cement ratio of not more than 0.42. Do not re-temper grout. Continuously agitate grout until it is pumped.
**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 devices.

Grout from the low end of the structure.

Keep the temperature of the concrete surrounding the duct 35 °F or higher at the time of grouting and until job-cured grout cubes reach 800 psi compressive strength.

Maintain grout temperature at least 50 °F but less than 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 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 pipe until:

- No visible slugs of water or air are ejected
- The efflux 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 pipe 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 a bonding agent from the CPL.
Measurement

00555.80 Lump Sum Basis - Measurement will be on the lump sum basis according to 00190.10. The Special Provisions will show an estimate of quantities for the purpose of providing a basis for adjustment of payment in the event that changes in the work are ordered. Estimated quantities are approximate and the bidder will be responsible to determine actual quantities required. If no changes are made in the work, there will be no measurement of the work.

If changes are ordered, the adjustment will apply only to those quantities involved in the plan changes ordered.

Payment

00555.90 Lump Sum Basis - Payment for post-tensioning will be made at the lump sum amount for the item "Post-Tensioning", which will include the furnishing of all materials, equipment, labor and incidentals necessary to perform all work required in stressing the concrete, including anchorages, ducts, tendons, pre-stress bars, cables, wires, grout and admixtures. Payment includes preparation and testing of grout.

If the Engineer orders plan changes, payment for quantities involved in the plan changes will be made according to 00190.10.
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, metal bridge drain pipes, scuppers, conduits, ducts, bearing devices and structural steel shapes.

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.

00560.03 Working Drawings - Submit 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 must be 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 General - Provide structural plates, shapes, bars and miscellaneous metals conforming to Sections 02530 and 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 - It is agreed that 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 for out-of-State inspection expenses according to 00165.91.
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 00165.60 and Section 02530. Identify each piece of steel to be fabricated.

Identify on working drawings each piece to be made of steel other than ASTM A 709/A 709M, 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 ASTM A 709/A 709M, 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 ASTM A 6/A 6M specification identification color code.

(b) Steel Identification during Fabrication - During fabrication, and until member assembly, each piece of steel, other than ASTM A 709/A 709M, Grade 36 steel, shall show clearly and legibly its specification identification color code shown in ASTM A 6/A 6M.

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 ASTM A 709/A 709M, Grade 36, with the ASTM A 6/A 6M specification identification color code before cutting to a smaller size.

Mark individual pieces of steel, other than ASTM A 709/A 709M, Grade 36 steel, which are furnished in tagged lifts or bundles with the ASTM A 6/A 6M specification identification color code immediately on being removed from the bundle or lift.

Pieces of steel, other than ASTM A 709/A 709M, 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 dropoffs or scrap material as deemed necessary. No more than two samples will be required from any one plate, 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 plate, shape or bar.

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 expense 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 permitted on two 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 must 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.
(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 and/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 permitted.
- Bent so no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are:

<table>
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<tr>
<th>Plate Thickness in Inches</th>
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<td>Up to 1/2</td>
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All grades of structural steel in this Specification

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 sign supports, luminaire poles, traffic signal poles, bridge railing posts, railing splices, deck expansion joints, maintenance walkways, 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 must 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, sub-punched, or sub-drilled 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 six 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 five 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 sub-punching and reaming are required by these specifications.

When there are more than five 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), sub-punch 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:

- Sub-punch or sub-drill 3/16 inch smaller than the nominal diameter of the bolt and ream, while assembled,

- Drill to a steel template, or

- Drill from the solid after assembling.

(h) **Holes for Field Connections**:  

(1) **Sub-punching and Reaming Field Connections** - Unless otherwise specified, sub-punch (or sub-drill if sub-drilling is required according to 00560.27(f) or (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 00560.33. Holes for field splices of rolled beam stringers continuous over floor beams or crossframes may be drilled full size unassembled to a steel template.

Sub-punch 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 sub-punching and reaming or sub-drilling 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 (N/C) Punched or Drilled Field Connections -
Alternately, for any connection or splice designated in 00560.27(f), instead of sub-punching and reaming field connections according to 00560.27(h), the Contractor may punch or drill bolt holes full-size in unassembled pieces and/or connections, including templates, for use with matching subsized and reamed holes by means of suitable numerically controlled (N/C) punching or drilling equipment subject to this article. 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 N/C 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 N/C 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 N/C 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 00560.33.

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.
00560.28(b)

- 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 bolthead) 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 ASTM A 325 or equivalent fasteners 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 miles, by air, from 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 miles, by air, 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 in conformance with 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 permitted.

(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 re-lubricate 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 ASTM A325 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 three 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>Table 00560-1</th>
<th>Nominal Bolt Size, inch</th>
<th>Minimum Tension kips</th>
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<tr>
<td>1/2</td>
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<tr>
<td>5/8</td>
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<td>1 1/4</td>
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<td>1 3/8</td>
<td>85</td>
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<tr>
<td>1 1/2</td>
<td>103</td>
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</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 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 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.

(3) Direct Tension Indicators (DTI's):

a. General - When direct tension indicators (DTI's) are used to indicate bolt tension, they shall be subjected to verification testing as described below and installed in accordance with the method specified below. Unless otherwise directed, the DTI's 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 DTI and additional washers, if any, required for the correct use of the DTI. 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 two stages. The bolt, nut, and DTI assembly shall be installed in such a manner that at least three, and preferably not more than five, 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 two-thirds 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 DTI’s 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 DTI’s 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 run out. 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 percent 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 must 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 DTI’s in two 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 DTI 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 DTI’s 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 DTI's under the turned element, the feeler gauge shall be refused in all spaces.

<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 DTI's under a stationary element. The maximum number of Verification Refusals for galvanized DTI's under a turned element shall be no more than the number of spaces on the DTI less one.

Minimum Installation Refusals are for galvanized DTI's under a stationary element. The gauge shall be refused in all spaces when galvanized DTI's 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 five 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 and of bolt)</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>
</tr>
<tr>
<td>Over 4 diameters but not exceeding 8 diameters</td>
<td>1/2 turn</td>
<td>2/3 turn</td>
</tr>
<tr>
<td>Over 8 diameters but not exceeding 12 diameters</td>
<td>2/3 turn</td>
<td>5/6 turn</td>
</tr>
<tr>
<td>1 Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by one-half turn and less, the tolerance shall be plus or minus 30°; for bolts installed by two-thirds turn and more, the tolerance shall be plus or minus 45°.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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 must be determined by actual test in a suitable tension measuring device according to 00560.29(c)(5).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(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 DTI’s if used, and the faying surfaces of joints for compliance with 00560.29(c)(1). The Engineer will observe calibration and/or testing procedures required in 00560.29(c)(2) through (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 ten percent (at least two) 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. Re-tension and re-inspect any bolt whose head or nut turns at this stage. The Contractor may, however, re-tension 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, saw-cut 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 two 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</td>
<td></td>
</tr>
<tr>
<td>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 (N/C) punched or drilled field connections and template drilled field connections of rolled beam stringers continuous over floor beams or cross frames according to 00560.33(g).

Obtain approval for each assembly, including camber, alignment, accuracy of holes and fit of milled joints before reaming is commenced or before an N/C 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 on the plans 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(m)(1). The review will not relieve the Contractor of responsibility for safe transportation of steel members.

00560.46 Erection:

(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 accordance with 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 Inspection and Testing - All erection 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 00560.36.

(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.

Finishing and Cleaning Up

00560.70   Finish (Non-Coated Weathering Steel Only) - Sandblast all exposed
surfaces of ASTM A 709/A 709M, Grade 50W non-coated weathering steel, in accordance
with 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 permitted.

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   General - The estimated quantity of structural steel to be paid for on the
lump sum basis will be shown in the Special Provisions.

No separate measurement will be made for bolts, studs or bearing devices made entirely of
structural steel (such as rockers and hinges) as the cost of these items is incidental to the
structural steel work.
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.

Unless otherwise specified, standard metal pipe attached to, or used in conjunction with, structure deck drains or catch basins 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 **General** - Payment for structural steel measured on the lump sum basis will be made at the Contract lump sum amount for the item "Structural Steel". The lump sum payment for all structural steel required will be in effect unless plan changes are ordered. Payment for quantities involved in Plan changes will be made according to 00195.20.

Payment for structural steel at the Contract lump sum amount, plus or minus adjustments, if any, will be payment in full for furnishing, fabricating, transporting and erecting the structure(s); for furnishing, erecting, and removing falsework; and for preparing and coating. This includes all materials, equipment, labor and Incidentals necessary to complete the work.
Section 00570 - Timber Structures

Description

00570.00 Scope - This work consists of furnishing and installing timber and glue-laminated timber in bridges, including lumber, all castings, hardware, fastenings, preservative treatment, coatings and other items necessary for the completed work. When preservative treatment of timber is required, the plans or Special Provisions will indicate the type and kind of treatment. Timber and lumber will be referred to as timber.

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 General - Use materials meeting the following requirements:

Connectors and fasteners ..............................................................02150
Driven piles ..................................................................................00520
Galvanizing ..................................................................................02530.70
Glued laminated timber .................................................................02140
Preservative treatment ....................................................................02190
Coatings for steel ...........................................................................00594
Timber ............................................................................................02130

00570.11 Metal Parts - Hot-dip galvanize all hardware and all other metal parts after fabrication according to 02530.70.

00570.12 Timber Connectors:

- 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 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 1/16 inch larger than the bolt diameter if in treated material and 1/16 inch smaller in untreated material.

- Submit for review material dimensions and details not otherwise shown or specified.

00570.13 Timber Storage - Store timber on the site in orderly piles or stacks. Provide protection from the weather by a suitable covering when necessary.

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.

Store timber after fabrication in a manner that prevents alignment changes of the members before assembly.
Store and protect glue-laminated timber according to the recommendations for Loading and Handling, Job Site Storage, and Erection in 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 carefully without dropping, breaking of outer fibers, bruising or penetrating the surface with tools. Use rope slings to handle treated timber. Do not use cant hooks, peaveys, pikes or hooks.

Do not cut, frame, or bore treated timber after treatment unless absolutely necessary. When treated timbers are to be placed in water infested by marine borers, no untreated cuts, borings and other joint framings below high-water elevation will be permitted.

Carefully trim all cuts and abrasions in timber, and cover with two applications of a field preservative conforming to 02190.30.

Pour field preservative into all bolt-holes bored after treatment, or treat such holes with field preservative conforming to 02190.30 by means of an approved pressure bolt-hole treater. Treat any unfilled holes with field preservative and plug with treated plugs.

Whenever 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 bolt holes.

Drive nails and spikes with just 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.

00570.41 Bolts, Dowels, Rods and Lag Screws:

- Bore holes for drift pins, bolts or dowels with a bit 1/16 inch smaller in diameter than the pin, bolt, or dowel.

- Bore holes for truss rods with a bit 1/16 inch larger than the rod.

- Bore holes for lag screws in two parts:
  1. Bore the lead hole for the shank the same diameter as the shank and the same depth as the length of the unthreaded shank.
  2. Bore the lead hole for the threaded portion a diameter equal to approximately two-thirds of the shank diameter.
Use a 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 wherever smooth faces are required. Coat horizontal recesses formed for countersinking with field preservative conforming to 02190.30 and, after the bolt or screw is in place, fill with asphalt roofing cement.

**00570.42 Framing** - Accurately cut and frame all timber to a close fit in such manner that the joints have even bearing over the entire contact surfaces. Make mortises true to size for their full depth, and make tenons fit snugly. No shimming will be permitted in making joints, nor will open joints be accepted.

(a) **Pile Bents** - Drive piles according to Section 00520. No shimming on tops of piles will be permitted.

Carefully select the piles for any one bent as to size, to avoid undue bending or distortion of the sway bracing.

Exercise care in the distribution of 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. Carefully finish concrete pedestals so the sills or posts support framed bents with even bearing.

Fasten posts to sills as shown. When possible, remove all earth from contact with sills 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 as shown.

**00570.43 Stringers** - Place stringers according to the following:

- Place stringers so 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 by drift bolting 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 of 4" x 12" planking and covering materials.

(a) Planking - Planking shall be 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" x 8" spike placed 3 inches in from each edge.

(b) Covering Materials - Cover the planking with one of the following:

- Timber strips, 2" x 2", placed transverse to the planking and nailed with 16d galvanized common nails at 12 inch centers. Cover deck with a Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00747.

or

- Tongue and groove structural CD exterior grade plywood, 1 inch thick. 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. Securely 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 Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00747.

00570.45 Wheel Guards and Railings - Accurately frame wheel guards and railing as shown, and erect true to line and grade.

Unless otherwise specified, surface wheel guards, rails and rail posts 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 - Trusses, when completed, shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and, in vertical projection, shall 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 applicable portions of Section 00594.
Measurement

00570.80 Volume Basis - All timber, except piling and glue-laminated timber incorporated and left as a permanent part of a finished structure, will be measured for payment on the volume basis (in units of thousand feet board measure (MFBM)), based on the nominal dimensions of the members. The length will be the shortest commercial length which could be used. No other allowance for waste will be made.

Glue-laminated timber members will be measured for payment on the volume basis (in units of thousand feet board measure (MFBM)), using the net dimensions of the members.

No separate measurement will be made of hardware, fastenings or other items required for the completed work as they will be considered part of the work and included in the measurement for lumber and timber, or glue-laminated timber.

Driven piles will be measured according to Section 00520.

Payment

00570.90 General - Payment for all materials, equipment, labor, and incidentals, including hardware, fastenings, preservative treatment and coatings required for construction of timber structures except driven piles, will be made at the Contract unit price per thousand feet board measure, MFBM for the one of the following pay items:

(a) Timber And Lumber

(b) Glued Laminated Timber

Driven piles will be paid for according to Section 00520.
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 General - Provide steel pipe of standard weight conforming to ASTM A 53 and galvanized after fabrication according to ASTM A 123/A 123M.

Provide deck drains, hangers, clamps and other incidentals according to Sections 02530 and 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 General - Measurement for bridge drains will be on the unit basis, by actual count of each deck drain installed. Drain pipe installed and accepted will not be measured separately, as it is included in the pay item "Bridge Drains".

Payment

00581.90 General - Payment for the pay item "Bridge Drains" will be at the Contract unit price per each deck drain.

Payment for "Bridge Drains" will be payment in full for furnishing materials, including fittings, tools, labor and incidentals necessary to complete the work.

There will be no separate payment for drain pipe connected to bridge drains.

If there is a pay item for water under Section 00340, the water used in testing structure drain systems will be measured and paid for according to Section 00340. Otherwise, no separate or additional payment will be made for water used in testing bridge drains.
Section 00582 - Bridge Bearings

Description

00582.00 Scope - This work consists of the following:

(a) Composite Bearings - Design, fabricate, test and install composite bearings selected from the CPL. The bearing fixity (fixed bearing, guided bearing, non-guided bearing) and restrictions about type of bearing (disc, fabric pad, pot, spherical) will be shown or specified.

(b) Elastomeric Bearings - Furnish and install elastomeric bearings as shown or specified.

(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.

Guided - Able to accommodate structural movement in a specified horizontal direction.

Non-guided - 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 General - Use materials meeting the requirements of Sections 02570 and 02571, as applicable.
Design of Composite Bearings

00582.20 General - Unless otherwise shown, use only one type of composite bearing per bridge. Design according to the current AASHTO Standard Specifications for Highway Bridges, subject to the following requirements:

(a) Composite Bearings - Make composite bearings, including all plates except distribution plates and masonry plates, removable and replaceable.

(b) Rotational Elements - Design rotational elements between upper and lower units to meet the following:

(1) 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 non-guided bearing, a stainless steel sheet shall be welded to the bottom surface of the sole plate.

(2) 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.

(3) 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 non-guided bearings, a polytetrafluoroethylene (TFE) 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.

Design for loads, movements, and rotations as shown.

Use schematic drawings, and/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:

(a) Upper and Lower Bearing Plates - Provide a limiting ring by welding a ring or by machining a recess in the bearing plate with:

- The depth of the limiting ring equal to or greater than inside diameter times 0.014
- The diameter of the limiting ring 4% to 6% greater than the diameter of the disc
• The thickness of the plate beneath the disc, where not limited by bending stresses, to no less than the outside diameter of the disc times 0.045, and no less than 1/2 inch

(b) Polyether Urethane Disc - The maximum average pressure on the polyether urethane disc shall not exceed 5,250 psi at the vertical design capacity shown.

c) Central Shear Restriction Mechanisms - The central shear restriction mechanism to transfer horizontal forces between the upper bearing plate and the lower bearing plate shall be designed to resist at least 10% of the vertical design load unless a larger force is shown.

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.

00582.22 Fabric Pad Bearings - Design fabric pad bearings according to the following:

The average maximum bearing pressure on fabric pads shall not be greater than 1,200 psi.

Select thickness to limit maximum pad edge compressive stress to 2,000 psi in the plane of rotation at service load. Maximum allowable total load on the bearing is 500 kips. If the design load exceeds this value, use another type of bearing.

00582.23 Pot Bearings - Design pot bearings according to the following:

(a) Pot - Provide a pot with the following dimensions:

• The inside diameter of the pot cylinder shall equal the diameter of the elastomeric disc.

• The depth of the pot cavity shall be equal to or greater than the quantity calculated as follows:

  \[(0.5 \times \text{pot inside diam.}) \times (\text{design rotation} + 0.02 \text{ radians}) + 0.1 \text{ inch} + \text{thickness of elastomeric disc}\]

• The thickness of the plate beneath the elastomer, where not limited by bending stresses, shall be no less than the inside diameter of the pot times 0.045, and no less than 1/2 inch.

• Size the ring to withstand the hydrostatic internal pressure caused by the elastomer considered as fluid without consideration of the lower plate.

(b) Piston - The thickness shall be no less than 0.06 times the inside diameter of the pot, and sufficient to provide 0.12 inch minimum clearance between the top of the pot and the sliding surface at design rotation plus 0.02 radians.
The outside diameter shall be from 0.03 inch to 0.05 inch, less than the inside diameter of the pot.

**c) Elastomeric Disc:**

- Minimum thickness for pot inside diameter (ID):

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.011 radians</td>
<td>ID/25</td>
</tr>
<tr>
<td>0.011 to 0.016 radians</td>
<td>ID/20</td>
</tr>
<tr>
<td>Greater than 0.016 radians</td>
<td>ID/15</td>
</tr>
</tbody>
</table>

- Provide for maximum average pressure on disc not to exceed 3,675 psi at the vertical design load shown.

- Provide for minimum compressive stress of 700 psi at the final dead load shown.

- The upper edge of the disc shall be recessed to receive the flat brass sealing rings so they sit flush with the upper surface of the elastomeric disc.

**d) Sealing Rings** - Sealing rings for pot bearings shall be flat brass rings at least 0.05 inch thick.

The minimum width of each ring shall be:

- 3/8 inch for bearings less than 1,000 kips capacity
- 1/2 inch for bearings 1,000 kips and over capacity

Minimum number of rings shall be as follows:

<table>
<thead>
<tr>
<th>Bearing Capacity Kips</th>
<th>Number of Rings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000</td>
<td>2</td>
</tr>
<tr>
<td>1,000 to 3,000</td>
<td>3</td>
</tr>
<tr>
<td>Over 3,000</td>
<td>4</td>
</tr>
</tbody>
</table>

**00582.24 Spherical Bearings** - Design spherical bearings according to the following:

**a) Spherical Convex Plate** - Provide for a minimum service rotation in radians equal to design rotation plus 0.03; where design rotation refers to the rotation of the structure itself.

The convex plate shall have a minimum edge thickness of 3/4 inch and a top (stainless steel rotational) surface of 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.
(b) **Spherical Concave Plate** - The spherical radius shall be such that the resulting bearing is capable of withstanding the design ratio of horizontal load to vertical load under all loading conditions without unseating the concave element, with a minimum center thickness of 3/4 inch.

Incorporate mechanical safety restraints to prevent overturning, if field construction is required.

00582.25 **Composite Bearings with Polytetrafluoroethylene (TFE) Sliding Surface:**

(a) **TFE Sliding Surfaces** - Design bearings so that the maximum average pressure on the TFE surface does not exceed 3,500 psi at the vertical design load shown for all bearings except fabric pad bearings. The maximum average pressure on the TFE surface for fabric pad bearings shall not exceed 1,200 psi at the vertical design load shown.

The maximum thickness of TFE bonded to the flat sliding surface shall be 3/16 inch. The minimum thickness shall be:

- Fabric pads without a recess - 3/32 inch
- All other composite bearings - 1/8 inch

Recess TFE 1/16 inch into the material it is bonded to for all composite bearings except fabric pad bearings.

Bond TFE to the steel substrate sufficiently to develop a horizontal force equal to a minimum of 10% of the vertical design capacity shown, in addition to the shear force developed as a result of the natural bearing friction shear force.

Use a maximum allowable coefficient of friction less than or equal to the minimum coefficient of friction for design according to Division I, Section 15.2.6 of the AASHTO Standard Specifications for Highway Bridges.

(b) **TFE Rotational Surface for Spherical Bearings** - Provide for a maximum working stress of 3,500 psi on the projected area of sheet TFE at full load of the structure.

Provide for a maximum working stress of 7,500 psi on the projected area of woven fiber TFE at the full load of the structure.

TFE sheet minimum thickness shall be 1/8 inch, and the sheet shall be recessed 1/16 inch into the spherical element.

TFE fabric minimum thickness shall be 1/16 inch when measured according to ASTM D 1777.

(c) **Stainless Steel Sliding Surfaces** - Provide stainless steel sheet with a minimum thickness of 14 gage.

Provide a flat stainless steel sliding surface which completely covers the TFE surface in all operating positions, plus at least 2 inches more in every direction of possible movement.
Design 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 - For a guided bearing, the sliding element of the bearing is restrained against movement in lateral direction by guide bars. Provide the space between the guide bars and the guide element with a sliding surface of polished stainless steel against virgin TFE. The virgin TFE shall be bonded and mechanically fastened to the guide bars. Provide TFE and stainless steel surfaces according to 00582.25(a) and (c).

Design:

- The guide bars and their connections to the sole plate for the horizontal forces on the bearing, but not less than 10% of the vertical design load of the bearing, unless otherwise shown
- Each guided bearing to 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.
- Integral guide bars machined from a solid plate, or attached by welding or with cap screws, or fabricated from a single steel plate
- The space between the guide bars and the guided member equal to 3/16 inch plus or minus 1/16 inch
- Guiding arrangements so the guided member is 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 pre-stressing systems.
Fabrication

00582.30 General - Fabricate bearings according to the reviewed working drawings and these Specifications.

(a) Working Drawings - Submit working drawings according to 00150.35(m)(2) 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 non-guided 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 - Fabricate composite bearings according to 02570 and the following:

(1) Flatness - Verify the flatness of bearing surfaces by placing a precision straightedge on the surface to be measured and inserting a feeler gauge under the straightedge as follows:

- Use a precision straightedge longer than the plan dimension being measured, or the actual dimension of the plate under the straightedge where the straightedge is not parallel to any plan dimension of the plate.
Use a feeler gauge having an accuracy of plus or minus 0.001 inch. A plate is considered acceptable if the feeler gauge does not pass under the straightedge for any random position of the straightedge on the plate surface.

Ignore a 1 inch wide border around the plate when determining flatness.

Tolerances for flatness of metal bearings are as follows:

- Class A = 0.0005 x plan dimension
- Class B = 0.0010 x plan dimension

The overall height of the bearing shall not exceed the plan height by more than 3/16 inch or less than 1/16 inch under the plan height of the bearing.

(2) Edges - Grind edges of all parts of the bearing so that sharp edges are eliminated.

(3) Welding - Perform all welding and inspection of welding for structural steel according to 00560.26.

(c) Minimum Requirements for Elastomeric Bearings - Fabricate elastomeric bearings according to Section 02571 and these Specifications.

(d) Special Requirements for Horizontal Capacity of Composite Bearings - Submit stamped calculations supporting the design for horizontal force capacity, according to 00150.35(m-1). 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 disc bearings according to the following:

(a) Polyether Urethane Disc - Make the disc in one piece.

The tolerance for diameter is:

- Plus or minus 1/16 inch for diameters less than or equal to 20 inches.
- Plus or minus 3/32 inch for diameters over 20 inches.

The tolerance for thickness is from 0 inch to plus 1/8 inch.

(b) Upper and Lower Bearing Plates - Finish upper and lower bearing plate surfaces to the following tolerances:

<table>
<thead>
<tr>
<th>Surface</th>
<th>Surface Roughness</th>
<th>Flatness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside surfaces facing the disc</td>
<td>125 microinches or better</td>
<td>Class A</td>
</tr>
</tbody>
</table>

City of Portland 2007
Outside surface of top plate 125 microinches or better Class A
Outside surface of bottom plate 250 microinches or better Class B

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.

(c) Shear Restriction Mechanism - Connect shear restriction mechanisms to bearing plates by welding or other acceptable means.

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 a 11 gage 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.

The tolerance for the inside diameter of the pot cylinder is:

- Plus or minus 0.005 inch for diameters up to and including 20 inches.
- Plus or minus 0.007 inch for diameters over 20 inches.

Finish inside surfaces of the pot cylinder to a roughness of 125 microinches or better.

Finish other surfaces to a roughness of 250 microinches or better.

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.

The tolerance for the diameter of the piston is:

- Plus or minus 0.005 inch for diameters less than or equal to 20 inches.
- Plus or minus 0.007 inch for diameters over 20 inches.

Finish the top and bottom surfaces to a roughness of 125 microinches or better.

Finish the top surface to Class A flatness.

Finish the bottom surface to Class B 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.

The tolerance for the diameter of the disc is:

- Plus or minus 1/16 inch for diameters less than or equal to 20 inches.
- Plus or minus 3/32 inch for diameters over 20 inches.

The tolerance for thickness is 0 inch to plus 1/8 inch.

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.

(d) Sealing Rings - Use flat brass sealing rings. Round cross section sealing rings will not be permitted.

Make split rings which fit snugly against the surface of the inside perimeter of pot cylinder.

Cut ring ends at an angle of 45° with a maximum gap of 0.050 inch when installed in the pot.

Stagger ring gaps equally around the circumference of the pot.

Finish to surface roughness of 63 microinches or better.

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.

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 (TFE) Sliding Surfaces:**

(a) **TFE Sliding Surfaces** - Bond TFE to steel substrate under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the TFE manufacturer.

After completion of the bonding operation, the TFE 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.

Finish the surface to a roughness of 20 microinches or better.

Finish the surface to Class A Flatness.

**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 length is plus or minus 1/8 inch.

The tolerance for section dimensions is plus or minus 1/16 inch.
Finish surfaces on guide bars that bear against another surface to Class A flatness.

If guide bars are welded to the sole plate, weld before attaching the stainless steel surface.

00582.37 Sole, Base, Distribution and Masonry Plates for Composite Bearings -

Fabricate to the following tolerances:

- Thickness: minus 1/32 inch to plus 1/8 inch.
- Plan dimensions less than or equal to 30 inches: 0 inch to plus 1/8 inch.
- Plan dimensions greater than 30 inches: 0 inch to plus 3/16 inch.

Finish surfaces in contact with concrete to a roughness of 500 microinches or better. Finish other surfaces to surface roughness of 250 microinches or better.

Finish the bottom surface of the sole plate to Class A flatness. Finish other top and bottom surfaces to Class B flatness.

00582.38 Coatings for Steel Bearings - Coat all exposed steel surfaces, except stainless steel, according to Section 00594 and this subsection.

(a) Coating New Steel - Prepare and coat steel bearing surfaces according to 00594.40, 00594.41(a) 00594.41(b), and the following:

(1) All New Steel Structures - Remove fins, tears, slivers and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing or similar operations, and grind all welds smooth. Grind back hardened edges 1/8 inch.

(2) Material Specifications - Use one of the following coating systems within the guidelines stated, at the Contractor's option:

a. NASA System - The coating system for all new bearing steel surfaces to be coated on the Project shall incorporate a National Aeronautics and Space Administration (NASA) formulated water-based, high-ratio potassium silicate inorganic zinc coating. Apply the coats in thicknesses as specified in 00582.38(a)(3)(a).

Coatings supplied for Project shall conform to the following minimum requirements:

- Zinc in Dry Film.................................................................86% by weight
- Solids........................................................................74% by weight
- Thinner ........................................................................2.65% by volume
- Water
- Dry Time .......................................................................15-20 minutes
- Top Coat.......................................................................2 hours

b. Galvanized Coating - For shop applied coatings in non-marine environments, hot zinc metallizing may be used as an option to the coating system outlined above. Provide zinc wire for thermal spraying (metallizing) in accordance with ASTM B 833.
(3) Coating Thickness:

a. NASA System Number of Coats and Film Thickness - Apply coating system to the prepared surfaces as follows:

Coat.......................................................... Water base  
Formula..................................................... High-ratio inorganic zinc  
Minimum Dry Film Thickness ......................... 4.0 mils  

All steel-to-steel and steel-to-concrete contact surfaces, whether coated in the shop or in the field, shall receive a coating of inorganic zinc primer only. The dry film thickness shall not be less than 3.0 mils nor more than 5.0 mils.

The coatings on faying surfaces for steel-to-steel contact surfaces at all slip-critical structural bolted connections using ASTM A 325/A 325M high-strength bolts in primary members shall meet Class B (slip coefficient of 0.5) coating requirements in accordance with "Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints" as adopted by the Research Council on Structural Connections.

Do not assemble coated joints before the coatings have cured for the minimum time used in the qualifying test.

b. Galvanized Coating Thickness - Provide a minimum coating thickness of 6.0 mils.

(b) Coating Existing Steel Structures:

(1) Description - Perform coating applications in conformance with the best practices of the trade, the recommendations of the coating manufacturer, and the applicable portions of the SSPC-PA 1

(2) Material Specifications - The coating system for all existing steel bearing surfaces to be coated on the Project shall incorporate three single-component moisture-cured polyurethane coats conforming to the following minimum requirements:

Primer

<table>
<thead>
<tr>
<th>Generic Type:</th>
<th>Zinc-filled single-component, moisture-cured polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td>Moisture-cured polyurethane</td>
</tr>
<tr>
<td>Pigment Type</td>
<td>Zinc dust</td>
</tr>
<tr>
<td>Pigment Content</td>
<td>80% minimum zinc by weight in dry film</td>
</tr>
<tr>
<td>Volume Solids:</td>
<td>60% plus or minus 2%</td>
</tr>
</tbody>
</table>
Intermediate Coat

Generic Type: Single-component, moisture-cured polyurethane  
Vehicle Type: Moisture-cured polyurethane  
Volume Solids: 50% minimum  
Pigment: A minimum of 3.0 lbs/gal of micaceous iron oxide  
Color: Tinted to distinguish from primer and top coat

Top Coat

Generic Type: Micaceous iron oxide-filled single-component moisture-cured polyurethane  
Vehicle Type: Moisture-cured polyurethane  
Volume Solids: 50% minimum  
Finish: Semi-gloss  
Color: As specified  
Pigment: A minimum of 3.0 lbs/gal of micaceous iron oxide

(c) Coating Thickness:

(1) Number of Coats and Film Thickness - Apply coating to the prepared surfaces as follows:

<table>
<thead>
<tr>
<th>Coat</th>
<th>Minimum Dry Formula</th>
<th>Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc-filled, Single-component moisture-cured polyurethane</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Single-component, moisture-cured polyurethane</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>Top Coat</td>
<td>Single-component, moisture-cured polyurethane</td>
<td>1.5 mils</td>
</tr>
</tbody>
</table>

TOTAL 7.5 mils

Apply the coating system for the steel surfaces in not less than three coats, each coat to the minimum thickness shown. A coat shall be considered to be as many applications as necessary to achieve the specified thickness.

(2) 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 all coats. Apply all coatings in sufficient thickness to achieve uniform and complete coverage and appearance. All thickness measurements shall be within the specified minimum dry film thickness. If thickness measurements or visual inspection of coverage do not meet the specified minimum, 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.
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) Elastomer Laminations - Elastomer laminations shall be of uniform thickness and in no case shall:

- The thickness of an individual elastomer lamination exceed 5/8 inch
- The variation in thickness of an individual elastomer lamination exceed 1/8 inch
- The variation in thickness of all elastomer laminations within a pad be such that any metal lamination varies by more than 1/8 inch from a plane parallel to the top or bottom surface of the pad

(c) Pad Sizing - Mold pads individually to the sizes required. No shearing to size or drilling of holes will be permitted except pads 1/2 inch and less in thickness may be sheared. Cover all edges of metal laminations with a minimum of 1/8 inch and a maximum of 3/8 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.

(d) 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 TFE bearings from contact with concrete or other foreign matter.

(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 General - Composite bearings completed and accepted will be measured on a unit basis per each by actual count of bearing devices in place.

No separate measurement will be made for elastomeric bearing pads.

Payment

00582.90 General - The quantities of composite bearings accepted for payment will be paid for at the Contract unit price per each for the item "Bearing Devices, Bent _______ _______". The location will be shown by the bent number inserted in the blank.

Payment will be payment in full for designing, fabricating, testing, furnishing and placing all materials, including all equipment, labor and incidentals necessary for complete installation of the bearing devices and including all items from the bearing seat attachment through the superstructure attachment.

No separate payment will be made for elastomeric bearing pads, as payment for furnishing and placing the pads is included in one or more of the pay items listed in the Schedule of 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 General - Provide galvanized rigid metal or intermediate metal conduit conforming to 02920.10, and non-metallic schedule 40 conduit conforming to 02920.11. Other materials shall conform to Section 02920.

Construction

00583.40 General - Install conduit as shown and specified, according to the applicable portions of 00530.41.

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 - Electrical conduit in structures will be measured on the length basis for each size of conduit installed in the structure and including the length of stub-outs shown. There will be no separate measurement for junction boxes, cabinets and other items encased in pole foundations or in the concrete structures for illumination and signal systems, as such items will be considered incidental to the work of this Section.

Payment

00583.90 Payment - Payment for all material, equipment and labor including cabinets, junction boxes, expansion joints, fittings and fastenings required for complete installation of the conduit in structures will be made at the Contract unit price per foot for the item "____inch Electrical Conduit", of the sizes listed in the Schedule of Items.
Section 00584 - Elastomeric Concrete Nosing

Description

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, in accordance with the plans and these Specifications. Expansion joints are covered in Section 00585. Repair of the deck adjacent to expansion joints and the joint edges is covered under Section 00586 "Concrete Repair".

Materials

00584.10 General - Construct elastomeric concrete nosing as shown, using materials from the CPL or as approved, and mixed at the site.

(a) Approval of Materials - Select products from the CPL, but submit them to the Engineer for Bridge Section approval of their use on the Project.

(b) Delivery, Storage and Handling of Materials - 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.
Equipment

00584.20 General - Use equipment recommended by the product manufacturer and approved by the Engineer.

Construction

00584.40 General - Construct elastomeric concrete nosing according to the following:

(a) Design - Submit working drawings according to 00150.35 for elastomeric concrete nosing, including:
   - Complete details of nosing materials
   - All ASTM, AASHTO or other material designations
   - A mix design
   - Method of nosing installation, including sequence and installation details at traffic barriers, roadway surfaces, curbs and sidewalks

(b) Notification of Installation Date - Notify the Engineer in writing a minimum of seven days prior to installation of the nosing. Include the Contract number, bridge number, concrete nosing material, product name and approximate date of installation.

(c) Training - Use installers trained in application methods and in the health and safety requirements specific to the materials used.

(d) 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.

(e) Weather Conditions at Time of Installation - Install elastomeric concrete nosing when the receiving surface is dry. Elastomeric concrete nosing installed in other than dry conditions will not be accepted.

Install elastomeric concrete nosing when the ambient temperature is at least 40 °F and rising, and at least 5 °F above the dew point.

(f) Manufacturer's Technical Representative - Discuss the work to be done with the manufacturer's representative to review the methods of installation and the equipment needed prior to beginning the work.

The manufacturer’s representative shall advise both the Engineer and the Contractor on-site regarding proper installation procedures to assure the elastomeric concrete nosing is installed correctly.

Mix, place, and cure the nosing material according to the recommendations of the manufacturer's representative.
00584.41 **Surface Preparation** - Repair existing concrete surfaces of spalled, cracked or deteriorated concrete as directed, to provide a firm surface on which to place the nosing. Concrete repair is covered under Section 00586.

Remove existing expansion joint material and construct the required elastomeric concrete nosing as detailed on the plans.

Ensure that all surfaces to receive elastomeric concrete nosing material are sound, dry, clean and frost free at the time of nosing installation. Surface clean the joint area to a width of 7 inches on each side of the joint opening by abrasive blasting. 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.

00584.42 **Primer** - Bond the nosing material to the substrates using the primer specified by the manufacturer of the nosing material. Prepare and apply the primer as recommended by the manufacturer.

00584.43 **Elastomeric Concrete** - 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 primer. Clean and dry the bonding surfaces and prepare joint surfaces in accordance with 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.

Place the elastomeric concrete before the bond coat sets. 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. Keep the nosing free of traffic for a minimum of four hours after nosing placement, or longer if required by the Engineer or the manufacturer.

**Measurement**

00584.80 **General** - Elastomeric concrete nosing will be measured on the length basis for the material required to construct the nosing from face of curb to face of curb. Measurement will be taken along the centerline of the joint, between the outer limits of the installed material. The assumed nominal depth of the joint is 2 inches. If the actual depth of joint is deeper than 2 inches, the basis for measurement for the additional depth of material is the cubic yard of material, rounded to the nearest cubic yard, required to complete the joint. The measurement includes nosing on one or both sides of the expansion joint as noted on the detail plans. Only a single measurement will be taken along each installed joint, regardless of the number of recesses, openings or voids filled with the elastomeric concrete nosing material.
Payment

00584.90 General - Elastomeric concrete nosing will be paid for at the Contract price per foot for the item "Elastomeric Concrete Nosing". Payment will be full and complete compensation for all labor, equipment and materials required to remove portions of the existing joint and construct the elastomeric concrete nosing detailed on the plans for a nominal 2 inch depth of joint. If the depth of joint is deeper than 2 inches, the basis for payment of material for the additional depth will be the cubic yard of material, rounded to the nearest cubic yard, for the material required to complete the joint.

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 the plans specifically required the removal.

Joint seal material to be placed between elastomeric concrete nosing will be described, installed, measured and paid for as described in Section 00585.
Section 00585 - Expansion Joints

Description

00585.00 Scope - This work consists of the fabrication, joint preparation and installation of expansion joints. Install the material or combination of materials shown or specified at the locations shown.

00585.01 Definitions:

Armored Corner Joint - A closed joint with steel armoring to protect the vertical edges. The armor may be steel angles or steel shapes with grooves for single or multiple strip seals.

Asphaltic Plug Joint - A closed expansion and contraction joint sealed with an inset strip of aggregate and flexible binder material placed over a steel bridging plate, and with a non-sag poured joint sealant at the curb or sidewalk.

Closed Expansion Joint - A joint in which a seal material is placed to prevent water or debris from entering the joint.

Filled Expansion Joint - A joint using a pre-formed expansion filler, poured joint filler, traffic loop sealant, or a combination of these materials.

Joint - The opening provided between two portions of a structure to allow for expansion and contraction of the structure.

Modular Expansion Joint - A closed expansion and contraction joint using a series of continuous preformed polychloroprene strip seals inserted into steel shapes to seal the joint.

Poured Sealant Joint - A closed expansion and contraction joint sealed with a rapid-cure poured joint sealant.

Preformed Polychloroprene Compression Joint Seal - A closed expansion and contraction joint sealed with a continuous preformed polychloroprene elastomeric compression gland.

Preformed Polychloroprene Strip Seal - 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 General - Construct expansion joints using materials from the CPL. Use materials meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphaltic plug joint binder</td>
<td>as specified or as recommended by the manufacturer</td>
</tr>
<tr>
<td>Backer rod</td>
<td>02440.14</td>
</tr>
<tr>
<td>Elastomer</td>
<td>02570.10(i)</td>
</tr>
<tr>
<td>Epoxy adhesive</td>
<td>02440.22</td>
</tr>
<tr>
<td>Lubricant/adhesive</td>
<td>02440.16</td>
</tr>
<tr>
<td>Polytetrafluoroethylene (TFE)</td>
<td>02570.10(g)</td>
</tr>
<tr>
<td>Poured joint filler</td>
<td>02440.30</td>
</tr>
<tr>
<td>Poured silicone sealant</td>
<td>02440.11</td>
</tr>
<tr>
<td>Preformed polychloroprene elastomeric joint seals</td>
<td>02440.20</td>
</tr>
<tr>
<td>Preformed expansion joint filler for concrete</td>
<td>02440.10</td>
</tr>
<tr>
<td>Stainless steel sheets</td>
<td>02570.10(b)</td>
</tr>
<tr>
<td>Steel bridging plate</td>
<td>02440.19</td>
</tr>
<tr>
<td>Structural steel</td>
<td>02530, as modified by Special Provisions</td>
</tr>
<tr>
<td>Traffic loop sealant</td>
<td>00990.43(b)(1)(c)</td>
</tr>
</tbody>
</table>

00585.11 Approval of Materials - Submit CPL-listed products to the Engineer for Project-specific approval.

00585.12 Temporary Plating - Temporary plating shall conform to Section 00275.

Equipment

00585.20 General - Use approved equipment as recommended by the product manufacturer and conforming to the following:

(a) Melters for Asphalt Binder - Melt binder for asphaltic plug joint seals in a dedicated unit, equipped with a continuous agitation system, temperature controls, and calibrated thermometers so that the binder material is maintained at the manufacturer's recommended temperature.

(b) Aggregate Mixers - Mix aggregate for asphaltic plug joint seals in a dedicated rotating drum mixer capable of heating aggregate to a temperature of 330 °F.

Labor

00585.30 Closed Expansion Joint Installers - Use installers trained in application methods of materials and health and safety to install closed expansion joints as detailed.

00585.31 Closed Expansion Joint Manufacturer's Representative - Furnish a manufacturer's representative on site during all stages of installation of closed expansion joints. The manufacturer's representative shall notify the Engineer verbally and in writing if joints are being installed against the manufacturer's recommendations. Any changes recommended by the manufacturer's representative and approved by the Engineer will be made without additional cost to the City.
00585.32 Asphaltic Plug Joint Installers - Use installers with experience in installing asphaltic plug joints.

Construction

00585.40 Filled Expansion Joints - Unless otherwise specified, form filled joints with preformed expansion joint filler by placing concrete directly against the preformed expansion joint filler material. Provide formwork behind the preformed expansion joint filler material firm enough to prevent deflection of the joint material when placing the concrete, or place preformed expansion 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(m)(1) for each expansion joint.

(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).

(4) Notification - Notify the Engineer in writing a minimum of seven days prior to installation of the joint. Include the Contract number, joint seal material, product name and the approximate date of installation.

(5) Certificate of Compliance - Provide the Engineer with a certificate of compliance, including the manufacturer's name, prior to joint installation, verifying that the materials as furnished will meet the requirements of these Specifications.
(b) **Safety** - Provide safety precautions from the manufacturer for hazardous chemicals. Wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) **Joint Preparation** - Repair existing joints of spalled, cracked or deteriorated concrete as shown or as directed to provide a uniform and smooth surface along the joint. Surface clean the joint area to a width of 10 inches on each side of the joint opening by abrasive blasting. Sandblast steel contact surfaces to SSPC-10, "Near-White Blast Cleaning", immediately before constructing the joint. Prepare the joint surfaces as directed in this Section and the material manufacturers' 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.

(d) **Weather Conditions at Time of Installation** - Install joint seals when the joint is dry. Joint seals installed in other than dry condition will not be accepted.

(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 expense to the City and according to the manufacturer's recommendations.

00585.42  **Armored Corner Joints** - 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, "Structural Welding Code for Steel".

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 Class 30 (4350) concrete or elastomeric concrete in the joint breakout. If Class 30 (4350) concrete is shown, install the preformed polychloroprene strip seal a minimum of seven days after the concrete blockouts have been cast or after the deck concrete reaches 3,000 psi. For elastomeric concrete installations, install the preformed polychloroprene strip seal a minimum of 24 hours after placing the strip rails in the elastomeric concrete.
00585.43  **Asphaltic Plug Joint Seals** - Furnish and install asphaltic plug joint seals 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 or as follows:

Place a continuous bond breaker, such as kraft paper, the width of the asphaltic plug joint centered over the existing joint opening prior to placing the deck wearing surface.

At least 24 hours after placing the wearing surface, saw cut the wearing surface to the bottom of the AC to the width of the asphaltic plug joint blockout. Center the saw cuts over the joint, parallel to each other, with a width tolerance of 1/2 inch. Without damaging the deck surface, remove all paving material between the saw cuts to the bottom of the blockout area, including any material in the joint that would interfere with the operation of the asphaltic plug joint seal.

Prepare the joint according to 00585.41(c) and as shown.

Place the backer rod into the expansion joint opening 10 inches below the bottom of the blockout.

Heat the binder material to a minimum of 400 °F in a melter meeting the requirements of 00585.20.

Pour the binder material into the joint gap. Overfill the joint gap, allowing the binder to cover the joint blockout surface forming a monolithic waterproofing membrane.

Center the steel bridging plates over the entire length of the expansion joint gap, without laps. Place the steel bridging plates on the hot binder material. Place spikes of a minimum of 3/8 inch diameter by 4 inches long into the predrilled holes and through the backer rod.

Coat the top surface of the bridging plate with the binder.

Heat the prepackaged aggregate to a temperature between 275 °F and 330 °F in a mixer meeting the requirements of 00585.21. Blend the binder into the aggregate at a ratio of 75% aggregate to 25% binder, plus or minus 2% by weight. Mix the aggregate and binder so that all of the aggregate is pre-coated with binder. Verify the temperature of the heated aggregate and binder.

Place the mixed aggregate and binder in the joint blockout. Add additional binder as needed to fill all voids between the aggregate. Place the final portion of the joint material layer above finish grade to allow consolidation upon compaction.

Compact the asphaltic plug joint seal using a 2 tons or larger steel wheeled roller.

Reheat the surface of the consolidated joint to ensure dryness. Install a final thin layer of binder followed by an application of dry sand. Protect the joint from traffic a minimum of 30 minutes after completing the joint.
Place non-sag poured joint sealant in curbs or sidewalks.

00585.44 Poured Sealant Joint Seals - Furnish and install poured sealant joint seals according to the following:

(a) General - Use a cold-applied 100% silicone joint sealant that:

- Is compatible with the surface to which it is to bond
- Develops sufficient integrity within eight hours to accommodate both thermal and vertical movements due to traffic loading and structure movement

Deliver the joint sealant to the job site in the manufacturer's original sealed containers, marked with the manufacturer's name and lot number. Accompany each lot number with the manufacturer's certification stating that the sealant meets the requirements of 02440.11.

(b) Installation Procedure - Prepare the joint according to the sealant manufacturer's recommendations and as shown.

Apply lubricant/adhesive/primer to the sides of the joint as recommended by the manufacturer prior to installation of the sealant and placement of the backer rod.

After the lubricant/adhesive/primer on the sides of the joint has dried, and prior to installation of the sealant, install the backer rod at the depth shown. Use a backer rod compatible with the sealant and primer, and that prevents bond between the backer rod and the poured sealant. Size the backer rod for the assumed joint opening based on the structure temperature joint construction. Ensure that the backer rod remains in place during the full sealant cure time.

Ensure that the backer rod is attached to the joint sides so that structure movement will not displace the backer rod.

Place the joint material in the joint.

00585.45 Preformed Polychloroprene Compression Joint Seals - Furnish and install preformed polychloroprene compression joint seals according to the following:

(a) General - Furnish and install joint seals:

- 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 ASTM D 3542.

Base the compression joint seal nominal size on the design movement of the joint and the seal’s anticipated compression set.
(b) Installation Procedure - Prepare the joint according to 00585.41(c) and as shown.

Install all seals with a lubricant/adhesive made of the same base polymer as the joint seal and blended with a suitable volatile solvent.

Remove all lubricant/adhesive from the top of the installed seal before the adhesive sets.

Remove, discard and replace all installed seals with twists, curls, nicks or other malformations.

00585.46 Pre-formed Polychloroprene Strip Seals - Furnish and install preformed polychloroprene strip seals according to 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.

Place strip seal assemblies in Class 4350 concrete or elastomeric concrete pre-formed blockouts as shown.

Field weld rail segments that are too long to ship in one piece.

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.

Install seals using a lubricant/adhesive made of the same base polymer as the joint seal and blended with a suitable volatile solvent.

Remove all lubricant/adhesive from the top of the installed seal before the adhesive sets.

00585.47 Modular Expansion Joint Seals - Design, fabricate, install, inspect and water test modular expansion joint seals according to 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 approval 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
   - 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 (a-2), submit stamped drawings and calculations, including the following:
   - 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** - Prior to joint installation, submit the following certifications to the Engineer:
   - A manufacturer's certificate of compliance with the AISC Quality Certification Program, Category III, Major Steel Bridges
   - A manufacturer's certificate of compliance verifying that the materials as furnished will meet the requirements listed herein.
   - Manufacturer's certification that all polytetrafluoroethylene (TFE) sheeting, TFE fabric and elastomer meet the requirements of Division II, Section 18 of the current AASHTO Standard Specifications for Highway Bridges. 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.

(4) Test Reports - Within four weeks of the shop drawing approval, submit certified mill test reports for all steel and stainless steel in the joint assemblies.

(5) 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 in accordance with 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 are welded.

• 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 polytetrafluoroethylene (TFE).

• 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 (Normal to the roadway surface)</th>
<th>Limit States Fatigue Horizontal Wheel Load Range (Parallel to the roadway surface)</th>
</tr>
</thead>
<tbody>
<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 two 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. Fatigue testing is necessary to establish the limiting or allowable stress range, $F_{sr\ test}$, at the endurance limit of 100 million cycles.
Satisfy the fatigue limit states equation shown below for all expansion joint steel structural members, connections both welded and bolted, and steel components.

\[
(0.5)f_{sr, \text{calc}} \leq F_{sr, \text{test}} \quad \text{Fatigue Limits States Equation}
\]

where:

\[f_{sr, \text{calc}} = \text{calculated stress range based on the simultaneous application of two sets of vertical and horizontal limit states fatigue wheel ranges at 6 feet spacing.}\]

\[F_{sr, \text{test}} = \text{allowable limit states fatigue stress range at the endurance limit of 100 million cycles.}\]

(5) **Fatigue Testing** - Perform constant amplitude fatigue testing to determine \(F_{sr, \text{test}}\), (the allowable limit states fatigue stress range at 100 million cycles) 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 in accordance with 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) **TFE Sliding Surface** - Bond the TFE under controlled conditions and in accordance with written instructions provided by the manufacturer of the TFE. Complete the bonding operation so that the TFE surface is smooth and free from bubbles.

(2) **Stainless Steel Sliding Surface** - Finish the stainless steel sliding surface to a finish of 200 microinches (RMS) or less.

Weld the stainless steel sheet all around to the steel backing plate by a tungsten-arc welding process in accordance with 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 Class 4350 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 seven 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)(5).

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 the expense of the Contractor.

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 Engineer will inspect expansion joint units upon arrival at the Project Site, prior to, and after installation.

(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 expense to the City.

Submit any proposed corrective procedures to the Engineer for approval before undertaking corrective work.

**00585.48 Coating** - Prepare and coat steel expansion joint surfaces, except stainless steel, as follows:

(a) **Preparation of Surfaces:**

(1) **New Steel Structures** - Prepare according to 00594.41(a) and (e). Use only solvents or detergents that are acceptable to the coating manufacturer and the Engineer.

Round or bevel all corners and edges of steel members at least 3/32 inch. Grind hardened edges back 1/8 inch. Except for stainless steel, hot dip galvanize expansion joint surfaces according to ASTM A 123/A 123M.

The contact surfaces at all galvanized slip critical structural bolted connections shall meet Class C (slip coefficient 0.33) surface preparation requirements.

(2) **Existing Steel Structures** - Prepare according to 00594.41(b) and (e).

(b) **Coating New and Existing Steel Expansion Joint Surfaces:**

(1) **General** - Perform coating application according to:

- The best practices of the trade
- The recommendations of the coating Manufacturer
- The applicable portions of the SSPC-PA 1

(2) **Material Specifications** - The coating system for all steel expansion joint surfaces to be coated shall incorporate either:

- Hot-dip galvanizing conforming to ASTM A 123/A 123M, or
- A three single component moisture curing polyurethane coat system conforming to the following minimum requirements:
Primer

Generic Type: Zinc-filled, single-component, moisture-cured polyurethane
Vehicle Type: Moisture-cured polyurethane
Pigment Type: Zinc dust
Pigment Content: 80% minimum zinc by weight in dry film
VOC: 2.8 lbs./gal. maximum
Volume solids: 60% plus or minus 2%

Intermediate Coat

Generic Type: Micaceous iron oxide-filled, single-component moisture-cured polyurethane
Vehicle Type: Moisture-cured polyurethane
Volume Solids: 50% minimum
Pigment: Micaceous iron oxide, minimum 350 g/L (3.0 lbs./gal.)
VOC: 2.8 lbs/gal maximum
Color: Tinted to distinguish from primer and topcoat

Topcoat

Generic Type: Micaceous iron oxide-filled, single-component moisture-cured aliphatic polyurethane
Vehicle Type: Moisture-cured, aliphatic polyurethane
Volume Solids: 50% minimum
Finish: matte
Pigment: Micaceous iron oxide, minimum 3.0 lbs./gal.
VOC: 2.8 lbs/gal maximum
Color: To be determined by the Engineer

In addition to the above listed requirements, the zinc primer shall meet AASHTO Class A slip coefficient requirements.

All micaceous iron oxide used in the intermediate coat and topcoat shall conform to ASTM D 5532, Type I. Furnish manufacturer’s certification of its conformance.
(c) Coating Thickness:

(1) Number of Coats and Film Thickness - Apply coatings to the prepared surfaces as follows:

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc-filled, single-component, moisture-cured polyurethane</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Micaceous iron oxide-filled, single-component, moisture-cured polyurethane</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>Micaceous iron oxide-filled, single-component, moisture-cured polyurethane</td>
<td>2.0 mils</td>
</tr>
</tbody>
</table>

TOTAL 8.0 mils

Apply a coating of the zinc filled primer only to all steel-to-steel and steel-to-concrete contact surfaces, whether in the shop or the field applied. The dry film thickness shall not be less than 3.0 mils nor more than 5.0 mils.

The coating on steel to steel contact surfaces at all slip critical structural bolted connections shall meet Class B (slip coefficient 0.50) coating requirements.

Measurement

00585.80 General - Closed expansion joints will not be measured. The estimated quantities of joints required at the various locations will be shown in the Special Provisions. These quantities, which are given along the centerline of the deck joint within the pay limits shown on the plans, are for estimating purposes only.

00585.82 Asphaltic Plug Joints - The estimated quantity of asphaltic plug joint seals is based on an assumed nominal depth of 2 inches. If the depth of the installed plug joint is deeper than 2 inches, the material required for the additional depth will be measured on the volume basis.

There will be no measurement for elastomeric concrete used to provide a plane surface on which to place the steel bridging plate.

00585.84 Filled Expansion Joints - There will be no separate measurement of preformed expansion joint filler, poured joint filler, traffic loop sealant or sawcutting.
Payment

00585.90  General - Payment for expansion joints will be made on the lump sum basis. 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.

00585.92  Asphaltic Plug Joints - Payment for the item "Asphaltic Plug Joint Seals" includes sawcutting, the steel bridging plate and installation of the asphaltic plug joint to a nominal depth of 2 inches.

If the depth of joint is deeper than 2 inches, the additional binder and aggregate will be paid for at the Contract price per cubic yard for the item "Asphaltic Plug Joint Seal Material", which will be full payment for all materials, equipment, labor and incidentals necessary to install any additional depth of material required to complete the joint.

Payment for expansion joint seals other than asphaltic plug joint seals will be made under one of the following pay items:

(a)  Poured Sealant Joint Seals
(b)  Type _____ Preformed Polychloroprene Compression Joint Seals
(c)  Preformed Elastomeric Strip Seals
(d)  Type _____ Modular Expansion Joint Seals

Payment will be payment in full and complete compensation for all, materials, equipment, labor and incidentals necessary to install the closed joints as detailed on the plans.

00585.94  Filled Expansion Joints - There will be no separate payment for filled expansion joints.
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 General - Use materials meeting the following requirements:

Cast steel posts ................................................................. 02810.40
Concrete ............................................................................. 02001
Concrete coating ................................................................. 02210.30
Galvanizing ......................................................................... 02530.70
Reinforcement ...................................................................... 02530.00
Structural steel ................................................................. 02810.50
Structural steel tubing ....................................................... 02810.28
Thrie beam rail ................................................................. 02810.50
Tube .................................................................................. 02810.30

Construction

00587.40 General - Construct bridge rails:

- True to line, grade and dimensions shown or established, and 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, 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 cost to the City.

2. Identify, for the purposes of evaluating work quality, at least two 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, plus or minus 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 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) above.

(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:

1. Allow free moisture to flash off, but only until the concrete surface does not glisten, and never for more than one hour.

2. 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 ft²/gal.
(3) Allow the first coat to air-dry for one hour.

(4) 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 General - Measurement of all bridge rails will be on the lump sum basis. Estimated quantities will be shown in the Special Provisions.

Payment

00587.90 General - Payment for all bridge rails, completed and accepted, will be made at the Contract lump sum amount for the appropriate bridge rail pay item. 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.

If changes ordered by the Engineer result in quantity changes, payment will be according to 00195.20.

Anchor bolts and anchorage devices, except those cast in precast concrete members, will be considered part of the bridge rail.

Payment for epoxy coated 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, respectively.

Payment for guardrail terminal connectors, connection plates, spacer blocks and other connection hardware will be included in the payment for the item, "Guardrail, Transition".
Section 00591 - Waterproofing Membrane

Description

00591.00 Scope - Furnish and place bridge deck waterproofing membrane on the decks of bridges identified in the plans.

Materials

00591.10 General - Use a warrantable 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, use a PCC patching material from the CPL that is compatible with the membrane.

(b) Tack Coat - Furnish hot asphalt tack coat meeting the requirements of Section 02710, or a primer coat as recommended by the membrane manufacturer. An emulsified tack will not be allowed.

00591.30 Manufacturer's Representative - Provide the services of a manufacturer's representative (the "Manufacturer's Representative"), authorized to sign a warranty (the "Warranty") on behalf of the manufacturer (See 00591.75). The Manufacturer's Representative shall observe the installation of each membrane system, including the wearing course. Follow the recommendations of the Manufacturer's Representative in all matters pertaining to proper installation of the membrane system. The Contractor shall require 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. The Contractor shall require the Manufacturer's Representative to fill out the Warranty form and sign it on behalf of the manufacturer.

Construction

00591.40 General - Do not begin membrane installation until all materials and equipment necessary to perform the installation and any repairs that are required during installation 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 carefully to prevent damage to the materials. Store membrane indoors at a temperature between 60 °F and 20 °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 ten 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(m), 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 00620, 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 00310.43.

(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.

Prevent possible damage to the membrane by placing AC on the membrane as carefully as possible, and instruct truck drivers to use caution when driving on the membrane.

If the membrane is pulled up 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 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 until no leakage is detected.

00591.75  **Manufacturer's Warranty** - Furnish a Warranty, for a Warranty period of two 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** - The Warranty shall recite that, upon notification by the Engineer of a failure as defined above, the manufacturer will have 60 days to repair the failure, at no additional cost to the City, unless another time period is approved. All repairs shall use materials and procedures meeting these Specifications, and shall be completed to finished grade. Coordinate timing of repair work with the Engineer.
(d) Traffic Control; **City's Right to Make Repairs** - The Warranty shall further recite that 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. Replacement of the temporary repair with a permanent repair shall be at the manufacturer's expense and shall be performed according to these Specifications.

**Measurement**

00591.80 **Waterproofing Membrane** - Measurement of waterproofing membrane will be the surface area sealed, excluding curb and rail faces, and limited to the neat lines, grades and dimensions shown. There will be no additional measurement of overlaps.

00591.81 **Protective Course and Surface Patching** - There will be no separate measurement of surface patching, or asphalt used in a protective course.

**Payment**

00591.90 **Waterproofing Membrane** - Waterproofing membrane will be paid for at the Contract unit price per square foot for the pay item "Warranted Waterproofing Membrane".

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals required to perform the work as specified, including removal of existing asphalt concrete wearing surface and pavement markings, preparation of the surface, installation of the membrane, and providing tack coat, and primer.

Payment includes providing the Manufacturer's Representative and furnishing the Warranty.

The City will not make final payment for work under this Section until the City has received the signed Warranty.

00591.91 **Protective Course and Surface Patching** - There will be no separate or additional payment for surface patching, or for asphalt used in a protective course, as they are considered incidental to the work under this Section.
Section 00594 - Preparing and Coating Steel Structures

Description

00594.00 Scope - This work consists of preparing and coating new steel structures and features in the shop and in the field, and preparing and coating existing steel structures. This includes all:

- Interior and exterior steel surfaces
- Steel railings, bearings, and expansion assemblies
- Other miscellaneous steel
- Galvanized and aluminum surfaces

00594.01 Abbreviations, Definitions and References:

(a) Abbreviations:

   FTMS - Federal Test Method Standard  
   AAMA - American Architectural Manufacturers Association

(b) Definitions:

   Apparent Magnetic Surface - The magnetic surface that a magnetic gage senses, somewhere between the peaks and valleys of the profile, after the steel is roughened as 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 - Coating new or existing steel structures at the Project Site after erection.

   Hold Point - A time at which the Contractor must cease 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.
**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 steel is transported to the erection site.

**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.

**Substrate** - Any surface to which a coating is to be applied. This may be the prepared surface of the steel 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.

**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". SSPC-Vis 1 refers to SSPC's "Visual Standards For Abrasive Blast Cleaned Steel".

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.

**00594.02 Location of Work:**

**(a) New Steel Structures** - Prepare and coat new steel structures and features erected as part of the Project. All required preparation and coating shall take place at the fabrication shop after completion of fabrication and before transporting to the Project Site, except as provided in these Specifications.

**(b) Existing Steel Structures** - Prepare and coat the existing steel structures described in the Special Provisions.
(c) **Rehabilitating Steel Structures** - Prepare and coat new steel members and existing steel structures impacted by erection as part of the Project. This includes all existing steel surfaces uncovered by the removal of existing structural and miscellaneous steel and concrete members, areas where rivets or bolts are removed, and existing steel surfaces damaged during erection or other Contractor operations. All required preparation and coating of new steel members shall take place at the fabrication shop after completion of fabrication and before transporting to the Project Site except as provided in these Specifications. Preparation and coating of existing steel structures impacted by erection shall be performed in the field.

(d) **Non-Steel Metallic Substrates** - Prepare and coat new non-steel substrates and features erected as part of the Project. All required preparation and coating shall take place at the fabrication shop after completion of fabrication and before transporting to the Project Site, except as provided in these Specifications.

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, shall meet with the Engineer for a precoating conference at a time mutually agreed upon. Ten workdays before the precoating conference, submit a plan that identifies the methods of operation to accomplish all phases of the work, including but not limited to the following:

- Personnel qualifications and training
- Surface preparation
- Coating materials
- Coating application
- Quality control inspections
- Containment and waste management

00594.04 **Notice** - Notify the Engineer, in writing, at least one week in advance of the date that preparation and coating operations are to begin.

**Materials**

00594.10 **General** - Use 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.

00594.11 **Coating Materials:**

(a) **General** - Steel coating materials shall be from the same manufacturer and shall be compatible with one another. Before notice required by 00594.04, submit a manufacturer's certification stating that:

- The coating materials meet the requirements of 00594.11(e).
The coating materials in the coating system are compatible.

The same manufacturer has produced all coats of the coating materials in the coating system specified and furnished for the Project.

The coating materials meet the specifications on the manufacturer's data sheets.

Application of coating materials will not be allowed until certifications have been provided and the materials are accepted for use by check testing by the City.

(b) Manufacturing - The coating material shall:

- 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. 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. When successive coats are specified, each coat of the system shall be of a different color to provide contrast between coats. The tinting material shall be compatible with the coating material and not detrimental to performance.

- For top coating material color, closely conform to ODOT Formula 317-74, or Federal Standard 595b color #24227, Green Finish, unless otherwise specified. Color chips for specified top coating material colors are available from the City's Material and Research Section. Coat a 1 square yard test panel on the bridge according to Specifications. Do not order full-scale manufacture of the top coat until the Engineer has approved the resulting color.

- 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 - Each container shall:

- 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.

• 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
  • City Specification number, if any
  • 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:

• Two unopened 1 quart containers of each coating material, each component of multi-component coating material, and each thinner, from each batch of each coat, sampled at the factory at the time of containerizing. The City may, at its discretion, place an inspector at the site of manufacture and/or 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 those of the following tests necessary to ensure that the coating materials conform to Specifications, and such 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 D1475</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>Infrared Identification of Vehicle Solids from Solvent-type Paints</td>
<td>ASTM D 2621</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 coating system for all steel surfaces to be painted on the Project shall incorporate the systems outlined in the following subsections by the type of application. The various coats of paint shall be applied in the thicknesses specified in 00594.42(d)(1).

The coatings on steel-to-steel contact surfaces at all slip-critical structural bolted connections using high strength bolts in primary members 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. Provide Manufacturer's certification of conformance before use.
(1) Coating New Steel (Other than Bridge Rails):

a. **Primer**

Generic Type: Zinc-filled, single-component, moisture-cured polyurethane
Vehicle Type: Moisture-cured polyurethane
Pigment Type: Zinc dust
Pigment Content: 80% minimum zinc by weight in dry film
VOC: 2.8 lb/gal maximum
Volume solids: 59% minimum

b. **Intermediate Coat**

Generic Type: Micaceous iron oxide-filled, single-component, moisture-cured polyurethane
Vehicle Type: Moisture-cured polyurethane
Volume Solids: 59% minimum
Pigment: A minimum of 2.9 lb/gal of micaceous iron oxide
VOC: 2.8 lb/gal maximum
Color: Tinted to distinguish from primer and top coat

c. **Topcoat**

Generic Type: Micaceous iron oxide-filled, single-component, moisture-cured, aliphatic polyurethane
Vehicle Type: Moisture-cured, aliphatic polyurethane
Volume Solids: 60% minimum
Finish: Matte
Pigment: A minimum of 2.9 lb/gal of micaceous iron oxide
VOC: 2.8 lb/gal maximum
Color: ODOT Formula No. 317-74 or Federal Standard 595b Color No. 24227

All micaceous iron oxide utilized in the intermediate and topcoats shall conform to ASTM D 5532, Type 1. Provide manufacturer’s certification of conformance.

(2) Coating New Steel and New Galvanized Steel for Bridge Rails:

a. **Primer**

Generic Type: Zinc-rich epoxy powder coating

b. **Topcoat**

Generic Type: TGIC-Polyester powder coating meeting the applicable performance requirements of AAMA 2604-98
Color: As specified or directed
(3) Recoating Existing Steel:

a. **Primer**

<table>
<thead>
<tr>
<th>Generic Type</th>
<th>Zinc-filled, single-component, moisture-cured polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td>Moisture-cured polyurethane</td>
</tr>
<tr>
<td>Pigment Type</td>
<td>Zinc dust</td>
</tr>
<tr>
<td>Pigment Content</td>
<td>80% minimum zinc by weight in dry film</td>
</tr>
<tr>
<td>VOC</td>
<td>2.8 lb/gal maximum</td>
</tr>
<tr>
<td>Volume solids</td>
<td>59% minimum</td>
</tr>
</tbody>
</table>

b. **Intermediate Coat**

<table>
<thead>
<tr>
<th>Generic Type</th>
<th>Micaceous iron oxide-filled, single-component, moisture-cured polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td>Moisture-cured polyurethane</td>
</tr>
<tr>
<td>Volume Solids:</td>
<td>59% minimum</td>
</tr>
<tr>
<td>Pigment</td>
<td>A minimum of 2.9 lb/gal of micaceous iron oxide</td>
</tr>
<tr>
<td>VOC</td>
<td>2.8 lb/gal maximum</td>
</tr>
<tr>
<td>Color</td>
<td>Tinted to distinguish from primer and top coat</td>
</tr>
</tbody>
</table>

c. **Topcoat**

<table>
<thead>
<tr>
<th>Generic Type</th>
<th>Micaceous iron oxide-filled, single-component, Moisture-cured, aliphatic polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td>Moisture-cured, aliphatic polyurethane</td>
</tr>
<tr>
<td>Volume Solids:</td>
<td>60% minimum</td>
</tr>
<tr>
<td>Finish</td>
<td>Matte</td>
</tr>
<tr>
<td>Pigment</td>
<td>A minimum of 2.9 lb/gal of micaceous iron</td>
</tr>
<tr>
<td>VOC</td>
<td>2.8 lb/gal maximum</td>
</tr>
<tr>
<td>Color</td>
<td>ODOT Formula No. 317-74 or Federal Standard 595b Color No. 24227</td>
</tr>
</tbody>
</table>

All micaceous iron oxide utilized in the intermediate and topcoats shall conform to ASTM D 5532, Type 1. Provide manufacturer’s certification of conformance.

(4) Rehabilitating Existing Steel:

a. **Primer** - Primer must be capable of penetrating and adhering to poorly prepared surfaces.

<table>
<thead>
<tr>
<th>Generic Type</th>
<th>Zinc and micaceous iron oxide-filled, single-component, moisture-cured polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type:</td>
<td>Moisture-cured polyurethane.</td>
</tr>
<tr>
<td>Pigment Type:</td>
<td>Zinc and micaceous iron oxide pigment</td>
</tr>
</tbody>
</table>
| Pigment Content: | 59% minimum zinc by weight in dry film  
15% minimum micaceous iron oxide by weight in dry film |
| VOC          | 340 g/L (2.8 lb/gal) maximum                                                       |
| Volume solids | 59% minimum                                                                        |
b. **Intermediate Coat:**

- **Generic Type:** Micaceous iron oxide-filled, single-component, moisture-cured polyurethane
- **Vehicle Type:** Moisture-cured polyurethane
- **Volume Solids:** 59% minimum
- **Pigment:** A minimum of 2.9 lb/gal of micaceous iron oxide
- **VOC:** 2.8 lb/gal maximum
- **Color:** Tinted to distinguish from primer and top coat


c. **Topcoat:**

- **Generic Type:** Micaceous iron oxide-filled, single-component moisture-cured, aliphatic polyurethane
- **Vehicle Type:** Moisture curing, aliphatic polyurethane
- **Volume Solids:** 60% minimum
- **Finish:** Matte
- **Pigment:** A minimum of 2.9 lb/gal of micaceous iron oxide
- **VOC:** 2.8 lb/gal maximum
- **Color:** ODOT Formula No. 317-74 or Federal Standard 595b Color No. 24227

All micaceous iron oxide utilized in the coats shall conform to ASTM D 5532, Type 1. Provide manufacturer’s certification of conformance.

**(5) Non-Steel Metallic Substrates:**

On all galvanized surfaces to be coated, except those covered by 594.11(e)(1), incorporate two coats of a single-component, moisture curing polyurethane system. On aluminum surfaces to be coated, incorporate a one coat of a single-component moisture curing polyurethane system. Apply according to the manufacturer's recommendations.

a. **First Coat (Galvanized Surfaces)**

- **Generic Type:** Micaceous iron oxide-filled, single-component moisture-cured polyurethane
- **Vehicle Type:** Moisture-cured polyurethane
- **Volume Solids:** 59% minimum
- **Pigment:** A minimum of 2.9 lb/gal of micaceous iron oxide
- **VOC:** 2.8 lb/gal maximum
- **Color:** Tinted to distinguish from substrate and top coat
b. Topcoat Galvanized Surfaces) or Single Coat (Aluminum) - Matte Finish

- Generic Type: Micaceous iron oxide-filled, single-component, moisture-cured, aliphatic polyurethane
- Vehicle Type: Moisture-cured, aliphatic polyurethane
- Volume Solids: 60% minimum
- VOC: 2.8 lb/gal maximum
- Finish: Matte
- Pigment: A minimum of 2.9 lb/gal of micaceous iron oxide
- Color: As specified

All micaceous iron oxide utilized in the coats shall conform to ASTM D 5532, Type 1. Provide manufacturer's certification of conformance.

00594.12 Sealant - Sealant called for in 00594.42(f) shall be an industrial grade polyurethane sealer approved for use by the coating manufacturer. The sealant color shall be clear or shall approximate the color of the coating, as the Contractor elects.

Backing material shall be industrial grade polystyrene or polyurethane of sufficient diameter to fill the crevices or gaps as required. Obtain the Engineer's approval of the sealant and backing material before using.

Construction

00594.40 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 00594.41 and 00594.42(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, slag, spatter and spalls by blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00594.41.

Do not apply coatings within 4 inches of the weld before finishing the welding operation.
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.

For new bridge rail steel to be coated, use an iron phosphate conversion coating as a surface pre-treatment, after abrasive blast-cleaning and prior to applying coating, to ensure proper adhesion to the steel substrate. The form and quality of the iron phosphate conversion coating shall meet the requirements of the powder coating manufacturer.

(b) Existing Steel Structures - Blast-clean existing steel structure surfaces to be coated according to SSPC-SP 6, "Commercial Blast Cleaning", except as modified by this Section. The appearance of the blast-cleaned surface shall closely approximate Pictorial Standard SP 6 of SSPC-Vis 1. No mill scale or paint will be allowed. Rust stains, paint stains or mill scale stains will be allowed.

(c) Rehabilitating Existing Steel Structures - Clean all existing steel surfaces to be painted down to clean, bare steel by power tool cleaning (SSPC-SP 11). The cleaned surface shall have no material detrimental to the subsequent application of the coating system. The use of vacuum shrouded tools is advised, along with the use of tarps set below the work areas to catch any material that escapes initial collection. Other methods that achieve the same surface preparation and waste containment may be used if approved prior to beginning work.

The areas to be prepared shall include all areas of existing coated surfaces exposed by the removal of the existing structural or miscellaneous steel 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. All existing lead-based coatings exposed by the removal of any structural or miscellaneous member shall be completely removed down to clean, bare steel. All prepared areas shall extend at least 2 inches into tightly adhering, intact paint. The subsequent coating shall overlap 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) New Galvanized Surfaces - New galvanized surfaces to be coated shall be solvent cleaned (SSPC-SP1) followed by either a light brush blast (SSPC-SP7) or surface etching with a 7%-10% hydrochloric acid solution, or a vinyl wash material (designed to prepare galvanized surfaces for coating application) to produce a slight abraded or etched appearance. Ensure that the surface is free of all debris or material resulting from the surface preparation procedures prior to painting. It is important that all oil, grease, or other contaminants be removed by the initial solvent cleaning prior to acid etching. If abrasive blasting is utilized, it shall be performed in a manner that properly removes contaminants but does not destroy the integrity of the galvanized surface. If vinyl wash is utilized, the material shall be compatible with the applied coating.
(2) **Weathered Galvanized Surfaces** - Existing weathered galvanized surfaces shall be lightly brush blasted (SSPC-SP7) with a light abrasive to remove loose, delaminating surface contaminants, corrosion, and other deleterious material. The abrasive blasting shall be performed in a manner that will properly clean the surface but not destroy the integrity of the galvanizing, and provide an adequate surface to which the coating system can adhere.

(3) **Aluminum** - Surfaces to be coated shall be solvent cleaned (SSPC-SP1) followed by either a light brush blast (SSPC-SP7) or light hand sanding.

(e) **All Steel Structures** - Remove fins, tears, slivers and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing or similar operations, and grind all welds smooth.

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

Use methods specified in SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning", and SSPC-SP 3, "Power Tool Cleaning", 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 ODOT TM 619.

If a centrifugal wheel is used for blast-cleaning, perform a final blast-cleaning with high-pressure air with an abrasive to obtain the specified profile.

Abrasives shall have no corrosion products, water, oil or any other material detrimental to the application and adherence of the coatings. Abrasive cleanliness will be tested according to ODOT TM 616 and ASTM D 4940. Wet abrasives are allowed if wet sandblasting methods are used.

The conductivity of the abrasive shall not exceed 250 microSiemen when tested according to ASTM D 4940.

(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 sandblasting, brush-blast any rust bloom on the surface before applying the coating. If an effective rust inhibitor is used, it shall not be detrimental to the coating system and shall 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 re-blast the surface.

(6) Final Preparation - Before coating, the prepared surface shall be:

- Blown down with high-pressure air, supplemented by brushing if required
- Free of all residue
- Acceptable to the Engineer

00594.42 Coating Metal Structures:

(a) Description - When not in conflict with this Section and the Special Provisions, perform coating application conforming to:

- The best practices of the trade
- The recommendations of the coating manufacturer
- The applicable portions of the SSPC-PA 1
- The applicable portions of the SSPC-PA 2

(b) Application Site Mixing and Thinning of Coating Materials:

(1) Rejection - The container contents will be rejected, and shall 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. Take care to ensure that any 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.

(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. 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. Such corrective work may require re-cleaning, application of additional coating, or other measures as directed, at no additional compensation.

(d) Coating Requirements:

(1) **Number of Coats and Film Thickness** - Apply coatings to the prepared surfaces as follows:

a. **New Steel Structures (Other than Bridge Rails):**

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc-filled single-component moisture-cured polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>2 mils</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>8 mils</strong></td>
</tr>
</tbody>
</table>

d. **New Steel Bridge Rails:**

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc-filled epoxy powder coating</td>
<td>3 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>TGIC-Polyester powder coating</td>
<td>2 mils</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>5 mils</strong></td>
</tr>
</tbody>
</table>

c. **Recoating Existing Steel Structures:**

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc-filled single-component moisture-cured polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>Micaceous iron oxide-filled, single-component, moisture-curing polyurethane</td>
<td>2 mils</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>8 mils</strong></td>
</tr>
</tbody>
</table>
d. Rehabilitating Existing Steel Structures:

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Zinc and micaceous iron oxide-filled single-component, moisture-cured polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>2 mils</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>8 mils</td>
</tr>
</tbody>
</table>

e. Aluminum Surfaces:

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topcoat</td>
<td>Single component, aliphatic, moisture curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>3 mils</td>
</tr>
</tbody>
</table>

f. Galvanized Surfaces

<table>
<thead>
<tr>
<th>Coat</th>
<th>Formula</th>
<th>Minimum Dry Film Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Coat</td>
<td>Micaceous iron oxide-filled single-component, moisture-curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>Topcoat</td>
<td>Single-component, aliphatic, moisture-curing polyurethane</td>
<td>3 mils</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>6 mils</td>
</tr>
</tbody>
</table>

Apply the coating system in as many coats as specified, 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 contact surfaces, whether in the shop or field. The dry film thickness shall not be less than 3 mils nor more than 5 mils.

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.

Regardless of the primary method selected for applying the full coating system, use brushes to ensure proper coverage of each coat around structural irregularities. Brush the coating into:

- Gaps and crevices between steel members
- Back edges of steel members
- Lips around and back sides of rivets and bolts
- Connection areas to which access is difficult
- Areas where spraying does not adequately coat or penetrate crevices

(2) **Stripe Coats** - Before applying each specified coat, apply a stripe coat on all edges, corners, seams, crevices, interior angles, junctions of joining members, rivet or bolt heads, nuts and threads, weld lines and similar surface irregularities, with the exception of non-steel substrates. Apply the stripe coat in sufficient thickness to completely hide the surface being covered, and follow it as soon as practicable with the application of the full prime, intermediate, or finish coat to its specified thickness.

(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 steel substrate.

The dry film thickness will be measured for acceptance using a magnetic gauge or magnetic flux gauge according to SSPC-PA2. In addition to the requirements of SSPC-PA2, an additional three readings in each connection area will be made. The average of the three readings at each connection shall meet the minimum dry film thickness specified in 00594.42(d). 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.

In areas where dry film thickness measurements are impractical, wet film thickness measurements will be made according to ASTM D 4414. On edges or other irregular surfaces visual inspection and a pencil (pull-off) gage will be used to verify thickness.
Each coat, whether a full, complete coat covering 100% of the steel surfaces, or a stripe coat utilized on the described areas subject to premature failure, shall be a separate entity meeting all specified thickness and coverage requirements. Do no use a preceding or succeeding coat to remedy deficiencies in any other coat. Each coat shall meet all applicable specifications, and shall completely cover the substrate to which it is applied.

(4) Additional Top Coat Requirements - Apply the top coat, regardless of the total thickness of prime and intermediate coats, in sufficient thickness to achieve uniform and complete coverage and appearance and to achieve the minimum required topcoat thickness. The topcoat shall be of a uniform appearance.

(e) Time of Application - Prime existing steel structure surfaces on the same day they are cleaned by dry blast-cleaning methods, weather permitting. Surfaces cleaned by liquid blast-cleaning methods shall be thoroughly dry before priming. Prime before any visible indication of rust formation but within two work days of initial blasting.

If weather does not permit priming the same day, up to two days of additional blasting will be permitted. If the three days of blast-cleaning occur near the end of the coating season, continue with the coating effort until all blast-cleaned surfaces have been coated with the complete coating system. If the delay is for any other reason, continue with the coating effort until all blast-cleaned surfaces have been coated with a prime coat.

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 prior to recoating.

When the Special Provisions permit, the Contractor may propose to blast-clean and prime extended areas, as defined in the Special Provisions, and come back at a later time to apply the remaining coats. Submit the proposed plan to the Engineer, and do not proceed until approved. Any extra costs of protecting and cleaning the partially completed work will be the Contractor's responsibility.

(f) Sealing - Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with:

- Coating materials where practicable
- Sealant, if the crevice or gap cannot be filled with coating materials. In areas that collect or channel water, apply sealant even if the coating fills the gap. Apply the sealant after complete application of the top coat.
- Backing material and sealant to fill the crevices and gaps that exceed 1/4 inch. Apply sealant over the backing material to form a watertight seal.
(g) **Adhesion** - Minimum adhesion shall be 250 psi within one week of application of each coat to its substrate. The Engineer will perform adhesion tests according to ASTM D 4541, using an Elcometer tester.

(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

Lengthy weather-related delays may be necessary. In scheduling the work, be aware of weather conditions likely to be encountered.

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 steel if coating is to be applied in adverse weather conditions. Heat the steel 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 near each end of each span on the structure being coated. The exact location of stenciling will be determined by the Engineer. The color of stenciling shall be flat black unless otherwise directed.

(00594.43) **Inspection** - The Engineer will inspect materials and 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. Repair coating system damages resulting from City inspection and testing at no 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>Measuring Humidity with a Psychrometer</td>
<td>ASTM E 337</td>
</tr>
<tr>
<td>Cleanliness of Abrasive Material</td>
<td>ODOT TM 616</td>
</tr>
<tr>
<td>Conduct Metric Analysis of Water Soluble Ionic</td>
<td>ASTM D 4940</td>
</tr>
<tr>
<td>Contamination of Blasting Abrasives</td>
<td></td>
</tr>
<tr>
<td>Indicating Oil or Water in 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 of Blast Cleaned Steel by Keane -</td>
<td>ASTM D 4417</td>
</tr>
<tr>
<td>Tator Comparator</td>
<td></td>
</tr>
<tr>
<td>Surface Profile of Blast Cleaned Steel by Replica Tape</td>
<td>ASTM D 4417</td>
</tr>
<tr>
<td>Wet Film Thickness by Notch Gages</td>
<td>ASTM D 4414</td>
</tr>
<tr>
<td>Dry Film Thickness by Magnetic Gauge</td>
<td>SSPC-PA 2</td>
</tr>
<tr>
<td>Dry Film Thickness by Tooke Gauge</td>
<td>ASTM D 4138</td>
</tr>
<tr>
<td>Pull-Off Strength by Elcometer Adhesion Tester</td>
<td>ASTM D 4541</td>
</tr>
</tbody>
</table>

00594.44 Protection against Damage:

(a) **Contaminated Surfaces** - If the prepared surface becomes contaminated by any material, other than rust, at any time, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust at any time, prepare the contaminated area again according to 00594.41 and recoat with all specified coats. Clean, re-prepare and recoat at no cost to the City.

(b) **Surfaces Not to Be Coated** - Protect surfaces not to be coated under the Contract from blast-cleaning, overspray and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no 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 compensation. Keep navigation lights operating and visible during the hours of darkness.
(c) Other Damage - Prevent, at no 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 594.42 as follows:

(a) Surface Preparation - Repair localized damage, corrosion, and unacceptable coatings.

Prepare the surface by solvent cleaning in accordance with SSPC-SP 1 followed by blast cleaning in accordance with SSPC-SP 6 or as approved by the Engineer. Use a solvent that is acceptable to the paint manufacturer or as approved by the Engineer.

Areas exhibiting coating failure down to the steel substrate and which may or may not be exhibiting visible corrosion shall be prepared down to clean bare steel as per SSPC-SP 6 unless the area is small and cleaning as per SSPC-SP 11 is allowed by the Engineer so as to not damage adjacent areas. The prepared area shall extend at least 2 inches into adjacent tightly adhering, intact coating.

Areas exhibiting coating failure which does not extend down to the steel substrate shall have all loose, delaminating, non-intact, non-sound coating, or otherwise failing coating removed down to sound, still performing coating. The prepared areas shall extend 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 existing coating at least two inches.

(c) Coating Application in Repair Areas - When the bare substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

Use the procedure in the subsection for all repairs.

When the damage does not extend to the bare substrate, apply only the affected coats.

Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.
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 **New and Existing Steel Structures** - No separate measurement will be made for work done under this Section.

**Payment**

00594.90 **General:**

(a) **New Steel Structures** - No separate payment will be made for preparing and coating new steel work, as payment for all preparing, coating and incidental items, including correction of damages according to 00594.44, will be included in the payment for furnishing and placing the new steel according to 00560.90.

(b) **Existing Steel Structures** - Payment for preparing and coating work as specified will be made at the Contract lump sum amount for the item "Prepare and Coat ________ Bridge". The bridge name will be inserted in the blank.

Payment for the item "Prepare and Coat ________ Bridge" will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified.

Partial payments will be made only for portions of the structure that have been prepared and coated with all coats specified. Such partial payment will represent an estimate of the work completed as a percentage of the total coating system work to be done.

No separate payment will be made for correction of damages according to 00594.44, as payment will be Incidental to the work under this Section.
Section 00595 - Reinforced Concrete Box Culverts

Description

00595.00 Scope - This work consists of constructing cast-in-place reinforced portland cement concrete box culverts (RCBC) and precast reinforced concrete boxes to the lines, grades and dimensions shown or as directed.

Materials

00595.10 General - Provide reinforcement and portland cement concrete according to Sections 00530 and 00540 for cast-in-place construction. Provide reinforcement and portland cement concrete according to ASTM C 789/C 789M or ASTM C 850/C 850M for precast construction. Provide joint seals conforming to 02440.40.

00595.11 Class of Concrete - Provide Class 3600 - 1 1/2" ,1" or 3/4" portland cement concrete for cast-in-place RCBC, wingwalls and aprons and cast-in-place ends for precast reinforced concrete boxes.

Provide Class 5000 portland cement concrete for precast reinforced concrete boxes.

Construction

00595.40 Reinforcement - Furnish and place reinforcing steel according to Section 00530 for cast-in-place RCBC. Furnish and place reinforcement according to ASTM C 789/C 789M for precast reinforced concrete boxes except as shown.

00595.41 Portland Cement Concrete - Furnish and place portland cement concrete for cast-in-place RCBC, wingwalls and aprons and cast-in-place ends used with precast reinforced concrete boxes according to Section 00540 and the following:

(a) 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 three days before placing the top slab according to 00595.41(b).

Construct each wingwall as a monolith.
(b) 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 eight hours or more.

² Except loads from form work and reinforcing steel for further concrete placements.

(c) Concrete Finish - All exposed concrete surfaces shall receive a general finish.

00595.42 Portland Cement Concrete for Precast Boxes - Furnish and place portland cement concrete for precast reinforced concrete boxes according to ASTM C 789/C 789M except as shown. A production run shall be considered continuous if not interrupted for more than three consecutive days.

00595.45 Joint Seals for Precast Boxes - Provide a continuous flexible watertight seal in the joint, on the sides and top, between each precast reinforced concrete box section.

Measurement

00595.80 General - Reinforced concrete box culverts will be measured on the length basis, along the centerline of the box culvert, from end to end of the box.

Wingwalls and aprons will not be measured, but considered a separate lump sum item.

Concrete and reinforcement used in box culverts will not be measured separately, but are incidental to the work under this Section. Estimated quantities of concrete and reinforcement will be shown in the Special Provisions.

Payment

00595.90 General - The accepted reinforced concrete box culvert will be paid for at the Contract unit price per foot for the item "Reinforced Concrete Box Culvert".

Wingwalls and aprons will be paid for at the Contract lump sum amount for the item "Wingwalls and Aprons" according to 00595.80.

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.
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 state the types and locations of walls to be constructed.

00596.02 Definitions - Geosynthetic terms not defined in this subsection may be found 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.

Class A MSE Granular Backfill - Backfill material with a specific gradation that is intended for use in conjunction with inextensible tensile reinforcements.

Class B MSE Granular Backfill - Backfill material with a specific gradation that is intended for use in conjunction with extensible tensile reinforcements.

Class C MSE Granular Backfill - Backfill material with a specific gradation that is intended for use in a zone beneath a spread footing.

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.

Connecting Wires - Internal wires used to prevent gabions from bulging.

Conventional Segmental Retaining Walls:

1) A basic gravity retaining wall type, and

2) retaining walls composed of segmental retaining wall units only (i.e., no soil reinforcements).

Extensible Tensile Reinforcements - Reinforcements in which the deformation at failure is comparable to or greater than the deformability of the reinforced backfill (e.g., geotextiles and polymeric materials).

Gabion Retaining Walls:

1) A basic gravity retaining wall type, and

2) 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.

**Geosynthetic** - See 00350.01.

**Geotextile** - See 00350.01.

**Inextensible Tensile Reinforcements** - Reinforcements in which the deformation at failure is significantly less than the deformability of the reinforced backfill (e.g., metallic materials).

**Mechanically Stabilized Earth (MSE) Retaining Walls:**

1) A basic gravity retaining wall type, and

2) Retaining walls composed of granular backfill and either extensible or inextensible tensile reinforcements in the granular backfill weight. Examples of facing include precast concrete panels, cast-in-place facades, and segmental retaining wall units.

**Prefabricated Modular Retaining Walls:**

1) Bin or crib gravity retaining walls composed of premanufactured components for field assembly into cells filled with specified backfill, or

2) Gravity retaining walls composed of concrete blocks greater than 3 cubic feet.

**Proprietary Retaining Walls:**

1) Retaining walls in which a private company identifies lawful claim to the product or design of the product,

2) Retaining wall products typically associated with a tradename or name brand, or

3) 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 - Supplement the City-prepared plans with such working drawings and design calculations, prepared by the provider of the proprietary retaining wall selected, as necessary, for completion of the work. Submit stamped working drawings, design calculations, field construction manuals and product brochures to the Project Manager according to 00150.35. Submit this information at least 30 calendar days before beginning retaining wall fabrication or construction for the Engineer's review. Obtain the Engineer's written approval before fabricating retaining walls.

(a) Working Drawings - The working drawings shall include at least the following:

   (1) General:

   - General Notes - Provide necessary information on design and construction of the retaining wall.

   - Materials and Quantity Summary List - Show all items of each wall, including incidental items.

   - 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 (e.g., top of cast-in-place footings and/or leveling pads); the distance along the face of the wall to all steps in the wall base; and the maximum applied bearing pressures.

   - Typical Sections - Show wall construction and limits of backfill, backfill material, and subgrade material.

   - Structural and Geometric Details - Provide all structural and geometric details, including but not limited to:

     - Loading conditions

     - Footing and/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 type, 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. Full height panels will not be allowed.

• **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 - The field construction manual shall be prepared by the provider of the proprietary retaining wall selected, and shall provide step-by-step directions for constructing the retaining wall.

**Materials**

00596.10 General - Furnish materials according to the following requirements:

(a) **City Approval** - Use only retaining wall materials, products or systems that have met the requirements of the ODOT Retaining Structures Program and have an "Approved" status according to the ODOT Retaining Structures Program prior to the Project Bid Opening. Information regarding approval or any other aspect of ODOT’s Retaining Structures Program may be obtained from the Retaining Structures Coordinator.

(b) **City-Furnished Designs** - For retaining wall designs shown (i.e., non-proprietary retaining walls), either provide specified materials in accordance with the applicable material Specifications herein or provide products from the CPL also in accordance with the applicable material Specifications herein. 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 in accordance with the company’s specifications and the applicable material Specifications herein. 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 - Provide backfill according to 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 of durable rock material, free from unsuitable materials and conforming to the following gradations as determined by AASHTO T 27 (Dry Sieve):

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Class A Inextensible</th>
<th>Class B Extensible</th>
<th>Class C Spread Footing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tensile Reinf.</td>
<td>Tensile Reinf.</td>
<td>Foundation Zone</td>
</tr>
<tr>
<td>4 inch</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2 inch</td>
<td>80 - 100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>50 - 100</td>
<td>100</td>
<td>65 - 85</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>40 - 100</td>
<td>40 - 100</td>
<td>50 - 80</td>
</tr>
<tr>
<td>No. 4</td>
<td>20 - 100</td>
<td>20 - 100</td>
<td>35 - 70</td>
</tr>
<tr>
<td>No. 10</td>
<td>15 - 100</td>
<td>15 - 100</td>
<td>30 - 55</td>
</tr>
<tr>
<td>No. 40</td>
<td>10 - 60</td>
<td>10 - 60</td>
<td>15 - 35</td>
</tr>
<tr>
<td>No. 100</td>
<td>5 - 35</td>
<td>5 - 35</td>
<td>5 - 15</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 15</td>
<td>0 - 15</td>
<td>0 - 15</td>
</tr>
</tbody>
</table>

The Uniformity Coefficient, $C_u$, the ratio of $D_{60}$ to $D_{10}$, shall exceed 1.5. $D_{60}$ and $D_{10}$ are the soil diameters at which 60% and 10% of the soil weight is finer.

The plasticity index of the MSE granular backfill material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T 90.

The MSE granular backfill material shall also conform to the following electrochemical requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Limits</th>
<th>Test Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.5 - 9.5</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 5000 Ω-cm but greater than 2000 Ω-cm may be accepted if they meet the following additional requirements:
The organic content shall meet one of the following conditions:

- Organic content as computed according to AASHTO T 267 does not exceed 2%.
- 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 - Provide gabion baskets according to 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, 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:**

   - **Tie Strips** - Locate tie strip connection devices within 1 inch of the plan location.
   
   - **Loop Embeds** - Locate loop embeds within 3/16 inch of the plan location.
   
   - **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 00540.16 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

• Non-specification 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
• Non-specification 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, Storage, 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 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 - Provide steel reinforcement for concrete according to Section 00530.
00596.15 **Steel** - Provide structural steel according to 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 ASTM A 775/A 775M, except where noted.

  1. **Reinforcing Strips** - Use steel reinforcing strips of the required shape and dimensions conforming to ASTM A 36/A 36M 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/A 641M.

    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/A 884M.

  3. **Tie Strips** - Provide tie strips of steel conforming to the requirements of ASTM A 570/A 570M, Grade 50, or equivalent.

  4. **Loop Embeds** - Fabricate 1 inch loop embeds from cold drawn steel wire conforming to ASTM A 82. Weld loop embeds according to 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 ASTM A 82.

00596.16 **Geosynthetics** - Provide geosynthetics according to the following:

(a) **Gabion Wall Filter** - Provide Type 2 riprap geotextile according to 02320.

(b) **Precast Concrete Facing Panel Joint Cover** - Provide Type 1 drainage geotextile according to 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, provide either preformed ethylene propylene diene monomer (EPDM) rubber pads conforming to ASTM D 2000, M2AA 810 A13B33C12F17 having a durometer hardness of 80 ± 5, or neoprene elastomeric pads having a durometer hardness of 55 ± 5, or other bearing material as recommended by the supplier, certified by the manufacturer and approved by the Engineer.

00596.18 Timber - Provide timber according to Section 00570.

00596.19 Piles - Provide piling according to Section 00520.

Labor

00596.30 Quality Control Personnel - Provide certified technicians in the following fields:

QCT (Quality Control Technician)

CEBT (Certified Embankment and Base Technician)

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.
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 over-excavated 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 expense to the City. As directed, correct misaligned units not meeting the limits specified due to backfill placement at no expense 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 238.

- Optimum Moisture and Maximum Density - Determine as required by AASHTO T 99 Standard Proctor Method A or C, 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 foundation material to 95% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method A or C, with coarse particle correction according to AASHTO T 224.
  • Compact backfill material to 95% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method A or C, 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 A or C, 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 laterally the width of the footing beyond the edge of the bottom 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 to verify that no soft or pumping areas remain in any layer or foundation soil. Correct any such areas.

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 expense to the City.

Place riprap geotextile according to Section 00350 and the following:
  • Minimum overlap shall be 12 inches.
• Place riprap geotextile 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 - Carefully 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 gage 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 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 - Construct a gravel or un-reinforced 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 CPL. 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 un-reinforced 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 and/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 CPL. 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 ASTM A 775/A 775M, 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 General - Retaining walls will be measured on the area basis and will be the area shown, in a vertical plane, for each retaining wall constructed and accepted. Field measurement of each retaining wall area will not be required. The quantity will be the theoretical area shown in the Schedule of Items for 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.
No separate measurement will be made for excavation, shoring, footings, leveling pads, or specified backfill.

Excavation below elevations shown will be measured according to 00510.84.

The estimated quantities of materials are listed in the Special Provisions.

Type ‘F’ coping will be measured on the length basis from end to end of coping.

Sidewalk coping will be measured on the area basis from end to end and from top of curb to exterior edge of coping.

**Payment**

**00596.90 General** - Payment for each retaining wall will be made at the Contract unit price per square foot for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

Options included in item (f), consisting of two or more wall types that would generally be paid individually under items (a) through (e), will be listed in the Special Provisions.

Payment will be made for the quantity shown in the Schedule of Items unless plan changes are ordered in writing by the Engineer.

No separate payment will be made for excavation, shoring, footings, leveling pads, or specified backfill.

Excavation below elevations shown and backfill will be paid according to 00510.94.

Payment for Type ‘F’ coping will be made at the Contract unit price per meter (foot) for the pay item "Type ‘F’ Coping". No separate payment will be made for reinforcing steel and concrete.

Payment for sidewalk coping will be made at the Contract unit price per square foot for the pay item "Sidewalk Coping". No separate payment will be made for reinforcing steel and concrete.
Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, technical representatives, and incidentals necessary to complete the work as specified.

Wall drainage and/or filter systems, including perforated pipe, drain material, geotextile, and drain pipe; cast-in-place or precast Standard Coping, including reinforcing steel and concrete; and other appurtenances that are not covered by other pay items under the Contract, will be incidental and included in payment made for the retaining wall.
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 General - 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 - Use concrete blocks conforming to the following:

- 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" x 8" x 16" size

Do not tint concrete blocks. Use uniform colored blocks along the length of individual walls.
(b) **Concrete Caps** - Construct concrete caps conforming to the following:

- Nominal 4" x 8" x 16" size
- Same color as concrete blocks

(c) **Reinforcement** - Provide reinforcement according to Section 00530.

(d) **Concrete** - For pile footings, provide Commercial Grade Concrete according to Section 00440. For all other components, including spread footings, provide concrete according to Section 00540.

(e) **Mortar and Grout** - Provide mortar conforming to ASTM C 270 that attains an ultimate compressive strength of at least 2,500 psi at 28 days. Provide coarse grout conforming to ASTM C 476 with a suitable consistency for pouring without segregation of materials.

(f) **Preformed Expansion Joint Filler** - Provide expansion joint filler conforming to 02440.10.

(g) **Fillers, Sealers and Damp-proofing** - Use fillers, sealers, and damp-proofing materials from the CPL.

**00597.12 Precast Concrete Panel Sound Walls:**

(a) **Reinforcement** - Provide reinforcement according to Section 00530.

(b) **Concrete** - For footings, provide Commercial Grade Concrete according to Section 00440. For all other components, provide concrete meeting the requirements of Section 00540.

**00597.13 Concrete Panel Lock Fence Sound Walls:**

(a) **General** - Provide concrete panel lock fence material and necessary components. Provide the manufacturer’s test results and certificate of compliance according to 00165.35.

(b) **Reinforcement** - Provide reinforcement according to Section 00530.

(c) **Concrete** - For footings, provide minor structure concrete according to Section 00440. For all other components, provide 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, and ice- 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 two 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" x 3".
- 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 inch 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" x 4" 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 two coats of sealer to a minimum thickness of 10 mils. The finished product shall be the color "Summer Gray".

(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 Fence Sound Walls - Construct concrete panel fence walls according to the manufacturer’s recommendations.
Measurement

00597.80 General - The quantities of sound walls will be measured on the area basis, to the nearest square foot, of actual surface area of one side of the wall.

No separate measurement will be made for excavating and backfilling, footings, waterproofing and damp-proofing when required.

Concrete and reinforcement used in sound walls will not be measured separately, but are incidental to the work under this Section.

Payment

00597.90 General - 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, performing all excavating and backfilling, constructing required footings, waterproofing and damp-proofing, and for all equipment, labor and incidentals necessary to complete the work.
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 General - Provide materials according to the following:

- Commercial grade concrete .............................................................00440
- Steel reinforcement for concrete ......................................................00530

Grout for joints shall consist of one part portland cement and three parts sand, mixed with water to produce a uniform mixture.

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 330.41(a)(5).

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 pre-cast 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) Pre-cast Blocks - Manufacture pre-cast 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 Sections 00440 and 00530.
Measurement

00599.80 Slope Paving - The quantity of concrete slope paving will be the area in square foot of slope paving completed as specified. Measurement will be on the slope paving surface, to the nearest full square foot for each bridge end slope.

00599.81 Berm Paving - The quantity of berm paving will be the area in square foot of berm paving completed as specified. Measurement will be on the berm paving surface, to the nearest full square foot for each berm.

00599.82 Slope Paving Curbs - The quantity of slope paving curbs will be the length, to the nearest full foot, of curb completed as specified.

Payment

00599.90 General - The accepted pay quantities will be paid for at the Contract unit price per unit of measurement for the following pay items in the Schedule of 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>
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 **General** - Provide self-propelled planning 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

00620.21 **Equipment for Grinding on Bridge Decks** - To remove AC from bridge decks, use power-operated diamond grinders, micro-milling equipment or hydroblast machines capable of uniformly removing the existing surface to 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:

(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 forward speed to 25 feet/minute. Operate at a drum speed of at least 120 RPM.
(2) Shot-Blasters - High-velocity, electric-powered shot-blast machines capable of imparting a minimum energy ($E_k$) of 50,000 ft-lb/sec, as calculated according to the following formula:

$$E_k = \frac{Wv^2}{2G}$$

Where:  
- $W$ = weight of shot blend expelled per second (lb/s)  
- $G$ = gravitational acceleration, 32.4 ft/s$^2$  
- $v = \pi dr$  
- $d$ = diameter of blast wheel (ft)  
- $r$ = blast wheel speed in revolutions per second (s$^{-1}$)

Machines shall cover at least 4 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.

(c) Hydro-blasting - Hydro-blasting equipment shall be capable of removing concrete at a rate and volume acceptable to the Engineer. Demonstrate the removal rate and accuracy of the equipment to the Engineer prior to commencing work.

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 permitted.

(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 lane 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.

(f) **Pavement Removal on Bridges** - Remove AC from bridge decks with equipment meeting the requirements of 00620.21.

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** - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of removal. Dispose of the material according to 00310.43 unless special site(s) are specified in the Special Provisions.

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 **General** - Cold plane pavement removal completed and accepted will be measured in place by the square yard. When the Schedule of Items shows that the depth of pavement to be removed is variable, the depth as shown on the plans 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

00620.90 **General** - Payment for performing all work required to remove and dispose of the existing pavement as specified, including replacement of cutting teeth, will be made at the Contract 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.

Temporary wedges constructed, maintained, and removed under 00620.40(d) will be at the Contractor's expense.

Payment will be payment in full for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Section 00640 - Aggregate Base and Shoulders

Description

00640.00 Scope - This work consists of furnishing and placing one or more courses of aggregate base and/or shoulders on a prepared surface to the lines, grades, thicknesses and cross sections shown or established.

Materials

00640.10 General - Aggregates shall be either 1" - 0 or 3/4" - 0 as the Contractor elects. Use clean, hard, durable aggregates, reasonably well-graded from the maximum size to dust. Base aggregates shall conform to Section 02630 and shoulder aggregate shall conform to Section 02640.

00640.16 Acceptance of Aggregates - Acceptance will be visual by the Engineer.

Construction

00640.40 Preparation of Foundation - Provide a firm surface on which aggregates are to be placed according to Section 00320 and Section 00330.

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 Compacting and Shaping - Compact each layer of material placed in shoulder and base areas by rollers conforming in general to 00641.24 or as directed.

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.

Continue the compactive effort until there is no reaction or yielding 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, ravelling, or rutting, until it is covered with a following layer or until all work is completed.

Measurement

00640.80 General - Aggregate will be measured by the ton in the hauling vehicle, according to 00190.10.

Water used in the care of the work under 00640.60 will be classed as incidental work for which no separate measurement will be made.

Payment

00640.90 General - The accepted quantities of aggregates will be paid for at the Contract price per ton 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</td>
</tr>
<tr>
<td>(b) Aggregate Shoulders</td>
<td>Ton</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing the materials including 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 00640.43 or in the care of the work according to 00640.60.
Section 00641 - Aggregate Subbase, Base, and Shoulders

Description

00641.00 Scope - This work consists of furnishing and placing one or more layers of aggregates, mixed with water, on a prepared surface to the lines, grades, thicknesses and cross sections shown or established.

Materials

00641.10 General - Aggregate shall be sized as specified. Shoulder aggregates shall be either 1" - 0 or 3/4" - 0 size as the Contractor elects. Aggregates shall meet the following requirements:

Base .................................................................................. Section 02630
Shoulder ............................................................................. Section 02640
Subbase .............................................................................. Aggregate for aggregate subbase shall be reasonably well graded from coarse to fine
Open-graded aggregates ....................................................... 02630.11

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.

(a) Grading - All of the grading requirements are given as percentages by weight. The gradation will be determined by sieve analysis according to AASHTO T 27.

(b) Abrasion - The source materials for aggregate subbase shall not exceed 45% wear when tested according to AASHTO T 96.

(c) Sand Equivalent - Aggregate subbase will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

00641.11 Stockpiling - If the produced aggregates are to be stockpiled, prepare the stockpile site and pile the materials according to 00680.40 and 00680.41.

00641.12 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 T99 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, according to 00641.84, if approved.
00641.15 Quality Control:

(a) Aggregate Production Quality Control - A CAgT shall perform sampling and testing of aggregates according to Section 00165 and the MFTP. Statistically evaluate the aggregates according to Section 00165.

(b) Preproduced Aggregate - Compliance of aggregates produced and stockpiled before issuance of Notice to Proceed will be determined according to (1) or (2) below.

   (1) Continuing production records meeting the requirements of Section 00165 and the MFTP

   (2) Sampling and testing the entire stockpile according to Section 00165 and the MFTP

In addition, the material shall meet the requirements of 00641.10.

00641.16 Acceptance of Aggregates - Acceptance will be according to Section 00165.

(a) Stockpiled Aggregate for Aggregate Base and Shoulders - Acceptance will be based on the Contractor's quality control testing, if verified, as required in Section 00165.

   (1) Aggregate Gradation - A stockpile contains specification aggregate gradation when the Quality Level (QL) for each sieve size, calculated according to 00165.40, is equal to or greater than the QL indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the QL indicated in Table 00165-2 yields a PF of less than 1.00 for any sieve size, the material is non-specification.

   (2) Non-specification Aggregate Gradation - Stockpiled aggregates having non-specification aggregate gradation will be rejected unless the non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material has been removed so that the QL for each sieve size is equal to or greater than the QL in Table 00165-2 for a 1.00 PF

No payment will be made for non-specification materials.

(b) Aggregate Base and Shoulder Mixture - Acceptance testing will be performed on random samples obtained immediately following mixing with water according to the MFTP. For non-specification mixture the Engineer will determine the appropriate price reduction or order its removal from the work according to 00150.80(g).

(c) Aggregate Subbase - Aggregate subbase will be accepted based on the Engineer's visual inspection. Samples will be obtained and tested for compliance with 00641.10 by the Engineer if it is suspected that the material does not meet Specifications.
Equipment

00641.20 Mixing Plant - Mix aggregate and water by one of the following methods:

(a) Mixing Plant - Mix with a pug mill, rotary mixer, or other equipment at a mixing plant that:

- Has adjustable weighing or calibrated feeders, and other equipment that produces uniform, non-segregated, specified mixtures.
- Discharges water into the mixer by weighing or metering. The device shall be adjustable and shall assure uniform water content in the mixture.
- Has mixing blades or paddles of proper size, adjustment and clearance to provide uniform mixture.

(b) Road Mix - Motor grader or other suitable equipment.

00641.21 Hauling Equipment - Provide mixture hauling vehicles capable of hauling and depositing the mixture with a minimum of mix segregation.

00641.22 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.

00641.24 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.

Labor

00641.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT (Certified Embankment and Base Technician)
- CAgT (Certified Aggregate Technician)
- CDT (Certified Density Technician)

Construction

00641.40 Preparation of Foundation - Provide a firm surface or material, on which aggregates are to be placed, according to Section 00320, or 00330 as applicable.
00641.41  **Mixing, Hauling and Placing** - Add water to the aggregate while mixing to provide a moisture content according to 00641.12.

Thoroughly mix the combined aggregate and water for as long as necessary to produce a homogenous mixture with all aggregate particles uniformly coated with water. 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 mixture without delay. Deliver the mixture to the spreading equipment by direct deposit into its receiving device, or by placing in uniform windrows in front of the equipment.

(b) **Road Mix** - Place materials for each layer, add water and mix with motor grader until homogeneous mixture is achieved.

Do not place aggregate shoulder material on the top lift of newly constructed EAC or open-graded pavement.

00641.42  **Placing Aggregate Base or Subbase on Geotextile** - When subgrade or drainage geotextile is required between the subgrade and base, place the first lift of material directly on the fabric, without road mixing.

00641.43  **Thickness and Number of Layers:**

(a) **Aggregate Base Courses** - 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 unless approved.

Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.

(b) **Aggregate Subbase Courses** - The maximum compacted thickness of any one layer shall not exceed 9 inches unless approved.

(c) **Shoulder Courses** - Place aggregates in shoulder areas, other than as part of the base course, in one layer, or in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00641.44  **Shaping and Compacting:**

(a) **Base Courses** - Begin compaction of each layer immediately after the material is spread and continue until a density of not less than 100% of the maximum density has been achieved when tested according to the MFTP.

Shape and maintain the surface of each layer during the compaction operations to produce a uniform texture meeting the requirements of 00641.45.
Apply additional water over the materials for proper compaction, according to Section 00340 and as directed.

**Subbase and Shoulder Courses** - Compact each layer of material until no reaction or yielding is observed under the compactor.

---

**Surface Tolerance** - The finished surface of the aggregate and the surface of each underlying layer shall parallel the established grade and cross section for the finished surface within 1/2 inches.

The finished surface of the compacted aggregate, 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.

---

**Care of the Work** - After construction of each layer and completion of base, maintain the layer to specified conditions and prevent or repair segregation, ravelling, or rutting until it is covered with a following layer or until all work is completed.

---

**Measurement**

**General** - Aggregate mixture will be measured by the ton, by the cubic yard, or by the square yard. The unit of measurement will be shown in the Schedule of Items.

If aggregates are mixed in a stationary plant, there will be no separate measurement of water added at the plant to bring the material to optimum moisture content.

If aggregates are mixed in the hauling vehicle (road mix), water used to bring the mixture to optimum moisture for mixing and compaction will be measured separately and paid for according to Section 00340.

Water used in the care of the work under 00641.60 will be incidental work with no separate measurement and payment.

**Weight Basis** - If measurement is by the ton, quantities will be measured in the hauling vehicle, the mixture will be measured after mixing according to 00190.10.

**Volume Basis** - If measurement is by the cubic yard in the hauling vehicle, transport material in vehicles whose maximum "water level" capacity may be readily measured and calculated. Quantities will be determined at the point of delivery, with no allowance for settlement of material during transit. When required to facilitate measurement, level the vehicle loads at the point of delivery. Payment will not be made for material in excess of the maximum "water level" capacity and deductions will be made for loads below the maximum "water level" capacity.
**00641.83 Area Basis** - If measurement is by the square yard, the quantity will be the number of square yards of aggregate base constructed to the full thickness. The full thickness will be identified by the pay item in the Schedule of Items. 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.

**00641.84 Adjustment of Water in Mixture** - If the water in the aggregate mixture placed according to 00641.41(a) 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 under 00641.12 or converted to the equivalent volume.

**Payment**

**00641.90 General** - The accepted quantities of aggregates 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) Aggregate Subbase</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(b) Aggregate Base</td>
<td>Ton or Cubic Yard</td>
</tr>
<tr>
<td>(c) Aggregate Base, ____ Inches Thick</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(d) Aggregate Shoulders</td>
<td>Ton or Cubic Yard</td>
</tr>
</tbody>
</table>

Item (b) will apply when the Contractor has the option of furnishing one or another of two or more designated sizes of aggregates.

In item (c), the designated size of aggregate to be used will be inserted in the blank.

In item (e), the depth of aggregate base will be inserted in the blank.

Payment will be payment in full for furnishing and placing the materials, including 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 the mixture, mixed and placed according to 00641.41(a), subject to the limitations of 00641.84.

No separate or additional payment will be made for water used in the care of the work according to 00641.60.

**00641.91 Material on Hand** - Payment for stockpiled materials on hand may be allowed according to 00195.50(i)(5), subject to the requirements of 00641.10, 00641.15, 00641.16(a), and subject to QA verification.
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 (Certified Aggregate Technician)

Construction

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 General** – 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 General** - 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 &amp; Asphalt Products Base</td>
<td>Ton</td>
</tr>
<tr>
<td>(b) Recycled Concrete &amp; Asphalt Products Shoulders</td>
<td>Ton</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing and placing the materials including 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 Section 00160 and the special provisions.

00680.11 Aggregates - Provide 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 00641.10.

(b) Emulsified AC Aggregate - Furnish aggregates in stockpiles of the following sizes or as specified:

\[
\begin{align*}
1" - 1/2" \\
3/4" - 1/2" \\
1/2" - 1/4" \\
3/8" - 1/4" \\
3/8" - No. 4 \\
3/8" - No. 8
\end{align*}
\]

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 T 11. Provide grading for the designated size aggregate according to the following:
Designated Sizes (inches)

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1 - 1/2</th>
<th>3/4 - 1/2</th>
<th>1/2 - 1/4</th>
<th>3/8 - 1/4</th>
<th>3/8 - No. 4</th>
<th>3/8 - No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>95 - 100</td>
<td>90 - 100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60 - 90</td>
<td>0 - 10</td>
<td>85 - 100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>85 - 100</td>
<td>80 - 100</td>
<td>100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>15 - 30</td>
<td>0 - 2</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>–</td>
<td>–</td>
<td>45 - 65</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 - 7</td>
<td>–</td>
<td>0 - 4</td>
<td>–</td>
<td>0 - 6</td>
<td>0 - 10</td>
</tr>
<tr>
<td>No. 30</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>–</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 2</td>
</tr>
<tr>
<td>No. 200*</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
<td>0 - 1</td>
</tr>
</tbody>
</table>

* In gravels

**00680.15 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 for Section 00641, 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.

**00680.16 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 Aggregate Technician (CAgT) certified by ODOT.

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 permitted, 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.

00680.43 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

00680.70 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

00680.80 General - The quantity of each designated size of material will be the number of cubic yards, or the weight of the designated size of material delivered to and placed in stockpiles or sand sheds, as specified. Measurement of cubic yards will be by cross-section measurement of the completed stockpiles, with no allowance for settlement or shrinkage. Measurement of weight will be according to 00190.10.

Work described in 00680.43 will be measured according to 00680.83.

00680.81 Hauling - Unless specified, hauling of stockpiled materials will not be measured separately. The hauling costs are included in the Contract unit price(s) for the stockpiled material(s).

00680.82 Sand Sheds - No separate measurement will be made for placing materials in sand shed(s).

00680.83 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, determine the weight of the material taken in City vehicles 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

00680.90 General - The accepted quantities of each size of specified material, will be paid for at the Contract price per unit of measurement for the following item:

______Material In Stockpile .............................................. Ton or Cubic Yard

The respective sizes of stockpiled aggregates will be inserted in the blank.

There will be no separate payment for source development and clean-up, preparation of stockpile sites, or placing materials in sand sheds, as the work will be considered incidental to payment for the listed pay item.

Payment will be payment 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.
PART 00700 - WEARING SURFACES

Section 00705 - 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 by the Engineer.

<table>
<thead>
<tr>
<th>Sieve Size (by Weight)</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>30 - 66</td>
</tr>
<tr>
<td>No. 30</td>
<td>8 - 28</td>
</tr>
<tr>
<td>No. 100</td>
<td>0 - 5</td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90 - 100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>55 - 75</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>40 - 60</td>
</tr>
</tbody>
</table>

* Of the fraction passing the 1/4 inch sieve, 40 to 60% shall pass the No. 8 sieve.

00705.11 Asphalt - Provide asphalt according to the following:

(a) General - Provide 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 MC-250 asphalt or 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 gages, 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 by the Engineer.

(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 by the Engineer.

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 three days after construction, as directed, before a succeeding course is placed upon it. If directed, traffic may be permitted 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 application of the 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 two power brooms.

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 pickup type power broom. On bridges, sidewalks and other areas off the roadway, remove all extraneous aggregates to the satisfaction of the Engineer.

Measurement

00705.80  General - The quantities of asphalt or emulsified asphalt will be measured by the ton according to 00190.10.

The quantities of aggregate cover material will be measured by the ton according to 00190.10 or by the cubic yard in the hauling vehicle.
Payment

**General** - The accepted quantities will be paid for at the Contract unit price per unit of measure for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 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>

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 including materials used during the maintenance period.

Item (b) includes water required to dilute the emulsified asphalt, according to 00705.11(c).
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 - Use CQS-1h emulsified asphalt meeting the following requirements when tested according to AASHTO T 59:

- Saybolt Viscosity, seconds at 77 °F 15 - 50
- Residue from Distillation, Weight % 57% minimum
- Sieve Test, % Retained on No. 20 Sieve 0.1 maximum
- Particle Charge, Electroplate (informational)
- Settlement (Storage Stability), 24 hour 1% maximum
- Cement Mixing Test (informational)

The residue shall pass the following specifications:

- Penetration at 77 °F, 3.5 ounces, 5 sec 40-90 minimum
- Solubility in CS₂ or TCE 97.5 minimum
- Ductility at 77 °F, inch 15.7 Minimum

00706.11 Polymer Modified Emulsion - Use a 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/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 thereof. 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.
(a) **Gradation** - Aggregate gradation shall meet one of the following types:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
<th>Percent Passing</th>
<th>Percent Passing</th>
<th>Stockpile Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>No. 4</td>
<td>100</td>
<td>90 - 100</td>
<td>70 - 90</td>
<td>± 5%</td>
</tr>
<tr>
<td>No. 8</td>
<td>90 - 100</td>
<td>65 - 90</td>
<td>45 - 70</td>
<td>± 5%</td>
</tr>
<tr>
<td>No. 16</td>
<td>65 - 90</td>
<td>45 - 70</td>
<td>28 - 50</td>
<td>± 5%</td>
</tr>
<tr>
<td>No. 30</td>
<td>40 - 65</td>
<td>30 - 50</td>
<td>19 - 34</td>
<td>± 5%</td>
</tr>
<tr>
<td>No. 50</td>
<td>25 - 42</td>
<td>18 - 30</td>
<td>12 - 25</td>
<td>± 4%</td>
</tr>
<tr>
<td>No. 100</td>
<td>15 - 30</td>
<td>10 - 21</td>
<td>7 - 18</td>
<td>± 3%</td>
</tr>
<tr>
<td>No. 200</td>
<td>10 - 20</td>
<td>5 - 15</td>
<td>5 - 15</td>
<td>± 2%</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 by the engineer.

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 pre-construction 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 permitted 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 shown in 00706.15(b). The final mix design shall meet the limits shown in 00706.15(b) and (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</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</td>
<td>1.5 lb/yd² max.</td>
</tr>
<tr>
<td></td>
<td>One hour soak</td>
<td></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 one percentage point variation will be permitted.

- The percentage of aggregate passing each sieve shall be within the stockpile tolerance range as stated in 00706.12(a).

- The percentage of aggregate passing shall not go from the high end to the low end of the specified range of any two 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 General - 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 two 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 (i.e., 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 and/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 - 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 (Certified Asphalt Technician 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. 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 00332.

(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 00747. Place the mixture in accordance with Section 00747.
(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 four 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.

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 in accordance with the following table:

**SUGGESTED APPLICATION RATE**

<table>
<thead>
<tr>
<th>Recommended Use</th>
<th>Suggested Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE I Parking Areas, Urban and Residential Streets, Airport Runways</td>
<td>6.7 - 10.0 lbs/yd²</td>
</tr>
<tr>
<td>TYPE II Urban and Residential Streets, Airport Runways</td>
<td>10.0 - 16.7 lbs/yd²</td>
</tr>
<tr>
<td>TYPE III Primary and Interstate Routes</td>
<td>15.0 - 25.0 lbs/yd²</td>
</tr>
</tbody>
</table>

**00706.44 Applying Slurry Seal Sample Strip** - The strip shall consist of two 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. 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 and/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 and/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**  - Apply a minimum of two 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 in accordance with the approved schedule, or an approved revision thereto, 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.

In the event that 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. Cost for this work shall be considered as incidental to the work.

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  **Slurry Seal**  - Slurry seal will be measured on an area basis.

00706.81  **Crack Seal**  - Crack seal will be measured on a length basis of material in place.

00706.82  **Base Repair**  - Base repairs will be measured according to Section 00332.

00706.83  **Surface Repair**  - Asphalt concrete will be measured according to Section 00747. All other work associated with surface repairs is considered Incidental to slurry seal.
Payment

00706.90  Slurry Seal - The accepted quantities of slurry seal will be paid for at the Contract unit price per square yard for the item "Slurry Seal".

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.

Unless there are pay items for crack sealing, base repair, and surface repairs, these items will be considered Incidental and included in payment made for the slurry seal item.

00706.91  Crack Seal - The accepted quantities of crack sealing will be paid for at the Contract unit price per foot for the item "Slurry Seal Crack Sealing". 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 also includes preparation work, sealant, routing, and backer rods.

00706.92  Base Repair - The accepted quantities of base repairs will be paid for according to Section 00332.

00706.93  Surface Repair - The accepted quantities of asphalt concrete will be paid for according to Section 00747.

00706.93  Incidental Basis - When not listed in the Schedule of Items, slurry seal, crack seal, base repair, and surface repair will be considered Incidental.
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 chip seal design will be designated on the plans or in the Special Provisions.

Materials

00710.10 Aggregates - Provide aggregates conforming to 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 two faces, as determined according to AASHTO TP 61.

(c) Grading - Perform sieve analysis according to AASHTO T 27 and 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</th>
<th>Single Size</th>
<th>Graded Size</th>
<th>Fine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2&quot; - 1/4&quot;</td>
<td>3/8&quot; - 1/4&quot;</td>
<td>3/8&quot; - No. 4</td>
<td>3/8&quot; - No. 4</td>
</tr>
</tbody>
</table>

Percent Passing (by Weight)

<table>
<thead>
<tr>
<th></th>
<th>Coarse</th>
<th>Single Size</th>
<th>Graded Size</th>
<th>Fine</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
(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 five cycles of the soundness test using sodium sulfate salt according to AASHTO T104.

(f) **Durability** - Provide aggregates meeting the following durability requirements:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test ODOT</th>
<th>AASHTO</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td></td>
<td>T 96</td>
<td>30.0%</td>
</tr>
<tr>
<td>Degradation (Coarse Aggregate)</td>
<td></td>
<td>TM 208</td>
<td>30.0%</td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td></td>
<td>TM 208</td>
<td></td>
</tr>
<tr>
<td>Sediment Height</td>
<td></td>
<td>TM 208</td>
<td>3.0”</td>
</tr>
</tbody>
</table>

(g) **Harmful Substances** - Provide aggregates meeting the following harmful substances requirements:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test ODOT</th>
<th>AASHTO</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td></td>
<td>T113</td>
<td>1.0% Maximum</td>
</tr>
<tr>
<td>Wood Particles</td>
<td></td>
<td>TM225</td>
<td>0.1% maximum</td>
</tr>
<tr>
<td>Elongated Pieces</td>
<td></td>
<td>TM229</td>
<td>10.0% maximum</td>
</tr>
<tr>
<td>(Coarse Aggregate at a 1 ratio of 5:1)</td>
<td></td>
<td>TM229</td>
<td>10.0% maximum</td>
</tr>
<tr>
<td>Cleanness Value</td>
<td></td>
<td>TM 227</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** - Provide 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, provide CRS-1, 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 chip seal 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 gages, 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 two pneumatic tired rollers and one 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 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 (Certified Aggregate Technician)

Construction

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 three 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 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.

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 one-half 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 chip seal. Apply the surface treatment, weather permitting, to both sides of the travel way so that the end of the work is squared up three 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 permitted by the Engineer. Carefully operate hauling equipment at all times, at moderate speeds that will not damage the new chip seal 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 Contractor's expense.

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 permitted.

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 two 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 two power brooms.

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 to the satisfaction of the Engineer.

Measurement

00710.80 General - The quantities of aggregate will be measured by the ton according to 00190.10, or by the cubic yard in the hauling vehicle.

The quantities of emulsified asphalt will be measured by the ton according to 00190.10.

When indicated by the appropriate pay item in the Schedule of Items, separate measurement will be made for the additional labor and other additional costs in constructing single application emulsified asphalt surface treatment on connections to public roads and streets, on approaches to private properties, and guardrail flares. Measurement will be on a unit basis, per each, by actual count of each location where the connections, approaches, and guardrail flares are constructed and accepted.

Payment

00710.90 General - 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 on connections, approaches, and guardrail flares. Payment will be in addition to payment made for the materials used in the work.

Unless a pay item is included in the Schedule of Items for emulsified asphalt surface treatment of connections, approaches, and guardrail flares, the treatment will be considered Incidental with no separate or additional payment being made for this work.

Payment will be payment in full for preparing the road surface, providing all materials in final position, brooming, and for all equipment, labor, and incidentals necessary to complete the work as specified.
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** - Provide aggregates according to 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 two faces, as determined according to AASHTO TP 61.

(b) **Grading** - Perform sieve analysis according to AASHTO T 27 and 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></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td></td>
<td></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></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 five 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 Method</th>
<th>Test</th>
<th>Maximum Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODOT</td>
<td>AASHTO</td>
<td></td>
</tr>
<tr>
<td><strong>Abrasion Degradation (coarse aggregate)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing NO. 20 Sieve</td>
<td>TM 208</td>
<td>30.0%</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>TM 208</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

(f) **Harmful Substances** - Provide aggregates meeting the following harmful substances requirements:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODOT</td>
<td>AASHTO</td>
<td></td>
</tr>
<tr>
<td><strong>Lightweight Pieces</strong></td>
<td>T 113</td>
<td>1.0% Maximum</td>
</tr>
<tr>
<td><strong>Wood Particles</strong></td>
<td>TM 225</td>
<td>0.1% Maximum</td>
</tr>
<tr>
<td><strong>Elongated Pieces</strong> (Coarse Aggregated at a ratio of 5:1)</td>
<td>TM 229</td>
<td>10.0% Maximum</td>
</tr>
<tr>
<td><strong>Cleanness Value</strong></td>
<td>TM 227</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** - Provide 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, provide CRS-1, 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 chip seal 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.

(b) **Materials on Hand** - Payment for stockpiled materials on hand may be allowed as described in 00195.50(i)(5), subject to meeting the requirements of 00715.10 and 00715.15.

**00715.16 Acceptance ofAggregate** - 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**

**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 gages, 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 two pneumatic-tired rollers and one 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 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 (Certified Aggregate Technician)

**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 three 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 by the Engineer during the progress of the work to produce the best results.

### Table 00715-1

<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></td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>1/2&quot; - 1/4&quot; Aggregate</td>
<td></td>
<td></td>
<td></td>
<td>0.014</td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td>0.008</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>.35</td>
</tr>
<tr>
<td>1&quot; - 1/2&quot; Aggregate</td>
<td></td>
<td></td>
<td></td>
<td>0.015</td>
</tr>
<tr>
<td>1/2&quot; 1/4&quot; Aggregate</td>
<td></td>
<td></td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td>0.006</td>
<td>0.007</td>
<td>0.002</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></td>
<td></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td></td>
<td></td>
<td></td>
<td>0.007</td>
</tr>
<tr>
<td><strong>Fourth Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td></td>
<td></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>3/8&quot; - No. 8 Aggregate</td>
<td></td>
<td></td>
<td></td>
<td>0.007</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 - gal/yd²
   Aggregates - yd³/yd²
(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 three 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 three hours prior to sunset each day.

- Square up first and second course (and third course for Type E-11) of the oil mat three 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 three hours prior to sunset.

- Complete all courses the same day. Square up all courses three 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 one-half 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 three 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 permitted by the Engineer. Carefully operate hauling equipment at all times, at moderate speeds that will not damage the new chip seal 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 Contractor’s expense.

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 permitted.

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 5 m (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 four 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 at the Contractor's expense within 10 working days following notification.
Measurement

00715.80 General - The quantities of aggregate will be measured by the ton according to 00190.10, or by the cubic yard in the hauling vehicle.

The quantities of emulsified asphalt will be measured by the ton according to 00190.10.

When indicated by the appropriate pay item in the Schedule of Items, separate measurement will be made for the additional labor and other additional costs in constructing multiple application emulsified asphalt surface treatment on connections to public roads and streets and on approaches to private properties. Measurement will be on a unit basis, per each, by actual count of each location where the connections or approaches are constructed and accepted.

Payment

00715.90 General - 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 on connections and approaches. Payment will be in addition to payment made for the materials used in the work.

Payment will be payment in full for preparing the road surface, providing all materials in final position, blading and/or brooming, and for all equipment, labor, and incidentals necessary to complete the work as specified.
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 Asphalt - Use CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-1, CRS-2, HFRS-2, or HFMS-2 as selected by the Contractor.

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 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 performed when allowed by the Engineer. If dilution is allow, for every part emulsion, do not add more than one part water. Add water and mix with emulsified asphalt as recommended by the asphalt supplier. The exact proportion of added water will be determined in a manner acceptable to the Engineer.

Obtain samples of the asphalt 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 gages, 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, 00744.40, or 00747.40 as applicable.

**00730.41 Traffic Control** - Do not apply the tack to more than one-half 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 asphalt with a pressure distributor conforming to 00730.22, unless otherwise permitted. Apply the 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 asphalt separates from the water (breaks), but before it loses its tackiness.

**Measurement**

**00730.80 Asphalt** - 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 Asphalt** - 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.
Section 00744 - Hot Mixed Asphalt Concrete (HMAC) Pavement

Description

00744.00  Scope - This work consists of constructing hot mixed asphalt concrete (HMAC) 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:

- TSR - Tensile Strength Ratio
- VFA - Voids Filled with Asphalt
- VMA - Voids in Mineral Aggregate

00744.02  Definitions:

Hot Mixed Asphalt Concrete (HMAC) - A hot plant mixed, uniformly coated mixture of asphalt cement, graded aggregate and additives as required.

Level 1 HMAC - HMAC for use in applications with very low traffic and only limited exposure to trucks.

Level 2 HMAC - HMAC for use in applications with low traffic volumes and low volume truck traffic.

Level 3 HMAC - HMAC for use in applications exposed to moderate bus and truck traffic.

00744.03  Reclaimed Asphalt Pavement (RAP) Material - Reclaimed HMAC pavement (RAP) material used in the production of new HMAC is optional. No more than 30% RAP material will be allowed in the new HMAC pavement.

Materials

00744.10  Aggregate - Provide coarse and fine aggregates for HMAC 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 five 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</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Aggregates Coarse</th>
<th>Aggregates Fine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>T 96</td>
<td></td>
<td></td>
<td>30.0%</td>
<td></td>
</tr>
<tr>
<td>Degradation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td>TM 208</td>
<td></td>
<td></td>
<td>30.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>TM 208</td>
<td></td>
<td></td>
<td>3.0&quot;</td>
<td>4.0&quot;</td>
</tr>
</tbody>
</table>

(c) **Harmful Substances** - Do not exceed the following maximum values:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>ODOT</th>
<th>AASHTO</th>
<th>Aggregates Coarse</th>
<th>Aggregates Fine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Pieces</td>
<td>T 113</td>
<td></td>
<td></td>
<td>1.0%</td>
<td></td>
</tr>
<tr>
<td>Wood Particles</td>
<td>TM 225</td>
<td></td>
<td></td>
<td>0.10%</td>
<td></td>
</tr>
<tr>
<td>Elongated Pieces</td>
<td>TM 229</td>
<td></td>
<td></td>
<td>10.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(at a ratio of 5.1)</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>T 90</td>
<td></td>
<td></td>
<td>0 or NP</td>
<td></td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>T 176</td>
<td></td>
<td></td>
<td>45 min</td>
<td></td>
</tr>
</tbody>
</table>

00744.11 **Asphalt Cement and Additives** - Provide the following:

(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 HMAC 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 Grades Mixes

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1&quot; Dense</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>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>99</td>
<td>100</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>90</td>
<td>100</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
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<td>90</td>
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<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>No. 4</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>No. 8</td>
<td>19</td>
<td>45</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0</td>
<td>7.0</td>
<td>2.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

### Open Graded Mixes

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1/2&quot; Open</th>
<th>3/4&quot; Open</th>
<th>3/4&quot; ATPB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% 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>99</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>90</td>
<td>98</td>
<td>55</td>
</tr>
<tr>
<td>No. 4</td>
<td>18</td>
<td>32</td>
<td>10</td>
</tr>
<tr>
<td>No. 8</td>
<td>3</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0</td>
<td>5.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Asphalt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cement</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
**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 5 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 calendar days prior to the anticipated use in HMAC, 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:

### Dense Graded Mixture

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Method</strong></td>
<td>Superpave</td>
<td>Superpave</td>
<td>Superpave</td>
</tr>
<tr>
<td><strong>Compaction Level</strong></td>
<td>65 Gyrations</td>
<td>75 Gyrations</td>
<td>100 Gyrations</td>
</tr>
<tr>
<td><strong>Air Voids, %</strong></td>
<td>3.5</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>VMA, % minimum</strong></td>
<td>1/2&quot; - 14.0</td>
<td>3/4&quot; - 13.0</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>
<td>1/2&quot; - 14.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3/8&quot; - 15.0</td>
<td>3/8&quot; - 15.0</td>
</tr>
<tr>
<td><strong>P No. 200/ Eff AC ratio</strong></td>
<td>0.8 to 1.6</td>
<td>0.8 to 1.6</td>
<td>0.8 to 1.6</td>
</tr>
<tr>
<td><strong>TSR, % minimum</strong></td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td><strong>VFA, %</strong></td>
<td>70 - 80</td>
<td>65 - 78</td>
<td>65 - 75</td>
</tr>
</tbody>
</table>

### Open Graded Mixture

<table>
<thead>
<tr>
<th></th>
<th>3/4&quot; Open and</th>
<th>3/4&quot; ATPB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Method</strong></td>
<td>ODOT</td>
<td>ODOT</td>
</tr>
<tr>
<td><strong>Air Voids, %</strong></td>
<td>13.5 - 16.0</td>
<td>---</td>
</tr>
<tr>
<td><strong>Draindown, %</strong></td>
<td>70 - 80</td>
<td>---</td>
</tr>
<tr>
<td><em><em>TSR</em>, minimum</em>*</td>
<td>80</td>
<td>---</td>
</tr>
<tr>
<td><strong>Coating, %, minimum</strong></td>
<td>---</td>
<td>90</td>
</tr>
<tr>
<td><strong>VFA, %</strong></td>
<td>40 - 50</td>
<td>---</td>
</tr>
</tbody>
</table>

*TSR* refers to the Gradation and Mix Design Specifications.
**00744.14  Tolerances and Limits** - Produce and place HMAC within the following JMF tolerances and limits:

<table>
<thead>
<tr>
<th>Gradation</th>
<th>Dense-Graded HMAC Type</th>
<th>Open-Graded HMAC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constituent</td>
<td>1&quot;</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>JMF</td>
<td>±5%*</td>
</tr>
<tr>
<td>1&quot;</td>
<td>JMF ±5%</td>
<td>90 - 100%</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>JMF ±5%</td>
<td>90 - 100%</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>No. 4</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>No. 8</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
</tr>
<tr>
<td>No. 30</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>
</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  
  0.80% max.

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the Control Points established in 744.12(b).

**00744.15  Pre-Approved Mix Designs** - Contact the Project Manager for list of pre-approved HMAC mixes.

**00744.16  HMAC 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 three or more tests are performed on a project, a price adjustment will be calculated according to 00744.95.
00744.17   Small Quantity Acceptance - When less than three test results are obtained on a project and testing has not been waived by the Engineer, the HMAC 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

00744.24   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
(b) Vibratory Rollers - Vibratory rollers shall be:

- Equipped with amplitude and frequency controls
- Specifically designed to compact HMAC
- 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 two times the maximum aggregate size for the type of HMAC being compacted.

00744.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT (Certified Aggregate Technician)
- CAT-1 (Certified Asphalt Technician I)
- CDT (Certified Density Technician)

Construction

00744.40 Season and Temperature Limitations - Place HMAC when the temperature of the surface that is to be paved is not less than the temperature indicated:

| Nominal Compacted Thickness of Individual Lifts and Courses as shown on the typical section of the plans | All Levels | All Courses *
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dense Graded Mixes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 1/2&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot; to 2 1/2&quot;</td>
<td></td>
<td>50°F</td>
</tr>
<tr>
<td>2 1/2&quot; and over</td>
<td></td>
<td>40°F</td>
</tr>
<tr>
<td><strong>Open Graded Mixes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2&quot;</td>
<td></td>
<td>60°F</td>
</tr>
<tr>
<td>2&quot; and Over</td>
<td></td>
<td>50°F</td>
</tr>
<tr>
<td>ATPB</td>
<td></td>
<td>40°F</td>
</tr>
<tr>
<td>Temporary</td>
<td></td>
<td>40°F</td>
</tr>
</tbody>
</table>

* If placing HMAC 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 HMAC Mixing Temperatures** - Produce HMAC 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 HMAC according to Section 00730. A tack coat is not required prior to placing HMAC on aggregate base.

**00744.49 Compaction** - Immediately after the HMAC 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 to a minimum of 91% MAMD. Perform finish rolling and continue until all roller marks are eliminated. Determine the density of each sublot by averaging five QC tests performed at random locations by a CDT with the nuclear gauge operated in the backscatter mode according to WAQTC TM 8. Calculate MAMD according to ODOT TM 305. When less than three sublot test results are obtained on a project, the HMAC will be accepted according to 00744.17. Perform a minimum of one sublot density test per day. The Engineer may waive compaction testing upon written notice.

**Maintenance**

**00744.61 Longitudinal Joints** - Construct longitudinal joints according to 00747.61.

**00744.62 Transverse Joints** - Construct transverse joints according to 00747.62.

**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
- Grind the pavement surface with a diamond blade to a maximum depth of 0.3 inch, 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 General - The accepted quantities of HMAC will be measured by the ton according to Section 00190.

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 General - The accepted quantities of HMAC incorporated into the Project, whether or not recycled materials are used, will be paid for at the Contract price per ton for the item "Level ___, _____, HMAC Mixture, ______".

The following will be inserted in the blanks:

- The level(s) of HMAC (1, 2, 3) will be inserted in the first blank
- The type(s) of HMAC (1 inch Dense, 3/4 inch Dense, 1/2 inch Dense, 3/8 inch Dense, 3/4 inch Open, 1/2 inch Open, 3/4 inch ATPB) 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

No separate payment will be made for the asphalt tack coat. Payment for this work will be included in the above item.

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.

00744.95 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 application 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 HMAC.

<table>
<thead>
<tr>
<th>Gradation Constituents</th>
<th>Dense Graded HMAC Type</th>
<th>Weighting Factor (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Aggregate Passing</td>
<td>3/4&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. 4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>No. 8</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>No. 30</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>No. 200</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Other Constituents**

- Asphalt Content: 26
- Moisture Content: 8
- Compaction: 40

Those HMAC 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:

\[(\text{CPF} - 1) \times \text{HMAC Unit Price} \times \text{LQ} = \text{______}\]

Where: LQ is the quantity of mixture in the lot
Section 00746 - Crack Sealing Flexible Pavements

Description

00746.00 Scope - This work consists of repairing and resealing cracks in flexible pavements at locations designated by the Engineer.

Materials

00746.10 Sealants - All sealant materials for crack repair of flexible pavements shall be 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.

Provide 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 General - 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 inch 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.

Rout out cracks narrower than 1 1/2 inch to provide an opening with a minimum width of 1 1/2 inch and a minimum depth of 1/2 inch.

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 by the foot according to 00190.10.

Payment

00746.90 Payment - The accepted quantities of sealed cracks will be paid for at the Contract unit price per foot for the item "Crack Sealing".

Payment will payment in full for furnishing and placing all material, including cleaning and routing as required, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.
Section 00747 - Hot Mixed Asphalt Concrete (HMAC)

Description

Scope - This work consists of constructing one or more courses of hot mixed asphalt concrete pavement, plant mixed into a uniformly coated mass, hot laid on a prepared foundation, compacted to specified density, and finished to a specified smoothness to the lines, grades, thickness, and cross sections shown or established. Typically used for high volume vehicle, bus or high volume truck roadways.

Abbreviations:

TSR - Tensile Strength Ratio
MDV - Mix Design Verification
GMM - Maximum Specific Gravity of Mixture
VFA - Voids Filled with Asphalt
VMA - Voids in Mineral Aggregate

Definitions:

Hot Mixed Asphalt Concrete (HMAC) - A hot plant mixed, uniformly coated mixture of asphalt cement, graded aggregate and additives as required.

Level 1 HMAC - HMAC for use in applications with very low traffic and only limited exposure to trucks.

Level 2 HMAC - HMAC for use in applications with low traffic volumes and low volume truck traffic.

Level 3 HMAC - HMAC for use in applications exposed to moderate truck traffic.

Level 4 HMAC – HMAC for use in applications exposed to very heavy traffic volumes, bus traffic, or heavy truck traffic.

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.
- The method for measuring compaction is changed
- A new compaction specification limit is required
- A change from one test procedure for measuring asphalt content to another test procedure for measuring asphalt content occurs
The Engineer may allow material for irregular areas not completed during the main paving operations, such as driveways or guardrail flares to be evaluated as a separate lot.

**Sublot Size** – A Sublot is 1000 tons of HMAC.

**00747.03 Reclaimed Asphalt Pavement (RAP) Material** - Reclaimed HMAC pavement (RAP) material used in the production of new HMAC is optional. No more than 30% RAP material will be allowed in the new HMAC pavement.

**00747.05 Pre-paving Conference** – Supervisory personnel of the Contractor and any subcontractor, who are to be involved in the paving work, shall meet with the City at a mutually agreed time to discuss means and methods of accomplishing all phases of the paving work.

**Materials**

**00747.10 Aggregate** - Provide coarse and fine aggregates for HMAC meeting the following requirements:

(a) **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.

(b) **Durability** - Provide aggregate not exceeding the following maximum values:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Aggregates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>ODOT</td>
</tr>
<tr>
<td>Abrasion</td>
<td>T 96</td>
</tr>
<tr>
<td>Degradation</td>
<td></td>
</tr>
<tr>
<td>Passing No. 20 Sieve</td>
<td>TM 208</td>
</tr>
<tr>
<td>Sediment Heights</td>
<td>TM 208</td>
</tr>
</tbody>
</table>

(c) **Harmful Substances** - Do not exceed the following maximum values:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Aggregates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>ODOT</td>
</tr>
<tr>
<td>Lightweight pieces</td>
<td>TM 225</td>
</tr>
<tr>
<td>Wood Particles</td>
<td></td>
</tr>
<tr>
<td>Elongated Pieces (at a ratio of 5:1)</td>
<td>TM 229</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>T 90</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>T 176</td>
</tr>
</tbody>
</table>

Conformation testing of aggregates for soundness, durability, and harmful substances will be at the discretion and expense of the City.
00747.11  **Asphalt Cement and Additives** - Provide the following:

(a) **Asphalt Cement** - Unless otherwise approved in writing by the Engineer use the grade of asphalt that is specified in the Contract documents. Provide asphalt cement conforming to the requirements of ODOT’s publication titled, "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 a minimum Tensile Strength Ratio (TSR) of 80.

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.

00747.12  **Mix Type and Broadband Limits** - Mix type and broadband limits shall meet the following:

(a) **Mix Type** - Furnish the type(s) of HMAC 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>1&quot; Dense</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>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>99</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td></td>
<td></td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>19</td>
<td>45</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0</td>
<td>7.0</td>
<td>2.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

### Open Graded Mixes

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1/2&quot; Open</th>
<th>3/4&quot; Open</th>
<th>3/4&quot; ATPB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
<td>Control Points (% passing by Weight)</td>
</tr>
<tr>
<td>1&quot;</td>
<td></td>
<td></td>
<td>99</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>99</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>90</td>
<td>98</td>
<td>55</td>
</tr>
<tr>
<td>No. 4</td>
<td>18</td>
<td>32</td>
<td>10</td>
</tr>
<tr>
<td>No. 8</td>
<td>3</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.0</td>
<td>5.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Asphalt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 00747.13 Job Mix Formula (JMF) Requirements

For mixes not covered under section 00747.15 provide the JMF for the project meeting the criteria set forth herein. JMF shall be developed according to the ODOT Contractor Mix Design Guidelines for Asphalt Concrete and performed or verified within 5 years of the date the contract was advertised. JMF must also be verified according to the ODOT Mix Design Verification process.

Submit the proposed JMF and supporting data to the Engineer for review and acceptance at least 10 calendar days prior to anticipated use. If acceptable, written acceptance will be provided. Perform a new TSR if the source of asphalt cement changes.
## Design Method

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Method</td>
<td>Marshall</td>
<td>Superpave</td>
<td>Superpave</td>
</tr>
<tr>
<td>Compaction Level</td>
<td>50 Blow</td>
<td>75 Gyrations</td>
<td>80 Gyrations</td>
</tr>
<tr>
<td>Air Voids, %</td>
<td>3.5</td>
<td>4.0</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>
<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>
<td>1/2&quot; - 14.0</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>
<td>0.8 to 1.6</td>
</tr>
<tr>
<td>VFA, %</td>
<td>70 - 80</td>
<td>65 - 78</td>
<td>65 - 75</td>
</tr>
</tbody>
</table>

## Open Graded Mixture

### 3/4" Open and 1/2" Open

<table>
<thead>
<tr>
<th>Design Method</th>
<th>ODOT</th>
<th>ODOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Voids, %</td>
<td>13.5 - 16.0</td>
<td>---</td>
</tr>
<tr>
<td>Draindown, %</td>
<td>70 - 80</td>
<td>---</td>
</tr>
<tr>
<td>TSR *, Minimum</td>
<td>80</td>
<td>---</td>
</tr>
<tr>
<td>Coating, % Minimum</td>
<td>---</td>
<td>90</td>
</tr>
<tr>
<td>VFA, %</td>
<td>40 - 50</td>
<td></td>
</tr>
</tbody>
</table>

### 3/4" ATPB

## Tolerances and Limits

- **Dense-Graded HMAC Type**
- **Open-Graded HMAC Type**

<table>
<thead>
<tr>
<th>Gradation Constituent</th>
<th>Dense-Graded HMAC Type</th>
<th>Open-Graded HMAC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot;</td>
<td>JMF ±5%*</td>
<td>99 - 100%</td>
</tr>
<tr>
<td>1&quot;</td>
<td>90 - 100%</td>
<td>JMF ±5%*</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>JMF ±5%</td>
<td>JMF ±5%*</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>No. 4</td>
<td>JMF ±5%</td>
<td>JMF ±5%</td>
</tr>
<tr>
<td>No. 8</td>
<td>JMF ±4%</td>
<td>JMF ±4%</td>
</tr>
<tr>
<td>No. 30</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>
</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
  - 0.80% max.
00747.15  **Pre-Approved Mix Designs** - The City maintains a list of pre-approved HMAC mixes. Contact the Project Manager for a list and submit to the Engineer the mix design to be used.

00747.16  **HMAC Acceptance, QC/QA** – Unless otherwise directed in the Special Provisions test the HMAC mixture for gradation, asphalt content, moisture, and RAP content (if applicable) according to appropriate procedures in the MFTP. Take corrective action when testing shows that HMAC is not within the tolerances and limits shown in 00747.14.

(a) **Quality Assurance and Acceptance** – Quality assurance (QA) testing will be done by and at the discretion of the Engineer. When performed, QA testing will be according to Section 00165. Regardless of QA testing, the Contractor’s quality control test results will be used for acceptance provided they are within acceptable limits of the QA test results as defined by ODOT’s Quality Assurance Program outlined in the MFTP.

00747.17  **Quantity Acceptance** – When less than three test results are required on a project, the HMAC will be accepted according to the following:

(a) **Within Specification Limits** – If all sublot sample test results are within specification limits for all constituents and compaction the material will be accepted for the full bid price of the material represented by the test. In no case will the CPF be above 1.0.

(b) **Outside Specification Limits** – If a sublot sample test result for any constituent is out of the specification limit, the Engineer will have the backup sample tested.

(1) **Backup Within Specification** – If the backup sample test results for all constituents are within specification, including compaction, the material will be accepted for full bid price for the material represented by the test.

(2) **Backup Out of Specification** – If the backup sample test results are out of specification, the Contractor may choose to accept a price adjustment, or choose to sample the in-place material for further testing. The price adjustment 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** – Sample the in-place material at three random locations from the area represented by the Sublot in question. Samples will be tested by the Engineer. If the test is 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 the specification limits, the Engineer may elect to accept and pay for it at an adjusted price or have it removed and replaced at the Contractor’s expense. In no case will the CPF be above 1.0.

(c) **Compaction** - Compaction will be required for each sublot tested by averaging the QC tests performed at random locations with a calibrated nuclear gauge operated in the backscatter mode. Perform at least one density test each day of production and compact the HMAC to at least the percent of the MAMD applicable for the mix type and lift indicated.
| 00747.18 | **Tack Coat** - Tack coat for sealing the edges of asphalt concrete paving shall be as specified in 00495.11. |
| 00747.19 | **Edge Sealing Sand** - Sand used for edge sealing shall be as specified in 00495.12. |

**Equipment**

| 00747.22 | **Hauling Equipment** - Provide hauling vehicles in good operating condition with tight, clean, smooth beds. Hauling vehicles shall be equipped with the ability to tarp or cover the load as required or when directed. Coat the beds with a minimum amount of an approved material to keep the HMAC from sticking to the beds. Do not use diesel oil. Drain and properly dispose of any excess coating material before loading. |
| 00747.23 | **HMAC 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 HMAC to a uniform texture, in the specified widths, thicknesses, lines, grades and cross sections
- Will not segregate, tear, shove or gouge the HMAC

(c) **Control System** - Equipped with a paver control system which:

- Controls the HMAC 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 the 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 footcandles as measured by the Engineer on the roadway surface at a distance of 16 feet from the front and back edges of the paver.

| 00747.24 | **Compactors** - Provide the specified 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

(b) Vibratory Rollers - Vibratory rollers shall be:

- Equipped with amplitude and frequency controls
- Specifically designed to compact HMAC
- 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 two times the maximum aggregate size for the type of HMAC being compacted.

If vibratory 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

(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

Do not use pneumatic-tired rollers to break-down or compact the wearing course or final lift of HMAC.

(d) Illumination - Provide adequate lighting to illuminate each compactor and the roadway in front of and behind each compactor during the period 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 footcandles as measured by the Engineer on the roadway surface at a distance of 60 feet from the front and back edges of each compactor.
Labor

**Quality Control Personnel** - Provide certified technicians in the following fields:

- CAgT (Certified Aggregate Technician)
- CAT-1 (Certified Asphalt Technician I)
- CAT-II (Certified Asphalt Technician II)
- CDT (Certified Density Technician)
- CMDT (Certified Mixture Design Technician)

Construction

**Season and Temperature Limitations** - Place HMAC 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 and Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface Temperature</td>
<td>From to Inclusive</td>
<td>From to Inclusive</td>
</tr>
<tr>
<td>All Courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel Lane Wearing Course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Other Courses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Open Graded Mixes**
- ATPB 40 °F All Year N/A N/A All Year

**Dense Graded Mixes**
- Less than 1 1/2" 60 °F All Year** 3/15 9/30 All Year**
- 1 1/2" to 2 1/2" 50 °F All Year** 3/15 9/30 All Year**
- 2 1/2" and over 40 °F All Year** 3/15 9/30 All Year**

**Temporary**
- 40 °F All Year** All Year** All Year**

* If placing HMAC 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.

**Prepaving Conference** - Supervisory personnel of the Contractor, including 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. A representative of the Contractor responsible for quality control on the project shall also attend for all Level 3 and Level 4 mixes where quantities exceed 5,000 tons.
00747.43 HMAC Mixing Temperatures - Produce HMAC within the temperature ranges recommended by the asphalt cement supplier for the grade of asphalt being used on the Project.

00747.44 Tack Coat - Construct a tack coat prior to placing each lift of HMAC according to Section 00730. A tack coat is not required prior to placing HMAC on aggregate base.

00747.49 Compaction, QC/QA - Provide a technician certified in density testing (CDT)

(a) General - Immediately after the HMAC has been spread, struck off, and surface irregularities and other defects remedied, perform breakdown and intermediate rolling of the entire surface with rollers meeting the requirements of 00747.24 until compacted as specified. Test each lift of HMAC for compaction according to the MFTP.

(1) Temperature - Complete breakdown and intermediate compaction before HMAC temperature drops below 180 °F, unless otherwise directed or required per the control strip. When the rolling causes tearing, displacement, cracking or shoving, make necessary changes in compaction temperatures, type of compaction equipment, and rolling procedures.

(2) Rolling – Compact the HMAC with rollers conforming to section 00747.24. Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperatures. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material as necessary to prevent the HMAC from sticking to them and spotting or defacing the HMAC.

Operate rollers at a slow, uniform speed recommended by the manufacturer. Drive rolls or wheels shall be nearest the paver unless otherwise approved. Operate vibratory rollers at frequencies of at least 2000 vibrations per minute.

Do not make sharp turns or park rollers on hot HMAC. Stop each pass at least 5 feet longitudinally from proceeding stops.

Perform finish rolling with rollers meeting the requirements of 747.24(a) or 747.24(b), and continue until all roller marks are eliminated.

(b) Normal Pavement (Nominal Thickness 2 Inches or Greater):

(1) General – Compliance with the density specifications for dense graded HMAC shall be determined by random testing of the compacted road surface with calibrated nuclear gauges. Use the MAMD method of compaction measurement unless the Engineer agrees to the control strip method.

The CDT shall notify the Engineer and CAT II when the average density for a sublot exceeds 95% of MAMD. The Cat II shall initiate an investigation to determine if the results indicate that a problem with the mix is developing. An adjustment to the JMF will not be allowed unless MDV testing supports a required change.
(2) Random Testing – Determine the density of each sublot by averaging five QC tests performed at random locations determined by the Random Sample Location worksheet with the calibrated nuclear gauge operated in the backscatter mode. Lots and sublots shall correspond with those defined in 00747.02. In addition, perform at least one density test each day of production.

a. Testing – After completion of the finish rolling, test according to WAQTC TM 8. Do not locate the center of a density test within 1 foot of the panel edge. Complete density testing before traffic is allowed on the new mat.

b. Core Correlation of Nuclear Gauge Reading – When requested by either the Contractor or Engineer, correlation of nuclear gauge readings shall be according to WAQTC TM 8. If correlations are requested, correlate each nuclear gauge used on the project. New correlations are required if the aggregate source or asphalt cement source changes. Apply correlation factors to all nuclear gauge readings for all dense graded HMAC. Determine the core correlation factor according to WAQTC TM 8 and provide the results to the engineer. The requesting party will pay the costs of the core correlation.

(3) Moving Average Maximum Density (MAMD) Method – The MAMD is the average of the current MDT and, if available, the four previous MDT’s for the JMF used. Determine each MDT using the GMM determined according to AASHTO T 209 and calculate the MAMD according to ODOT TM 305. When this method is used, compact the HMAC to at least the percent of the MAMD applicable for the mix type and lift as follows:

<table>
<thead>
<tr>
<th>Course of Construction</th>
<th>Level 1, Level 2, and Level 3 HMAC</th>
<th>Level 4 HMAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Lift</td>
<td>91.0*</td>
<td>92.0</td>
</tr>
<tr>
<td>Single</td>
<td>91.0</td>
<td>92.0</td>
</tr>
<tr>
<td>All Other</td>
<td>92.0</td>
<td>92.0</td>
</tr>
</tbody>
</table>

* If any part of a lift requires 91%, the entire lift shall be 91%.

When using the MAMD method, a new control strip will be required when there is a new JMF. The Engineer may waive the control strip for irregular areas too small to establish a reasonable roller pattern.

(4) Control Strip Method – Construct and test a designated strip to establish optimum rolling procedures and target density. The target density will be used as a basis for acceptance of compaction of the HMAC.
a. Construction of a Control Strip – When beginning work on each lift of pavement, construct one or more control strips that are:

- The length of the rolling pattern (maximum 500 feet)
- Part of the roadway
- Placed to the specific width and thickness
- Composed of the same materials as the rest of the lift
- Compacted with the same equipment as the rest of the lift

The first valid target density for each lift of pavement shall be applied to sublot density tests for previously placed pavement with the same JMF.

A target density is not valid if it is less than the percent of the MAMD in 00747.49(b)(3) for the applicable mix type and lift.

Construct a new control strip when:

- There is a new JMF
- 10 days of production have been accepted without construction of a new control strip
- A new lift of pavement is started

b. Establishing Target Density – Determine the target density of the control strip according to ODOT TM 306 and WAQTC TM 8 by averaging the final results of five density tests taken with a calibrated nuclear gauge at random sites within the control strip selected according to ODOT TM 306.

c. Compaction Requirement – Compact the HMAC mixture to a density of at least 98.0% of target density.

d. Control of Operations – Stop paving if three consecutive control strips fail to achieve the target density. Take all necessary actions to resolve compaction problems. Do not resume paving without the approval of the Engineer.

5 Test Results – Provide density results for the completed sublots to the Engineer by the middle of the following working shift.

(c) Thin Pavement:

1 General - Compaction to a specified density will not be required for leveling, patches, or where the nominal compacted thickness of a course of dense graded mixture will be less than 2 inches.
(2) Projects with Less Than 500 Tons of HMAC – For all levels of HMAC, perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverage’s of the roller(s). Perform additional coverage’s, as directed, to obtain finish rolling of the HMAC.

Temporary

00747.50 Temporary Surfacing Course – Provide HMAC for temporary surfacing that is a well graded, uniform, durable commercial mix. All new materials, or a combination of new material and reclaimed materials, may be used, according to 00747.03. The Contractor is responsible for the quality of material furnished according to Section 00165. Mix used for temporary surfacing will not be eligible for price adjustment under 00747.95.

Maintenance

00747.60 Correction of Defects – Correct any defect in material and work, as directed, at the Contractor’s expense. These include segregation of materials, non-uniform texture, fouled surfaces preventing full bond between successive spreads of mixture, and (a) through (d) below. No adjustment in Contract time will be made for corrective work.

(a) Boils and Slicks – Immediately remove and replace boils and slicks with suitable materials.

(b) Roller Damage to Surface – Immediately correct any displacement with the addition of fresh mixture, or by other approved methods regardless of thickness or course.

(c) Nonspecification Compaction - Immediately take corrective measures when it is determined that specified compaction density is not achieved.

(d) Other Defects – Remove and replace any HMAC that:

- Is loose, broken, or mixed with dirt
- Shows visually too much or too little asphalt
- Is defective in any way

Remove and replace HMAC defects, excesses or deficiencies at the Contractor’s expense.

00747.61 Longitudinal Joints - At longitudinal joints, bond, compact and finish the new HMAC equal to the HMAC against which it is placed.

(a) Location - Place the HMAC 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

If unable to complete the pavement without drop-offs according to 00747.61(c) do the following:

- Construct and maintain a wedge of HMAC 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 City, except that HMAC for the temporary wedge will be paid for at the pay item price

(c) **Placing HMAC Under Traffic** - When placing HMAC 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.

(2) **Less Than or equal to 2 Inches** - Schedule work so that 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.

00747.62 **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 an 25 foot long wedge (1V:160H taper rate)

Construct, maintain, remove and dispose of the temporary wedge at no expense to the City. HMAC 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 HMAC 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 HMAC - After completing a temporary end panel as specified, dispose of unused, remaining HMAC as directed. Payment will be made for the entire load of HMAC, 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 HMAC abutting bridge ends and other rigid type structures in the transverse and/or diagonal direction, as well as longitudinally, as directed.

(c) Bridge Deck Overlays - Saw cut 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 saw cut 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 saw cut 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 poured filler from the CPL. No separate payment will be made for this work.
Finishing and Cleaning Up

00747.70 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 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.

00747.75 Correction of Pavement Roughness - Immediately correct equipment or paving operation procedures when tests show the pavement smoothness does not comply with 00747.70. 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
- Grind the pavement surface with a diamond blade to a maximum depth of 3/8", 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

00747.80 General – Unless otherwise defined in the Special Provisions the accepted quantities of HMAC will be measured to the nearest 0.01 ton. No deductions or 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

00747.90 General - The accepted quantities of HMAC incorporated into the Project, whether or not recycled materials are used, will be paid for at the Contract price per ton for the item "Level ___, _____, HMAC Mixture, ______". The level(s) of HMAC (1, 2, 3, 4) will be inserted in the first blank. The type(s) of HMAC (1 inch Dense, 3/4" Dense, 1/2" Dense, 3/8" Dense, 3/4 inch Open, 1/2 inch Open, 3/4 inch ATPB), 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.

No separate payment will be made for the asphalt tack coat. Payment for this work will be included in the above item. Payment under the listed bid item will be full and complete compensation for furnishing and placing the materials and for furnishing all labor, equipment, materials, and incidentals necessary to complete the work as specified.
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 00747.90 and to the application 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 HMAC.

<table>
<thead>
<tr>
<th>Gradation Constituents</th>
<th>Dense Graded HMAC Type</th>
<th>Weighting Factor (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Aggregate Passing</td>
<td></td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>No. 8</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>No. 30</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Other Constituents

<table>
<thead>
<tr>
<th></th>
<th>Asphalt Content</th>
<th>Moisture Content</th>
<th>Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>8</td>
<td>40</td>
</tr>
</tbody>
</table>

Those HMAC 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:

\[(\text{CPF} - 1) \times \text{HMAC Unit Price} \times (\text{LQ}) = \ldots\]

Where: \( \text{LQ} \) is the quantity of mixture in the lot.
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 - Provide aggregate base materials for base, foundation courses, leveling courses, or bedding conforming to 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 - Provide asphalt tack coat material according to Section 00730.

00749.13 Asphalt Concrete - Unless another class is shown, provide Level 2, 1/2 inch Dense HMAC according to Section 00747. 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 General - Equipment shall conform to Section 00747.

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 00745.48(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 00745.49(e) or as directed.

00749.46 **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**

00749.80 **General** - 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** - The actual count of each location where the structure is constructed and accepted.

- **Area Basis** - Surface measurement of the neat lines of the structure.

- **Length Basis** - From end to end of the pertinent structure along its longitudinal axis for each separate item or continuous run.

00749.81 **Method "A" - Weight and Extras Basis** - Under this method, asphalt concrete actually incorporated into the structure will be measured for payment according to 00745.80. 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.

00749.82 **Method "B" - Complete in Place Basis** - Under this method, measurement will be of the structure complete in place and accepted.

**Payment**

00749.90 **General** - The accepted quantities measured according to 00749.81 and 00749.82 will be paid for at the Contract unit price per unit of measurement for each of the particular pay items listed in the Schedule of Items.

The Contract unit prices under this Section will not include payment for:

(a) **Earthwork** - When earthwork is covered for payment under separate pay items, payment will be made according to Section 00330.

(b) **Aggregate Base** - Aggregate base used according to 00749.42 will be paid for under Section 00641.

(c) **Street Connections** - Payment for street connections, or the extra costs for them, which meet the criteria outlined in 00749.80 will be included in payment for the pavement items.

Earthwork required under 00749.41 not covered for payment under Section 00330, will not be paid for directly but will be considered as Incidental to other Contract 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 including 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 Project Manager, 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 Project Manager, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving work.
00756.10 **General** - Materials shall meet 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** - Unless otherwise noted in the plans or Special Provisions, provide Class 4350 - 1 1/2 paving concrete.

00756.13 **Concrete Mix Designs** - Prepare and submit either new mix designs or current mix designs for each class of concrete required according to Section 02001. The Engineer will review the mix design for compliance with the Specifications.

00756.14 **Concrete Mix Tolerances and Limits** - Provide a workable concrete mixture that is uniform in composition and consistency and conforms to the properties and limits of 02001.30 and 02001.50.

00756.15 **Quality Control** - Perform quality control according to Section 00165 and the following.

(a) **Aggregates** - Provide a CAgT to perform sampling and testing of aggregates during production. 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.

(b) **Concrete Mixture** - Provide a QCT to sample and test concrete for all classes of concrete and for trial batches when required. Provide a CCT to prepare new mix designs and to make adjustments in current mix designs for all paving concrete. Provide a CCT, as required in Table 02001-1 for all paving concrete during concrete placements, who is authorized to control the production of concrete.

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.

Reject the concrete mix if it has not been placed within one hour after being mixed, or it has begun to take initial set before placement, or it has been re-tempered with water.
(c) **Records** - Deliver all batch tickets, water-cement ration calculations, and all other records required in (b) above to the Engineer upon availability but no later than the morning of the next day.

00756.16 **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 02001.50 and Table 02001-1.

(d) **Hardened Concrete** - Cast and cure the test specimens according to AASHTO T 23 in 6” x 12” 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 three cylinders tested. If the compressive strength of a single test specimen varies by more than 10% from the average of the other two specimens, that compressive strength value will be discarded. The average compressive strength test of the two 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 three 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 00540.20.

00756.21 Mixers - Provide mixers according to 00540.21 except mix concrete in the batch plant mixer. Truck mixers may be used only as permitted in 00756.45.

00756.22 Hauling Equipment - Transport concrete in non-agitating equipment. Truck mixers may be used to transport concrete only as permitted in 00756.45. Hauling equipment shall conform to AASHTO M 157.12 or M 157.11.6 when permitted.

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 screeds, floats, rollers or combinations thereof. Screed type machines shall have at least two oscillating type transverse screeds. 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) 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.
Labor

00756.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT (Certified Aggregate Technician)
- CCT (Concrete Control Technician)
- QCT (Quality Control Technician)
- CSTT (Concrete Strength Testing Technician)

(a) CCT’s Duties:

- Before batching is started and when there is a significant change in the slump of the concrete due to variations in aggregate moistures, test the fine and coarse aggregates for total moisture content according to AASHTO T 255. Moisture testing may be by an alternate method if approved by the Engineer.

- Visually inspect the coarse aggregate for changes in moisture content throughout the day. Perform necessary testing for total moisture and make adjustments if necessary.

- Calculate the amount of free water present in the fine and coarse aggregates and adjust the batch proportions accordingly.

- Calculate the total allowable amount of water, including liquid admixtures and free water in the aggregate, for each batch; determine the amount of water added during batching; determine the allowable maximum amount of water that can be added after batching; and record these on the ticket.

- Make sure all water is removed from the transit-mix trucks before each loading.

- Send a ticket with each load on which the Contractor’s batch person records and attests to the Engineer the mix design number, day, time of batch, size of load and quantity of individual constituents in the load.

- Instruct the plant control personnel how to adjust the batch weights to maintain the proper water-cement, cement content, air content and aggregate proportions to produce the specified mix.

- Be present at the plant or at the jobsite unless otherwise approved by the Engineer.

- Monitor the mix properties and compressive strength test results throughout the Project.

- Make recommendations or adjustments to maintain a satisfactory over-design (f’cr).
• Perform an analysis and make adjustments if necessary whenever the density (unit weight) of the fresh concrete varies from the mix design by more than plus or minus 50 3 lb/ft³. Submit a written analysis along with any recommendations to the Engineer by noon of the following workday.

• 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-cement ratio varies from the mix design target by more than plus or minus 0.03 and submit to the Engineer by noon of the following workday.

(b) QCT’s Duties:

• Attend prepaving conference meetings.

• Be at the concrete sampling and testing site when placement is in progress.

• Have a copy of the mix design on site and available during concrete placements.

• Check each batch ticket on arrival at the jobsite for the correct mix design for the placement.

• Sample and test the concrete for ambient air and fresh concrete temperatures, slump, air content, density, water/cement ratio, yield, and cement content as required and according to the tests listed in the MFTP, and at such times as requested by the Engineer to validate compliance with the Specifications.

• 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 necessary to convey important mix information.

• Notify the CCT of loads rejected by the QCT and the reason for rejection.

• Notify the CCT immediately whenever the density of the fresh concrete varies from the mix design target by more than 3 lb/ft³.

• Notify the CCT immediately whenever the water-cement ratio varies from the mix design target by more than plus or minus 0.03.

(c) Additional Quality Control Duties Required By The Contractor:

• 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.
Reject the load if the materials in any load are outside the specified limits of the mix proportions.

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 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 seven days after placing.

Remove and replace weather-damaged pavement at no expense 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 two or more traffic lanes, construct at least two traffic lanes in one strip panel unless shown otherwise.

If the Contractor proposes a method of placement other than that shown or specified, the Contractor shall bear 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** - Separately weigh into the hoppers the fine aggregate, each separated size of coarse aggregate, cement and fly ash in the respective proportions set by the mix design. Provide a device to indicate positively that the full amount of cement and fly ash was discharged into the batch box or container. Measure water and admixtures either by volume or by weight.

Conduct batching so that the individual weights of each material required are within the following tolerances:

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregates</td>
<td>± 2%</td>
</tr>
<tr>
<td>Cement</td>
<td>- 1% to + 4%</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>- 1% to + 4%</td>
</tr>
</tbody>
</table>

00756.45  **Mixing Concrete:**

(a) **General** - Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving equipment. Also mix as follows:

- Charge the batch into the receiving drum so some water enters before the solids and continues to flow uniformly for a portion of the mixing time
- Keep the skip and the throats of drums free of accumulations
- Mix the concrete only in the quantity required for immediate use
- Do not intermix batches
- Do not re-temper concrete by adding water or by other means
(b) **Batch Plant Mixers** - The mixing time for batch plant mixers shall be at least 60 seconds unless the Contractor's CCT documents meeting "Concrete Uniformity", according to AASHTO M 157, Annex A1 for concrete produced at the batch plant mixer set up for this Project, to the satisfaction of the Engineer. The mixing time may then be reduced to the extent the test permits but not less than 45 seconds.

(c) **Truck Mixers** - The mixing time for truck mixers shall be 70 to 100 revolutions at a mixing speed recommended by the manufacturer of the truck mixer.

**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 hauling 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, at the Contractor's expense, to the satisfaction of the Engineer. 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 two 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 the Contractor's expense.

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 and/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 three test strips fail to meet smoothness requirements before grinding, remove all three strips at the Contractor’s expense and construct additional test strips.

**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.
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.

Accomplish the textured finish with a steel-tine tool with 1/8 inch tines that will mark the finished concrete to a depth of 1/16 to 1/8 inch. Randomly space the markings from 1/2 to 1 1/4 inch as approved. Avoid overlaps of the texturing. Markings shall be transverse to the roadway centerline and full roadway width. With approval of the engineer an astroturf or broom finish may be used in place of tining on roads with a posted speed limit of 35 mph or less.

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 permitted 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. All remedial work shall be at the Contractor's expense.

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 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:

\[
\text{Profile Index} = \frac{\text{Total Count} \times 0.10}{\text{Length of Full 0.10 Mile Segment or of Partial } \times \text{ Mile Segment}}
\]

* 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 profilometer under the supervision of the Engineer. Perform all corrective work and graphic profiling at the Contractor's expense, including traffic control.

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 one lane, 100 feet for two lanes, 70 feet for three 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, at the Contractor's expense and according to AASHTO T 24. Repair core holes as directed at the Contractor's expense. 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 grinding 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 the Contractor's expense. 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 three 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 **Pavement** - 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.
00756.90 Payment - The accepted quantities of plain concrete pavement will be made 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) Plain Concrete Pavement, Undowelled, ____ 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 including construction joint reinforcement bars, tie bars, dowel bars, curing materials, and saw cutting, including all equipment, labor, and incidentals necessary to complete the work as specified.

No separate payment will be made for providing trial and test batches as they will be Incidental to the other pay items.

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 permitted by the Engineer to remain in place under the provisions of 00756.57.
**00756.95  Bonus Payment for Smoothness** - If a 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 two 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:

\[
\text{Bonus} = 0.006 \times (5.0 - \text{PI}) \times \text{Quantity} \times \text{Unit Price}
\]

- **PI** = Average of the two profile indexes in the segment or partial segment (inches per mile)
- **Quantity** = The quantity (square yards) represented by the segment or partial segment
- **Unit Price** = The unit price for the concrete pavement as shown in the Schedule of Items
Section 00759 - Miscellaneous Portland Cement Concrete Structures

Description

00759.00 Scope - This work consists of furnishing, placing and finishing commercial grade concrete curbs, islands, traffic separators, 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

00759.10 General - Materials shall meet the requirements of the following:

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

00759.11 Aggregate Base - Provide aggregate base materials for base, foundation courses, leveling courses or bedding conforming to Section 02630. If a designated size is not shown or given, provide 1" - 0 or 3/4" - 0, as the Contractor elects.

00759.12 Sidewalk Ramp Treatment - Supply truncated dome detectable warning surfaces for sidewalk ramps and accessible route island as indicated in the Special Provisions.

Use only adhesives recommended or supplied by the manufacturer.

00759.13 Temporary Plating - Temporary plating shall conform to Section 00275.

Equipment

00759.21 Concrete Extruding Machine - Concrete extruding machines shall operate under sufficient restraint to forward motion to produce a well consolidated mass of concrete.

Construction

00759.41 Earthwork - Make excavations and backfills for the structures according to Section 00330 and to the depths, widths, and cross-sections shown, specified, or directed.

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

| Construct bases under sidewalks and driveways using a minimum of 2 inches of sand. |

**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 00755.43 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 Surfacing** - 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 one-third 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 Surfacing** - 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 re-stamped into the new concrete. Stamp the dates and/or names in the curb as close to the original location as practical. Re-stamp the dates and names exactly as they existed in the sidewalk corner. This includes miss-spelled 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 re-stamped 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 seven calendar days or longer as directed.
Do not apply curing compounds to the designated truncated dome areas of sidewalk ramps and accessible route islands.

00759.52 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.

Measurement

00759.80 General - The quantities of structures will be measured on the following basis:

- Volume Basis - The volume calculated to the neat lines of the structure.
- Area Basis - Surface measurement of the neat lines of the structure.
- Length Basis - Along the face of the structure, from end to end including curb tapers or depressed lengths at driveways and ramps.
- Unit Basis - Per each, by actual count in place and accepted.

00759.81 Sand Base - There will be no separate measurement of the sand base under sidewalks and driveways. The estimated quantity of sand base will be shown in the Special Provisions.

00759.82 Historic Dates and Names - There will be no measurement for preservation or re-stamping of dates and/or names into curbs at sidewalk corners.

Payment

00759.90 General - The accepted quantities of structures will be paid at the Contract price per unit of measurement for the following:

<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) Monolithic Curb and Driveways..................................................Square Foot</td>
<td></td>
</tr>
<tr>
<td>(f) Monolithic Curb and Driveways, Reinforced .............................Square Foot</td>
<td></td>
</tr>
<tr>
<td>(g) Concrete Walks ........................................................................Square Foot</td>
<td></td>
</tr>
<tr>
<td>(h) Monolithic Curb and Sidewalks ................................................Square Foot or Foot</td>
<td></td>
</tr>
<tr>
<td>(i) _____Concrete Surfacing ..........................................................Square Foot</td>
<td></td>
</tr>
<tr>
<td>(j) Concrete Stairs ........................................................................Cubic Yard</td>
<td></td>
</tr>
<tr>
<td>(k) Concrete Driveway Connections...............................................Square Foot</td>
<td></td>
</tr>
<tr>
<td>(l) Concrete Bus Shelter Pads .........................................................Each</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. It also includes all work associated with applying truncated domes.

<table>
<thead>
<tr>
<th>Items (c), (d), (e), (f), (g) and (h) include the sand base.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Items (c), (d), and (g) include the joint filler in the joint between the sidewalk or driveway and the curb if applicable.</th>
</tr>
</thead>
</table>

Item (g) includes sidewalk ramps. It also includes all work associated with applying truncated domes.

Item (h) includes sidewalk ramps. It also includes all work associated with applying truncated domes.

In item (i) the specified thickness, or type, of concrete surfacings will be inserted in the blank, if appropriate.

Item (j) includes pipe handrail.

The preservation or re-stamping of dates and/or names into sidewalk corner curbs will be incidental to the curb work for which no separate payment will be made.

The Contract unit prices under this section will not include payment for:

(a) **Earthwork** - When earthwork is covered for payment under separate pay items, payment will be made according to Section 00330.

(b) **Aggregate Base** - Aggregate base used according to 00759.42 will be paid for under Section 00640.

Earthwork required under 00759.41, not covered for payment under Section 00330, will not be paid for directly but will be considered as Incidental to other Contract items.

Payment will be payment in full for furnishing and placing all materials, including all equipment, labor, and incidentals necessary to complete the work as specified.
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 sand - A layer of coarse, washed sand screeded smooth for bedding the pavers.

Bedding layer - a layer of clean crushed aggregate 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" to 1/2" 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 General - Materials shall meet the requirements of the following:

- 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.

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 one half inch in width and may be buttered or poured and tamped to provide one hundred percent 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 percent. 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 Re-Filling 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 General - The quantities of unit pavers will be the surface measurement of the neat lines of the structure.

Payment

00760.90 General - The accepted quantities of pavers will be paid for at the Contract price per square foot for the following:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Brick Pavers</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(b) Concrete Pavers</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(c) Permeable Pavers</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

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.

The Contract unit prices under this section will not include payment for:

(a) Earthwork - When earthwork is covered for payment under separate pay items, payment will be made according to Section 00330.

(b) Aggregate Base - Aggregate base specified in the plans and conforming to 00760.11 will be paid under Section 00640.

(c) Drainage Blanket - Drainage blanket specified in the plans and conforming to Section 00360 will be paid under Section 00360.

Earthwork required under 00760.40, not covered for payment under 00330, will not be paid for directly but will be considered as incidental to other Contract items.

Payment will be payment in full for base preparation and for furnishing all materials, 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 on the plans.

Materials

00810.10 General - Materials shall meet the requirements of the following:

- Guardrail anchor hardware ........................................................ 02820.40
- Guardrail hardware ................................................................. 02820.30
- Metal beam rail ....................................................................... 02820.10
- Metal posts ............................................................................ 02820.20
- Wood guardrail posts .............................................................. 02110.10
- Wood guardrail blocks ............................................................. 02110.20

Use guardrail terminals from the CPL conforming to the National Cooperative Highway Research Program (NCHRP) Report 350.

00810.11 Optional Posts - Posts, except as specified for use on bridges or otherwise shown or directed, may be of steel or wood, as the Contractor elects, conforming to the requirements of 00810.10. Once a type has been selected, use it throughout the Project.

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** – Salvaged wood posts may not be reused in new construction. 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 and 00310.82.

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, any materials that become fouled, at the Contractor's expense. 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 the Contractor's expense. Dispose of excess materials according to 00330.41(a)(5).

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 02420.10(d), except add 1 1/2 ounces of leafing aluminum powder to each quart of high zinc dust content paint.

Toe nail blocks to post with two 10d, galvanized, flat head nails to prevent rotation.

Draw tight all bolts, except adjustment 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 Metal Guardrail, Metal Median Barrier and Guardrail Anchors** - Anchors will be measured on the unit basis, per each. The quantities of metal guardrail and metal median barrier will be the length of each type complete and in place as specified, measured 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 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.

**(b) 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.

Transitions and connections between guardrail and bridges will be measured on a unit basis according to 00810.82 and 00810.83.

**00810.81 Guardrail End Pieces** - Guardrail end pieces will be measured on the unit basis, per each, by actual count of units in place as specified.

**00810.82 Guardrail Transitions** - Guardrail transitions between Type 3 guardrail and bridge rail as shown, regardless of required length, will be measured on the unit basis per each by actual count of units in place as specified.
00810.83 Guardrail Connections - New guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, not included in guardrail transitions, will be measured on the unit basis per each by actual count of units in place as specified.

00810.85 Guardrail Terminals - Guardrail terminals will be measured on the unit basis per each by actual count of units in place as specified.

Payment

00810.90 General - The quantities accepted for payment will be paid for at the unit price per unit of measurement for the following items in the Contract Bid Schedule:

<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 8 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 with a separate pay item provided for each type.

Payment for items (a) and (b) will be payment in full for all costs involved in constructing the respective items except for:

- End pieces
- Anchors
- Transitions
- Extra costs involved in constructing guardrail connections to existing bridges

In item (c) the type of anchor will be inserted with a separate pay item provided for each type. Payment will be payment in full for all costs involved in constructing guardrail anchors.

In item (d) the type of guardrail end piece will be inserted with a separate pay item provided for each type. Payment will be payment in full for all costs involved in furnishing and installing guardrail end pieces.
Payment for item (e) will include payment in full for all costs involved in furnishing and constructing guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, including any terminal connectors, connection plates, anchor bolts, etc. required to provide the connections and including any work necessary to prepare the bridge rail or concrete barrier for the connection and/or restore the guardrail.

Payment for item (f) will be payment in full for all costs involved in furnishing and constructing guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, not included in guardrail transitions, including any section of guardrail not included in pay limits for guardrail, any terminal connections, connection plates, anchor bolts, and other materials required to provide the connections, and including any work necessary to prepare the bridge rail or concrete barrier for the connections.

In item (g) the type of terminal will be inserted in the blank. Payment for item (g) will be payment in full for furnishing and installing guardrail terminals, including posts, anchors, slotted rails, slot guards, end pieces, struts, soil tubes, and all necessary appurtenances and hardware to complete the work as specified.

Payment for item (h) is payment in full for any and all extra costs involved in furnishing and installing 8 foot long posts instead of standard 6 foot long posts, it being understood that such extra costs are those not covered and included in the unit price bid for some one or another of the other listed pay items.

There will be no separate payment for furnishing and placing steel posts, base plates or base plate concrete anchors as payment will be included in the pay item "Guardrail, Type ______".

Payment for the above items will be payment in full for furnishing and placing the materials, all necessary excavation and backfill work, and including all equipment, labor and incidentals necessary to complete the work, as specified or directed.
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 **General** - 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 by application of two coats of Formula 22-74 paint or approved equal.

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 **General** - 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:

(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 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.

(b) **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 General - The accepted quantities of adjusted guardrail, measured as provided above, will be paid for at the Contract unit price per yard for the pay 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 furnishing and installing bollards at locations shown or as directed.

Materials

00815.10 General - Provide materials meeting the following requirements:

Granular drain backfill .................................................................00430.11
Commercial grade concrete .........................................................00440
Reflective sheeting .................................................................02910.30

00815.11 Posts and Sleeves - Use Schedule 40 posts and sleeves conforming to ASTM A 53/A 53M.

00815.12 Plates, Shapes, Fasteners and Hardware - Use plates and shapes conforming to ASTM A 36/A 36M. Use fasteners and hardware conforming to ASTM A449.

00815.13 Galvanizing - Hot-dip galvanize all metal components after fabrication according to ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable.

00815.14 PVC Pipe - Use Schedule 40 PVC pipe.

Construction

00815.40 General - Install bollards as shown or as directed.

Measurement

00815.80 General - The quantities of bollards will be measured on a unit basis, per each, by actual count.

Payment

00815.90 General - The accepted quantities of bollards will be paid for at the Contract unit price per unit of measurement for the following item(s):

Pay Item                                      Unit of Measurement
(a) Bollards.................................................................Each
(b) Removable Bollards.....................................................Each

Payment will be payment in full for furnishing and placing materials, performing all excavation work, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.
Section 00820 - Concrete Barrier

Description

00820.00 Scope - This work consists of constructing precast pin-and-loop and cast-in-place portland cement concrete barrier, to the lines and grades shown or established.

Materials

00820.10 General - Materials shall meet the following requirements:

Deformed bar reinforcement................................................... 02510.10
Concrete coating.......................................................................... 02210
Portland cement grout ............................................................ 02080.40
Preformed joint filler................................................................ 02440.10
Concrete ..............................................................00440, except as provided in this Section

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 one 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 one year old.

(b) Hardware - Pins and dowels shall conform to ASTM A 449 and shall be hot-dip galvanized according to ASTM A 153/A 153M.

(c) Loop Bars - Fabricate loop bars from ASTM A 36/A 36M, hot-rolled round bar and hot-dip galvanize according to ASTM A 153/A 153M and ASTM A 143.

(d) C-shape Connectors - Furnish perforated C-shape connectors fabricated from ASTM A 36/A 36M channel, hot-dip galvanized after fabrication according to ASTM A153/A 153M 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.

(f) Barrier Markers - Provide concrete barrier markers from the CPL that are compatible with the selected reflective sheeting or provide integral plastic, prismatic, reflective units.

(g) Reflective Sheeting - Provide reflective sheeting for barrier markers from the CPL, of a color appropriate for the intended use.
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 two 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 expense 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 - 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 seven 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 glisten, and never for more than one hour.
   - Apply first coat of latex paint approved for barrier use and meeting the requirements of Section 02210 at an application rate of 150 square foot per gallon.
   - Allow 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.
(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 seven 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/C 403M. 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 two 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.

00820.46 Barrier Markers - Fasten markers to the top of the concrete barrier as recommended by the manufacturer or as directed. Install markers at 50 feet nominal spacing or as shown or directed. Orient reflectors to face oncoming traffic.

00820.47 Replacement or Price Reduction - Remove and replace barrier represented by cylinders that fail to meet the minimum strength requirement, at no additional expense 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 General - Barrier will be measured by one of the following methods:

(a) Cast-In-Place Barriers - The quantities of cast-in-place barrier accepted will be the length in feet of barrier in place as specified, measured along the line and grade of each separate run, including terminal sections and transition sections.

(b) Precast Barriers - The quantity of precast barrier accepted 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 General - The accepted quantities will be paid for at the unit price per foot for the following items when in the Schedule of Items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Concrete Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Concrete Barrier, Reflectorized</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Concrete Barrier, Tall</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) Concrete Barrier, Tall, Reflectorized</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing all material, equipment, labor and incidentals required to construct shoulder barrier and median barrier, as specified.

No separate payment will be made for excavating and backfilling concrete barrier buried ends, as this work will be considered incidental to the appropriate concrete barrier pay item.
Section 00822 - Glare Shields

Description

00822.00 Scope - This work consists of furnishing and installing glare shields on concrete median barrier.

Materials

00822.10 Materials - The Contractor has the option of providing modular glare shields or individual glare shields as specified.

(a) Glare Shields - Provide glare shields from the CPL.

(b) Base Plate Brackets - Provide 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 ASTM A 123/A 123M.

(c) Assembly Hardware - Provide 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 ASTM A 123/A 123M.

All base plate brackets and necessary assembly hardware installed in a continuous run shall be of the same material.

Construction

00822.40 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

00822.80 Measurement - Glare shields will be measured by the foot along the line and grade of each run.

Payment

00822.90 Payment - The accepted quantities will be paid for at the Contract unit price per foot for the pay item listed below:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>___ inch Glare Shields</td>
<td>Foot</td>
</tr>
</tbody>
</table>

In the item above, the length of the blades in inches will be inserted with a separate pay item for each size.

Payment will be payment in full for providing all materials in final position, and including 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.

Materials

00830.10 General - Provide impact attenuators from the CPL and as specified.

Concrete shall meet the requirements of Section 00440. Reinforcement shall conform to Section 00530.

Epoxy resin used in epoxy grout pads, where required, shall be a color similar to portland cement concrete pavement and shall conform to AASHTO M 200.

Aggregate used in epoxy grout pads shall be surface-dry when added to the epoxy mixture and shall conform to Section 02690.

00830.15 Acceptance - Provide a manufacturer's quality compliance certificate for impact attenuators according to 00165.35.

Construction

00830.40 General - Construct concrete according to 00440.40. Give exposed concrete surfaces a general surface finish according to 00440.41.

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.

00830.41 Sand-Filled Inertial Barrier Systems - Thoroughly mix dry sand filler, if required, with salt, 5% by volume. Outline the location of each module with paint for future reference. Paint, or otherwise denote, the weight of sand of each module within the module outline.

Measurement

00830.80 Unit Basis - Impact attenuator systems accepted for payment will be measured on the unit basis per each by actual count at each location a system is installed.
Payment

00830.90 **Unit Basis** - Payment for the impact attenuator installation will be made at the Contract unit price per each for the pay item "Impact Attenuator, ______ ".

The type of impact attenuator will be inserted in the blank, with a separate pay item for each type.

Payment will be payment in full for furnishing and installing all required materials, including the object marker, for each attenuator system as specified.
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 General - Materials shall meet the following requirements:

- Flexible delineators ................................................................. 02850.30
- Galvanized support posts ......................................................... 02850.10
- Reflective sheeting for milepost markers .............................. 02910.30
- Reflective sheeting for delineators ........................................ 02850.40
- Target members ..................................................................... 02850.20

00840.11 Delineators at Guardrail Locations - Delineators installed at guardrail locations shall be guardrail-mounted (Type 4). Full-length ground-mounted delineators (Types 1 and 2) may be substituted if approved.

00840.12 Use of Salvaged Materials - Delineator components salvaged from existing or temporary delineators may be reused in new permanent delineator installations providing they are of the current design, conform to the Specifications and are free of damage that would impair their appearance or serviceability.

Suitability of salvaged materials proposed for reuse will be determined by the Engineer.

Construction

00840.40 Lines, Grades and Preparation Work - 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, as approved. Remove vegetative growth, litter and debris from the post sites.

00840.41 Installation of Posts - Post depths may vary from that recommended by the manufacturer. Posts set in sandy, gravelly or other unconsolidated material may need to be longer to provide adequate anchorage. Posts may be shortened to avoid unnecessary penetration in solid rock or in large rock fragments, as approved. 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. The posts shall be vertical and firm. Remove and discard posts that become split, cracked, twisted, or bent, or whose tops become badly misshapen during installation, and replace with undamaged posts.

Firmly attach guardrail-mounted delineators to guardrail posts as shown on ODOT Standard Drawing TM570.
00840.42 **Target Members** - Assemble, fasten, set and align target members and reflective material appropriate to the type and color of delineators involved as shown or directed. All fastenings shall be tight. Attach the reflective sheeting to the posts by an approved positive means, which has adequate strength to prevent loss of the reflective material during the life of the post or target.

**Finishing and Clean Up**

00840.70 **General** - Repair and restore exposed, damaged surfaces of installed delineators and milepost markers as directed. Replace parts of delineators showing damage beyond repair with new parts.

Remove and dispose of excess excavated materials, litter, and debris resulting from the operations according to 00310.43. Replace fouled stone bases with clean material of the same kind. Clean traveled surfaces, and finish areas disturbed by the Contractor's operations to the lines, slopes and conditions shown or specified.

**Measurement**

00840.80 **Unit Basis** - The quantities for delineators and milepost marker posts will be determined as follows:

(a) **Delineators** - The quantities will be the actual number of each type of delineator furnished, installed and accepted, regardless of color or number of reflectors.

(b) **Milepost Marker Posts** - The quantities will be the actual number of milepost marker posts furnished, installed and accepted.

Required preparation work, earthwork, grouting, backfilling, repair, restoration replacement and cleaning up are considered incidental to delineator or milepost marker post installation, and no separate measurement for this work will be made.

**Payment**

00840.90 **Unit Basis** - The accepted quantities will be paid for at the Contract unit price per each for the following pay 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>
Payment will be payment in full for furnishing and placing all materials, including all equipment, labor and incidentals necessary to complete the work.

In item (a) the type of delineator will be inserted, with a separate pay item provided for each type.

When "Delineators, Type 4" are shown or specified, and the Contractor substitutes ground-mounted delineators according to 00840.11, they will be paid for as "Delineators, Type 4".

Payment for milepost marker signs will be made according to 00940.90.
Section 00850 - Pavement Markings for Legends

Description

00850.00 Scope - This work consists of furnishing, preparing, placing and warranting pavement markings on surfaces to the lines shown or as directed.

00850.02 Definitions:

Type A - Liquid, Hot-Laid Thermoplastic - Liquid, hot-laid thermoplastic containing traffic paint beads with a separate application of additional traffic paint beads on the surface.

Type B - Preformed, Fused Thermoplastic Film - Preformed, fused thermoplastic film with intermixed traffic paint beads, and with or without a separate application of additional traffic paint beads on the surface.

Materials

00850.10 General - Use materials conforming to the requirements of the following:

Reflective Elements .......................................................... 02840.20
Primer ............................................................................. 02840.50

| Use marking materials from the CPL.

00850.30 Manufacturer's Representative - Provide the services of a manufacturer's representative (the "Manufacturer's Representative"), authorized to sign a warranty ("the Warranty") on behalf of the manufacturer (See 00850.75). The Manufacturer's Representative shall observe the placement of the legend materials. The Contractor shall require the Manufacturer's Representative to immediately alert the Contractor and the Engineer of anything that could affect the performance of the product or the Warranty. Cooperate with the Manufacturer's Representative and the Engineer to ensure that the materials are placed in accordance with the manufacturer's recommended procedures. The Contractor shall require the Manufacturer's Representative to fill out the Warranty form and sign it on behalf of the manufacturer.

Construction

00850.40 General - Place markings as shown or as directed, and in compliance with the MUTCD. Apply the markings according to the manufacturer's recommendations. Furnish a copy of the manufacturer's instructions to the Engineer a minimum of seven days before placing markings.

Unless otherwise specified, apply pavement markings before public traffic is allowed on the freshly paved surface.

Remove and replace pavement markings not conforming to these Specifications or not properly installed, at no expense to the City, before continuing the operation.
Install pavement markings so that the completed markings have a uniform cross-section. Pre-formed markings 12 inch or wider may be fabricated from 12 inch or 6 inch wide material.

00850.41 Prepare and Prime Pavement - Completely remove, by approved methods, existing pavement markings (painted, thermoplastic, raised buttons or other durable materials) that are being replaced with new pavement markings, unless otherwise approved.

Clean the pavement before application of the marking material. Remove contaminants such as curing compounds, and existing pavement markings by an approved mechanical means. Sweep and air blast the pavement, as necessary, with an acceptable high-pressure system to remove extraneous or loose material.

After the pavement surface is clean and dry, apply a primer, if recommended by the manufacturer, to the area receiving the pavement markings. Apply primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

00850.42 Application of Pavement Marking Materials - Follow the manufacturer's recommendations for installing these marking materials. Provide manual or automatic application equipment as necessary for the job requirements. Pay particular attention to the manufacturer's recommendations when placing material over an asphalt construction joint.

(a) Type A: Liquid, Hot-Laid Thermoplastic Material - Apply the thermoplastic material to the pavement by a gravity and/or extrusion method, to the full width specified, in a single application. Place the pavement marking at least 120 mils, but not more than 200 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 reflective elements to the material as it is placed. Locate the dispenser behind the pavement marking extrusion die and imbed the reflective elements in the pavement marking to a depth of at least one-half their diameters at a rate of 0.1 pound per square foot. Uniformly distribute the reflective elements over the entire width of the thermoplastic material.

(b) Type B: Preformed, Fused Thermoplastic Film - Longitudinal and transverse joints will be allowed with no overlap or gap permitted at the joint.

00850.44 Public Safety and Convenience - Provide for the safety and convenience of the public as follows:

Protect applied markings from traffic until sufficiently dry so as not to be damaged or tracked by normal traffic movements. At a minimum, place tubular markers or conical markers next to all markings, and place barricades by all areas where cross traffic is anticipated. Additional protection, as required by the Engineer, may be necessary and will be considered incidental to the pavement markings.
Immediately correct improper alignment, broken equipment, spilled product, or other striping problems that impair traffic, at no expense to the City, including appropriate traffic control. Provide documentation from DEQ indicating proper cleanup. Blacking out or covering up the lines will not be allowed, except in a short-term emergency, and when approved.

Conduct work at all times so that there is the least possible interference with the traveling public, according to the requirements of Sections 00220 and 00225.

Do not open any work area to traffic that is not adequately striped and cured.

Do not perform any work, or close any lane to traffic, until the area is adequately signed and protected according to the Traffic Control Plan and when approved by the Engineer.

**00850.46 Substrate Materials** - Apply materials to a surface that is clean, dry, free of contaminants and meets the following requirements:

(a) **New Asphalt Concrete** - Apply materials to new asphalt concrete that is sufficiently cured.

(b) **Existing Asphalt Concrete** - Apply materials to existing asphalt concrete free of surface oils and existing road marking materials.

(c) **Portland Cement Concrete** - Apply materials to concrete that has reached a minimum compressive strength of 3,000 psi, and is free of curing agents, laitance, surface oils and road marking materials.

**00850.47 Disposal of Waste** - Waste material is the property of the Contractor. Remove all waste materials, including grindings and old markings, from the jobsite and dispose of according to applicable state, federal and local regulations. Cost of disposal will be incidental to the work under this Section.

**00850.75 Manufacturer's Warranty** - Furnish a Warranty, signed by the Manufacturer's Representative, that all lines will stay in place, and maintain their color and retroreflectivity for 18 months.

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 six months of the City's request to do so.

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.

(a) **Retroreflectivity** - Markings shall maintain a minimum retroreflectivity of 100 millicandellas. If retroreflectivity becomes a concern at any time during the Warranty period, the City will measure the retroreflectivity for compliance, with a Mirolux 12, Mirolux 30, Ecolux, LTL 2000, or other similar device. No correlation will be made between these pieces of equipment. Each legend will be tested separately, at several random locations chosen by the Engineer. Clean areas of obvious contamination and remove loose debris prior to testing.

The wheel tracks will be measured and averaged separately. If just the wheel tracks become deficient during the Warranty period, replace the sections having low retroreflectivity. If a larger section has low readings, replace the entire legend. Repair markings that drop below the required minimum retroreflectivity during the Warranty period.

(b) **Color Stability** - Yellow markings will be compared to the PR-1 chart, and shall meet 33538 Federal Yellow. White markings shall have a minimum daylight reflectance of 84 throughout the Warranty period. Failure of the material to maintain color stability will be considered a complete failure of the material on that legend.

(c) **Adhesion** - Markings shall remain in place and bonded to the substrate during the Warranty period.

### Measurement

**00850.80 Existing Traffic Markings** - Removal of existing pavement markings, preparation, cleaning, and priming the pavement will be on a lump sum basis and no separate measurement will be made.

**00850.81 Pavement Markings** - The measurement of accepted pavement markings, other than line markings, will be measured on the unit basis, per each, by the actual count of markings accepted and in place.

**00850.82 Pavement Line** - Pavement line for stop bars and crosswalks, complete and in place will measured on the area basis, computed to the nearest square foot.
Payment

00850.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for the pay items listed below when in the Schedule of Items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Removal of Existing Pavement Markings</td>
<td>……………………Lump Sum</td>
</tr>
<tr>
<td>(b) Pavement Legend, Type ____ : Arrows</td>
<td>……………………Each</td>
</tr>
<tr>
<td>(c) Pavement Legend, Type ____ : &quot;ONLY&quot;</td>
<td>……………………Each</td>
</tr>
<tr>
<td>(d) Pavement Legend, Type ____ : &quot;SCHOOL&quot;</td>
<td>……………………Each</td>
</tr>
<tr>
<td>(e) Pavement Legend, Type ____ : &quot;SCHOOL CROSSING&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</td>
</tr>
<tr>
<td>(j) Pavement Line, Type ____</td>
<td>…………………………………… Square Foot</td>
</tr>
</tbody>
</table>

Payment for item (a) will be payment for removal of existing pavement markings, preparation, cleaning and priming the pavement as specified.

In items (b) through (j), the designation for the type of pavement marking materials, listed in 00850.02, will be inserted in the first blank.

Items (b) through (j) include preparing, cleaning, and priming pavement surfaces and laying out the locations of new pavement markings.

Payment for item (b) will include single or multiple headed arrows as required.

Payment for item (f) will include a R x R Symbol and three 24 inch wide white pavement bars as shown.

For item (i) the name of the legend will be inserted in the second blank.

Payment for item (j) will include the pavement lines for stop bars and crosswalks.

Payment for the items above will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work.

Payment includes providing the Manufacturer's Representative and furnishing the Warranty.

Payment for work under this Section will be limited to 90% of the amount due until the City has received the signed Warranty.
Section 00860 - Pavement Markers

Description

00860.00 Scope - This work consists of furnishing and installing reflective and non-reflective pavement markers as shown or directed.

Materials

00860.10 General - Materials shall meet the following requirements:

Adhesive ...........................................................................02840.61
Pavement markers ................................................................02840.60

Construction

00860.40 Pavement Markers:

(a) General - Install reflective (Type I) and nonreflective (Type II) markers as shown. Place reflectorized markers so that future striping, if required, will not cover the marker.

(b) Surface Preparation - Prepare the surface by removing dirt, curing compound, paint, grease, oil, moisture, loose or unsound layers, and any other material which would adversely affect the bond of the adhesive.

Prepare by sandblasting or steel shot-blasting the pavement surface for a sufficient length of time to remove all surface contaminants but not so long as to expose buried aggregate. Use a blast of clean air to ensure removal of all loose particles from the surface.

Apply pavement markers to a dry surface. Do not place markers on the pavement surface if visible moisture is present.

(c) Alignment - Install all markers on the established alignment, which will consist of either:

- Control points at 50 foot intervals on tangent and at 25 foot intervals on curves, or
- A temporary painted line.

One painted line or a line of points will be established for each direction of traffic on a divided highway. Perform all additional work necessary to establish satisfactory lines for markers, including correction of minor irregularities in the line established.

Do not install markers spanning a pavement joint or crack. Adjust spacing between the markers to avoid installation of markers across a joint or crack. Maintain the alignment.

Adjust alignment of a full pattern of markers away from existing lane lines to avoid installing markers that span a longitudinal construction joint or crack. For such deviation in the line of pavement markers, construct a gradual taper of pleasing appearance.
(d) **Installation** - If epoxy adhesive is used, thoroughly mix according to 02840.61(a). 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.

The use of mineral spirits will be permitted for removing adhesive from the surfaces of nonreflective and reflective pavement markers. Cleaning shall effectively remove the adhesive so no loss in the reflective characteristic results. Protect the marker against impact until the adhesive hardens to the degree directed.

**Measurement**

00860.80 **Unit Basis** - Pavement markers will be measured on the unit basis by actual count of each type of marker furnished, installed and accepted. Constructing grooves, preparing pavement, adhesive and clean-up are considered incidental to the work and no separate measurement will be made.

**Payment**

00860.90 **Pavement Markers** - Payment for accepted quantities will be at the Contract unit price, per each, for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Mono-Directional Crystal Type I Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Bi-Directional Yellow Type I Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(c) White Type II Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(d) Yellow Type II Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(e) Mono-Directional Crystal Type I Markers, Recessed</td>
<td>Each</td>
</tr>
<tr>
<td>(f) Bi-Directional Yellow Type I Markers, Recessed</td>
<td>Each</td>
</tr>
<tr>
<td>(g) Multidirectional Crystal Type I Markers</td>
<td>Each</td>
</tr>
<tr>
<td>(h) Multidirectional Yellow Type I Markers</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment for items (a) through (d) will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work.

Payment for items (e) and (f) will be payment in full for constructing pavement grooves, pavement preparation and furnishing and placing materials including equipment, labor and incidentals necessary to complete the work.
Section 00861 - Painted Permanent Pavement Striping

Description

00861.00 Scope - This work consists of permanently striping the top lift of pavement with paint within the limits of the Project as shown or as directed, and in compliance with the MUTCD.

00861.02 Pre-Striping Meeting - Prior to starting work, meet with the Engineer and striping subcontractor. At this meeting, do the following:

- Furnish a Traffic Control Plan for approval, including lane restriction time periods.
- Furnish a striping schedule showing areas and timing of work, and placing of materials.
- Discuss placement of materials, potential problems.
- Discuss work plan at off-ramps, on-ramps and any intersections.
- Discuss material handling procedures and procurement.
- Provide a copy of the manufacturer’s installation instructions and copies of Material Safety Data Sheets (MSDS).
- Provide a spill recovery plan including:
  - Name, address and phone number of the Contractor’s contact with the DEQ
  - Name, address and phone number of persons certified and on call to do cleanup

Materials

00861.10 General - Use paint and traffic paint beads conforming to the requirements of Section 02840.

Equipment

00861.20 General - Use paint sprayers made specifically for the purpose of applying paint, containing traffic paint beads, to a uniform width and thickness on the roadway surface, using a three-gun system.
Construction

00861.40 General - Before striping, prepare the surface according to the paint manufacturer’s recommendations. Apply striping to the lines and locations shown, or as directed. For overlays and shoulder widening projects, replace striping to match existing striping unless otherwise directed. If the roadway has changed significantly or is a new roadway, propose variations in standard layouts to handle unusual conditions, subject to approval.

Place permanent striping prior to traffic being allowed on the pavement, or if approved, the Contractor may install flexible pavement markers in conformance with Section 00225 prior to final striping.

00861.41 Alignment - Lay out a spot alignment for the striping consisting of control points every 50 feet on tangent and every 25 feet on a curve or as directed. Do not proceed with striping prior to receiving approval of the layout.

00861.42 Application - Apply painted stripes as follows:

- Apply two separate applications of painted stripes.
- Retrace the second application directly over the first application.
- Apply each painted stripe application at a thickness of 15 mils (wet), equivalent to 17 gallons per mile for a 4 inch wide solid stripe.
- Apply traffic beads to each application at a rate of 5 pounds per gallon of paint. Embed the traffic paint beads in the paint to a depth of 40% to 60% of their diameter.
- For stripe lines that delineate opposing traffic, retrace the first painted stripe with the second painted stripe in the reverse direction of the first application. For all other painted stripes, retrace in the same direction of the first application.
- Apply the second application after 2 hours but within 48 hours of the first application or as recommended by the manufacturer.

Immediately clean up paint dribbled beyond the cutoff. Avoid tracking of new paint. If more than one incident of tracking occurs in a 1,500 foot section, improve the level of traffic control and protection. All areas tracked through will be reviewed by the Engineer for possible cleanup and retracing at the Contractor’s expense.

00861.45 Placement Tolerance - Place striping parallel and true to line. Make skip ends square and clean. Place skip stripes so that they are in cycle with at least one end of any adjacent project.
Allowable tolerances for installation are:

- **Lateral location on roadway** - 1/2 inch on tangents; 1 inch on curves
- **Length of 10 foot skip stripe** - ± 2 inches
- **Length of 9 foot skip stripe** - ± 2 inches
- **Length of 3 foot skip stripe** - ± 3/4 inch
- **Length of 2 foot skip stripe** - ± 1/2 inch
- **Length of 30 foot gap** - ± 2 inches
- **Length of 15 foot gap** - ± 2 inches
- **Length of 9 foot gap** - ± 1 inch
- **Length of 6 foot gap** - ± 3/4 inch
- **Skip cycle** - A tolerance of 1/10 of the skip line length will be allowed on the first skip line of a run, but it shall be on a cycle within one skip
- **Double lines** – Parallel, with a gap tolerance of ± 1/2 inch
- **Line thickness** - ± 5 mils / - 3 mils

**Finishing and Cleaning Up**

00861.70 **Removal or Repair of Unacceptable Work** - Remove or repair all unacceptable work and dispose of at the Contractor’s expense. Repair or replace unacceptable work immediately if it causes a safety problem. The removed material becomes the property of the Contractor. If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the City.

**Measurement**

00861.80 **General** - Painted permanent pavement striping will be measured on the length basis or the lump sum basis, according to the unit of measurement in the Bid Schedule.

00861.81 **Length Basis** - The quantity of painted permanent striping accepted will be the number of feet of striping placed, to the nearest foot, complete and in place as specified. There will be no payment for the gap between skip stripes.

00861.82 **Lump Sum Basis** - No separate measurement of painted permanent pavement striping will be made.
Payment

00861.90 General - Painted permanent pavement striping accepted for payment will be paid for on the length basis or on the lump sum basis, as follows:

00861.91 Length Basis - Painted permanent pavement striping will be paid for at the Contract unit price per foot for the pay item "Painted Permanent Pavement Striping". The width of lines will be assumed to be 4 inches. If lines other than 4 inch are specified, the length will be adjusted by converting it to an equivalent length of 4 inch line on a proportionate area basis.

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified, including layout work.

00861.92 Lump Sum Basis - Payment for painted permanent pavement striping will be made on the lump sum basis for the pay item "Painted Permanent Pavement Striping, Complete". Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified, including layout work.

00861.93 Incidental Work - When required by construction staging, additional temporary flexible pavement markers will be paid for according to 00225.93. No payment will be made for temporary flexible pavement markers required by the Contractor's operations or placed for the Contractor's convenience.

No extra payment will be made for retracing the first application of striping; payment will be based on the total quantity of permanent striping provided as a finished product, complete and in place as specified.
Section 00862 - Durable Permanent Pavement Striping

Description

00862.00 Scope - This work consists of permanently striping the wearing surface with durable lines within the limits of the Project, as shown or according to the Manual on Uniform Traffic Control Devices (MUTCD).

For each Project, the striping contractor shall be certified by the marking materials manufacturer to perform the applicable work, prior to beginning the work.

00862.02 Pre-Striping Meeting - Prior to starting work, meet with the Engineer and striping subcontractor. At this meeting, do the following:

- Furnish a Traffic Control Plan for approval, including lane restriction time periods.
- Furnish a striping schedule showing areas and timing of work, and placing of materials.
- Discuss placement of materials, potential problems.
- Discuss work plan at off-ramps, on-ramps and any intersections.
- Discuss material handling procedures and procurement.
- Provide a copy of the manufacturer’s installation instructions and copies of Material Safety Data Sheets (MSDS).
- Provide a spill recovery plan including:
  - Name, address and phone number of the Contractor’s contact with the DEQ
  - Name, address and phone number of persons certified and on call to do cleanup

Materials

00862.10 General - Use materials from the CPL. For all lines use Extruded, 90 mils, Non-Profile, Thermoplastic.

Color Stability - Using the PR-1 Chart. Yellow marking shall meet 33538 Federal Yellow. White marking shall have a minimum daylight reflectance of 84.

00862.11 Reflective Elements - Furnish reflective elements meeting the requirements of 02840.20, or as recommended by the marking material manufacturer.
Equipment

00862.20 Equipment - Use sprayers or extruders approved by the marking material manufacturer and made specifically for the purpose of applying beaded markings to a uniform width and thickness on the roadway surface. Hand units will not be allowed. Use automatic bead applicators that place a uniform layer of beads on the line.

Place double lines using equipment designed to place two parallel lines in one pass.

00862.30 Manufacturer's Representative - Provide the services of a manufacturer's representative (the "Manufacturer's Representative"), authorized to sign a warranty ("the Warranty") on behalf of the manufacturer (See 00862.75). The Manufacturer's Representative shall observe the application of durable permanent pavement striping materials. The Contractor shall require the Manufacturer's Representative to immediately alert the Contractor and the Engineer of anything that could affect the performance of the product or the Warranty. Cooperate with the Manufacturer's Representative and the Engineer to ensure that the materials are placed in accordance with the manufacturer's recommended procedures. The Contractor shall require the Manufacturer's Representative to fill out the Warranty form and sign it on behalf of the manufacturer.

00862.32 Manufacturer-Certified Installers - Install durable permanent pavement striping using only striping installers certified by the marking materials manufacturer for the specific striping material and method. Submit documentary evidence of such certification to the Engineer prior to beginning work. Do not begin installation prior to receiving the Engineer's approval.

Construction

00862.40 General - Install the markings according to the manufacturer's recommendations and the Engineer's instructions.

Place references as may be necessary to accurately control the layout of the pavement markings. Place spot alignment for the striping, consisting of control points no further apart than 50 feet on tangent and 25 feet on curves, or as directed. Lay out a continuous narrow guideline for each line, along one edge of, or uniformly offset from, the intended permanent line location. Do not proceed with permanent striping until the layout is approved by the Engineer.

For inlaid markings, indicate the exact grind-out location with a 4 inch wide marking line in addition to the continuous guideline. Use painted striping meeting the requirements of Section 02840, applied at a thickness of 6 mils. Reflective elements are not required, unless the layout line is to be used for temporary direction of traffic.

Do not use layout lines for temporary direction of traffic unless approved in writing. If using layout lines for temporary direction of traffic, apply at a minimum thickness of 10 mils and include reflective elements.

Do not proceed with placement of permanent striping prior to receiving the Engineer's approval.
For overlays and shoulder widening projects, replace striping to match existing striping unless otherwise directed. If the roadway has been changed significantly by the Project, or is a new roadway, propose variations in standard layouts to handle changed or unusual conditions.

Place lines wider than 4 inches with one pass.

Place permanent striping prior to allowing traffic on the pavement, and only if the Manufacturer's Representative determines that the pavement has cured sufficiently. If the Manufacturer's Representative determines that the pavement has not cured sufficiently, install flexible pavement markers according to Section 00225 prior to allowing traffic on the pavement, until permanent striping can be installed.

00862.41 Pavement Surface - Prepare the pavement surface as the manufacturer recommends, and as follows:

(a) New or Existing Asphalt Concrete - Apply material only when the Manufacturer's Representative has determined that the surface is sufficiently dry, clean and free of contaminants such as surface oils and existing road marking materials. Some products require the asphalt to cure for several weeks prior to placement of certain striping materials. This time is considered contract time.

(b) Portland Cement Concrete - Apply material to concrete that has reached a minimum compressive strength of 3,000 psi, and only when the Manufacturer's Representative has determined that the surface is sufficiently dry, clean and free of contaminants such as curing agents, laitance, surface oils, and road marking materials.

Remove contaminants by approved mechanical means, such as turbo-blasting or grinding, and dispose of according to 00862.47.

00862.42 Application - Use skip cycles consisting of a skip line stripe followed by a gap, containing no markings, until the next skip line stripe. Length of stripes and gaps shall be as shown. Match new skips to the pattern of existing markings on at least one end of the Project.

Monitor the bead application to ensure proper bead embedment and density. Apply reflective elements at a sufficient rate to obtain a minimum reflectivity reading of at least 300 mcd for white and 250 mcd for yellow.

Apply non-profile markings as shown. This method is designed to be done by an extrusion process. A ribbon type application will not be allowed.

00862.43 Quality of Work - Place markings and beads on the roadway in proper alignment with existing markings. Make skips parallel and true to line, with skip ends square and clean. Immediately clean up dribbling of markings beyond the cutoff.

(a) Test Stripe - Prior to starting, and in the presence of the Engineer, place a 150 foot test stripe on roofing felt or other approved material or location, to demonstrate the pavement marking application process. If the Project involves only inlaid applications, this test stripe is not required. Do not place permanent materials without receiving the Engineer's approval.
of the test performance. Repeat the performance test until the Engineer is satisfied that the Contractor has suitable skills to place the materials accurately and properly. Any delay due to this test requirement will be at the Contractor’s expense.

(b) Allowable Tolerances - Record the following readings, and the locations where they were taken, for evaluation by the Engineer:

- For inlay applications, record the depth of the slot every 300 feet during the grinding operation.

- For all other applications, measure the thickness of the lines (above the pavement surface), at the time of application, at intervals not to exceed 300 feet.

Inspect the line initially, and again two weeks after placement, to ensure the material has cured properly. Remove all soft spots or abnormally darkened areas and replace with specification material.

Allowable tolerances for installation are:

- **Lateral location on roadway** - 1/2 inch maximum on tangent, 1 inch on curves

- **Space between parallel (double) lines** - 3/8 inch

- **End-to-end on skips (for re-trace)** - 2 inch overlap

- **Length of 10 foot skip stripe** - ± 2 inches

- **Length of 9 foot skip stripe** - ± 2 inches

- **Length of 3 foot skip stripe** - ± 3/4 inch

- **Length of 2 foot skip stripe** - ± 1/2 inch

- **Length of 30 foot gap** - ± 2 inches

- **Length of 15 foot gap** - ± 2 inches

- **Length of 9 foot gap** - ± 1 inch

- **Length of 6 foot gap** - ± 3/4 inch

- **Skip cycle** - A tolerance of 1/10 of the skip line length will be allowed on the first skip line of a run, but it shall be on cycle within one skip

- **Width of lines** - 1/16 inch, + 3/8 inch

- **Divergence of parallel double lines** - 3/8 inch maximum
If existing pavement markers are to be left in place, adjust skip spacing to place skips midway between pavement markers, or as directed.

If it is determined that the material is being placed too thin, or otherwise not to specification, make immediate adjustments to correct the problem. Do not allow the top of the line to be cupped, or lower than the wearing surface.

Durable permanent pavement markings applied by any method will be unacceptable if:

- The marking is not straight, not wide enough, or not true to line.
- The thickness of the line is inconsistent or less than specified.
- The top of the line is not smooth and uniform.
- Any lines or profile bumps are damaged prior to curing.
- Retro-reflectivity is too low.
- The material is uncured.
- The substrate is visible in the striped areas.
- The material blackens or is inconsistent in color.
- The marking exhibits poor adhesion.
- The color does not match 33538 Federal Yellow.

(c) Retro-reflectivity - Measure the retro-reflectivity of each line, using a Mirolux 12, a retro-reflectometer, or similar device, mobile or hand-held, at intervals not exceeding 1,000 feet of road distance. Record the location of each test. Perform testing within 48 hours of curing. Make results available to the Engineer immediately.

Prior to acceptance of the Project, the initial retro-reflectivity may also be tested by the Engineer for compliance. This testing will take place at least two days, but not more than 90 days, after the Project is complete. Notify the Engineer as soon as possible when the lines are ready to measure.

If the retro-reflectivity is less than 250 mcd for white and 200 mcd for yellow, the affected materials will be considered unacceptable. The Engineer may elect to use the Contractor’s retro-reflectivity readings for the initial retro-reflectivity.

(d) Repairs to the Work - Perform repairs using equipment similar to the equipment initially used to place the material. Do not perform repairs in a "patch-work" manner. If more than one repair is required in a single 300 foot section, grind and repair the entire section.
**00862.44 Public Safety and Convenience** - Provide for the safety and convenience of the public according to Section 00220 and the following:

- Be responsible for protecting all applied markings from traffic until sufficiently dry to prevent damage or tracking by traffic movements. At a minimum, place cones or tubular markers by all skips, and barricades by all areas where cross traffic is anticipated. Additional protection may be necessary and will be considered incidental.

- Immediately correct striping problems that impair traffic, such as improper alignment, broken equipment, or spilled product, at the Contractor's expense, including appropriate traffic control. Provide documentation from DEQ indicating proper cleanup. Blacking out or covering up lines will not be allowed, except in a short-term emergency when approved.

- Do not open up any work area to traffic that is not adequately striped and suitable for safe driving.

**00862.45 Winter Activities** - If the Project continues for more than one construction season, and has sections of roadway that, in the opinion of the Engineer, are insufficiently marked to facilitate safe driving:

- Furnish and place painted permanent pavement striping according to Section 00861 to ensure safe driving conditions throughout the Project, until the durable permanent striping can be placed. Temporary flexible pavement markers are not acceptable for the purposes of this subsection.

- Unless an offset configuration is previously approved by the Engineer, remove pavement striping placed under this subsection, prior to placement of the durable striping.

**00862.47 Disposal of Waste** - Waste material becomes the property of the Contractor. This includes all grindings and all removed marking material. Do not dispose of or store stripe removal waste material on City property. Dispose of waste material according to applicable State, federal and local regulations.

**Finishing and Cleaning Up**

**00862.70 Removal or Repair of Unacceptable Work** - Remove or repair all unacceptable work and dispose of according to 00862.47, at no expense to the City. Repair or replace unacceptable work immediately if it causes a safety problem. Remove unacceptable materials by an effective method, such as grinding if material has hardened. The removed material becomes the property of the Contractor (see 00862.47). If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the City.
Manufacturer's Warranty - Furnish a Warranty, signed by the Manufacturer's Representative, according to the following:

For surface-mounted thermoplastic materials, provide a Warranty that all markings will stay in place and will maintain a minimum retroreflectivity of 150 millicandellas for white and 125 millicandellas for yellow. The period of the Warranty shall be three years.

For protected inlaid thermoplastic materials, provide a Warranty that all markings will stay in place and will maintain a minimum retroreflectivity of 150 millicandellas for white and 125 millicandellas for yellow. The period of the Warranty shall be four years.

For methyl methacrylate materials, provide a four-year Warranty that all markings will stay in place and will maintain a minimum retroreflectivity of 150 millicandellas for white and 125 millicandellas for yellow. The period of the Warranty shall be four years.

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 or drop below the required minimum retroreflectivity during the Warranty period, within six months of the City's written request to do so.

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.

If retroreflectivity becomes a concern at any time during the Warranty period, the Engineer will measure the retroreflectivity of the area in question, using a Mirolux 12, a 30 m retroreflectometer (mobile or handheld), or similar device. The surfaces of the roadway will not be cleaned in preparation for taking readings, but areas of obvious contamination will be avoided.

For the purpose of the Warranty, a cumulative 5% or greater loss of line due to non-adhesion on any 328 foot segment of marking will constitute failure of the material in that segment.

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.

Measurement

General - The quantity of durable permanent pavement striping will be the length, to the nearest foot, complete and in place as specified. For skip stripes, measurement will be for the actual stripe, excluding the gap between skip stripes. The standard application width is considered to be 4 inches. If wider lines are specified, the length of those lines will be adjusted by converting them to an equivalent length of 4 inch line on a proportionate area basis.

Thickness will be measured from the top of the 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.
Temporary flexible pavement markers required by 00862.40 will be measured on the unit basis when a pay item is included in the Schedule of Items. When no pay item is provided, there will be no separate measurement of temporary flexible pavement markers.

Payment

00862.90 General - The accepted quantities will be paid for at the Contract unit price per foot for the pay items listed below when in the Schedule of Items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermoplastic, Non-Profile, 90 mils, Extruded</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Payment will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified, and includes payment for the following:

- Laying out the alignment
- Checking dimensional tolerance
- Removing and disposing of unacceptable materials
- Furnishing a striping schedule
- Placing a test stripe
- Removing existing pavement markings and other waste materials
- Testing retro-reflectivity
- Placing layout guidelines
- Providing the Manufacturer's Representative
- Furnishing the Warranty
- Placing and removing winter markings according to 00862.45

There will be no separate or additional payment for the following:

- Over-runs of material caused by the variation of the gradation of the asphalt
- Additional material required to apply markings on open-graded pavement
- Material used to fill depressions resulting from pavement line removal
- Disposal of stripe removal waste material
Temporary flexible pavement markers required by 00862.40 will be paid for according to Section 00225, if a pay item is provided. If no pay item for temporary flexible pavement markers is in the Schedule of Items, payment will be incidental to the permanent pavement striping pay item(s) and no separate payment will be made.

Payment for work under this Section will be limited to 80% of the amount due until the City has received the signed Warranty.
Section 00863 - Pavement Marking Removal

Description

00863.00  Scope - This work consists of removing markings from the pavement surface within the limits of the Project.

Construction

00863.40  Construction - Remove pavement markings by an approved method as necessary to remove the markings, but without damaging the pavement surface. Repair any damaged surface at no additional compensation, and to the satisfaction of the Engineer.

Painted stripes may be removed by sandblasting, hydroblasting, steel-shot blasting, or other approved method. Grinding will not be allowed for the removal of painted stripes unless directed.

Coordinate all removal work with construction activity. Remove pavement markings the same day permanent striping is applied, unless otherwise directed. Use vacuum shrouded equipment or other equally effective containment procedures. Properly dispose of all waste materials in accordance with DEQ regulations, where applicable.

Measurement

00863.80  Measurement - The quantities of pavement line removed will be measured on the length basis, to the nearest foot. Pavement line removal will be based on a nominal width of 4 inches. If the width of the line is other than 4 inch, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis.

The quantities of legends removed will be measured on the unit basis, per each, by actual count of legends removed. One legend is considered to include all letters, characters, etc. associated with the particular pavement legend.

Payment

00863.90  General - The accepted quantities of work performed under this Section will be paid for at the Contract unit price per unit of measure for the following items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pavement Line Removal</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) 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.
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PART 00900 - PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS

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 cost to the City. Liquidated damages will be assessed against the Contractor in the amount of $200 per day for each sign out of service for more than five calendar days.

Install rigid, temporary vertical ties to the back of all extruded aluminum panel signs to prevent buckling of the sign panels and/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 Lump Sum Basis - No measurement of quantities will be made for this work.
Payment

00905.90  General - Removing existing signs will be paid for at the Contract lump sum amount for the item "Remove Existing Signs". Removing, moving and reinstalling existing signs will be paid for at the Contract lump sum amount for the item "Remove and Reinstall Existing Signs". Payment will be payment in full for all Materials, Equipment, labor and Incidentals necessary to complete the work as specified.
Section 00920 - Sign Support Footings

Description

00920.00 Scope - This work consists of constructing sign support footings of the dimensions and design shown and at the locations shown or directed. Sign support footings include foundations for overhead sign supports and roadside sign supports.

Materials

00920.10 General - Materials for constructing sign support footings shall meet the following requirements:

Anchor bolts................................................................. 02560.30
Backfill (unless otherwise directed) ......................... 00510.10 or .11
Commercial Grade Concrete.............................................. 00440
Conduit ...................................................................... 02920.10 -.12
Reinforcement ............................................................. 00530

00920.11 Breakaway Footings - Provide 2-inch diameter schedule 40 pipe post breakaway footings complying with NCHRP350 testing and have a “WZ” letter of approval from Federal Highway Administration such as Sign Support Systems at P.O. Box 8041, Greensboro, North Carolina, 27419, 1-866-549-7706, Part No. BOR 238-1012 or approved equal.

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 asphaltic markers.

00920.41 Concrete - Construct concrete sign foundations according to Section 00440.

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.

00920.42 Reinforcement - Fabricate and place steel reinforcement according to Section 00530.

00920.43 Conduit - Fabricate and install conduit according to Sections 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 Lump Sum Basis - No measurement of quantities will be made for work under this Section unless plan changes are ordered.

The estimated quantity of concrete required to complete the footings and pedestals will be listed in the Special Provisions for the purpose of providing a basis for adjustment if changes in the work are ordered. No adjustment in the Contract lump sum amount will be made except as provided above. Any adjustment in the Contract lump sum amount will be made according to 00190.10(f).

Payment

00920.90 General - Payment will be made 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) Sign Support Footings</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Sign Support Footings, Breakaway</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Item (b) is for breakaway footings conforming to 00920.11.

Payment, plus or minus adjustments if any, will be payment in full for excavation, backfill, shoring, reinforcement, anchor bolts, conduit, and all materials, 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, including sign bridges and sign structures.

00930.01 Definitions and Terms:

(a) 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.

(b) Pipe Sign Posts, Special Pipe Sign Supports, Square Tube Sign Supports, Single Post Breakaway Sign Supports, Triangular Base Breakaway Sign Supports and Offset Single 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.

(c) Sign Bridge, Ell Sign Bridge, Butterfly Sign Structure and Cantilever Sign Structure - The complete structure is composed of base plates, support columns, cantilever arms, trusses, sign support arms, supporting brackets, and fasteners, but does not include the sign illumination equipment, maintenance walkways and sign support footings.

(d) Double Sign Support and Triple Sign Support - The complete structure is composed of post stub, base plate, pipe support column, sign frames, and supporting brackets, but does not include the sign support footing.

(e) Structure Mount - The I-beam or special detailed attachments used for mounting signs to bridge structures, and includes all necessary support brackets and arms, and fasteners, but does not include sign illumination equipment and maintenance walkways.

(f) Exit Number Sign Supports - The I-beams, spacers, special mounting brackets, and fasteners, necessary to install the exit number signs.

(g) Sign and Luminaire Supports and Signal Pole Mounts - The complete support including horizontal and vertical arms, supporting brackets, and fasteners.

(h) Route Marker Frames - The channel frame used to mount two or more route shield assemblies to a single support.

(i) Special Sign Bracket - The bracket used to mount two or more signs on a single support when all signs are not parallel or at right angle to the others.

(j) Maintenance Walkways - The complete structure is composed of safety rails and posts, horizontal and vertical walkway support arms (except sign support arms), grating, post brackets, supporting brackets, and fasteners, but does not include sign illumination equipment.
00930.02 Working Drawings - Submit six copies of stamped working drawings, plans, details, and calculations according to 00150.35(m)(1) for all structural metal work. Any material ordered or work done before the review of working drawings shall be at the Contractor's risk. All engineered details and drawings that are not prepared by the City but are required in the Contract Documents and Specifications for the Project shall be submitted for review prior to fabrication.

In addition to the working drawings, submit six 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:

- Single Post Breakaway Sign Supports
- Triangular Base Breakaway Sign Supports
- Multi-Post Breakaway Sign Supports
- Signal Pole Mounts

Working drawings for these supports will be provided by the Engineer of Record. Use the Field Verification of Post Lengths form, available from the Engineer, to provide necessary site data to the Engineer of Record for use in producing working drawings. Any work done, or materials ordered, prior to receiving working drawings from the Engineer of Record will be at the Contractor’s expense.

00930.03 Commercially Manufactured Products - Instead of fabricating "Sign Structures" as shown, the Contractor may offer for consideration and approval, as a substitution, a standard manufactured product of aluminum or steel. Submit stamped engineered details and drawings for manufactured products according to 00150.35(m)(1).

If commercially manufactured sign structures are furnished, they shall be designed for the ultimate sign size and wind pressure given on the plans and meet the requirements of the current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

Furnish complete, proposed material specifications and fabrication criteria with the working drawings.
00930.09 **Identifying Tags** - Overhead 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 **General** - Provide structural steel materials and pipe sign posts conforming to the applicable portions of Section 02530, with weights and sizes as shown or specified.

Provide galvanized bolts, nuts, hardened washers, and direct tension indicators conforming to Section 02560, except the Rotational Capacity Test of 02560.60(a) need not be repeated at the job site.

All components of steel sign structures shall be galvanized after fabrication and before assembly. Galvanizing shall conform to the requirements of Section 02530.

**Labor**

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.

**Construction**

00930.40 **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 permitted.

(c) **Welding** - Weld steel sign structures according to AWS D1.1. The fabricator shall inspect welds in accordance with details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 1.4.2 WELDING OF STEEL STRUCTURES 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. Lubricated fasteners that accumulate dirt shall be cleaned and relubricated according to 02560.70.

(1) **Bolt Installation for Slip Bases (Breakaway)** - Furnish, at no additional compensation, 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.
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 gage, 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 00560-2 of Section 00560. During the tightening operation do no 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 two 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 one-half 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, the following inspection procedure shall be used:

- 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 must not produce greater nut rotation than 1.5 times that permitted 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 two 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** - Furnish and install a bracket that is adjustable horizontally and vertically to facilitate signal pole mast arm and pole mounting of flat sign sheets. The mount shall allow vertical adjustment for positioning the sign and shall rotate to plumb the sign. Construct the bracket from cast aluminum and galvanized steel elements that attach to the signal pole mast arm or other support with stainless steel straps. Use galvanized or stainless steel nuts, bolts and washers for fasteners.

**Measurement**

**00930.80 Lump Sum Basis** - No measurement of quantities will be made for metal sign supports unless plan changes are ordered or the field-verified post length increases or decreases by more than 25% of the length specified.
The estimated quantities of structural steel for an item will be listed in the Special Provisions for the purpose of providing a basis for adjustment. No adjustment in the lump sum Contract amount will be made, except as provided above. Any adjustment in the lump sum Contract amount will be made according to 00190.10(f).

00930.81 Unit Basis - Measurement of adjustable sign mounts will be on a unit basis, per each, by actual count of adjustable sign mounts installed and accepted.

Payment

00930.90 Lump Sum Basis - Payment will be made at the Contract lump sum amount for the following items, unless this price is adjusted according to 00930.80:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridges</td>
<td></td>
</tr>
<tr>
<td>(a) Sign Bridge</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Ell Sign Bridge</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Structures</td>
<td></td>
</tr>
<tr>
<td>(c) Butterfly Sign Structures</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Cantilever Sign Structures</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Mounts</td>
<td></td>
</tr>
<tr>
<td>(e) Structure Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(f) Signal Pole Mounts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Posts</td>
<td></td>
</tr>
<tr>
<td>(g) Pipe Sign Posts</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Supports</td>
<td></td>
</tr>
<tr>
<td>(h) Multi-Post Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(i) Special Pipe Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(j) Single Post Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(k) Triangular Base Breakaway Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(l) Offset Single Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(m) Double Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(n) Triple Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(o) Exit Number Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(p) Sign and Luminaire Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(q) Mast Arm Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(r) Square Tube Sign Supports</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(s) Square Tube Sign Supports W/TBB</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
Walkways

(t)  Maintenance Walkways .......................................................... Lump Sum

Item (t) includes support arms as specified except where sign support arms perform the dual purpose of supporting walkways and signs. Payment for the dual purpose sign support arms will be included in payment for the sign structure.

No separate payment will be made for route marker frames, wind bracing, pole clamps, stainless steel clamps, or special sign brackets. Payment will be included in payment made for one or more of the listed pay items.

Payment, plus or minus adjustments if any, 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.

00930.91  Unit Basis - Payment for accepted quantities of adjustable sign mounts will be at the Contract unit price per each for the pay item "Adjustable Sign Mounts". Payment will be payment in full for furnishing, attaching and adjusting the mounts and includes equipment, labor and Incidentals necessary to complete the work.
Section 00940 - Signs

Description

00940.00 Scope - This work consists of furnishing, fabricating and erecting traffic signs of the types shown.

00940.01 Sign Backgrounds - Use either reflectorized or nonreflectorized sign backgrounds as shown and according to 00940.02. The use of baked enamel will not be allowed.

(a) Color - Use sign background colors conforming to the Federal Highway Administration "Color Specifications for Retrospective Sign and Pavement Marking Materials". Non-reflective, reflective, and retroreflective sheeting shall conform to Section 02910.

In addition, specified color coordinates shall be subject to visual matching by the Engineer to determine that all panels in any one sign match.

00940.02 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 on extruded aluminum panels, sheet aluminum, or plywood.

"B1" Blue Type I enclosed lens reflective sheeting background with silver-white Type III or Type IV permanent or removable legend with retroreflective silver-white screened legend on extruded aluminum panels, sheet aluminum, or plywood.

"B2" Blue Type III or Type IV sheeting background with white Type VII or Type IX permanent or removable legend on extruded aluminum panels or sheet aluminum.

"B3" Blue Type IX sheeting background with white Type VII or Type IX permanent or removable legend on extruded aluminum panels or sheet aluminum.

"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 IV sheeting overlaid with brown transparent paste background, with retroreflective silver-white screened legend on extruded aluminum panels, sheet aluminum, or plywood.

"C1" Brown Type III or IV sheeting background with white Type VII or Type IX permanent or removable legend on extruded aluminum panels or sheet aluminum.

"C2" Brown Type IX sheeting background with the 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 on extruded aluminum panels or sheet aluminum.

"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 on sheet aluminum or plywood.

"F1" White Type IX sheeting background overlaid with red and blue transparent paste background with white Type VII or Type IX permanent legend on sheet aluminum.

"G" 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 on extruded aluminum panels, sheet aluminum, or plywood.

"G1" Green Type III or Type IV sheeting background with white Type VII or Type IX removable legend on extruded aluminum panels.

"G2" Green Type III or Type IV sheeting background with white Type VII or Type IX permanent legend on sheet aluminum.

"G3" Green Type IX sheeting background with white Type VII or Type IX permanent legend, or white IX sheeting background overlaid with green transparent paste background with retroreflective silver-white screened legend on sheet aluminum.

"G4" Green Type IX sheeting background with white Type VII or Type IX removable legend on extruded aluminum panels.

"G5" 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)

"O" Orange Type I sheeting background with black nonreflective permanent or removable legend on extruded aluminum panels, sheet aluminum, or plywood.

"OO" Orange Type III or Type IV sheeting background with black nonreflective legend on extruded aluminum panels, sheet aluminum, or plywood.

"O3" Orange Type III or Type IV sheeting background with black nonreflective permanent legend and red retroreflective symbol on sheet aluminum or plywood. (Stop or Yield Ahead Symbol Sign)

"O4" Fluorescent orange Type VII, Type VIII, Type IX or Type X sheeting background with black nonreflective removable legend on extruded aluminum panels.

"O5" Fluorescent orange Type VII, Type VIII, Type IX or Type X sheeting background with black nonreflective removable legend on extruded aluminum panels.

"R" 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 on sheet aluminum or plywood. (Stop Sign, Wrong-Way, Do Not Enter, etc.)
"R1" White Type IX sheeting background overlaid with red transparent paste background with white Type VII or Type IX permanent legend on sheet aluminum or plywood.

"R2" 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 on sheet aluminum or plywood. (Yield Sign)

"R3" White Type IX sheeting background overlaid with screened red transparent paste triangle and permanent legend on sheet aluminum or plywood.

"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 screened, cut-out permanent, or removable legend on extruded aluminum panels, sheet aluminum, or plywood.

"W2" Silver-white Type III or Type IV sheeting background with a screened nonreflective black legend overlaid with red transparent paste circle and continuous diagonal bar on sheet aluminum or plywood. (Prohibition)

"W3" Silver-white Type III or Type IV sheeting background with transparent brown screened legend or brown Type III or Type IV Type III or IV cut-out permanent legend on sheet aluminum or plywood.

"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 on sheet aluminum or plywood.

"W5" Silver-white Type III or Type IV sheeting with green transparent screened legend or green Type III or Type IV cut-out permanent legend on sheet aluminum or plywood.

"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 on sheet aluminum. (Prohibition Sign Overhead).

"W7" White Type IX sheeting background with black nonreflective screened cut-out permanent legend on sheet aluminum.

"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 on sheet aluminum or plywood.

"W9" Silver-white Type III or Type IV sheeting background with fluorescent orange Type IX border and OTIA logo permanent legend. Lower legend is black nonreflective screened or cut-out permanent legend.

"W10" White Type IX sheeting background with black nonreflective removable legend on extruded aluminum panels.
"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 on sheet aluminum or plywood. (Bicycle Stop or Bicycle Yield Symbol Signs)

"W12" Silver-white encapsulated lens retroreflective sheeting background on sheet aluminum or plywood, with a screened nonreflective black legend and a retroreflective circle and continuous diagonal bar overlaid with green transparent paste. (No Parking Sign)

"Y1" Yellow Type III or Type IV sheeting background with black nonreflective screened, cut-out permanent, or removable legend on extruded aluminum panels, sheet aluminum, or plywood.

"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 on sheet aluminum or plywood. The center yellow circle 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 on extruded aluminum panels or sheet aluminum.

"Y4" Yellow Type III or Type IV sheeting background with black black nonreflective screened or cut-out permanent legend and red Type III or Type IV symbol on sheet aluminum or plywood. (Stop or Yield Ahead Symbol Sign)

"Y5" Fluorescent yellow Type IX sheeting background with black nonreflective screened, or cut-out permanent or removable legend on extruded aluminum panels or sheet aluminum

"Y6" Fluorescent yellow IX sheeting background with black nonreflective screened or cut-out permanent legend and red and green Type IX circles on sheet aluminum. The center yellow circle shall be part of the background sheeting. (Signal Ahead Symbol Sign Overhead)

"Y7" Fluorescent yellow IX sheeting background with black nonreflective screened or cut-out permanent legend and red Type VII or Type IX circle on sheet aluminum. The center yellow circle shall be part of the background sheeting. (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 on sheet aluminum or plywood. (Speed Reduction Symbol Sign)

"YG" Fluorescent yellow-green Type IX sheeting background with black nonreflective screened or cut-out permanent legend on sheet aluminum.

"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 on sheet aluminum. (In-Street Pedestrian Crossing Symbol Sign)
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" or City of Portland Standard Drawings.

00940.04 **Construction** - Signs shall be fabricated of matched components from the same supplier, to ensure that all components of each sign are compatible, and are warrantable by the manufacturer. The removable legend does not have to be fabricated with sheeting from the same supplier as the background sheeting on the sign panels.

**Materials**

00940.10 **General** - Materials for signs shall conform to Section 02910. The use of reinforced sheet aluminum signs is not allowed unless otherwise shown or specified.

00940.11 **Alternate Materials** - The use of plywood as an alternate material, except for temporary signs, will not be allowed on the Project.

In cases where the Contractor utilizes a standard manufactured item in the construction of signs, do not permit the mixing of items from more than one manufacturer unless otherwise shown or specified.

**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 5' to 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>

See Table 02910-1 in Section 2910 for sheet aluminum thicknesses for various sizes of signs.

Construct standard signs as shown in the FHWA "Standard Highway Signs" manual or in the metric or English version (as appropriate) of ODOT’s "Sign Policy and Guidelines for the State Highway System". The latter are available for purchase from the ODOT Traffic Management Section, Transportation Building, Salem.
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 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 two mounting holes. Signs having a vertical dimension of 48 inches or greater shall have three 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.

00940.45  **Legend Installation:**

**(a) General** - The word "legend" means the entire message and border for a sign. A group of words, numbers and/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 and/or numbers shall conform to the FHWA "Standard Alphabets for Highway Signs" manual.

Spacing between words for Series "E" (modified) legend shall be 1.5 times the upper case letter height. Spacing between words for other 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>(0.836) H</td>
</tr>
</tbody>
</table>

Where 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** - Apply screened legend according to the sheeting manufacturer's recommendations. Apply cut-out legend according to 00940.44.
(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&quot; Capital or Upper Case</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>8&quot; or 10 2/3&quot; Upper Case</td>
<td>1&quot;</td>
</tr>
<tr>
<td>10&quot; or 12&quot; Capital</td>
<td>1&quot;</td>
</tr>
<tr>
<td>13 1/3&quot; or 16&quot; Upper Case</td>
<td>2&quot;</td>
</tr>
<tr>
<td>15&quot; or 16&quot; Capital</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

The corner radii shall be approximately one-eighth of the least dimension of the sign. The corner radii shall be determined by rounding this approximate value to the nearest of the following values:

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)** - The overhead street names signs shall consist of the standard guide sign with a green background and white letters. Refer to City Standard Drawing D-426. The sign shall be fabricated on white prismatic lens reflective sheeting ASTM Type IX on 0.125" 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 City rose logo followed by the sign legend, which consists of the street name, prefix, street name (primary copy), primary copy suffix, and street name suffix as described below.

The length of the message will be dependent upon the name length plus the prefix, suffix and City’s “Rose” logo as required, in multiples of six inches. The OSN sign shall have an overall length of not more than 84 inches and shall be not less than 36 inches. The sign faces shall be 12 inches in height, except the sign height shall be increased to 22 inches when two copy lines are required. No border is to be applied to the sign.

Legends shall be upper case in standard lengths and shall be fabricated using standard FHWA Series “C” letters for all primary copy, except “B” series 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.

The primary copy (name message) letters shall be 8 inches upper case. The prefix and suffix, where required, shall be 6 inches upper case lettering.

The charts for Standard Alphabets for Highway Signs, Edition 1977, shall be used. The direction prefix (one or two letters) will be upper case, 6 inches in height and centered on the primary copy capital letters. The suffix of the primary copy shall be uppercase superscript and shall be 4 inches in height. The suffix copy shall be all caps and shall be 6 inches in height and aligned in line with the bottom of the primary copy’s capital letters. See illustration for placement of the prefix, main copy, copy suffix and suffix.
Street Name Signs shall have a single message on one face only. Two lines of copy shall not be used.

The City’s “Rose” logo shall be placed on the left side of the sign face, vertically centered on the sign face. The City “Rose” logo design shall be obtained from the City of Portland, Bureau of Maintenance, Traffic Operations Division 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.

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. 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 Erection - 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 $3^\circ$ 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 $-3^\circ$ 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 the Contractor's expense.

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 General - The quantity of signs measured will be the area, to the nearest 0.1 square foot, computed by multiplying height and 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 General - The accepted quantities of signs will be paid for at the Contract unit price per square foot, in place, for the item "Type ______ Signs In Place".

The type of sign will be inserted in the blank with a separate pay item provided for each type.

Payment will be payment in full for furnishing all materials, equipment, labor and Incidentals necessary to complete the work.

00940.91 Incidental Basis - When neither the Special Provisions nor the Schedule of Items indicates separate payment for signs, perform the work as incidental work for which no separate payment will be made.
Section 00941 - Sign Covers

Description

00941.00 Scope - This work consists of covering sign faces as shown, specified or directed.

Materials

00941.10 General - 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 permanent sign covers.

Covers for temporary signs shall conform to 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 re-install legend as directed.

- Remove entire sign and store in a vertical position for future reinstallation.

Measurement

00941.80 General - Sign covers are considered incidental to the work. No measurement will be made.

Payment

00941.90 General - No separate or additional payment will be made for sign covers or for the alternate methods listed in 00941.42. The cost for this work is included in one or more of the listed pay items.
Section 00950 - Removal and Reinstallation of Highway Illumination and Traffic Signals

Description

00950.00 Scope - This work consists of removing, abandoning, salvaging and reinstalling existing illumination and traffic signal material as shown or directed.

Materials

00950.10 General - 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 illumination or traffic signal devices in the order directed. Do not damage reusable equipment when removing and salvaging existing material. Replace material damaged by the removal and salvage operations at the Contractor's expense. If directed, replace all other material salvaged for reinstallation that is not repairable, or that is not electrically or mechanically sound, with new material according to Section 00196.

Keep existing installations to be removed in operation until the new installations are ready to be turned on or as directed. If downtime is authorized, keep downtime to change from the existing operation to the new operation to a minimum. Perform the changeover with a minimum disruption to traffic.

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.

Remove or salvage 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 four calendar days in advance of such action.

00950.41 Removal and Abandonment - Unless otherwise specified, remove from the right of way underground conduit, conductors and foundations not reused and dispose of according to 00310.43. Items not interfering with construction may be abandoned in place with written approval. Plug abandoned conduit.

Wood poles shall be completely removed from the ground.

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 the resulting hole with material equivalent to the surrounding material. Finish and blend the surface area to the adjacent surface area.
Give the location of all abandoned items to the Engineer.

Correct or repair any holes or damage to existing surfacing caused by removal of existing installations as directed at the Contractor’s expense.

00950.42 Stockpiling Existing Materials - Remove, deliver and stockpile all materials specified to be stockpiled at the locations specified in the Special Provisions or as 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, etc., 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 Lump Sum Basis - There will be no measurement for work done under this Section.

**Payment**

00950.90 Lump Sum Basis - Payment for work performed under this Section will be made 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 Existing Illumination</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(b) Removal of Existing Traffic Signals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(c) Reinstallation of Existing Illumination</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>(d) Reinstallation of Existing Traffic Signals</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment will be payment in full for removing, abandoning, salvaging and reinstalling existing illumination and traffic signals including all materials, 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.

No separate payment will be made for traffic signal removal work done under this Section. Payment for removing traffic signal items will be included in payment made for the appropriate items listed in 00990.90.

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".
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
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. 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, and/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
Materials

Fiber Optic Cable - Provide 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:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Single Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Step Index</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</td>
</tr>
<tr>
<td></td>
<td>mechanically or chemically without damaging</td>
</tr>
<tr>
<td></td>
<td>fibers</td>
</tr>
<tr>
<td>Optical fibers:</td>
<td>doped silica core with concentric silica cladding</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>
</tbody>
</table>
FOP cable: all dielectric, gel-filled, duct-type
Proof/Tensile Test: 345 MPa, min
Attenuation at 1310 nm and at 1550 nm: ≤ 0.4 db/km
Test cable in accordance with:
EIA-455-25 (FOTP-25)
EIA-455-33 (FOTP-33 Condition II)
EIA-455-41 (FOTP-41)
EIA-455-81 (FOTP-81)
EIA-455-82 (FOTP-82)
EIA-455-104 (FOTP-104 Conditions I and II)
Test optical fiber in accordance with:
EIA-455-3A (FOTP-3)
Attenuation at the Water Peak: ≤2.1 dB/km @ 1383 ± 3 nm
Chromatic Dispersion
Zero Dispersion Wavelength: 1301.5 to 1321.5 nm
Zero Dispersion Slope: ≤0.092 ps/(nm² *km)
Maximum Dispersion: ≤3.3 ps/(nm² *km) for 1285 -1330 nm
≤0.092 ps/(nm² *km) for 1550 nm
Cut-Off Wavelength: <1250 nm
Mode Field Diameter
(Petermann II) 9.3 ± 0.5 µm at 1310 nm
10.5 ± 1.0 µm 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 antioxidant 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 and/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 ± 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 six feet in length.
(c) Jumper - 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 ST or 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 a 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 two 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 percent 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.
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 shrunk 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 five 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 four 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 and/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 percent 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 percent 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 Contractor's expense. 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 two working days after the test is completed. At least 15 working days prior to the arrival of cable on site, 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 percent 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.

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**Measurement**

**00959.80 Lump Sum Basis** - There will be no separate measurement of work done under this Section.

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**Payment**

**00959.90 General** - 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 all materials, equipment, labor and incidentals necessary to complete the work.
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: ____________________________
**Fiber System Performance Margin Calculations Worksheet**

**A. Calculate the Passive Cable Attenuation**

1. **Determine the Fiber Loss at Operating Wavelength:**
   - 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
Section 00960 - Common Provisions for Highway Illumination and Traffic Signals

Description

00960.00 Scope - This work consists of furnishing and installing materials for highway illumination and/or traffic signal projects and for modifying existing installations. The location of illumination/signal material shown is approximate, with exact locations established in the field.

00960.01 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.

Do not begin illumination and/or traffic signal installations until all permits are obtained and copies are given to the Engineer.

00960.02 Equipment List and Drawings - Within 30 calendar days after execution of the Contract, submit at least three 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 according to 00150.35.

- 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.

- Designs of all poles and nonstandard pole foundations.
Submittals shall be in orderly bound form with specific items for installation clearly marked. Partial submittals will not be accepted.

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(m)(1).

Upon completion of the installation, submit six 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 **General** - Materials shall meet the following requirements:

- Aluminum Poles ................................................................. 02920.31
- Anchor Bolts ................................................................. 02920.34
- Ballasts ................................................................. 02920.52
- Cabinets ........................................................................ 02920.40
- Cable and Wire ................................................................. 02920.20, 02920.28
- Circuit Breakers ................................................................. 02920.41
- Conduit ........................................................................ 02920.10, 02920.12
- Detection Devices ................................................................. 02920.45
- Electrical Splice Materials ................................................................. 02920.25
- Frangible Bases ......................................................................... 02920.33
- Illumination Control Devices ................................................................. 02920.42
- Interior Illumination Signs ................................................................. 02920.61
- Junction Boxes ........................................................................ 02920.13
- Lamps ........................................................................ 02920.50, 02920.51
- Luminaires ........................................................................ 02920.53
- Signal Indication Devices ................................................................. 02920.60
- Steel Poles ........................................................................ 02920.31
- Steel Towers ........................................................................ 02920.32
- Traffic Signal Control Devices ................................................................. 02920.42
- Wood Poles ........................................................................ 02920.30

00960.11 **Temporary Plating** - Temporary plating shall conform to Section 00275.

**Labor**

00960.30 **Licensed Electricians** - In accordance with 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. This includes, but is not limited to:

- Assembling conduit systems
- Installing field mounted enclosures, junction boxes, and terminal cabinets
- Installing or splicing wiring for vehicle detector systems
- Participating in the installation of electrical conductors in conduits or poles (i.e. pulling wire)

Construction

00960.40  General - Complete all construction according to the Contract Documents or as directed.

Correct faulty workmanship and materials at no cost to the Owner, even if not notified by the Engineer.

The Owner will continue operation and maintenance, including the furnishing of electrical energy, of existing signal facilities.

Maintain new signal equipment until notification by the Engineer. The Owner will continue to furnish electrical energy.

00960.41  Excavation:

(a) General - Protect all existing pipes that become a part of a foundation as directed by the Engineer.

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.

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 minimum 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.

Do not install conduit by means of plowing without approval. Submit the request in writing and include details on how the plowing will be performed.

Restore all disturbed landscaping and underground systems to original condition at Contractor’s expense upon completion of the work. Use hand excavation if directed.
(b) Excavation for Pole, Pedestal and Tower Foundations - Make all excavations for pole, pedestal and tower 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.

(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" past the face of the curb and gutter.

Special precautions should be taken when installing conduits in the vicinity of NW Natural Gas Company mains. These mains are protected by cathodic protection system. Any contact with electrically ground conduits will interfere with this cathodic protection systems. Maintain 12 inches of separation from gas mains where practical. If this is not possible, notify NW Natural Gas Company 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 approved sand blanket in trench bottom before placing conduit.

b. **Cover** - Cover conduit with 2 inches of additional sand drainage blanket.

c. **Backfill** - Backfill according to the following:

   1. **New Roadway and Shoulder, or Existing Non-roadway, Non-shoulder Pavement** - 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 traffic signal conduit trenches in roadway areas (including paved shoulders) in the following manner:

      Construct CLSM backfill according to 00442, placed 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 drainage 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 according to 00749.13 or PCC according to Section 00755 as follows, unless otherwise directed.

   1. **Existing Non-roadway, Non-shoulder Pavement** - Match surfacing thickness.

   2. **Existing Roadway and Shoulder** - In paved areas, pave to a minimum thickness of 6 inches.

e. **Finish** - In paved areas, finish to a smooth riding surface.

(2) Rigid Metal or Intermediate Metal Conduit - Omit the sand drainage blanket of a. and b. above, and backfill according to c.
**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 expense of the Contractor. Use it for the entire length of the run 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.

Each conduit over 1 inch except service conduits shall have one yellow #12 THWN stranded copper wire as a locate wire. Extend the wire 2 feet beyond conduit ends and install a wire nut. Do no join multiple locate wires under a common wire nut.

Each conduit shall have polyester line installed with a break strength of at least 1250 lbs and 40 inches of slack, tied off at each end of the conduit run. Any pull lines utilized by the Contractor shall be replace with a new polyester pull line.

If corrosive soil conditions exist and if shown or specified, coat metallic conduit with a nonmetallic coating or wrap with corrosion protection tape according to 00960.41(c).

**(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. Mount only service conduit on the outside of poles unless otherwise shown or approved.

**(d) Conduit in Foundations** - Use rigid metal conduit and extend it 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 signal 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. Give the location of conduit and junction boxes to the Engineer. 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

Do not cover conduit runs until inspected.

Installation of HDPE conduit may be by drilling or open trench methods, or by plowing if approved. Minimum cover shall be 3 feet.

(f) Conduit Bends - 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 six 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 permitted for coupling conduit. Use an approved threaded union coupling when a standard coupling cannot be used.

Paint the following with rust-preventative coating:

- Threads on all metal conduit before couplings are made up
- 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.

Cut nonmetallic conduit with a hacksaw or other approved tool, and connect with solvent welds.

Plug or cap all conduit ends with approved material until wiring is started.

Use a nonmetallic female threaded connector to connect nonmetallic conduit to metallic conduit.

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.

A closed cell polyethylene plug shall be installed in all conduits that terminate less than 20 inches above ground level to prevent moisture and foreign objects from entering the conduits. All conduit ends shall be sealed using care to notch the plug to encase conductors and cables to achieve a secure seal. The plugs shall be used continuously during all stages of construction so that the conduits are kept clean and free of foreign materials.

All closed cell polyethylene plugs shall meet or exceed the following specifications:

- Density = 2 lb./cubic foot
- Tensile strength = 25 psi
- Water Absorption = 0.5% by volume
- Compression Deflection = 25% at 8 psi
- Compression Recovery = 90% per minute
Plug diameters shall be 1/4 inch larger than the conduit diameter for conduits sizes from 1/2 inch to 1 1/4 inches. These plugs shall be 2 inches to 3 inches long. Plug diameters shall be 1/2 inch larger than the conduit diameter for conduit sizes from 1 1/2 inches to 4 inches. Plugs for 1 1/2 inches to 2 1/2 inches conduits shall be 3 inches long. Plugs for 3 inches to 4 inches conduits shall be 4 inches long. Approximately one third of the plug length shall be exposed after installation. Plugs shall be Molded Plug© plugs or approved equivalent.

(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.

In poles, controller boxes, and junction boxes leave 3 feet of slack in the polyethylene line.
(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 required by 00960.42(g).

(k) **Conduit in or on Structures** - Install conduit in or on structures according to the plans and Section 00583. Use approved expansion devices at all expansion joints in or on a structure. Install Type "AX" conduit expansion joints with bonding jumper where conduits cross bridge and other expansion joints. The expansion joints shall permit a 8 inch conduit movement on steel structures and a 4 inch conduit movement on concrete structures. Expansion-deflection fittings shall consist of two silicon bronze couplings and a molded neoprene sleeve with a bonding jumper passing through a separate waterproof compartment. Fittings shall permit at least 3/4 inch expansion and contraction and a 3/4-inch deflection without deformation.

(l) **Installation by Plowing or Horizontal Directional Drilling** - High-density polyethylene (HDPE) conduit conforming to 02920.11(c) may be used for horizontal directional drilling and plowing installations. Plowing is only allowed if shown. If rigid metallic or rigid nonmetallic are used, verify the joints have not separated by pulling a mandrel through after installation. Use 3 feet minimum cover for drilling installations regardless of the type of conduit installed.

00960.43 **Foundations:**

(a) **General** - Construct foundations for signal and luminaire poles, pedestals, posts, towers, cabinets and tower service pads of concrete (\( f'c = 3,300 \text{ psi} \)) according to the applicable portions of Section 00440 or 00540 as shown or specified. Place concrete:

- With a continuous pour
- To the elevation shown or directed
- With conduit ends and anchor bolts held securely in proper vertical position, to proper height, with a manufacturer’s recommended template until the concrete sets

Make no adjustment of anchor bolts 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 the concrete has set. In foundations for signal, luminaire and high-mast luminaire poles, use a steel template to accurately locate the anchor bolts and hold them plumb and in proper alignment. Out-of-position anchor bolts and anchor bolts installed more than 1:40 (H:V) out of plumb are cause for rejection of the foundation. Field bending of anchor bolts and field modification of the base plate are not allowed.

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 breakaway bases are specified, the post stub projection shall not exceed the limits shown.

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 must extend deeper than shown, the extra foundation depth will be paid according to Section 00196.

(b) Treatment for Aluminum-Concrete Contact - If aluminum poles are used, furnish anchor bolts, nuts, and washers as specified for steel poles.

(c) Pre-cast Footings - Pre-cast footings will only be accepted for those projects where they have been approved and are clearly indicated on the plans set.

Installation and backfill of pre-cast concrete pole bases shall be done only with the inspector present. Any pre-cast concrete pole bases that are installed without the inspector present shall be removed by the Contractor and reinstalled and back-filled with the inspector present at no additional expense to City.

Installation of pre-cast concrete pole bases shall be on undisturbed native materials. All disturbed material shall be removed from the excavation of the pole base. Over excavation shall be replaced by class 2200 concrete backfill at no additional expense to the City.

Separate the aluminum from the concrete with one layer of 30 pound non-perforated, asphalt-saturated felt meeting the requirements of 02920.31(b). Neatly trim the felt pad to the size and shape of the base contact surface.

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.

Size all junction boxes as required by the NEC for the number and size of conductors to be placed in the box. Sizes of junction boxes shown on the plans or in the Special Provisions are inside dimensions.

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 about 1/2 inch below the pavement surface.
In boxes having an open bottom, construct a sump of reasonably well graded 3/4 inch - 0 crushed gravel, 12 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:

If junction boxes are installed in unpaved areas, install a portland cement concrete apron even if not shown.

00960.45 Cable and Wire:

(a) General - 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. Prevent damage to the insulation when installing wire.

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 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.

00960.46 Metal Poles:

(a) General - Metal poles include towers, mast arm poles, strain poles, pedestals, posts, upsweep arms, mast arms, luminaire arms and necessary mounting appurtenances. The fabrication of metal poles from steel and other metals shall comply with all applicable portions of 02920.31 and AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. before the pole is placed. Do not erect poles until the Engineer has made a visual inspection of pole welding.

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.
Fabricate entrance openings in metal poles and arms, including handholes, before galvanizing, except as shown for mounting traffic signal material.

City of Portland Signals and Streetlighting personnel will mark traffic signal pole locations in the field.

(b) Design - All metal poles with self-supporting upsweep arms shall be designed similar to details shown on the plans.

(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. The length of upsweep bracket arms shall be as shown in the Metal Light Pole Table or on the plans. Height of traffic signal poles shall be as shown or specified. Height of poles requiring slip plate bases is the length of shaft above the slip plate.

(d) Mast Arm - Install mast arms for traffic signals and signs according to details provided by the manufacturer. Mounting appurtenances shall be the proper type and size to correctly fit the pole furnished, or as shown. Mast arms shall be self-supporting without tie rods, or braces. Mast arms and risers shall be tapered octagonal tubes conforming to the City's design standards.

All mast arms shall allow wiring entrances directly into the pole from inside the mast arm.

(e) Luminaire Arm - 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. The mast arm rise shall be according to the Metal Light Pole Table, or as shown or specified. All luminaire arms shall allow wiring entrances directly into the pole from inside the mast arm.

Arms shall be self-supporting without tie rods, or braces. Measure upsweep rise from the point of attachment to the pole to the end tangent portion of the arm. Arms shall be tapered and either round, octagonal, or elliptical, if similar in design to those shown on the 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 in the Metal Light Pole Table or 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) Erecting Metal Poles:

(1) General - Erect metal poles and towers 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 and towers.

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 paint the top of any steel bolt that has been cut off.

Steel Strain 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.

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 grout 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 under 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 and fine sand with just enough water so that the mixture will stick together when molded into a ball by hand and will not exude moisture when so pressed.

(2) Repair Damaged Finish - Repair damaged galvanizing or other finish as approved. Apply cold galvanizing to 4 inch diameter poles after cutting threads.
(3) Assembly of Supports and Bolt Tightening - Nuts shall have full thread engagement.

Furnish, at no additional compensation, a calibrated torque wrench of a capacity appropriate to the size and type of the bolts being tightened. Confirm the accuracy of the calibrated torque wrench through calibration by an approved independent testing agency at least one a year.

a. Anchor Bolts for Signal Supports, Fixed Base Luminaire Supports, and High Mast Luminaire (Tower) 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 bolts 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 bolt 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 bolt 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 .d below. Several passes may be required to obtain uniform final tightness. "Cheater" bars or slugging wrenches are allowed if required for large diameter anchor bolts.

b. Anchor Bolts for Slip Base (Break-away) 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.

Install the anchor plate on the leveling nuts and washers. Make sure all leveling nuts and washers are in full contact with 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 bolts are snug tight, proceed with the "Slip Base Bolting Procedure" as shown on the plans. When the "Slip Base Bolting Procedure" is complete, final anchor bolt tightening may begin. As a safety measure, provide crane support of the pole until anchor bolt tightening is complete.

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 bolt past snug tight by the amount shown in .d below. Several passes may be required to obtain uniform final tightness. "Cheater" bars or slugging wrenches are allowed if required for large diameter anchor bolts.

c. 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 bolts 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.

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 .d below. Several passes may be required to obtain uniform final tightness.

d. Final Tightening - Required final tightening of anchor bolts and high-strength bolts is shown in the following Table:

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Rotation Past Snug Tight</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A 307 Anchor Bolts</td>
<td>30° (1/12 turn)</td>
</tr>
<tr>
<td>ASTM A 449 Anchor Bolts</td>
<td>60° (1/6 turn)</td>
</tr>
<tr>
<td>ASTM A 325 Arm Connection Bolts</td>
<td>60° (1/6 turn)</td>
</tr>
</tbody>
</table>

(5) Bolt Inspection - The Engineer will observe the installation and tightening operations to insure that proper procedures are followed. All inspections will be visual and no testing will be conducted.

00960.47 Wood Poles - Submit wood pole designs according to 00960.02 including proposed ANSI 05.1 wood pole Class, guy anchor and span wire designs, and pole setting depths.
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 Service:**

(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. When the size of wire from the utility company’s secondary to the disconnect circuit breaker is not shown on the plans, use the size specified by the NEC, but not less in current-carrying capacity than the disconnect circuit breaker rating. Do not use less than No. 6 AWG for the service conductor. 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.

Where eyebolts are to be used on signal or illumination poles to receive overhead power service, determine from the local serving utility the direction the eyebolt should face.

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 and meeting the requirements of 02920.41.

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 expense 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.

Use No. 6 AWG copper wire to connect the ground rod to the electrical system.

(c) Services and Cabinets - Ground 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 steel pole.

Instead of placing the ground rod outside the traffic signal controller cabinet foundation, the ground rod shall be placed within the cabinet base opening.

(d) Structure Mounted Poles and Cabinets - Ground 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.

(e) Metal Poles - Install a ground rod at each pole, pedestal, or tower foundation. At each pole or tower location, supply and install a grounding electrode conductor from a lug inside the pole or tower to the ground rod clamp at the ground rod. Bond all conduit within the pole or tower 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.

On the inside of tower shafts, weld a 1/2 inch, Type 308, 309, or 310 threaded stainless steel stud for a grounding lug. Locate the grounding lug 90° from, and level with, the bottom of the handhole.

For slip base poles, the grounding wire shall not intrude into the slip plane. Instead, run a bond wire from the grounding electrode to a 1/2 inch, Type 308, 309 or 310 threaded stainless steel stud welded to the bottom base slip plate.
For standard four-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 - On wood poles, ground all metallic conduit, messenger cable, terminal cabinet, and other equipment.

(g) Nonmetallic Conduit - In all nonmetallic type conduit, 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:

- At traffic signal installations when the conduit contains only loop feeders, emergency vehicle preemption cables, or DC interconnect cable
- Where nonmetallic conduit is to be installed for future conductors
- Where only low voltage DC currents are present

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 and/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.
Section 00970 - Illumination

Description

00970.00 Scope - In addition to requirements of Section 00960, "Common Provisions for Highway Illumination and Traffic Signals", the following Specifications apply to illumination installations.

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 or Tower Table - The metal light pole or high mast tower table for the Project can be found on the highway 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.

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. Mount the relay above adjacent light units, so the light sensitive element’s surface is oriented to the northern sky. Mark the date of installation on the bottom of the photocontrol electronic relay.

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:

<table>
<thead>
<tr>
<th>TABLE 00970-1 A</th>
<th>TABLE 00970-1 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamp Wattage</td>
<td>Lamp Type</td>
</tr>
<tr>
<td>Identifying</td>
<td>Type</td>
</tr>
<tr>
<td>Number</td>
<td>Background Color</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>250</td>
<td>25</td>
</tr>
<tr>
<td>400</td>
<td>40</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

<table>
<thead>
<tr>
<th>Lamp Burning Position</th>
<th>Target Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Position</td>
<td>None</td>
</tr>
<tr>
<td>Base up to horizontal</td>
<td>None</td>
</tr>
<tr>
<td>Base down to horizontal</td>
<td>Gold</td>
</tr>
<tr>
<td>Position-oriented-mogul socket (POM)</td>
<td>Red</td>
</tr>
</tbody>
</table>

#### 00970.45 Pole Identification
Identify cobrahead and shoebox luminaire poles with a numbered label corresponding to the pole numbers on the illumination plans. Labels shall:

- Be made of noncorrosive, pressure-sensitive material suitable for outdoor use and resistant to fading and abrasion
- Have blue or black numbers with a high-contrast colored background
- Have 1/4 inch block numbers at least 2 inches high
- The letter “C” shall be painted above the numerals.

Install labels on poles so they are visible from a passing vehicle.

#### 00970.48 Coating:

**(a) Poles** - All light poles, mast arms, and associated hardware shall have a finish as indicated on the plans.

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 (W21.0261.4)
- Silver MC-Luster (W21.82.1)
Post "WET PAINT" signs near each pole.

Spray application will not be permitted at any time.

**b) Service Cabinets** - Pole mounted service cabinets shall be painted to match the pole.

**(c) 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.

**Maintenance**

**00970.60 Maintaining Existing and Temporary Illumination Systems** - Keep existing illumination systems (street lighting), their approved temporary replacements, or temporary construction lighting in effective operation for the benefit of the traveling public during progress of the work, except when shutdown is permitted to allow alteration or final removal of the systems. 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.

If damage is caused by the Contractor’s operations, repair or replace damaged facilities promptly at no additional compensation according to 00170.80. If the Contractor fails to perform the required repairs or replacements, the City retains the right to perform this work according to 00170.80(d).

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.

Keep temporary construction lighting installations in effective operation until they are no longer required for the protection of the traveling public.
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 seven (7) days under normal conditions (off during the day, on at night). Notify Street Lighting Inspector forty eight hours in advance of start of the seven day test.

Measurement

00970.80 General - No measurement of quantities will be made for this work. If plan changes are ordered, or the field-verified pole or arm lengths increase or decrease for lighting poles and arms, adjustment will be made according to 00970.91.

The estimated quantities of lighting poles and arms will be listed in the Special Provisions for the purpose of providing a basis for adjustment. No adjustment in the Contract lump sum amount will be made, except as provided above. Any adjustment in the Contract lump sum amount will be made according to 00190.10(f)

Payment

00970.90 Lump Sum Basis - Payment will be made 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) 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.

Labeling lights or poles will be considered incidental to the appropriate light or pole pay item.

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.
00970.91 Adjustments - In items (b), (c) and (d) no adjustment in payment will be made for increases or decreases of individual pole or arm lengths up to and including 3 feet.

Adjustment in payment for increases or decreases of individual pole or arm lengths more than 3 feet will be made only on the increased or decreased length more than 3 feet.

00970.92 Electrical Energy Costs - All electrical energy costs for the lighting systems or subsystems will be paid for by the City.

00970.93 Incidental Items - If shown or specified as part of the work under the pay items for concrete bridges or retaining walls, all conduit, junction boxes, cabinets and other items permanently encased within the concrete of bridges and retaining walls, as well as pole foundations incorporated in a bridge or wall, will be considered incidental to the work for those items. Include the cost of this work in those items.
Section 00980 - Sign Illumination

Description

00980.00 Scope - This work consists of furnishing and installing all necessary conduits, junction boxes, cabinets, wiring and other equipment as shown and specified for sign illumination.

00980.01 Regulations and Code - All electrical equipment and work shall conform to 00960.01.

00980.02 Equipment Lists and Drawings - Submit required equipment lists, working drawings and as-constructed drawings according to 00960.02.

Submit six copies of isocandela diagrams for each different size sign to be illuminated. Provide data in tabular form showing the luminance levels, in lx (footcandles), at 1 foot intervals in both the horizontal and vertical directions over the entire sign surface. Submit from the luminaire manufacturer details of lamp socket position with respect to lamps and refractors furnished, for each type of luminaire specified.

Complete description data is required including noted exclusions for any of the luminaires specified.

00980.03 Luminaire Submittals - If directed, provide a sample luminaire for inspection and photometric testing. Sample luminaires may be considered as part of the shipment furnished for installation.

Materials

00980.10 General - Materials shall meet the following requirements:

Ballasts .........................................................................................02920.52
Cabinets .......................................................................................02920.40
Cable and wire.......................................................................02920.20 -.28
Conduit ..................................................................................02920.10 -.12
Control devices.............................................................................02920.42
Electrical splice materials .............................................................02920.25
Junction boxes..............................................................................02920.13
Lamps...........................................................................................02920.50
Wood poles...................................................................................02920.30

All conduit, junction boxes, and cabinets for sign illumination circuits that are also used for roadway illumination are discussed in Section 00960 and Section 00970.

00980.11 Sign Luminaire Ballasts - Provide high-intensity discharge ballasts of the type and wattage shown or specified.
00980.12 Sign Luminaires:

(a) General - Bottom-mount all sign luminaires as shown.

Electrical components of the sign luminaires shall bear the label of approval by the Underwriters' Laboratories, Inc.

(b) High Intensity Discharge Sign Luminaires - Fabricate high-intensity discharge sign luminaire housings of either cast aluminum, 0.80 inch minimum die-formed aluminum, or 0.064 inch minimum extruded aluminum. The reflector shall be die-formed, anodized specular aluminum. Fabricate lens frames of cast or extruded aluminum. Mount the refractor in the lens frame assembly and hinge to the luminaire housing. The refractor and lens frame assembly, when closed, shall exert even pressure against a gasket seat. Furnish gaskets of material capable of withstanding temperatures encountered. Securely seat the gasket in place. Glassware shall be thermal, shock-resistant borosilicate glass.

Provide stainless steel or corrosion-resistant fasteners. Protect all aluminum surfaces with either an anodized finish or an approved aluminum paint finish.

Mount ballasts integrally with the luminaire. Mount luminaires on the luminaire support arms as shown and with a low profile, not to exceed 11 inches in height when mounted. Shield luminaires so no light will be visible from behind the luminaire.

Determine, provide and install the number of luminaires needed to illuminate each sign.

The total nominal lamp power (not including ballast) for each sign length shall not exceed the following:

<table>
<thead>
<tr>
<th>Sign Length, L</th>
<th>Maximum Lamp Power (watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 9' 0&quot;</td>
<td>250</td>
</tr>
<tr>
<td>9' 0&quot; to less than 17' 0&quot;</td>
<td>500</td>
</tr>
<tr>
<td>17' 0&quot; to less than 26' 0&quot;</td>
<td>750</td>
</tr>
<tr>
<td>26' 0&quot; to 35' 0&quot;</td>
<td>1000</td>
</tr>
</tbody>
</table>

Use only 100, 175 or 250 W phosphor coated mercury vapor lamps. When necessary, adjust spacing of the luminaires and/or safety rail posts to prevent interference.

The photometric performance of mercury vapor luminaires equipped with a 4000, 8000, or 11 500 lm lamp, with the light center 12 inches below and 48 inches front of the sign (54 inches when sign height is equal to, or greater than, 7' 0"), shall meet the following criteria on each sign:

- Average Horizontal Footcandles, minimum 35.0
- Footcandles, minimum 8.5
- Maximum/minimum uniformity 6.0:1 or less
- Maximum gradient 1.7:1 or less
- Uniformity of illumination, minimum 60%
Maximum gradient is the ratio of the illumination value on any 1 square foot area of the sign to the value on any adjacent 1 square foot.

\[
\text{Uniformity of Illumination} = 1 - \frac{\text{mean deviation}}{\text{average FC}} \times 100\%
\]

Where mean deviation = \(\frac{\sum \text{ABS}(\text{FC}_{\text{point}} - \text{FC}_{\text{ave}})}{\text{number of points}}\)

00980.13 Sign Luminaire Identification Decals for High-Intensity Discharge Lamps - Provide identification decals meeting the requirements of 00970.44(c-1) and (c-2). Install decals on the bottom side of luminaires to provide good visibility from the ground.

Construction

00980.40 General - Furnish and place miscellaneous materials not shown or specified, but required to complete the illumination installation, as shown or specified. Such materials will be approved as suitable for the use intended.

Construct and test according to this Section and Sections 00960 and 00970.

00980.41 Installation of Wiring and Conduit - Install all sign illumination wiring, both above and below ground, according to the NEC with type and wire size as shown or specified. Install all conduits according to Section 00970. All conduit, junction boxes and cabinets for sign illumination circuits, which are used for roadway illumination, are covered under Section 00960 and Section 00970.

Use No. 10 AWG type XHHW wire from the sign disconnect breakers to the sign luminaires.

Install rigid metal or intermediate metal steel conduit on the sign structure with flexible conduit connections to the junction box on the pipe support and at the end connection to the sign luminaires. The minimum size of any type of conduit to be installed shall be 3/4 inch.

Install the power feed conductors from the service pole to the sign structures as shown.

00980.42 Grounding and Bonding - Ground and bond according to 00960.50, except provide a handhole in the sign support column to provide access to the grounding conductor and grounding lug. Ground metal sign support structures using the same method as for metal light poles.

00980.43 Sign Control Equipment - Install electrical sign disconnect circuit breakers of the size shown in disconnect cabinets on sign support structures or where shown, or provide one circuit breaker for each overhead sign and all ballasts for that sign.

00980.44 Cabinets - Mount the sign control cabinet on the support column on the side away from traffic.

00980.45 Galvanizing - Galvanize all components of steel sign illumination equipment after fabrication and before assembly. Galvanize according to ASTM A 123/A 123M.
Measurement

00980.80 Lump Sum Basis - There will be no separate measurement for work done under this Section.

Payment

00980.90 General - Payment will be made at the Contract lump sum amount for the item "Sign Illumination Equipment". Payment will be payment in full for all equipment labor and incidentals necessary to complete the work.

00980.91 Incidental Items - If shown or specified as part of the work under the pay items for concrete bridges or retaining walls, all conduit junction boxes, cabinets and other items permanently encased within the concrete of bridges and retaining walls, as well as pole foundations incorporated in a bridge or wall, will be considered Incidental to the work for those items.
Section 00990 - Traffic Signals

Description

00990.00 Scope - In addition to requirements of Section 00960, install traffic signals according to the Manual on Uniform Traffic Control Devices with Oregon Supplements, Institute of Traffic Engineers standards, and the following Specifications.

Materials

00990.10 General - Materials required for completion of the installation will be shown or specified. Materials shall meet the requirements of the following:

- Aluminum poles ................................................................. 02920.31
- Anchor bolts ................................................................. 02920.34
- Audible pedestrian signal .................................................. 02920.66
- Ballasts .......................................................................... 02920.52
- Cabinets ........................................................................ 02920.40
- Cable and wire .................................................................. 02920.20 - .23
- Circuit breakers ............................................................... 02920.41
- Conduit ........................................................................... 02920.10 - .12
- Detection devices .............................................................. 02920.45
- Electrical splice materials .................................................. 02920.25
- Flasher mechanism (remote from controller cabinet) .............. 02920.42
- Frangible bases ............................................................. 02920.33
- Illumination control devices ............................................... 02920.41
- Inductive loop feeder cable ................................................ 02920.22(d)
- Inductive loop wire .......................................................... 02920.23(b)
- Interior illumination signs .................................................. 02920.61
- Junction boxes ................................................................. 02920.13
- Lamps ............................................................................. 02920.50 - .51
- Luminaires ...................................................................... 02920.53
- Pedestrian signal heads and push buttons ......................... 02920.65
- Signal heads ................................................................. 02920.64
- Signal indication devices ................................................... 02920.60
- Steel poles ................................................................. 02920.31
- Steel towers ................................................................. 02920.32
- Traffic signal control devices .......................................... 02920.42
- Wood poles ................................................................. 02920.30

Construction

00990.40 Cable and Wire:

(a) General - Install wire and cable according to 00961.45 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 (PC 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.

(b) Control Cable Attachment - Use self-locking plastic straps to attach control cables to the messenger cable. Do not allow gaps between the control cable and the messenger cable. After tightening, trim all excess material neatly.

Provide sufficient conductors to perform the functional operation shown. Tape the ends of extra conductors with insulating tape. Where the plans omit necessary wiring to provide the operation shown, furnish and install wire as needed to meet the operational requirements shown or specified. The number of conductors in a cable may be greater than that shown.

(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” x2” 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 - Install tether and stabilizer cables on traffic signal spans where shown. Tighten cables to limit signal and sign movement. Install City-furnished S-hooks between the eyebolt and turnbuckle.

(e) Interconnect Cable:

(1) 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:

All cable installation shall meet the requirements of the Standard Specifications, the National Electric Code, and the National Electrical Safety Code, and will be approved by the Engineer, where applicable. 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.

Match the sag as closely as possible with wires already on poles to minimize movement in windstorms and conflict with adjacent wires.

Use a grip to grip 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 StrandVises® or similar devices. 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.

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.

Cable in trunk runs may be installed by hand or by mechanical methods, as approved. Trunk runs are those lengths of conduit that will have 25 or more pairs of interconnect cable installed. Install all other cable by hand methods only.

Before installing cable, provide the Engineer with one copy of the cable manufacturer's recommended and maximum pulling tensions for each cable type. Specify these pulling tensions for both pulling from the cable's conductors and for pulling from the cable's outer jacket.

When installing cable using a pulling eye, do not exceed the cable manufacturer's maximum recommended pulling tension for pulling from the pulling eye. When installing cable using a pulling sock over the outer jacket, do not exceed the cable manufacturer's maximum recommended pulling tension for pulling by the outer jacket, or 80% of the manufacturer's maximum recommended pulling tension for pulling by a pulling eye, whichever is smaller. Use an approved dynamometer to ensure that the maximum allowable pulling tension is not exceeded during installation.

Run all cable continuously without splicing from termination point to termination point. Splicing cable at any location other than shown is not permitted. Splicing cable in conduit, junction boxes, underground vaults, manholes, or handholes is not permitted.
Do not pull cable through any intermediate junction box, handhole, or any other opening in the conduit, unless shown or approved. 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.

Label all interconnect cable with approved bronze or plastic labels, permanently and ruggedly attached. The labels shall be embossed with the cable identification number. 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. In all junction boxes, interconnect terminal cabinets, auxiliary cabinets, controller cabinets, and terminal cabinets, permanently attach 10 inch lengths of 1 inch wide light blue or royal blue plastic surveyor’s marker tape, or equivalent, to all interconnect cable. No adhesive marker tape or other such malarkey will be permitted.

Where the Contractor is to remove or install interconnect cable in conduit containing service wiring and/or field wiring, whether or not the plans indicate service and/or field wiring in that conduit, use the following procedure, unless another procedure is approved:

- **a.** Disconnect all necessary service and/or field wiring.
- **b.** Furnish, install and maintain all traffic control devices and procedures.
- **c.** Remove all cable and wiring from the conduit, being careful not to damage any wiring. Replace to the Engineer's satisfaction all wiring to be reinstalled that is damaged by the Contractor, at no expense to the City. Any wiring, except solid-conductor ground wiring, not suitable for reinstallation that has been removed by the Contractor with all reasonable care, as determined by the Engineer, shall be replaced to the Engineer's satisfaction and paid for as Extra Work.
- **d.** Replace all solid-conductor ground wiring removed from conduit with No. 6 bare or green THWN stranded copper wire.
- **e.** Clean the conduit as described in 00961.45(a).
- **f.** Reconnect all wiring.

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).
(3) **Interconnect Cable 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” to 3/4". 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.

(b) **Remote Detector Amplifier Cabinet** - The minimum size for cabinets shall be:

<table>
<thead>
<tr>
<th>Number of Detector Amplifiers</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Number of Shelves</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 or less</td>
<td>16&quot;</td>
<td>12&quot;</td>
<td>10&quot;</td>
<td>1</td>
</tr>
<tr>
<td>5 to 8</td>
<td>20&quot;</td>
<td>16&quot;</td>
<td>10&quot;</td>
<td>2</td>
</tr>
</tbody>
</table>

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All amplifier cabinets shall contain:

- A 20A circuit breaker for power disconnect

- A 1/2 inch, screened drain hole in the bottom. Use a fine mesh screen made of either brass or stainless steel, soldered or spot-welded in place.

- An adequate number of double-barrier screw terminals, as determined by the Contractor, based on the number of field connections required and cable harness connections

Crimp and solder all spade connectors and wires connecting the input panel to the input files.

Submit the cabinets with amplifiers for visual inspection and testing.

The lock for the cabinet shall be Best Co. padlock 21B722-L-606 with a "Green" core for the cabinet.

(c) Flasher Cabinet - The cabinet shall be 14" high x 10" wide x 7" 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</th>
<th>Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>AC+</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>AC-</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>LD Cut #1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>LD Cut #2 Common</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>EQ GND</td>
<td></td>
</tr>
</tbody>
</table>

(d) 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.)

(e) 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. Install all lamps with the open end of the horseshoe-shaped filament in the up position.

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.

For requirements relating to special vehicle signal heads (signal heads required to produce an indication other than those resulting from the use of standard red, yellow and green lenses) see the Special Provisions.

(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. Mount the kit using the existing lens mounts. Kits are not required to fit 3M® optically programmed signal heads.

(c) Optically Programmed Vehicle Signals - Furnish and install complete, optically programmed vehicle signals that 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.

(1) Optical System - Optically programmed vehicle signals shall:

- Have lenses with a nominal diameter of 12 inch
- 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
- Include an easily accessible visibility-limiting device that can be programmed to restrict the viewing area of the projected indication without the use of hoods or louvers
• Include an integral means for regulating the intensity of the projected indication as a function of the ambient light conditions. The reduction in lamp intensity shall be proportional to the reduction in ambient light within the following limitations:

• If ambient light is 1,000 foot-candles or more, the lamp intensity shall be at least 97% of maximum.

• If ambient light is 1 foot-candle or less, reduce the lamp intensity to approximately 15% of maximum.

(2) **Installation** - Provide a manufacturer-certified technical representative who shall:

• Program the visibility-limiting device as outlined by the signal manufacturer. The technical representative shall furnish all needed special materials

• Program the signals satisfactorily before placing the signal installation in operation

On programmed vehicle signals mounted on span wires, install washers on the pin that connects the signal hanger to the cable clamp. Install enough washers to limit the lateral movement of the hanger to a minimum.

(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 02920.51. Do not wire green arrows into the flashing circuit where used with flashing beacon indications.

Where a flashing yellow lens of 12 inch nominal or greater diameter is to be used as a beacon, provide and install an effective voltage reducer to the lamp circuit that will reduce the voltage level at least 33%, but not more than 50%, of rated voltage when ambient light conditions reach about 0.1 foot-candle.

Mount single-section heads on span wires as shown for three-section heads. Hang heads as nearly plumb as feasible.
(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’ 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 signs 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” 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" 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” pole.

The clamshell assembly shall provide a "pole to pedestrian head" clearance of approximately 3 inches.

The head half of the assembly shall be secured to the pedestrian signal with four 5/16” bolts.
The pole mounting half of the clamshell assembly shall be equipped with a conventional terminal compartment type twelve 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 at all times until the signal installation is ready for continuous operation. Cover the entire face of the signal head to the rim of the backboard with burlap, canvas, black plastic or other approved cover material, except that 10% of each lens may be left visible to facilitate testing.

(h) Audible Pedestrian Signal (APS) - When shown or specified, the APS shall provide a unique sound coincidental with the WALK indication. The APS shall include a solid state electronic board(s), power supply, enclosure, loudspeaker and mounting hardware necessary for fulfilling the intended use stated herein and in applicable portions of Chapter 1 of the September 2001 Standard Specification for Microcomputer Signal Controller.

(1) General - The exterior dimensions of the APS unit shall not exceed 6 inches in height, 4 inches in width, and 6 inches in depth.

The weight of the APS unit shall not exceed 1 pound.

The button actuated delay time shall be adjustable in one-second increments throughout the range of 0 to 15 seconds.

The APS unit shall have a sound inhibit circuit capable of control by an external device.

(2) Electrical Requirements - The APS unit shall operate on 95 to 130 VAC, 60Hz, ≤3 W.

Provide a power protection circuit consisting of both fuse and transient protection.

Provide an optically isolated circuit allowing delayed actuation of the audible signal.

(3) Environmental Requirements - The APS unit shall function properly throughout an ambient air temperature range of -35 °F to 165 °F.

(4) Outputs - Provide voice message including automatic repeat capability for messages up to 20 seconds in length.
The audible signal shall be self-adjusting based on ambient noise during the WALK period.

The volume level at a distance of 3 feet from the APS enclosure shall be 66dB typical, with a maximum of 90dB.

The minimum volume level shall be adjustable proportionally from 66dB to 90dB without dismantling the APS unit housing.

Provide two switch-selectable electronic sounds as specified in the following:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sound #1</th>
<th>Sound #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound type</td>
<td>&quot;Peep-peep&quot;</td>
<td>&quot;Cuckoo&quot;</td>
</tr>
<tr>
<td>Method</td>
<td>Electronic var.</td>
<td>Electronic var.</td>
</tr>
<tr>
<td>Period</td>
<td>1.0 sec. ± 20%</td>
<td>1.5 sec. ± 20%</td>
</tr>
<tr>
<td>Duration</td>
<td>0.2 sec. ± 20%</td>
<td>0.6 sec. ± 20%</td>
</tr>
<tr>
<td>Frequency Base</td>
<td>2800 Hz ± 20%</td>
<td>1100 Hz ± 20%</td>
</tr>
<tr>
<td>Frequency Deviation</td>
<td>- 800 Hz ± 20%</td>
<td>+120 Hz ± 20%</td>
</tr>
</tbody>
</table>

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) Saw Cut - 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 saw cuts at least 1/2 inch wide for loop wire and loop feeder cable. 1/2 inch saw cuts may be made with single blades. For wider cuts, use multiple-blade saws.

Saw cuts shall have smooth bottoms, with no edges due to differences in cut depth.

Saw cuts shall not require greater than a 90° 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.

Dry before placing wire. Remove rocks or other material that may be wedged in the cut.
Any number of loop wires may be installed in a single saw cut, as long as the minimum cover shown is provided (see standard drawings) and adequate pavement depth is available. The Engineer may limit the allowable saw cut depth and width to avoid damage to the pavement.

Do not make saw cuts in a new open-graded AC wearing course. Instead, install loops in the base lift, or in the existing surfacing if it is to be overlaid, and after milling has been completed.

When there is insufficient pavement depth and when shown, construct detector loop pads. Detector loop pads not shown, but required by the Engineer, will be paid for as Extra Work according to Section 00196.

When preformed loops are called for, refer to Standard Drawings for requirements. Preformed loops may be used in lieu of sawn-in loops, if minimum loop cover can be obtained.

Preformed loops installed during the paving operation shall have a minimum cover of 2 inches. Slotting of the underlying surface may be required to obtain this clearance. Replace loops damaged during installation at no additional cost to the City. Fill preformed detector loops and runs to junction boxes with an approved sealant if subjected to high temperatures and compaction of backfill.

Round loops, 6 feet or 5 feet in diameter may be used in 12 foot or wider lanes as an alternate to standard 4-foot diamond vehicle detector loops. Round loops, 5 feet in diameter may be used in lanes less than 12 feet in width as an alternate to standard 4 foot diamond vehicle detector loops. Install according to standard loop installation Specifications, but make the saw cut exiting the loop perpendicular to the loop.

(2) Wire - Use XHHW loop wire conforming to 02921.23(b). Encase loop wire in a polyethylene tube conforming to IMSA Specification No. 51-7.

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.

(3) Installation - The Engineer will mark or approve the center point location of all loops to be installed. Do not place wire in saw cuts until the Engineer has inspected the cuts.

After the saw cut 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. 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 six 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, test before filling the slots with hot-melt sealant. The loop saw cuts shall be completely filled and sealed with 3M detector loop sealant (Oregon formulation), MSI #34271 Detector loop sealant or an approved equal. Install the sealant in slots according to the manufacturer's instructions and recommendations using an approved pressure feed wand system. Pour pot application will not be allowed. 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 saw cuts. Have a manufacturer’s representative present if using a sealant for the first time on a City project.

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 saw cut, 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 saw cuts after curing, at any time within the warranty period, will be rejected. Remove sealant that fails within this period, clean the cuts of debris and reseal with a sealant satisfactory to the Engineer at no additional expense to the City.

There are three options for loop wire access points. Refer to the plans for the option to be used at each location. Do not make loop wire splices in the access point.

Splice loop wires to feeder cable in junction boxes. Connect loop wires to loop feeder cable with a soldered-compression splice. Remove 4" - 6" 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. Crimp with seamless, non-insulated butt connector (3M® part #M14BCX or equivalent) of the proper size. Solder the splice with 60/40 rosin-core solder using a soldering iron, gun or flameless soldering torch. Do not use an open flame torch. Sweat the connection to ensure solder fills voids in the splice. Make sure all edges are smooth. Cover the splice with self-sealing shrink tubing (UL 486, 90 °C, 600 V) constructed of homogeneous polyolefin and having an internally applied sealant. Use heat-shrink tubing on individual wire splices and also over the entire cable splice, extending the tubing at least 1 inch beyond the ends of the insulation and/or inner heat-shrink tubing. **Apply silicon sealant before shrinking the heat-shrink tubing.**
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 uninsulated.

(4) **Resistance Testing** - The resistance to ground of the loop and loop feeder combinations, tested with a 500 V Megger tester, shall be 200 MΩ or greater when checked both before placing the sealant and after the sealant has set.

(5) **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 expense to the City, and repeat the procedure.

(6) **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 saw cut 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 three lifts. There shall be a minimum of 2 1/2 inch 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:

(a) General - 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.

(b) Advance Warning Signs - Signs shall conform to applicable portions of Section 00940. Sign message shall be as shown. If called for on the plans, complete the sign with a flashing beacon unit and/or floodlights.

(c) Overhead Interior Illuminated Signs (Fluorescent Tube, Neon Tube or Fiber Optic) - Use signs designed for span wire, bracket, bridge or mast arm mounting and make sign legends as shown or specified.

Drill and tap setscrews used in sign mountings through the first wall of the conduit. The conduit shall extend a minimum of 1/2 inch beyond the setscrew.

(d) Overhead Aluminum Signs - Signs shall use retroreflective sheeting (Type B ASTM Type IX or XI (DG cubed)), and shall conform to the applicable portions of Section 00940.

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** - Where interconnection to railroad circuits is shown or specified, interconnect the traffic signal cabinet and the railroad cabinet. The railroad company will furnish two sets of contacts in the railroad cabinet. The contacts open upon actuation of the track circuit by a train. The interconnect circuit operates as a “fail-safe” device which will cause an actuation if power to the track circuit is interrupted.

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 under any circumstance do any 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).**

00990.48 **Coating:**

(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 Control 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 two 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.

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. ODOT will require six weeks for completion and evaluation of the testing.

(1) Physical Testing - Physical testing of the traffic signal control equipment will consist of an inspection for quality of work and conformance to Contract Documents. The inspection will include:

- All specified equipment, wiring diagrams, operation manuals and documentation supplied
- The overall quality of the equipment and cabinet wiring
(2) **Functional Testing** - The functional testing of traffic signal control equipment will include checking:

- All specified input and output control functions for proper operation
- For proper operation of all noncontrol devices, such as switches, circuit breakers, outlets, fans and ground fault interrupts (GFIs)

Functional testing will be done at normal temperature and supply voltage, with the control devices set up and connected to a display panel and input simulator.

The controller unit timing and control functions will be programmed, and the inputs adjusted to simulate actual traffic control conditions.

The control devices will be visually observed during the test for proper input, output and control operation.

(3) **Environmental Testing** - Environmental testing of traffic signal control equipment will include checking the ability of devices to operate as specified, under conditions of variable temperature and power supply voltage.

The control equipment will be set up in an environmental chamber. Testing, monitoring and simulation apparatus will be connected and adjusted. Controller unit timing and control functions will be programmed. The control equipment will be turned on and the operation allowed to stabilize at least 30 minutes before testing.

The initial testing is performed at normal temperature and power supply voltage, and includes the spike test and timing test.

The spike test introduces 300 V AC positive and negative spikes onto the power supply. The equipment is observed for any disruption to normal operation.

The timing test monitors and records the accuracy of controller timing functions, such as minimum green, maximum green, walk, and yellow.

The control equipment will be cycled through temperatures from -30 °F to +165 °F. The control equipment will be required to operate for a maximum of 12 hours at both the high and low temperatures. During operation of the high and low temperature limits the accuracy of the controller unit timing functions will again be monitored and recorded.

The power supply voltage will be varied between 95 V AC and 130 V AC during the temperature test. Standard procedure is to use 95 V AC during the low temperature cycle and 130 V AC during the high temperature cycle.

Following completion of the temperature testing, the control equipment is removed from the environmental chamber, set up and connected to a display panel and input simulator. The control equipment will be required to operate for a maximum of 72 hours at normal temperature and power supply voltage under simulated traffic control conditions. Operation will be visually observed on a random basis during the test.
(c) Control Equipment Failure - A traffic signal control equipment failure is any occurrence that results in nonspecified operation of the equipment.

The Contractor will be notified of all control equipment failures, and shall make on-site repairs within five days of receiving the notification.

Following repair of the control equipment, the testing will be resumed at the beginning of the test category in which the failure occurred.

(d) Control Equipment Rejection - The traffic signal control equipment will be rejected under either of the following conditions:

1. Twice Fail - The control equipment fails twice in the same testing category.

2. Failure to Repair - The Contractor fails to repair the control equipment within five days of receiving notification of the failure.

Pick up rejected traffic signal control equipment within 10 days of receiving the rejection notice, or it will be returned, at Contractor’s expense, to the Contractor.

Replace with control equipment having a different serial number.

Rejected control equipment will not be accepted for testing or installation on any subsequent traffic signal project within the State of Oregon.

(e) Control Equipment Acceptance - Traffic signal control equipment that successfully passes the testing procedure will be certified by the ODOT Traffic Signal Services Unit as acceptable for installation. Acceptability for installation does not guaranty final acceptance of the completed installation.

The successful completion of the testing does not relieve the Contractor of the responsibility to furnish a complete working signal installation at the time the equipment is placed in operation.

The Contractor will be notified when the testing has been completed. Pick up the controller cabinet at the test facility.

(f) Control Equipment Installation - Be responsible for pick-up, delivery and installation of the controller cabinet.

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.
(g) **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.

(h) **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.

(i) **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 $\Omega$ 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 M$\Omega$/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.

00990.75 Warranty - The warranty of 00170.85(b) and other warranty provisions apply to work done under this Section. A one year warranty applies to all work done and all materials incorporated under this Section. This does not replace or reduce other warranties specified in excess of one year.

Payment

00990.90 General - Payment will be made at the Contract price for the following items:

<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>
</tbody>
</table>

Items (a) through (d) 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.
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 all materials, equipment, labor, and Incidentals necessary to complete the work as specified.

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 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.

00996.01 Abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>ATMS</td>
<td>Advanced Traffic Management System</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gauge</td>
</tr>
<tr>
<td>BNC</td>
<td>Bayonet Neill Concelman</td>
</tr>
<tr>
<td>bps</td>
<td>Bits per second</td>
</tr>
<tr>
<td>CCD</td>
<td>Charge-Coupled Device</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel</td>
</tr>
<tr>
<td>EIA</td>
<td>Electronics Industries Association</td>
</tr>
<tr>
<td>EPA</td>
<td>Effective Projected Area</td>
</tr>
<tr>
<td>FCC</td>
<td>Federal Communications Commission</td>
</tr>
<tr>
<td>FDU</td>
<td>Fiber Distribution Unit</td>
</tr>
<tr>
<td>FO</td>
<td>Fiber Optic</td>
</tr>
<tr>
<td>FOP</td>
<td>Fiber optic outside plant cable</td>
</tr>
<tr>
<td>Hz</td>
<td>Hertz</td>
</tr>
<tr>
<td>MHz</td>
<td>Megahertz</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>nm</td>
<td>nanometer</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>NTSC</td>
<td>National Television Standards Committee</td>
</tr>
<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
</tr>
<tr>
<td>OFNP</td>
<td>Nonconductive Optical Fiber Plenum Cable</td>
</tr>
<tr>
<td>OFNR</td>
<td>Nonconductive Optical Fiber Riser Cable</td>
</tr>
<tr>
<td>OTDR</td>
<td>Optical Time Domain Reflectometer</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>PCB</td>
<td>Printed circuit board</td>
</tr>
<tr>
<td>PTZ</td>
<td>Pan/Tilt/Zoom</td>
</tr>
<tr>
<td>p-p</td>
<td>Peak to Peak</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>REA</td>
<td>United States Rural Electrification Administration</td>
</tr>
<tr>
<td>RG</td>
<td>Radio Grade</td>
</tr>
<tr>
<td>SM</td>
<td>Single Mode</td>
</tr>
<tr>
<td>SMFO</td>
<td>Single Mode Fiber Optic</td>
</tr>
<tr>
<td>ST</td>
<td>Type of Fiber Optic Connector</td>
</tr>
<tr>
<td>TIA</td>
<td>Telecommunications Industries Association</td>
</tr>
<tr>
<td>THWN</td>
<td>Moisture and Heat Resistant Thermoplastic with Nylon Jacket Conductor</td>
</tr>
<tr>
<td>TMOC</td>
<td>Traffic Management Operations Center</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriter's Laboratory</td>
</tr>
<tr>
<td>UPC</td>
<td>Ultra Physical Contact</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>V</td>
<td>Volt, vertical</td>
</tr>
<tr>
<td>VAC</td>
<td>Volts, Alternating Current</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable Message Sign</td>
</tr>
<tr>
<td>W</td>
<td>Watts</td>
</tr>
</tbody>
</table>
00996.02 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, and 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 and may include splices and couplers.

Pan/Tilt Unite (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 and/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

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.

<table>
<thead>
<tr>
<th>Code of Federal Regulations (CFR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title 29, Part 1910.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institute of Electrical and Electronics Engineers, Inc. (IEEE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C62.41 – 1991</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National Fire Protection Association (NFPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 – 2002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Underwriters Laboratories (UL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Appliance and Utilization Equipment Directory – 1998</td>
</tr>
<tr>
<td>Electrical Construction Equipment Directory – 1998</td>
</tr>
</tbody>
</table>
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 Suppressers
1778 – 1994  Uninterruptible Power Supply Equipment

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 ohms with 18 AWG solid, bare copper center conductor with 95 percent 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  - Provide one pair of 14 AWG THHN/THWN, copper stranded conductors.

00996.13  Camera Grounding and Bonding  - Provide 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:
<table>
<thead>
<tr>
<th><strong>Video Signal Type:</strong></th>
<th>NTSC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Sensor:</strong></td>
<td>1/4 inch CCD</td>
</tr>
<tr>
<td><strong>Pixels:</strong></td>
<td>724 min. Horizontal by 494 Vertical</td>
</tr>
<tr>
<td><strong>Horizontal Resolution:</strong></td>
<td>470 TV lines</td>
</tr>
<tr>
<td><strong>Lens:</strong></td>
<td>F=4.1~11/16 inch optical minimum</td>
</tr>
<tr>
<td><strong>Zoom:</strong></td>
<td>18X optical minimum, 12X digital</td>
</tr>
<tr>
<td><strong>Zoom Speed:</strong></td>
<td>5.8 seconds maximum</td>
</tr>
<tr>
<td><strong>Horizontal:</strong></td>
<td>47° at 5/32 inch wide zoom</td>
</tr>
<tr>
<td><strong>Angle of View:</strong></td>
<td>3° at 11/16 inch minimum telephoto zoom</td>
</tr>
<tr>
<td><strong>Focus:</strong></td>
<td>Automatic with manual override</td>
</tr>
<tr>
<td><strong>Max. Sensitivity at 35 IRE:</strong></td>
<td>0.08 lux minimum at 1/2 sec shutter</td>
</tr>
<tr>
<td><strong>Shutter Speed:</strong></td>
<td>Automatic with manual override 1/2~1/30,000</td>
</tr>
<tr>
<td><strong>Iris Control:</strong></td>
<td>Automatic with manual override</td>
</tr>
<tr>
<td><strong>Synchronization:</strong></td>
<td>Internal/AC line lock</td>
</tr>
<tr>
<td><strong>Signal to Noise Ratio:</strong></td>
<td>Greater than 48 dB</td>
</tr>
<tr>
<td><strong>Gain Control:</strong></td>
<td>Automatic/Off</td>
</tr>
<tr>
<td><strong>Video Output:</strong></td>
<td>1.0 Vp-p (75 ohms composite)</td>
</tr>
<tr>
<td><strong>Video Connector:</strong></td>
<td>BNC bulkhead on rear of camera</td>
</tr>
<tr>
<td><strong>White Balance:</strong></td>
<td>Automatic with manual override</td>
</tr>
<tr>
<td><strong>Power:</strong></td>
<td>24V AC, 60 Hz (nominal)</td>
</tr>
<tr>
<td><strong>Dome Pendant Construction:</strong></td>
<td>316 SST or Steel (painted)</td>
</tr>
<tr>
<td><strong>Finish Color:</strong></td>
<td>White</td>
</tr>
<tr>
<td><strong>Lower Dome Construction:</strong></td>
<td>Acrylic</td>
</tr>
<tr>
<td><strong>Pan Movement:</strong></td>
<td>360° continuous pan rotation</td>
</tr>
<tr>
<td><strong>Vertical Tilt:</strong></td>
<td>Unobstructed 2° to –92°</td>
</tr>
<tr>
<td><strong>Manual Pan Speed:</strong></td>
<td>0.1 to 80° per second minimum</td>
</tr>
<tr>
<td><strong>Preset Pan Speed:</strong></td>
<td>250° per second minimum</td>
</tr>
<tr>
<td><strong>Manual Tilt Speed:</strong></td>
<td>Variable, 0.1 to 200 degrees per second</td>
</tr>
<tr>
<td><strong>Present Tilt Speed:</strong></td>
<td>200° per second</td>
</tr>
<tr>
<td><strong>PTZ Protocol:</strong></td>
<td>Pelco’s P&amp;D</td>
</tr>
<tr>
<td><strong>Communication:</strong></td>
<td>RS-485</td>
</tr>
<tr>
<td><strong>Light Attenuation:</strong></td>
<td>Clear, zero light loss</td>
</tr>
<tr>
<td><strong>Cable Entry:</strong></td>
<td>1 1/2 inches (nominal) NPT connection</td>
</tr>
<tr>
<td><strong>Operating Temperature:</strong></td>
<td>-49 °F to 122 °F</td>
</tr>
<tr>
<td><strong>Effective Projected Area:</strong></td>
<td>1.18 ft²</td>
</tr>
<tr>
<td><strong>Power:</strong></td>
<td>24 VAC, 60 Hz (nominal)</td>
</tr>
<tr>
<td><strong>Environmental:</strong></td>
<td>NEMA Type 4X rated, sunshield, fan, and heater included</td>
</tr>
<tr>
<td><strong>Interior Pressurization:</strong></td>
<td>Dry nitrogen gas, dual Schraeder valves for purging and pressurization, 8 psi minimum</td>
</tr>
<tr>
<td><strong>Listings:</strong></td>
<td>UL, FCC Class B</td>
</tr>
<tr>
<td><strong>Alarm Inputs:</strong></td>
<td>4</td>
</tr>
</tbody>
</table>

The Camera Housing and Pan/Tilt assembly shall be Pressurized Pelco’s Spectra III™ series.

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 antioxidant 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 non-conductive, 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 and/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 percent 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.

00996.15 **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.

00996.16 **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>Video Input:</th>
<th>1V peak to peak (75 ohms), NTSC</th>
</tr>
</thead>
<tbody>
<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:</td>
<td>Variable, up to 10 Mb/s</td>
</tr>
</tbody>
</table>

**Video Output**

| Physical:              | 100Base-FX                     |
| Connector:             | LC                              |
| Wavelength:            | 1310 angstroms                  |

**Ethernet Switch**

| Physical:              | 10/100 Base-FX                 |
| Number of Switch Ports: | 8                               |
| Wavelength:            | 1310 angstroms                  |
| Port Types:            | LC                              |
| Mean Launch Power:     | -5 to 0 dBm                     |

**Networking Protocols:**

- Multicast filtering, IEEE 802.1p, IEEE 802.1D,
- SNMP, HTTP, TCP/IP

**Distance:**

19.9 miles minimum over single mode fiber

**Terminal Server**

| Data Types:           | RS-232, RS-422, RS-485         |
| Number of Ports:      | 3                               |
| Data Connector:       | RJ-45 or DB9                    |
| Bit Rate:             | Up to 115 kbps                  |

**Mounting:**

Rack, 19 inches, 1U

**Operating Temp Range:**

-4 °F to 160 °F

**Storage Temp Range:**

-22 °F to 160 °F

**Relative Humidity:**

0 to 95% non-condensing

**Power:**

12V DC from 120V/12V DC converter

The video encoder shall be Teleste EASI IP Series IPE or approved equivalent.

**00996.17 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:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Output</td>
<td>1V peak to peak (75 ohms), NTSC</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>5 Hz – 6.5 MHz</td>
</tr>
<tr>
<td>Differential Gain</td>
<td>Less than 3%</td>
</tr>
<tr>
<td>Differential Phase</td>
<td>Less than 3°</td>
</tr>
<tr>
<td>Signal to Noise Ratio</td>
<td>60 dB minimum at maximum optical loss budget</td>
</tr>
<tr>
<td>Receiver Sensitivity</td>
<td>-30 dB</td>
</tr>
<tr>
<td>Data Interface</td>
<td>RS-232, RS-422, 2 wire RS-485</td>
</tr>
<tr>
<td>Data Format</td>
<td>NRZ, NRZI, Manchester, Bi-phase</td>
</tr>
<tr>
<td>Data Rate</td>
<td>DC-100 kbps (NRZ)</td>
</tr>
<tr>
<td>Operating Mode</td>
<td>Simplex or full duplex</td>
</tr>
<tr>
<td>Fiber Wavelength</td>
<td>1310/1550 angstroms, single mode</td>
</tr>
<tr>
<td>Optical Emitter</td>
<td>Laser diode</td>
</tr>
<tr>
<td>Optical Detector</td>
<td>PIN</td>
</tr>
<tr>
<td>Indication</td>
<td>Input sync presence</td>
</tr>
<tr>
<td></td>
<td>Transmitted data</td>
</tr>
<tr>
<td></td>
<td>Received data</td>
</tr>
<tr>
<td></td>
<td>Optical carrier detect</td>
</tr>
<tr>
<td></td>
<td>Power</td>
</tr>
<tr>
<td>Optical Connector</td>
<td>ST</td>
</tr>
<tr>
<td>Power Connector</td>
<td>Provided by rack assembly</td>
</tr>
<tr>
<td>Data Connector</td>
<td>Terminal block</td>
</tr>
<tr>
<td>Video Connector</td>
<td>Gold plated BNC</td>
</tr>
<tr>
<td>Mounting</td>
<td>Rack</td>
</tr>
<tr>
<td>Mean Time Between Failure</td>
<td>Greater than 100,000 hours</td>
</tr>
<tr>
<td>Operating Temp Range</td>
<td>-40 °F to 165 °F</td>
</tr>
<tr>
<td>Storage Temp Range</td>
<td>-40 °F to 185 °F</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>0 to 95% non-condensing</td>
</tr>
<tr>
<td>Listing</td>
<td>UL</td>
</tr>
</tbody>
</table>

**00996.18 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:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Transient Protection</td>
<td>UL 1449</td>
</tr>
<tr>
<td>Safety Compliance</td>
<td>UL 1778</td>
</tr>
<tr>
<td>Waveshape</td>
<td>True sine wave</td>
</tr>
<tr>
<td>EMC Compliance</td>
<td>FCC Class B</td>
</tr>
<tr>
<td>Voltage (nominal)</td>
<td>120 VAC, 60 Hz</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Sealed, maintenance free</td>
</tr>
<tr>
<td>Runtime (full load)</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Maximum load</td>
<td>1300 Watts (minimum)</td>
</tr>
<tr>
<td>Backup Receptacles</td>
<td>5-15R (minimum)</td>
</tr>
<tr>
<td>Mounting</td>
<td>Rack mounted, 19 inches</td>
</tr>
</tbody>
</table>
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.

Construction

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.

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.

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.

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 (Lump Sum Basis) - There will be no separate measurement of work done under this Section.

Payment

00996.90 Payment (Lump Sum Basis) - The following items will be paid for at the contractor lump sum amount:

(a) CCTV Cameras - Payment for the bid item “Traffic Camera Installations, Complete”, accepted in place, includes all cameras, PTZ units, camera lowering systems, cabling, and associated wiring. Payment will be in full for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(b) Camera Cabinets - Payment for the bid item “Camera Cabinet Installations, Complete”, accepted in place, includes the camera cabinets, UPS, and associated video equipment. Payment will be in full for all materials, equipment, tools, labor, and incidentals necessary to complete the work.
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PART 01000 - RIGHT OF WAY DEVELOPMENT AND CONTROL

Section 01030 - Seeding

Description

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 occurs in its natural habitat without direct or indirect human actions.

Noxious Weed - Any weed designated by the Oregon State Weed Board, County, or Weed Control District that is injurious to public health, agriculture, recreation, wildlife, or any public or private property as authorized by the most current edition of the following:

- Oregon Revised Statute (ORS) 570.505, Noxious Weed Control Law
- Oregon Department of Agriculture (ODA) Noxious Weed Policy and Classification System
- Oregon Administrative Rule (OAR), 603-56, Noxious Weed List
- ODA Quarantine on Kudzu and Purple Loosestrife
- ORS Chapter 452, Vector and Weed Control
- ORS Chapter 561, Quarantines, State Weed Board
- ORS Chapter 570, Plant Inspection, Quarantine, Pest, and Weed Control

Pure Live Seed (PLS) - The seed in a quantity of seed which is viable (alive) and able to germinate and grow into a living plant.

Weed - A plant that is undesirable where it is growing.
Materials

01030.11 Topsoil - Furnish topsoil according to 01040.14.

01030.12 Soil Conditioners, Amendments, and Bio-Amendments - Furnish soil modifiers according to 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.

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 that is not sprouted, moldy, or shows evidence of having been wet or otherwise damaged and meets one of the following requirements:

- Certified as "Oregon Certified Seed" at the time of planting, or the equivalent from another state. The current certified seeds are found in the most recent edition of the "Oregon Certification Acres Applied for Certification Summary". The minimum requirements of Oregon certified seed are published in the current year's "Oregon Certified Seed Handbook". Both certified seed references are available from County Extension Offices or Oregon State University. This seed is typically used for specialty or lawn seeding.

- Meets the requirements of the Oregon Seed Law. This seed is typically used for permanent and temporary erosion control and for seed varieties that are not available as certified seed.

Furnish seed that has been tested within 18 months of the planting date and labeled according to the Oregon Seed Law and Federal Seed Act.

(c) Pure Live Seed (PLS) - PLS is the amount of living, viable seed in a larger total amount of seed. The amount of seed to be applied is obtained by using the purity and germination percentages from the label on the 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, $0.80 \times 0.90$ 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.

(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 the Contractor's expense.

(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.

(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 actually have multiple functions on a project site):

- **Temporary Seeding** - To provide short-term control of soil erosion until permanent seeding is done or the potential for erosion is removed.

- **Permanent Seeding** - The final seeding, or only seeding, performed for control of soil erosion.

- **Lawn Seeding** - Seeding for high visibility or pedestrian areas where a 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 for revegetation or restoration, often using native plant seeds, and which may include woody plant species.

- **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.

- **Wetland Seeding** - To revegetate wetlands, most often using native plant species.

(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 conforming to the following:
(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 - Furnish fertilizer according to the following:

(1) Inorganic fertilizer - Furnish inorganic fertilizer 22-16-8, 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)
- Isobutylidene Diurea (IBDU)
- Polymer coated urea (no sulfur)

(2) Near Water - Furnish Low-phosphorus fertilizer 22-2-11, analyzing 22% nitrogen, 2% phosphorus, and 11% potassium which releases slowly over an eight to nine month period. In the fertilizer, furnish a minimum of 60% available water-insoluble, controlled-release nitrogen derived from one of the three sources stated above. Furnish phosphorus and potassium coated to allow a minimum of 95% controlled-release.

01030.15 Mulch - Furnish mulch materials free of noxious weed seeds and plants and which contain no substances detrimental to plant life. The kind of mulch material(s) acceptable for use will be shown on the plans or listed in the Special Provisions, or 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** - Cellulose fiber produced from virgin wood, straw, or paper fiber product from the CPL.

Process the wood or straw mulch so that the fibers remain uniformly suspended under agitation in water. Furnish wood or straw fiber having 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** - Straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass singly or in combination. If grass seed straw is not available within a reasonable distance of the Project, 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 will show either (1) that the straw source is from an "Oregon Certified Seed" field, or (2) the seed lab test results of the seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content. Use a straw binder or tackifier.

**c) Tracer** - For hydromulch application, include green dye for visibility.

**01030.16 Tackifier** - Furnish a commercial quality tackifier containing no agent toxic to plant life. Provide tackifier of either a liquid stabilizing emulsion or a dry powder tackifier complying with the following:

**(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 acrylcs. 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 one 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)

**Construction**

**01030.40 General** - Notify the City not less than 24 hours in advance of any seeding operation. Do not begin work until the prepared slopes have been approved for seeding. Following approval, begin seeding immediately and continue seeding the Project slopes as they become ready. 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 the Contractor’s expense.

**01030.41 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 01030.42. 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 the Contractor's expense.

**01030.42 Permanent and Other Seeding** - Perform permanent seeding during the permanent seeding dates shown below. If work done within the seeding dates does not provide coverage according to 1030.60, re-seed according to 1030.48 and as directed. The dates for permanent, wildflower, plant, water quality, wetland, and lawn seeding are as follows:

- March 1 through May 15 and September 1 through October 31. If new lawn areas are regularly watered, they can be seeded anytime from March 1 through November 15.
- **Wetland** - September 1 through October 31 and March 1 through April 30.

Permanent seeding outside the permanent seeding dates requires written authorization from the City. Written approval to seed outside of the seeding dates will only be given when physical completion of Project work is imminent and environmental conditions are conducive to satisfactory growth. For permanent seeding work done outside the seeding dates, ensure that the seeding provides the coverage of live plants required by 01030.60, achieved no later than three weeks into the next permanent seeding period. If this coverage is not achieved, re-seed and re-fertilize areas of insufficient coverage according to the permanent seeding requirements, at the Contractor's expense.

**01030.43 Area Preparation** - Refer to 01040.48 for the following:

- Temporary Seeding - Method E soil preparation
- Permanent Seeding - Method D soil preparation
- Wildflower Seeding - Method B soil preparation
- Plant Seeding - Method B soil preparation
- Water Quality Seeding - Method B soil preparation
- Wetland Seeding - Method B soil preparation
- Lawn Seeding - Method C soil preparation
01030.44  Fertilizer:

(a) General Use - Do not apply inorganic fertilizer within 50 feet of bodies of water. In all other areas, apply 22-16-8 or 22-10-5 at the rate of 400 pounds per acre.

(b) Low-phosphorous - Use low-phosphorus fertilizer within 50 feet of bodies of water and for water quality swales only when indicated in the Special Provisions. 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 in a one-step or two-step process. The two-step process is preferred.

a. Two-step operation - Apply materials in two steps:

   • Step 1 - Apply seed, fertilizer, and tracer (separately or together).

   • Step 2 - Apply mulch and tackifier. (The 500 pounds per acre of mulch used for tracer may be included as part of the specified rate per acre of mulch.)

b. One-step operation - Apply seed, fertilizer, mulch, tackier, and tracer in one step. When using the one-step process, double the amount of seed (to compensate for seed suspended above soil by the mulch).

(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:

- **Slopes Flatter Than 1V:2H** - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

- **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.

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 mass 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
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 areas where material is not specified.

(c) Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace any material that becomes displaced before acceptance of the work.

Maintenance

01030.60 General - Ensure that seeded areas have 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 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 - The Special Provisions will list the minimum living plant coverage standards.

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, and permanent seeding by the following:

(1) Protection - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at the discretion and expense of the Contractor. 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 the Contractor's expense.

(3) Weed Control - Weed control includes identifying, killing, and removing plants as defined by the Oregon Department of Agriculture to be Type "A" or Type "B" rated weeds and Weeds as defined in 01030.02 prior to plants going to seed. Keep the seeded areas "weed-free" throughout the establishment period. "Weed free" is defined as zero Type "A" weeds, one Type "B" weed per square yard, and two Weeds, as defined in 01030.02, per square yard. Conduct weeding according to 01040.21 and as approved by the City.

(4) Mowing - Mowing is required for lawn seeding and water quality seeding only. 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 the Contractor's expense.
Finishing and Clean Up

01030.70 Cleanup - Remove weeds, litter, debris, stones, and all other extraneous matter from seeded areas as directed and dispose of according to 00310.43.

01030.71 Waste Disposal - Do not flush excess materials into the drainage system. Dispose of protective coverings used on structures off site. All waste materials associated with seeding, fertilizing, and mulching become the property of the Contractor.

Measurement

01030.80 General - The quantities of seeding and associated items will be measured by the applicable basis as follows:

- **Lump Sum Basis** - No separate measurement will be made for lump sum items.
- **Unit Basis** - Unit basis items will be measured on a unit basis, per each, by actual count of each item that is constructed or placed and accepted.
- **Area Basis** - Area basis items will be measured on the ground surface by the foot and computed to the square yard or acre unit as applicable.

Payment

01030.90 General - The accepted quantities of seeding and associated 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) Seeding Mobilization</td>
<td>Each</td>
</tr>
<tr>
<td>(b) Fertilizing</td>
<td>Acre</td>
</tr>
<tr>
<td>(c) Mulching</td>
<td>Acre</td>
</tr>
<tr>
<td>(d) Permanent Seeding, _____</td>
<td>Acre or Lump Sum</td>
</tr>
<tr>
<td>(e) Plant Seeding, _____</td>
<td>Acre</td>
</tr>
<tr>
<td>(f) Temporary Seeding, _____</td>
<td>Acre</td>
</tr>
<tr>
<td>(g) Water Quality Seeding, _____</td>
<td>Acre</td>
</tr>
<tr>
<td>(h) Wetland Seeding, _____</td>
<td>Acre</td>
</tr>
<tr>
<td>(i) Wildflower Seeding, _____</td>
<td>Acre</td>
</tr>
<tr>
<td>(j) Lawn Seeding, _____</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

In items (d) through (j), the type of seed mix, (Mix No. 1, Mix No. 2, etc.), if applicable, will be inserted in the blank.

Item (a) 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.

Mobilization for application by blowers, mechanical spreaders, or hand spreading is Incidental work for which no separate payment will be made.
If "Seeding Mobilization" is not listed as a pay item, it is Incidental work for which no separate payment will be made.

Items (d) through (j) include preparing the seed bed, soil preparation, seeding, fertilizing, mulching, applying tacking agent, and all establishment work.

Payment will be payment in full for furnishing and placing all materials, performing all work including inspecting and maintenance, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

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.

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).

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.

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.

Noxious Weed - See 01030.02.

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 soil wetness at which a plant wilts and can no longer recover its turgidity when placed in a saturated atmosphere for 12 hours.

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.
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 permitted 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 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 and/or Wetland Topsoil approvals according to 01040.14
• Plant installation and establishment
• Weed Control Plan, including the following:
  • List of weeds and unwanted vegetation to be controlled (show all plants required to be removed from site)
  • Proposed methods of weed control
  • Schedule of all weed control measures required under the Contract
  • Name, application rate, and a printed version of the federal registered label for all proposed chemicals
  • Proof of current pesticide applicators license
• Emergency contact person, including the Name, telephone and pager numbers, and voice mail and/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 the Contractor's expense 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 - Furnish materials and equipment that meet the following requirements:
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. Any materials installed without approval will be subject to removal and replacement with acceptable material at the Contractor's expense.

Substitute materials may be permitted 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 - When required by the Special Provisions, 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 five samples per hectare of each soil type. Mix the five 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 five samples per hectare of each soil type. Mix the five 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:

<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 X 10^8 per gram of dry soil</td>
</tr>
<tr>
<td>Total fungal biomass</td>
<td>100 μg for grasslands</td>
</tr>
<tr>
<td></td>
<td>200 μg for shrubs or perennials</td>
</tr>
<tr>
<td></td>
<td>300 μg 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 the Contractor's expense.
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><strong>Particle Size Range</strong></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><strong>Particle Size Range</strong></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 percent 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** - The soil mix shall consist of 67% sandy loam soil and 33% compost material by volume.

(1) **Sandy Loam Soil** - The soil shall be a sandy loam as defined by the USDA soil texture classification. Additionally, when tested according to AASHTO T 88, the soil shall conform to the following limits:

<table>
<thead>
<tr>
<th>Standard Sieve Analysis</th>
<th>Sieve Size</th>
<th>Percent Retained (By Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2 inch</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. 4</td>
<td>0-10</td>
</tr>
</tbody>
</table>

Of the fraction passing the No. 4 sieve, excluding organic material, furnish soil that conforms to the following:

<table>
<thead>
<tr>
<th>Hydrometer Analysis</th>
<th>Component</th>
<th>Sieve Size</th>
<th>Percent (By Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td>No. 4 - No. 200</td>
<td>55 - 75 (Retained)</td>
</tr>
<tr>
<td></td>
<td>Silt</td>
<td>No. 200 - 5µm</td>
<td>15 - 35 Retained</td>
</tr>
<tr>
<td></td>
<td>Clay</td>
<td>Less than 5µm</td>
<td>5 - 20 (Passing)</td>
</tr>
</tbody>
</table>

In addition, furnish soil that analyzes at less than 10 percent organic matter according to ASTM D 2974.

The soil shall be loose friable material and meet the following conditions:

- Be free of subsoil, debris, weeds, foreign matter, and any other material deleterious to plant material health
- Have pH range of 5.5 to 7.5. Soils having a pH below 5.5 shall be treated with dolomitic limestone as necessary to attain this pH range. Soils having a pH above 7.5 shall be treated with sulfur as necessary to attain this pH range
- Have a moisture content between 25% and 55%
The soil texture gradation and other specifications shall be documented in a report by an approved independent soils testing laboratory. The report shall indicate the source of the soil, and the date of the analysis shall be no more than six months prior to the date of the delivery. The report shall be submitted to and approved by the Engineer prior to delivery of the soil to the project site.

(2) Compost Material - The compost shall be provided by a US Composting Council Seal of Testing Assurance (STA) Member. See www.compostingcouncil.org/section.cfm?id=23 for a list of local providers. A copy of the provider's most recent independent STA test report shall be submitted to and approved by the Engineer prior to delivery of the compost to the project site.

The compost material shall be the result of biological degradation and transformation of plant-derived materials under controlled conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth. The material shall meet the following criteria:

- 100 percent of the material shall pass through a 1/2 inch screen
- PH of the material shall be between 6.0 and 8.5
- Manufactured inert material (plastic, concrete, ceramics, metal, etc) shall be less than 0.5 percent on a dry weight or volume basis, whichever provided for the less amount of foreign material
- Moisture content shall be between 35 and 50 percent
- Maturity greater than 80 percent
- Minimum organic matter shall be 40 percent dry weight basis
- Soluble salt content shall be no greater than 5500 parts per million
- Phosphorus content shall be no greater than 325 parts per million
- Heavy metals (trace) shall not exceed 0.5 parts per million

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 conforming to 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 one-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 Nurseriesmen. 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 three months before planting, at a location north of the 42nd Latitude (Oregon - California border).

Furnish plants that posses 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 permitted 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 permitted, 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 two 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.

(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) **Grass Straw Mulch** - Grass straw mulch from bentgrass, bluegrass, fescue or ryegrass, singly or in combination. If no grass seed straw is available, straw from barley, oat, or wheat is allowed if approved by the City. The straw shall not be moldy, caked, decayed or of otherwise low quality. Submit verification from the supplier that the straw is free of noxious weeds. Submit documentation showing either (1) that the straw source is from an "Oregon Certified Seed" field, or (2) the seed lab test results of the seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content.

(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 polyacrylamide copolymers. Provide commercial quality product from the CPL.

01040.23 Miscellaneous Items - Provide miscellaneous items according to the following 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 substance 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 - Finished or rough sawn tree stakes of 1 1/2" x 1 1/2" 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.
01040.44   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 nine worms per cubic yard of topsoil (this roughly equates to three 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></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Rate</td>
<td>Size</td>
</tr>
<tr>
<td>Tree</td>
<td>3 per tree</td>
<td>3/4 ounce</td>
</tr>
<tr>
<td>Shrub</td>
<td>2 per shrub</td>
<td>3/4 ounce</td>
</tr>
<tr>
<td>Vine/Ground Cover</td>
<td>1 per plant</td>
<td>3/16 ounce</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 two-thirds filled with backfill. Mix granular fertilizer into the upper one-half 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 12 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".

**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 the Contractor's expense.

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.

**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 conforming to the Specifications with plants as specified or otherwise directed, at the Contractor's expense. 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.

• Ball 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 the Contractor’s expense. 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 streets streets that are to receive hard surfaces around them such that 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 shrubs at a minimum frequency described 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 three 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 three 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.
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 four 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 the Contractor's expense.

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 tubelining plants and seeding as required.

   (2) Wood Chips - Spread wood chips to a nominal depth of 2 inches. Add 15 pounds of ammonium nitrate per 100 square feet to neutralize the 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 any lawn vegetation damage at the Contractor's expense.
(a) **Pressure Moisture Sensor** - When a pressure moisture stress instrument is specified, the City will make a midday test a 1% to 5% representative sample of plant material 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 found to have 30 bars or greater will be considered to have reached its permanent wilting point. Replace any such material during the next planting period. Testing will occur at the following times until the end of the establishment period(s):

- After plant delivery, during temporary storage, and before planting
- At one-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 one carton for seedlings and tubelings, two cartons for No. 1 containers, and four cartons for larger plant material.

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 one-third to one-half 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.

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**Plant Establishment**

01040.52  **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.

01040.70  **General** - The plant establishment work will begin immediately once the original planting is complete and accepted. The length of the first year establishment period will be one calendar year.

Any additional establishment period work will consist of the same tasks as the first year establishment and will begin when the City accepts the first year plant establishment work.

Establishment period work includes removing all plants that are dead, dying, or which do not meet Specifications, and replacing them with healthy plants during the planting season. All plants in place after this replacement will be recognized as the "original planting" and will be subject to the establishment specifications. Plant replacement due to vehicle damage, vandalism or theft will be the responsibility of the City according to 00170.80.
01040.71  **Care of Work** - 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

01040.72  **Periodic Inspections** - During each establishment period, the City will make a minimum of four inspections jointly with the Contractor at the following times:

- Spring, early May
- Summer, mid July
- Fall, late September
- Winter, late February

Depending on when the establishment period begins, one of the above inspections will be the final inspection.

Complete the specified establishment work prior to each scheduled inspection. If, in the opinion of the City, a good faith attempt to complete the work has not been made prior to the inspection, the City will cancel the inspection. In this case, the City reserves the right to have unacceptable work corrected, removed, and replaced according to 00150.80.

During each inspection the City may determine, based upon the specified success criteria, that supplemental corrective actions are required. If so, the City will provide the Contractor with a written notice of required corrective actions sent by hand-delivery or mail. Notify the City when the supplemental corrective work is ready for re-inspection.
01040.73 Success Criteria - The determination of a successful planting establishment will be made at the periodic inspections. A successful planting establishment is defined as follows:

- 100% survival and vigorous growth of all individual trees larger than 1/2 inch caliper
- 100% coverage of lawn or sod
- 95% survival and vigorous growth of all smaller trees and shrubs
- 90% survival and vigorous growth of individual groundcovers (non-seeded), small container plants, bulbs, tublings, wetland plants, and cuttings
- Care of the work described in 01040.71
- Plants are free of insects and disease
- Plants show signs of continuing growth
- 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 three plots per hectare 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.

01040.74 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.

Provide plant replacements of the same variety, size and quality as specified for the original plants, unless otherwise approved.

01040.75 Weed Control - In addition to continuing application according to the Weed Control Plan, apply chemical herbicides and pesticides according to the federal registered label requirements, and those of the Oregon Department of Environmental Quality, the Oregon Department of Agriculture, and local laws and ordinances. Control weeds before they seed. If the Contractor's work is not satisfactory, the City reserves the right to do the work at the Contractor's expense.
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 the Contractor's expense.

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.

(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 lawn or sod areas may be 45 days, depending on its health and condition. Keep turf 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 one-third 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 - Begin vegetation management activities immediately after emergent wetland planting is completed. Remove noxious weed species from the Project site.
(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 Soil Testing - Soil testing will be measured on the unit basis per each by actual count 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

01040.81 Topsoil and Wetland Topsoil - Topsoil and wetland topsoil will be measured by the cubic yard in the hauling vehicle as follows:

The maximum "water level" capacity of the vehicle will be measured. Quantities will be determined at the point of delivery, with no allowance for settlement of material during transit. When required to facilitate measurement, vehicle loads at the point of delivery will be leveled. 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.

Topsoil taken from the required excavations according to 00330.10 will be measured according to 00330.82.

01040.82 Soil Conditioners - Soil conditioners will be measured by cubic yards in the hauling vehicle or in containers delivered to the Project site.

01040.83 Plant Materials - Plant materials will be measured by one of the following methods:

- Method "A" - Unit Basis - Under this method, plant materials will be measured on a unit basis per each by actual count.

- Method "B" - 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 and calculated to the nearest square yard
• 1% to 5% of the plant bed area will be divided into 30 square yard representative plots

• All the plants in each representative plot will be counted. Unless otherwise approved by the City, 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 total quantities of each bid 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.

01040.84  **Sod Lawn** - Sod lawn will be measured on an area basis measured on the ground surface by the foot.

01040.85  **Mulches** - Mulch will be measured by the cubic yard in the hauling vehicle, or ton according to Section 00190. No measurement will be made for mulch materials required as part of replacement planting.

01040.86  **Plant Establishment Work** - No separate measurement will be made for plant establishment work.

01040.87  **Additional Establishment Periods** - Additional establishment periods will be measured by the year and be the successful completion of work for each periodic inspection, conducted on the same schedule and basis as the first year establishment period. Additional establishment periods will begin after the "Plant Establishment Work" period ends.

01040.88  **Miscellaneous** - Miscellaneous items will be measured as follows:

- **Tree Grates** - Tree grates will be measured on a unit basis, per each by actual count. 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, per each by actual count.

- **Boulders** - Boulders will be measured on a unit basis, per each by actual count or by the ton.

- **Root Barrier** - Root barrier will be measured by the foot.

- **Weed Control Geotextile** - Weed control geotextile will be measured on the area basis measured on the ground surface by the foot.
If not listed in the Schedule of Items, these items are considered Incidental to planting and no separate measurement will be made.

01040.89 Incidental - No separate measurement will be made for the following:

- 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 sensors

Payment

01040.90 Soil Testing - The accepted soil tests will be paid for at the Contract unit price per each for the item "Soil Testing".

Payment will be payment in full for mobilization, soil sampling, testing, analyses, and preparation of the soil amendment and bio-amendment reports.

01040.91 Topsoil and Wetland Topsoil - The accepted quantities of topsoil, not taken from required excavations, will be paid for at the Contract unit price per cubic yard for the item "Topsoil".

The accepted quantities of 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".
Payment will be payment in full for furnishing, excavating, loading, hauling, placing, grading, and cleanup of all topsoil, including all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for topsoil taken from required excavations 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.

01040.92 Soil Conditioners - The accepted quantities of soil conditioners will be paid for at the Contract unit price per cubic yard for the item "Soil Conditioner".

Payment will be in full for furnishing and incorporating the soil conditioner into the planting areas, and includes all equipment, labor, and incidentals necessary to complete the work as specified.

01040.93 Plant Materials - The accepted quantities of plants will be paid for at the Contract unit price per each for the items listed in the Schedule of Items. Plant materials will be listed by caliper size, size of container, or other size, or condition shown.

The accepted quantities of transplanted plants will be paid for at the Contract unit price per each for the item "Transplanted Specimen Plants".

Payment will be in full for all plants, and related materials including all equipment, labor, and incidentals necessary to complete the work as specified.

(a) Materials on Hand - If the Contractor requests partial payment for plant materials on hand, the payment will be made according to 00195.60.

01040.94 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".

Payment will be in full for preparing the bed, furnishing and placing materials and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

01040.95 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>Ton</td>
</tr>
<tr>
<td>(e) Rock Mulch</td>
<td>Ton</td>
</tr>
</tbody>
</table>
Payment will be payment in full for preparing the mulch beds, furnishing and applying soil sterilant, and furnishing and placing the mulch, including all equipment, labor, and incidentals necessary to complete the work as specified.

01040.96 Plant Establishment Work - Plant establishment work will be paid for at the Contract lump sum amount for the item "Plant Establishment Work". Payment will be payment in full for all necessary work activities during the first year plant establishment period including but not limited to watering, fertilizing, weeding, pruning, and mowing.

<table>
<thead>
<tr>
<th>Partial payments for plant establishment work will be made as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At one-fourth of the establishment period ....................... 20%</td>
</tr>
<tr>
<td>At one-half of the establishment period ............................ 20%</td>
</tr>
<tr>
<td>At three-fourths of the establishment period ..................... 20%</td>
</tr>
<tr>
<td>At completion of the establishment period ......................... 40%</td>
</tr>
</tbody>
</table>

01040.97 Additional Establishment Periods - Additional establishment periods will be paid for at the Contract unit price per year for the item "Additional Establishment Period".

Partial payments for each additional establishment period will be made as follows:

| Beginning of additional establishment ................................ 0% |
| At one-fourth of additional establishment ......................... 20% |
| At one-half of additional establishment .............................. 20% |
| At three-fourths of additional establishment ...................... 20% |
| Final Acceptance of additional establishment ..................... 40% |

Payment will be payment in full for all plant replacement, planting materials, other materials and all equipment, labor, and incidentals necessary to complete the work.

01040.98 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 preparing the areas for installation and furnishing and placing the items, including all equipment, labor, and incidentals necessary to complete the work as specified.

01040.99 Incidental - When the Schedule of Items does not indicate payment for work items under this Section, it will be considered Incidental and no separate payment will be made.
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
- Rock protection fences and slope protection mats
- 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** - A swinging unit(s) 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.

   - **Rock protection fence** - The lengths between the designated beginning and ending locations as shown.

   - **Bridge protective fence** - A section of fence 150 feet or less in length.
Materials

01050.10 General - Unless otherwise specified, provide new materials meeting the following requirements:

- Bar Reinforcement ................................................................. 02510.10
- Barbed Wire .............................................................................. 03010.10
- Chain Link Fabric ........................................................................ 03010.30
- Fence Gates ................................................................................ 03010.60
- Fence Grounding ........................................................................ 03010.50(e) and (f)
- Fence Posts, Braces, and Appurtenances .................................. 02110.30, 03010.50
- Gabion Wire Mesh Fabric .......................................................... 03010.70(i)
- Guardrail Elements ..................................................................... 02820.10
- Commercial Grade Concrete ...................................................... 00440
- Pickets ....................................................................................... 03010.31
- Protective Fence Materials, On and Off Structures ..................... 03010.75
- Rock Protection Fences and Slope Protection Mat ....................... 03010.70
- Vinyl Clad Fabric ........................................................................ 03010.40
- Woven Wire Fabric .................................................................... 03010.20

Equipment

01050.20 Rock Bolt Equipment - Provide a hydraulic, non-impact type drill.

Provide equipment to establish the rock bolt anchor in the hole, and to tighten the bolt to the required tension according to the instructions of the manufacturer subject to approval of Engineer.

Provide and maintain in good working condition necessary torque wrenches and related equipment for installing rock bolts.

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 and/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 livestock 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 01050.49.

Dispose of materials removed under these provisions, including excess excavation, in a satisfactory manner.

01050.42 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
01050.43 Installing Posts and Braces:

(a) General - Set all metal end posts, intermediate end posts, corner posts, gate posts, chain link fence posts, rock protection posts and slope protection posts in concrete footings except as provided in 01050.46. 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 permitted 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.

(3) 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 five 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 permitted 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 six 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 one-half 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 six 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 Rock Protection Fence/Slope Protection Mat:

(a) Posts and Footings - Space posts as shown. Measure parallel to existing ground slope to determine post spacing. Place all posts in a vertical position unless otherwise directed.
(1) **Solid Rock** - Where solid rock is encountered without an overburden of soil, anchor posts with rock bolts set a minimum of 24 inches into the solid rock, as shown.

Where solid rock is covered by overburden of soil, loose rock, or surfacing materials, set the posts to the full depth of 3 feet. If solid rock is encountered before this depth is reached, anchor the post with rock bolts to the minimum depth specified above unless otherwise directed.

(2) **Soil** - All posts installed in soil shall be installed in sleeves set in 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 sleeve while the sleeve is 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 to cure for at least five calendar days before the posts are inserted into the sleeve and subjected to strain.

Heavily coat the bottom 3 feet of the posts with high-temperature wheel bearing grease, or other approved grease, before inserting into the sleeves. Leave the bead of grease that forms around the top of the sleeve in place.

(b) **Concrete Barrier** - Construct concrete barrier mounted rock protection fence according to Section 00820. Attach fence to barrier as shown.

(c) **Anchor Rods** - Anchor each individual fence post to the slope as shown. Place the anchor rods on the uphill side of the fence and securely bolt to the fence. The length of the anchor rod required will be determined, and if there is any variation in the anchor rod lengths, mark and install the rods with the proper post. After the anchor has been placed in the ground, backfill the hole with the material removed and thoroughly tamp in place.

(d) **Tension Cable and End Post Anchors** - Install tension cable on the posts as shown. Ensure that the cable will move freely in the hook bolt hangers. Use one continuous length of cable for each complete section of fence. Backfill the end post anchor with material removed for placing the anchor and thoroughly tamp in place with a mechanical tamper. If solid rock is encountered that makes a concrete anchor impractical, install a loop eye rock bolt and attach a turn buckle and anchor spring assembly. Then tension the cable so there is not more than a 2 inch sag when the fence fabric is in place. Pass the cable through the eye of the turnbuckle on the thimble, and after full tension has been applied, place two wire rope clips around both cables and securely tighten. Take up any additional tension with turnbuckles. Ensure that a minimum of 4 inches of take-up remains in the turnbuckle when full tension has been applied. Do not tension the bottom cable.

(e) **Gabion Wire Mesh Fabric** - Place gabion wire mesh fabric as shown. Secure the fabric to the tension cable with galvanized steel hog rings at 6 inch spacing or with lacing wire. Do not tension the fabric in any direction. It is to remain loose to increase its dampening effect on rolling rocks. Do not fasten the fabric to the fence posts or any other part of the fence except as shown for end posts. The bottom of the fabric shall rest on the slope as shown.
Lap wire mesh, both horizontal and vertical, for the slope protection mat as shown. Make all horizontal laps by overlapping 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 tie wires to the fabric with a minimum of 1.5 turns.

(f) **Slope Protection Mat Anchors** - If the slope protection mat is not secured to the rock protection fence, install anchors for the slope protection mat with the type and layout shown. The spacing and number of the anchors and cables shown are approximate only and the Engineer will direct the spacing needed to hold the wire mesh against the slope.

(g) **Rock Bolts** - If rock bolts are required, drill the holes for the rock bolts to the diameter recommended by the manufacturer of the rock bolts unless otherwise directed. Clean each hole of all drill cuttings, sludge and debris before inserting the anchor device. All threads of the rock bolts shall be free from rust, burrs and foreign matter immediately before installation of the bolts.

Set the anchor systems and place rock bolts in the holes. Adjust the position of the bolt threads so a length of thread of at least 1 inch extends beyond the nut when the installation of the rock bolt is complete. Tighten according to manufacturer’s instructions, unless otherwise directed.

(h) **Tensioning** - Tension rock bolts with a torque wrench. Once a rock bolt has been tensioned, do not relax the tension for any purpose unless authorized.

01050.47 **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.

01050.48 **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.
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.

**Measurement**

01050.80 **Barbed and Woven Wire Fence and Gateways** - The quantities of barbed wire fence, woven wire fence, and barbed and woven wire fence will be measured on the length basis of each type of 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. 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 Bid Item; otherwise this work will be according to 00140.60.

01050.81 **Metal Gates for Barbed and Woven Wire Fence** - The quantities of 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.

01050.82 **Chain Link Fence** - The quantities of 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.
01050.83  **Metal Gates for Chain Link Fence** - The quantities of chain link fence metal gates 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 chain link fence gates will be by width and height. The width will be the width of opening the gate is to fit.

01050.84  **Rock Protection Fence/Slope Protection Mat** - The quantities of rock protection fence and rock protection fence, barrier mounted, will be measured on the length basis. Measurement will be from center to center of end posts along the line and grade of each separate continuous run.

The quantities of slope protection mat, and rock protection fence with slope protection mat, will be measured by the square foot of surface area of wire mesh fabric in the "mat" and the "fence".

Rock bolts anchor blocks, cables, and hardware are considered Incidental to the work and no measurement will be made.

01050.85  **Protective Fence for Bridges** - The quantities of protective fence will be measured on the length basis. Measurement will be between beginning and ending locations as shown.

01050.86  **Removing and Rebuilding Fence** - The quantities of removing and rebuilding existing fence will be measured on the length basis, including gates.

Measurement will be from center to center of posts, measured along the line and grade of fence removed and reconstructed.

### Payment

01050.90  **General** - Payment will be payment in full for furnishing and placing all materials, and performing all earthwork, including 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 (f), will be paid for according to Section 00196.

01050.91  **Barbed and Woven Wire Fence** - The accepted quantities will be paid for at the contact 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.
01050.92 Chain Link Fence - The accepted quantities will be paid for at the contact 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 placed 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.

01050.93 Rock Protection Fence/Slope Protection Mat - The accepted quantities will be paid for at the contact 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) Rock Protection Fence</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) Rock Protection Fence, Barrier Mounted</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) Slope Protection Mat</td>
<td>Square Foot</td>
</tr>
<tr>
<td>(d) Rock Protection Fence with Slope Protection Mat</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Rock bolts, anchor blocks, cables, and hardware are considered Incidental to the work and no separate or additional payment will be made.

Item (b) includes furnishing and installing the concrete barrier.

01050.94 Protective Fence for Bridges - The accepted quantities 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.

01050.95 Removing and Rebuilding Fence - The accepted quantities will be paid for at the contact unit price per foot for the item "Removing and Rebuilding Fence". Payment will be payment in full for all work, including any new materials necessary to complete the rebuilding of the fence.
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 - Provide reinforcement for concrete collars according to Section 00530.

01070.11 Concrete - Provide concrete for concrete collars according to Section 00440.

01070.12 Tube Support Frame - Provide tube support frames meeting either of the following requirements:

- Requirements of ASTM A 500, Grade B, and galvanized according to ASTM A 123/A 123M)

- Tensile requirements of ASTM A 53/A 53M, Grade B, and galvanized with a minimum 0.9 ounce per square foot coating, as tested according to ASTM A 90/A 90M, 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 - Provide mailbox mounting brackets, angles, adapter plates, and hardware as shown and galvanize according to ASTM A 153/A 153M. Provide mounting brackets for newspaper boxes according to ODOT Standard Drawing RD 100.

01070.14 Post Mounting Socket - Provide 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 five 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 00310.43.

**Measurement**

**01070.80 General** - The quantities of mailbox supports and concrete collars will be the actual number 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 the actual number of mailbox supports, regardless of type, installed in permanent locations.

**Payment**

**01070.90 General** - 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) 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 in permanent locations.

Payment will be payment in full for all materials, equipment, labor, and incidentals necessary to complete the work as specified including:

- 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 - Provide Simazine 80W, Karmex 80W, Hyvar-X, or one 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 - Provide 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></td>
<td>Percent Passing (by Weight)</td>
<td></td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>0 - 15</td>
<td></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></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.

(d) **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 two complete coverages.

- **Gravel Blankets** - Cover the geotextile with gravel blanket aggregates to the depth specified or directed.

**Measurement**

01090.80 **General** - The quantities of gravel beds and gravel blankets will be measured on the volume basis or area basis by cross section or surface measurement, respectively, of the material in place limited to the established neat lines and grades.

**Payment**

01090.90 **General** - The accepted quantities of gravel beds and gravel blankets 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) 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 all excavating, shaping, and disposing of materials and for all materials including soil sterilant, weed control geotextile, and gravel bed and gravel blanket aggregates, and includes all equipment, labor, and incidentals necessary to complete the work as specified.
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 (P.O.C.), is the largest, or otherwise presents the most challenging hydraulics). Starting from the P.O.C., 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.

01120.11 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>Main and lateral lines</td>
<td>Schedule 40 PVC</td>
</tr>
<tr>
<td>Irrigation sleeves</td>
<td>Schedule 40 PVC</td>
</tr>
<tr>
<td>Caps</td>
<td>Schedule 80 PVC</td>
</tr>
<tr>
<td>Direct bury pipe, not in sleeves, placed</td>
<td>Schedule 40 PVC</td>
</tr>
<tr>
<td>under road beds or other paved areas</td>
<td></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:

**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.

**Soil Moisture Sensor** - A sensor that interrupts programmed irrigation cycles until the soil moisture reaches a predetermined condition at the sensor's probe location.

**Central Controller** - A computer system programmable to receive data from and provide commands to multiple irrigation systems remotely located from the central system location.

**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.

**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 Output Transmitter** - A device that reads electronic pulses from the flow sensor and sends data to the pulse-decoding device.

**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.
**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 five seconds and the opening speed is not less than three 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.
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 four 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.
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.

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.
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.

(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 two 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 five 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 two weeks before the proposed date of the training and orientation session. The date and time of the session will be mutually agreed to.

Measurement

01120.80  General - There will be no separate measurement of work done under this Section.

Payment

01120.90  General - Payment will be made at the Contract lump sum amount for the pay item "Irrigation System", which will be payment in full for furnishing and placing all materials, equipment, labor, and Incidentals necessary to complete the work, including excavation and 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 General - Materials shall meet 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
- Restrained 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 crackling 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 00290.20 (h).

(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 in the same manner described above for ductile iron pipe 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.

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 40 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 four (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 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 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:

(a) Installation - Install 8 mils thickness polyethylene encasement according to AWWA C105 and the manufacturer's recommendations. Exercise care during backfilling to prevent puncturing or otherwise damaging the polyethylene encasement. Overlap tears with one foot minimum width of polyethylene and secure with tape. Use sand backfill only with polyethylene. Fittings shall be wrapped with 40 mil geomembrane. Valves shall have two layers of the polyethylene tube encasement.

(b) Connections - When connecting to existing polyethylene-encased pipe, cut the existing encasement within 1 foot of the connection couplings or fittings. After the connections are made, overlap the existing polyethylene encasement with a minimum of 3 feet of additional polyethylene encasement and seal the overlaps with 2-inch wide polyethylene adhesive tape.
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 mils 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 direct preapproval.

(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 contact.

01140.48 **Backfilling** - After the pipe is installed and inspected, backfill the trench according to Section 00405 and as shown.
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 larger than 12 inches 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 - 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) Pre-Test Preparation - Provide all labor, materials, and equipment such as but not limited to fittings, pumps, hoses, valves, and meters, necessary to fill and test the line. Fill the mains with water and allow to stand under pressure at least 12 hours at minimum 75 percent of test pressure to allow the escape of air and to allow the lining of the pipe to absorb water. The City will provide the water to fill the pipeline at no cost to the Contractor for flushing and testing the water pipeline on water projects only.

(d) 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 disinfesting 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 one and one-half 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 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 at 95% of Standard Proctor. Place all thrust blocks and allow time for the concrete to cure to meet design strength of 75% minimum before testing. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.

(2) **Materials and Equipment** - Provide 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. 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 two hours. Provide additional pumping during the test period to 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:

\[
L = \frac{SD \times (P)^{1/2} \times 128}{148,000}
\]

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 two 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 Hydrostatic Testing** – Air testing may be used in lieu of hydrostatic testing on steel pipe for full double welded lap and double welded butt strap joints. Air test method 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:**

(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) **Disinfection** - Disinfect all new mains according to the following procedure:

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 and/or disinfection is the active distribution system. Do not test against a closed isolation valve on a live system.

2. **Valve Position** - Make sure all non-isolation valves on new main, fire hydrants and branches are 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 in the batch discharge permit make this flushing velocity unattainable. De-chlorinate and properly dispose of all water generated by this flushing activity in accordance with 01140.52(c).

4. **Chlorine Amount** - Calculate the amount of liquid sodium hypochlorite bleach (chlorine) necessary to disinfect the main, branches and services. Any bleach used for the disinfection process must be NSF 61 certified and conform to AWWA B300. The minimum residual required by DHS regulations is 25 ppm. In order to ensure that this is achieved; use a target dose of 50 ppm unless otherwise directed. Maximum dosage is 75 ppm unless otherwise directed.

5. **Chlorine Application** - Inject the main with 50 ppm chlorinated water. Use a flowmeter or pitot tube to measure flow and maintain a steady flow rate. The objective is to achieve a uniform mixture throughout the length of the pipe that is close to the target dose. 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 somewhere close to the injection point while filling the main. These measurements ensure that the applied chlorine dose is close to the target dose. Adjust the dose rate as necessary.

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, de-chlorinate and properly dispose the chlorinated water in the main and 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 not, de-chlorinate and properly dispose the chlorinated water in the main and repeat steps (3) through (7). If chlorine residual is 10 ppm or higher, then de-chlorinate and properly dispose of chlorinated water in the main, branches, and service lines and proceed to the next step.
(9) **Refill and Flush** - Refill the main, branches, and services with potable water and flush thoroughly. There is no minimum flushing velocity for this step. The City will measure the chlorine residual with the low-range test kit to ensure that the main is clear of all chlorinated water. System water is generally less than 2 ppm and if the reading is higher than that, further flushing of the main is necessary to remove the remaining chlorinated water. Dechlorinate and properly dispose of all water according to 01140.52(c). No samples will be taken until the chlorine residual of water in the main is approximately the same as the source water.

(10) **Bacteria Sampling** - If trench water or excessive quantities of dirt and debris have entered the main during construction, then follow this step. Otherwise, proceed to step (11). Bacteriological samples will be taken by the City at a maximum of 1,200-foot intervals on the main and all branches. The samples shall be taken not less than 16 hours after final flushing has occurred. Allow 24 hours for the test results. Proceed to step (12). Service laterals of 2 inches or less shall be sampled at a rate and frequency defined by the City.

(11) **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 one sample will be taken for every 1200 feet of new main. Allow 24 hours for results to return. DHS rules and the AWWA standards referenced therein require that a main pass two successive sets of bacteriological tests (the successive sets of samples shall not be collected on the same day). Two consecutive passing (negative) test results are required. Allow 24 hours for the test results.

(12) **First Sample Set** - If one or more samples in the first set test positive for coliforms, then the City will take another set of samples (including one or more samples of the source water). This is to determine if the source water is a problem or if there is a sampling error. Allow 24 hours for the test results. If all main re-samples and source water sample(s) are negative for coliforms, take a second set of bacteriological re-samples. If any main re-samples or source water samples are positive for coliforms, the Engineer will determine how to proceed.

(13) **Second Sample Set** - If all bacteriological samples in the second set of re-samples are negative for coliforms, the disinfection process is complete. Notify the City in writing that the main is ready to be tied in.

(14) **Positive Test Results** - If one or more bacteriological sample(s) in the second set of re-samples are positive for coliforms, perform another round of sampling. Allow 24 hours for the test results. If any positive samples occur in the re-sampling, the Engineer will determine how to proceed, up to and including rejecting the pipe.

(15) **Negative Test Results** - If all results are negative, take another set of samples. Allow 24 hours for results to return. If all results for coliforms are negative, the disinfection process is complete. Notify the City in writing that the main is ready to be tied in.

(16) **Resampling** - If any of the bacteriological re-samples test positive for coliforms, the Engineer will determine how to proceed.
Measurement

01140.80 Trench Work - Quantities for trench work will be measured according to Section 00405.

01140.81 Installation Under Pavement:

(a) Pavement Replacement – Quantities for replacement of pavement will be measured according to Section 00495.

(b) Tunneling, Jacking, or Boring - When the pipe is installed under pavement by tunneling, jacking, or boring methods, measurement will be according to Section 00406.

01140.82 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 bid items will be measured on a foot basis along the horizontal centerline of the finished trench.

01140.83 Couplings - Flex couplings and insulated flex couplings will be measured on a per each basis by size. All other couplings will not be measured.

01140.84 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 bid item and Sections 00195, 00196 and 00197.

01140.85 Incidental Basis - There will be no separate measurement for fittings, concrete thrust blocks, detectable marking tape wire, temporary blow offs, temporary blocking and restraint, flushing, hydrostatic testing, and disinfection test sampling points, and geomembrane or polyethylene for encasement of water line and appurtenances.

Payment

01140.90 General:

(a) Accepted Quantities - The accepted quantities will be paid for at the contract unit price per unit of measurement for each of the pay items listed in the Schedule of Items. Payment will be payment in full for furnishing and placing materials, including all equipment, labor and incidentals necessary to complete the work as specified.
(b) Price Amount - 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).

01140.91 Pipe and Couplings - Pipe and couplings will be paid at the contract unit price for one or more of the following pay items:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) inch Ductile Iron Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>(b) inch Ductile Iron Pipe Restrained</td>
<td>Foot</td>
</tr>
<tr>
<td>(c) inch Concrete Cylinder Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) inch Concrete Cylinder Pipe Restrained</td>
<td>Foot</td>
</tr>
<tr>
<td>(e) inch Steel Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>(f) inch Steel Pipe Restrained</td>
<td>Foot</td>
</tr>
<tr>
<td>(g) inch Sanitary Sewer Crossing</td>
<td>Foot</td>
</tr>
<tr>
<td>(h) inch Flex Couplings</td>
<td>Each</td>
</tr>
<tr>
<td>(i) inch Insulated Flex Couplings</td>
<td>Each</td>
</tr>
</tbody>
</table>

Payment for trench work will be according to Section 00405.

Payment for trench resurfacing will be according to Section 00495.

Payment for tunneling, jacking or boring will be according to Section 00406.

01140.92 Incidental Basis - There will be no separate payment for the following, which are considered incidental to the appropriate pipe pay items:

- Concrete thrust blocks
- Detectable marking tape or wire
- Fittings
- Flushing, hydrostatic testing and disinfection
- Geomembrane
- Polyethylene encasement
- Temporary blocking and restraint
- Abandoning out-of-service pipes
- Temporary blow offs
- Test sampling points
- All coupling, 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 General - Materials shall meet 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
- 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. 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 valve boxes 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 cast iron valve 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 pre-cast 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 five 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.

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 Disinfection - Disinfect valves according to 01140.52.

Measurement

01150.80 General - The quantities of valves will be measured on the unit basis, per each by actual type, size and count of units in place as specified. There will be no separate measurement for valve boxes, valve stem extensions or valve pads.

01150.81 Blowoff Assemblies - Blowoff assemblies will be measured on the unit basis, per each, by actual size and count of units installed.

Payment

01150.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for each of the pay items listed in the Schedule of Items. Payment will be payment in full for furnishing and placing the materials, including all equipment, labor and incidentals necessary to complete the work as specified.

01150.91 Valves - The pay items for valves will be as follows:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>____ inch Gate Valve, MJ .......................................................... Each</td>
</tr>
<tr>
<td>(b)</td>
<td>____ inch Butterfly Valve, MJ ...................................................... Each</td>
</tr>
<tr>
<td>(c)</td>
<td>____ inch High Pressure Butterfly Valve, MJ .................................. Each</td>
</tr>
<tr>
<td>(d)</td>
<td>____ inch Combination Air Release/Air Vacuum Valve ..................... Each</td>
</tr>
<tr>
<td>(e)</td>
<td>____ inch Air Release .................................................................... Each</td>
</tr>
</tbody>
</table>

In items (a) through (e) the size of the valve or assembly will be inserted in the blank.

01150.92 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.

01150.93 City Furnished Materials - Payment will be for obtaining, installing, and returning unused City-furnished valve boxes and for furnishing and installing the valves complete in place, including all earthwork not covered under other pay items, jointing, blocking of valves, protective coatings, valve boxes, PVC riser, valve operator extensions, valve pads, and hydrostatic testing.
01150.94  **Blowoff Assembly** - Payment for the item "____ inch Blowoff Assembly" will be payment in full for furnishing and placing all materials including main line tee or tapping sleeve, gate valve, fittings, ductile iron pipe or copper pipe, joint restraint, valve operator extension, testing and cleanup, all earthwork and surface restoration for this item.
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 General - Materials shall meet the following requirements:

<table>
<thead>
<tr>
<th>Base Aggregate</th>
<th>Potable Water Fitting Materials</th>
<th>Potable Water Pipe Materials</th>
<th>Potable Water Service Connection Materials, 2 Inch &amp; Smaller</th>
<th>Potable Water Valve Material</th>
<th>Precast Concrete Vaults</th>
</tr>
</thead>
<tbody>
<tr>
<td>02630</td>
<td>02475</td>
<td>02470</td>
<td>02490</td>
<td>02480</td>
<td>02484</td>
</tr>
</tbody>
</table>

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 bedding layer of 1"-0 or ¼"-0 aggregate placed and compacted to 95% Standard Proctor. Place and level fill material to reduce the occurrence of voids between the vault and the backfill. Additional thickness of aggregate may be necessary if inferior subgrade soil conditions are encountered.

(b) Sidewall Backfill - Place 1"-0 or ¼"-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. Hydrostatically test and flush all piping through the vault. Test for bacteria during the same time as main line testing.

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 crystal seal coated.

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.
01154.46 **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.

**Measurement**

01154.80 **Unit Basis** – The quantities of vaults and assemblies will be measured on the unit basis, per each by actual type, size and count of units installed in place as specified.

01154.81 **Incidental Basis** - There will be no separate measurement for valves, appurtenances, excavation, or acceptance testing.

**Payment**

01154.90 **Unit Basis** – The accepted quantities will be paid for at the Contract unit price per each for the pay item listed below:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______ Inch, _____Type Vault and Assembly.......... Each</td>
<td></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 including all equipment, labor, and incidentals necessary to complete the work as specified or as shown.

01154.91 **Incidental Basis** – Valves, appurtenances, earthwork and acceptance testing will be considered incidental to the work with no separate payment being made.
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 General - Materials shall meet the following requirements:

- Auxiliary gate valves ........................................................ 02480.20
- Concrete hydrant pad ............................................................ 00440
- End connections .............................................................. 02485.20
- Fire hydrants .................................................................... 02485.10
- Guard posts ..................................................................... 02485.70
- Hydrant dimensions ......................................................... 02485.30
- Hydrant extensions .......................................................... 02485.40
- Traffic flange .................................................................... 02485.50
- Valve boxes ..................................................................... 02480.25
- Valve operator extensions ............................................... 02480.26

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.

Construction

01160.40 Setting Hydrants:

(a) Delivery Inspection - Inspect hydrants upon delivery in the field to ensure proper working order.
(b) 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.

(c) Drainage Gravel - Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

(d) 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.

(e) 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.

(f) 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 Reconnect Existing Hydrants

- Reconnect existing hydrants where shown. Leave the location and elevation of the existing hydrant unchanged, but change the existing hydrant lateral to connect with a new auxiliary gate valve and hydrant tee provided in a new main. Install new hydrant lateral according to Section 01140 where the lateral must be extended to connect to the new main. Where existing hydrants were not restrained with tie rods to the old main, restrain the new connections with tie rods as shown, or by other joint restraint method as directed.

### 01160.46 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.

### 01160.47 Hydrant Pads

- Hydrants shall have a 3’ x 3’ x 6”, 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 Disinfection

- Disinfect hydrants according to 01140.52.

## Measurement

### 01160.80 General

- The quantities of hydrant assemblies, resetting existing hydrants, moving existing hydrants, reconnecting existing hydrants, hydrant extensions, and hydrant guard posts will be measured on the unit basis, per each, by actual count of units in place as specified.

## Payment

### 01160.90 General

- The quantities of hydrant assemblies will be measured on the unit basis, per each.

### 01160.91 Hydrant Assemblies

- Payment for fire hydrant assemblies will be full payment for all labor, materials, and equipment necessary to furnish and install a complete fire hydrant assembly, including hydrant, hydrant tee, 6 inch resilient-seated gate valve, 6 inch ductile iron pipe, fittings, hydrant extension for grade adjustment, restraint on hydrant run and the main run for the hydrant tee, excavation, bedding, backfill, 3’ x 3’ x 6” concrete hydrant pad, 8 inch PVC for valve box, valve operator extension, hydrant guard posts, out-of-service cover, concrete hydrant pier block, painting, compaction, testing, surface restoration, and clean up. Costs of installing City-furnished valve boxes and making any interim and final adjustments to match final grade are incidental to this pay item.
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:

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.

Long Run – A long run service is a service connection that crosses the roadway centerline between the main and the meter box.

Materials

01170.10 General - Materials shall meet 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 Casings or Sleeves - PVC casings or sleeves shall meet the requirements of AWWA C900

01170.12 Steel Casings or Sleeves - Steel casings or sleeves 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) **Services** - 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.

(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 combination of swing joint and elbow or a wide bend to allow limited movements by the main or the service piping.

**Testing**

01170.50 **Testing** - Testing shall be performed according to Section 01140.

**Measurement**

01170.80 **General** - Measurement of service line installation will be made on a per each basis by size for short runs and per each by size for long runs. Any service length greater than 20 feet will be measured by lineal foot 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 by the foot.

**Payment**

01170.90 **General** - The pay items for potable water service connections will be as follows:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ____ inch Service Line, Short Run</td>
<td>Each</td>
</tr>
<tr>
<td>(b) ____ inch Service Line, Long Run</td>
<td>Each</td>
</tr>
<tr>
<td>(c) ____ inch Service Line, Footage Exceeding 20 ft</td>
<td>Foot</td>
</tr>
<tr>
<td>(d) ____ inch Casing or Sleeve</td>
<td>Foot</td>
</tr>
</tbody>
</table>

In items (a) through (d), the size will be inserted in the blank.

Payment for service line installation will be made at the contract unit price for each size and type of service. Any service length exceeding 20 feet will be paid at the contract unit price per foot for that portion exceeding 20 feet. Payment will be payment in full for all equipment, labor and incidentals necessary to complete the work as specified including excavation, bedding and backfill, piping, tapping saddles, fittings, valve, vaults, meter boxes, restraint, tape wrap, testing, flushing, disinfection, cathodic protection, complete restoration and clean up.

01170.91 **Valve Boxes and Covers (CIV)** - Valve boxes and covers (CIV) will be City-furnished and installed by the Contractor. The Contractor is responsible for picking up these materials according the requirements of 01150.11(b). No separate payment will be made for the installation and for any interim and final adjustments to match final grade.
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 - 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 - 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.
Materials

01180.10  Exothermic Welds:

(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 factory installed 1/2 inch diameter steel rod.

(c) Weld Caps - Furnish weld caps of high-density polyethylene plastic, 15 mils (minimum) thickness, as manufactured by Royston Laboratories, Phillips Petroleum, 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 provided pre-filled with mastic/adhesive and supplied with primer/activator.

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-lb bare metal weight. Magnesium anodes shall meet the requirements of ASTM B-843-M1C High Potential Magnesium Alloy with an open circuit potential of (-)1.7VDC to CSE. 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 USE- or THHN-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 cast iron valve boxes and covers (CIVs).

(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 #12 shall be single-conductor, stranded copper, with USE-type insulation. Wire AWG #12 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 ft 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, 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, two insulating washers, and two 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 restraining pins on the other side.

(c) **Insulating Copper Service Fittings** - Fittings shall have insulators integral to the body of the fitting, as manufactured by Meuller 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 Seals:**

(a) **Casing Insulators and Casing End Seals** - Casing insulators shall be constructed with fusion-bonded epoxy coated steel bands and reinforced insulating runners. 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) **Sleeves and Sleeve End Seals** – Sleeves shall be schedule 40 PVC pipe, 4 inch minimum pipe diameter.

(1) **Sleeved Pipe End Seals** - End seals for sleeved pipe shall be pull on molded pipe sleeve seals with stainless steel clamps. Provide pipe sleeve seals by FERNCO, Inc. or approved equal. Molded end seals shall be sized to specific pipe type and sizes.

(2) **Copper Services End Seals** - End seals for sleeved copper services shall be pull on 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 40 PVC reducers. Molded end seals shall be sized specific to the pipe type and sizes.

01180.18 **Encasement and Tape Wrap:**

(a) **Polyethylene Encasement** - 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) **Geo-membrane** - Furnish 40 mil PVC reinforced geo-membrane with 300V/mil dielectric strength and minimum 150-lb puncture resistance and 150-lb tensile strength.
(c) Tape Wrap Coating for Casing - Provide tape wrap coating for casing pipes in accordance with AWWA C203, AWWA C209, AWWA C214, and AWWA C216. Provide tape system per manufacturer’s requirements for repair and to complete holdbacks. Provide petrolatum wax tape system per AWWA C217 with an auxiliary thin film conforming stretch outer wrap.

(d) 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.

01180.19 Thin Film Coatings:

(a) Epoxy Coating for Buried Pipe, Fittings, and Specials - Provide coating materials per AWWA C210 or AWWA C213, except no coal tar epoxy will be allowed.

(b) Epoxy Repair for Buried Pipe Coating – Provide 100% solids two component quick cure epoxy coating, NSF approved for potable water. Provide 3M Scotchkote 323 brush grade or approved equal.

(c) Coatings for Pipe on Bridges and Pipe in Vaults:

| (1) Ductile Iron Pipe | Provide a leafing aluminum epoxy mastic. |

| (2) Steel Pipe | 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. |

| (3) Alternative | As an alternative for steel pipe provide a zinc and micaceous 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. |

(d) 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.

(e) Leafing Aluminum Epoxy Coating - Provide a leafing aluminum epoxy mastic for marginally prepared surfaces. Provide Carbomastic 15 LO by Carboline or approved equal.

(f) Galvanizing - Galvanized items shall be per ASTM A123 & ASTM A 153. Provide zinc base alloys for repair per ASTM A780, zinc-rich paints are not acceptable.

(g) 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 coat tar mastic or surface tolerant epoxy.

01180.23  **Polyvinyl Chloride (PVC) Pipe** – Use PVC pipe conforming to 02410.70.

01180.24  **Gravel** – Use gravel conforming to 00405.14(c).

**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 ft maximum length.

(1) Transmission mains crossing an electric rail track shall be cased under the track and for a minimum of 10 ft 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. 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. Casing installations shall include dielectric spacers, end seals, anodes, and test stations.

(d) Piping in Vaults - Piping in vaults and above ground facilities shall be painted with a leafing aluminum epoxy mastic.

(e) Pipe on Bridges - Pipe on bridges shall be painted with an epoxy coating 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. Properly cover exothermic welds with weld caps or in the case of mortar coated steel or Concrete Cylinder pipe (CCP), tape wrap all exposed copper of weld and wire then encase all 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 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. Bond wires shall be un-spliced wire with field welds made in the trench. Alternatively, "pig tails" can be pre-welded (exothermic) to the pipe then the pigtails spliced together in the trench with split bolt connectors. To permit inspection of the welds 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 two 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 ft 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 ft 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 insulating 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 two 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 two AWG #8 wires to the casing, two AWG #8 wires to the casing side of the dielectric joint and two 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 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. Trap wrap 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 / Geo-membrane Encasement and Tape Wrap:

(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.

(b) Geo-membrane Installation - Install geo-membrane when crossing a cathodically protected foreign line where the pipe configuration does not allow for a PVC pipe sleeve. 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 polyethylene 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.

(c) Tape Wrap Coating for Pipe and Casings - Apply tape wrap coating on steel casing pipe in accordance with AWWA C203, AWWA C209, AWWA C216 for manufacturer applied tape wrap and AWWA C214 for minor field applications. For tape wrap 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 Wrap 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 as permitted, to allow the application of a dielectric coating and installation of anodes at a valve, fitting or other appurtenance in lieu of mortar coating.
Thin Film Coatings:

(a) Paint for Buried Pipe, Casings, Casing Welds - Provide an epoxy coating per AWWA C210 and AWWA C213. 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 with a thixotropic coal tar mastic, one coat of 20 mdft.

(b) Paint Coating for Pipe in Vaults and Facilities - Coat all piping except copper, brass, and 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.

(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 an epoxy coating system, 3 coats of 3-4 mdft per coat, 9-12 mdft total. Alternatively coat with 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 **Lump Sum Basis** - No separate measurement of quantities will be made for corrosion control.

01180.81 **Insulating Flex Couplings** - There will be no separate measurement of insulating flex couplings.

**Payment**

01180.90 **Lump Sum Basis** - Payment for work performed under this Section will be made at the Contract lump sum amount for the item "Corrosion Control".

Payment will be payment in full for all materials, 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.
02001.00  **Scope** - This work consists of the furnishing and testing of quality portland cement concrete, hereafter referred to as concrete, for all structures, bridges and concrete paving according to these Specifications.

Provide quality control and certified technicians according to Section 00165.

02001.01  **Abbreviations and Definitions**:

- **AEA** - Air Entrainment Admixture
- **ASTV** - Actual Strength Test Value - The average of the test cylinders' compressive strengths
- **c** - Cement
- **f'c** - Minimum Specified or Design Compressive Strength at 28 days
- **f'cr** - Average Over-design. The average compressive strength required to assure that normal variations in compressive strength will still meet or exceed \( f'c \).
- **HRWRA** - High-Range Water-Reducing Admixture (super-plasticizer)
- **LSL** - Lower Specified Limit
- **p** - Pozzolan (fly ash)
- **SSTV** - Sublot Strength Test Value
- **USL** - Upper Specified Limit
- **w** - Water
- **WRA** - Water Reducing Admixture
- **cm** - Cementitious Materials (portland cement, fly ash, silica fume, ground granulated blast furnace slag)
- **GGBFS** - Ground Granulated Blast Furnace Slag
**High Performance Concrete (HPC)** - Structural concrete, with enhanced durability and strength characteristics, for use in structures where improved durability and performance is required.

**Current Mix Design** - A mix design that meets the tolerances and limits for a specified class of concrete, and that is currently being used or has been used on any project, public or private, within the past 12 months.

**Moderate Exposure** - Concrete exposed to the environment at elevations below 1,000 feet.

**Severe Exposure** - Unless otherwise designated by the Engineer, concrete exposed to the environment at elevations above 1,000 feet.

**Tolerance** - The permitted variation from a given dimension, quality, quantity or range of variation permitted in maintaining a specified limit.

**Materials**

**02001.10 General** - Materials shall meet the following requirements of Part 02000:

- Chemical admixtures ................................................................. 02040
- Modifiers (fly ash, silica fume, latex, GGBFS) ............................. 02030
- PCC aggregates ......................................................................... 02690
- Portland cement and blended hydraulic cement ....................... 02010
- Water ....................................................................................... 02020

**Aggregate Quality**

**02001.20 General** - Blending of two or more products or sources, for the purpose of improving the properties of specification materials is permitted unless otherwise specified. Blending involving one or more non-specification materials, with the exception of non-specification gradations, is not permitted unless approved.

Provide quality control sampling and testing according to Section 00165.

**Classes of Concrete**

**02001.30 General** - Provide concrete as shown below and conforming to Table 02001-1.

(a) **Structural Concrete** - Required for bridges, structures and concrete paving when the total quantity of concrete for the Project exceeds 100 cubic yards or when high performance concrete (HPC) is specified.

(b) **Structural Concrete (Option A)** - This option is suitable for smaller projects and bridges or other structures when the total estimated quantity of concrete is equal to or less than 100 cubic yards, and for use in severe exposures for sidewalks, curbs and exposed pole and sign foundations.
(c) **Commercial Grade Concrete** - Concrete for use in sidewalks, curbs, pole foundations and sign foundations, etc. in moderate exposures.

(d) **Classes** - The class of concrete designates the $f'c$ followed by the nominal maximum size of aggregate to be used in the concrete. For example, Class 3600 - 1 1/2 indicates an $f'c$ of 3,600 psi with a nominal maximum size aggregate of 1 1/2 inch.

HPC is required when the letters "HPC" precede the $f'c$. For example, HPC4400 - 3/4 indicates high performance concrete with an $f'c$ of 4400 psi with a nominal maximum size aggregate of 3/4 inch.
### Table 02001-1

<table>
<thead>
<tr>
<th>Type of Concrete</th>
<th>Class</th>
<th>Minimum Cement Content</th>
<th>Maximum Water Cement Ratio</th>
<th>Trial Batch for New Designs</th>
<th>Test Records for Existing Designs</th>
<th>Aggregate Source Quality Tests</th>
<th>Aggregate Quality Control Testing</th>
<th>Certified Technicians Required</th>
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<tbody>
<tr>
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<td>3600 (Seal)</td>
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</table>

1. For structural concrete under Option 'A' - When a trial batch is performed and the compressive strength test results show performance in accordance with 02001.42 and 02001.43, or 02001.46, the maximum water-cement ratio for that mix design may be increased by 0.02. The minimum cement contents shown for structural concrete under Option 'A' may be reduced by up to 30 pounds for each class in which a trial batch is performed and the compressive strength performance is shown to comply with the provisions of 02001.43 or 02001.46.

2. All cementitious material (portland cement, fly ash, and silica fume). Fly ash shall be 30% by weight of the total cementitious materials.
Concrete Mix Designs

02001.40 Proportioning of Concrete Mixes - Prepare and submit either new mix designs or current mix designs for each class of concrete required. The Engineer will review the mix design for compliance with the Specifications. The proportions for structural concrete mixtures shall be determined by a certified CCT. Design each mix by the volumetric method outlined in ACI 211.1 and according to 02001.30, Table 02001-1 and 02001.50.

02001.41 Concrete Mix Design Constituents:

(a) Portland Cement - Furnish only Type I or II portland cement for structural concrete. Type III cement may be used in concrete for precast and prestressed members.

(b) Fly Ash - Except for HPC, fly ash may be used in concrete to replace a portion of the cement and as an additive to increase the total amount of cementitious materials. As a replacement for cement, fly ash may comprise up to 20% of the minimum specified cement content. Additionally, the maximum allowable percent of fly ash shall be 35% of the total cementitious materials, provided that the mix design contains at least 80% of the minimum specified cement content as shown in Table 02001-1.

(c) Blended Hydraulic Cement - Blended hydraulic cement may be used instead of fly ash and cement subject to the limits of 02001.41(b) and 02010.20.

(d) Chemical Admixtures - Add chemical admixtures to the concrete mix according to the manufacturer's recommendations. Adjust the dosage rates as necessary to obtain the qualities indicated in 02001.50. Do not exceed the manufacturer's recommended dosages. Use a water reducing chemical admixture in all seal concrete and Class 5000 or greater.

Use high range water reducing admixtures (HRWRA) in all HPC. Add other water reducing admixtures (WRA) as needed.

(e) Coarse 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.

Proportion all HPC to include a minimum course aggregate solid volume of 0.40 cubic yard per cubic yard of concrete.
02001.42 **New Mix Designs** - New mix designs are those that have not been used previously, or do not meet the requirements of 02001.46 for current mix designs. Structural concrete on projects with a total estimated quantity of concrete greater than 100 cubic yards and all structural concrete, Class HPC will require verification of mix performance by either trial batch method or the procedure described in ACI 318 Chapter 5. The mix performance verification must also comply with the following:

(a) **Trial Batch Method** - Make at least one trial batch for each class of mixture, except for CGC. Prepare and test the trial batch using the same ingredients and proportions that will be used on the Project. In order to ensure proper workability on site, simulate the haul time and mixing conditions that are forecast to occur on the Project. Cast, cure and test three or more cylinders for compressive strength. Notify the Engineer at least 48 hours in advance of when trial batches will be performed. The Engineer may witness the preparation and testing.

(b) **Plastic Concrete** - For each trial batch, test the temperature, slump, density, and air content, and compute the water-cementitious ratio and yield, according to the tests listed below. Slump, air content and water-cementitious ratio shall be within the specification limits of this Section. The mix design shall be representative of what will actually be used on the job.

(c) **Plastic Concrete Tests** - Perform the following sampling and testing of plastic concrete:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>AASHTO</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Concrete Specimens in the Field</td>
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<tr>
<td>Sampling Fresh Concrete</td>
<td></td>
<td>WAQTC TM 2(^{2})</td>
<td></td>
</tr>
<tr>
<td>Slump</td>
<td>T 119</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density/Yield Cement Content</td>
<td>T 121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air content</td>
<td>T 152</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Temperature</td>
<td></td>
<td>WAQTC TM 10</td>
<td>(^{3})</td>
</tr>
<tr>
<td>Water-Cementitious Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{1}\) Unless otherwise directed, cast cylinders in single-use plastic molds.

\(^{2}\) Obtain samples from the discharge of the delivery vehicles unless otherwise directed by the Engineer.

\(^{3}\) Use ODOT’s modified field operational procedure for AASHTO T 121, found in the MFTP.

(d) **Strength Tests** - Cast at least three 6” x 12” or 4” x 8” test cylinders, in single-use plastic molds, for each mix design. Cast and cure all strength specimens according to AASHTO T 23 or T 126, and test 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.
02001.43 **Required Strength $f'_{cr}$ for New Mix Designs** - The ASTV of the trial batch cylinders must meet or exceed option (a) or (b) below:

(a) $f'_{cr} = f'_{c} \times 1.20$  
(b) $f'_{cr} = f'_{c} + 1.34S$  

Where $S$ = standard deviation of 28-day cylinder strengths from a similar class, plus or minus 1,000 psi, mix design produced at the same plant. There must be at least 10 sets of 28-day cylinders from this similar class mix design to use option (b).

Additionally, concrete paving must also meet the following:

(c) **Flexural Beams** - The required strength for flexural beams for concrete paving mixtures shall be at least 600 psi at 28 days.

02001.44 **Review of Mix Designs** - Submit mix designs for review for all classes of concrete to the Engineer. Do not proceed with concrete placement using the mix design until the Engineer has determined that it complies with the Specifications. Review of concrete mixes will not relieve the Contractor of the responsibility to provide concrete conforming to the Specifications.

02001.45 **Required Submittals for All New Structural Mix Designs** - Submit the following information:

(a) **Contractor's Unique Number** - To identify the mix design.

(b) **Mix Design Proportions** - The weight per cubic yard and absolute volumes of cement, fly ash and aggregates (SSD), and mix water. Indicate dosage rates for chemical admixtures.

(c) **Aggregates** - Identify the source of the aggregates by the ODOT source number. Report current values obtained for:

- Bulk SSD specific gravities
- Fine and coarse aggregate absorptions
- Dry-rodded density of coarse aggregates
- Fineness modulus of sand used in the mix design calculations

(d) **Cement** - Identify the:

- Manufacturer or brand
- Type
- Source or location of cement plant

(e) **Fly Ash** - Identify the:
• Manufacturer or Brand
• Class
• Source or location of power plant

(f) Admixtures - Identify the:
• Manufacturer
• Brand name of each admixture
• Anticipated dosage rate

(g) Water - Identify the source of water to be used.

(h) Additional Requirements for All Structural Concrete - When compressive strength performance is verified by trial batches, also do the following:

(1) Tests on Plastic Concrete - Report the temperature, slump, density, air content, yield, cementitious content and water-cementitious ratio of the trial batch or batches representing this mix design.

(2) Compressive Strength Test Results - Report both the individual test results and the ASTV from the trial batch cylinders representing this mix design.

(3) Strength Analysis - Perform an analysis showing the calculations that were used to demonstrate that the mix performance meets or exceeds the minimum over-design criteria.

(4) CCT - Furnish the name and certification number of the CCT who prepared and submitted the mix design.

(i) Latex - Identify the:

Manufacturer or Brand
Type

(j) Silica Fume - Identify the:

Manufacturer or Brand
Trade name
Type - slurry or dry densified

02001.46 Current Mix Designs - Current mix designs must meet the tolerances and limits in 02001.30 and 02001.50. Demonstrate that the average of all 28-day strength tests from cylinders cast and cured according to AASHTO T 23 and tested according to AASHTO T 22 exceeds the \( f'_{cr} \) determined from the following formula:
\[ f^{*}\text{cr} = f^{*}\text{c} + 1.34S \]

where \( S \) = standard deviation of 28-day cylinder strengths

For Class 40 and higher,

\[ f^{*}\text{cr} = f^{*}\text{c} + 1.28S \]

If these requirements are not met, or if aggregates from a different source are used, submit a new mix design according to 02001.42 unless otherwise approved.

02001.47 Required Submittals for Current Mix Designs - If the current mix design has not been used on City projects, submit the information required for new mix designs (field tests may be substituted for trial batches). If the current mix design has been reviewed and accepted by the City within the past 12 months, only the following information is required:

(a) Mix Design Identification - Identify in writing the mix design proposed for use by the Contractor's unique number and the City number.

(b) Adjustments - If mix proportions have been adjusted since the design was originally reviewed, provide the adjusted mix proportions, the reasons for the adjustments, and the name and certification number of the CCT who made the adjustments. Also note changes in cement, fly ash, aggregates or admixtures, and brands.

(c) Product Source Compliance - Provide product compliance test results on samples of the coarse and fine aggregates to be used in the mix. If the test results are more than 12 months old, sample the aggregates and submit samples to the Engineer for testing according to the MFTP.

(d) Compressive Strength History - Furnish compressive strength test results obtained within the past 12 months.

02001.48 Adjusting Mix Proportions - After a mix design has been reviewed and accepted, submit any proposed adjustments to mix proportions for approval. Significant changes to the mix design (such as decreases in cement content, increases in fly ash that replaces cement, or the use of aggregates from a different source) require verification of compressive strength performance by trial batch, according to 02001.43, or test results from field tests according to 02001.46. Aggregates from new sources must meet aggregate source quality requirements according to Section 02690.

02001.49 Contractor 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 the Contractor's expense. Costs of City personnel monitoring or performing check tests will be paid by the City.
Concrete Mix Tolerances and Limits General - The concrete shall be a workable mixture, uniform in composition and consistency, and have the following properties or limits:

### Entrained Air Content Limits

<table>
<thead>
<tr>
<th>Type of Concrete</th>
<th>Entrained Air Content Tolerances</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seal Concrete</td>
<td>Not required</td>
<td>N/A</td>
</tr>
<tr>
<td>Drilled Shaft Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prestressed Members under Cast-in-Place Decks</td>
<td>+/- 1.5% from design targets shown in Table 02001-2.</td>
<td>AASHTO T 152</td>
</tr>
<tr>
<td>All Other Concrete</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 02001-2**

#### Target Air Content

<table>
<thead>
<tr>
<th>Nominal Maximum Size Aggregate</th>
<th>Severe Exposure</th>
<th>Moderate Exposure</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>
</tr>
<tr>
<td>3/4&quot;</td>
<td>6.0 %</td>
<td>5.0 %</td>
</tr>
<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>

If exposure is not denoted by the Engineer, use the values for severe exposure for elevations above 1,000 feet.

**Table 02001-3**

#### Tolerances and Limits

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Conditions</th>
<th>Limits</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Concrete Temperature at Time of Placing</td>
<td>50 °F min. 90 °F max. ¹</td>
<td>WAQTC TM 10</td>
</tr>
<tr>
<td>Slump ²</td>
<td>Concrete without WRA</td>
<td>4&quot; maximum</td>
<td>AASHTO T 119</td>
</tr>
<tr>
<td></td>
<td>Concrete with WRA</td>
<td>5&quot; maximum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concrete with HRWRA</td>
<td>3&quot; - 8&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seal Concrete</td>
<td>6&quot; - 10&quot;</td>
<td></td>
</tr>
<tr>
<td>Maximum Water-Cementitious Ratio expressed as w/cm</td>
<td>Water-cementitious ratio may not exceed the values in Table 02001-1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Except for bridge decks, where 80 °F is maximum.
² Take corrective action as necessary to maintain a consistent slump at the point of discharge from the delivery vehicle.
Section 02010 - Portland Cement

Description

02010.00 Scope - This Section includes the requirements, Specifications and tolerances 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/lb) 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 and/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 (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, cement treated base 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 two 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 seven-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/C 94M, Table 1, Acceptance Criteria for Questionable Water Supplies, and 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/C 94M, the chemical tests in Table 2 and testing for specific gravity. The testing shall be at the Contractor's expense. 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 and tolerances 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><strong>Polymer Type Stabilizers</strong></th>
<th><strong>Styrene Butadiene</strong></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)** - GGBF slag 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  General  - Use 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>ASTM C 260</td>
</tr>
<tr>
<td>Water-reducing</td>
<td>ASTM C 494/C 494M</td>
</tr>
<tr>
<td>Retarding</td>
<td>ASTM C 494/C 494M</td>
</tr>
<tr>
<td>Accelerating</td>
<td>ASTM C 494/C 494M</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 - Liquid membrane-forming curing compounds shall be from the CPL and shall conform to 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 - Clear or white polyethylene films for curing concrete shall conform to 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. |
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 - Grout used in the keyways of precast, prestressed concrete members shall be 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 one part portland cement and three 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 three parts portland cement, one part lime and twelve parts sand.
Type N – Typically one part portland cement, one part lime, six 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 - Granular quicklime (CaO) shall conform to the following:

Calcium Hydroxide Content - 113% Minimum

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 - Hydrated lime shall conform to 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 fabricating and treating wood posts and blocks for guardrail, median barrier, signs, fence posts, and braces for fencing.

Materials

02110.10 Guardrail Posts:

(a) General - Posts for guardrail and median barrier shall be of the size shown, manufactured from Douglas fir (Coast Type), or Hem-fir. Wood for posts shall have a minimum extreme fiber bending stress ($f_b$) of 1,200 psi.

(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.

(c) Certificates - Furnish certificates of lumber inspection by a recognized inspection City.

(d) Fabrication - Before preservative treatment of the post, bore the required holes perpendicular to the longitudinal axis of the post and cut the top and bottom of the post square with the longitudinal axis of the post, as shown.

(e) Preservative Treatment - Treatment shall be according to Section 02190.

(f) Seasoning and Checking - Each preservative treated post shall show evidence of reasonable amount of seasoning and/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. Treat holes for fastenings according to the requirements of AWPA Standard M 4.

\[(g)\] **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. The purpose of inspection is to cull out and reject posts that fail to meet all requirements of the Specifications, by entire lot where determinable. A "lot" comprises the posts in any charge of the treating cylinder.

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 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.

As 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.

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 (f)
- Preservative visibly oozing or bleeding 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. Posts on which splits, checks, or shakes have opened or deepened sufficiently to expose untreated wood may be repaired by treating with a field preservative from the CPL applied to all such opened or deepened wood separations and completely filling the separations to the surface of the post.

Remove from the work 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 (Coast Type) or Hem-fir meeting the requirements of 02110.10, or 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.

(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 permitted. 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. Holes in gate posts for gate hinge bolts and holes for dowels may be bored before pressure-treating, or may be bored in the field and treated with a field preservative from the CPL, applied by swabbing according to AWPA Standard M4, or applied under pressure by an approved bolt-hole treater. Where field boring or field cutting of a treated member is required, field-treat the exposed untreated surface of the member to be used in a similar manner. 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>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>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 treated 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 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 with a preservative listed in the CPL.

(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 - All wood poles shall conform to ANSI O5.1, Wood Poles, for Class 4 machine shaved Pacific Coast Douglas fir, and shall be treated according to Section 02190. All poles shall be round, sound, well proportioned from butt to tip, without short kinks or crooks, and of the dimensions specified by ANSI O5.1.

02120.20 Timber Piling - Timber piling shall conform to the requirements of ASTM D25. The butt or tip size, or whether the piling are to be friction or bearing piles, will be stated 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 American National Standard, Structural Glued Laminated Timber, Manufacturing Requirements for Glulam.

Provide quality control according to the AITC Inspection Manual.

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, but not less than 12,400 psi.

Adhesives shall meet the requirements of the glued laminated lumber standards, and be waterproof.

Appearance of members shall be architectural appearance grade as defined in AITC 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 creosote stain.

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.
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, according to ASTM A 123/A123M.

(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) Shearplate Connectors:

(1) Pressed Steel Type - Provide 2 5/8 inch diameter pressed steel shearplates manufactured from steel conforming to 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 shearplates manufactured according to ASTM A 47/A 47M, Grade No. 22010, 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 bolthole 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/A 36M. 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 ASTM A 153/A 153M. Provide these items in standard type and make, or as shown.

02150.20 Acceptance - Lumber and timber Connectors will be accepted according to 00165.35 and this Section.
Section 02190 - Preservative Treatment of Timber

Description

02190.00 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

02190.10 General  - All preservative treatment shall be according to AASHTO M 133 and its referenced AWPA Standards, except that only the following preservatives are allowed:

- Creosote
- Pentachlorophenol (any solvent)
- Ammoniacal Copper Zinc Arsenate
- Chromated Copper Arsenate, Type A, B, or C
- Copper Naphthenate
- Ammoniacal Copper Quat, Type B, C, or D

02190.20 Drying Time  - Air-dry items treated with waterborne preservatives, as defined in AWPA P5, a minimum of 30 calendar days before installation. Kiln drying for two 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. Collect all spacers and other treated wood waste from the construction site and dispose of them in a sanitary landfill.

02190.30 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 general requirements for coating materials used on timber and concrete. Detailed coating materials Specifications for the Project will be as specified.

Materials

02210.10 General:

(a) Manufacturing - The coating material shall:

- 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.

Apply coating materials before expiration of the manufacturer's recommended shelf life.

(b) Packaging - Each container shall:

- 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.

• Be lined, if necessary, to prevent attack by the coating material. The lining shall not come off the container.

• Be labeled with a quality compliance certificate showing the following:
  • Manufacturer's name
  • Exact title of coating material
  • City Specification number, if any
  • Manufacturer's batch number
  • Date of manufacture
  • Identification of all toxic substances
  • Handling and application precautions

(c) Sampling and Testing - Have the coating material manufacturer furnish the following to the City’s Materials Laboratory:

  • Two unopened 1 quart containers of each coating material, each component of multi-component coating material and each thinner, for testing of each batch of each coat, and sampled at the factory at the time of containerizing. The City may, at its discretion, place an inspector at the site of manufacture and/or obtain check samples at the Project Site.

  • A test results certificate according to ODOT’s Nonfield-Tested Materials Acceptance Guide for each batch of each coat

  • A product data sheet for each type of coating material and thinner

  • A material safety data sheet with the initial sample for each type of coating material and thinner

City testing will only include those of the following tests necessary to ensure that the coating materials conform to specifications and such other testing as the City determines appropriate.
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density Determination of Paints and Coatings</td>
<td>ODOT TM 613</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 Systems</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>Infrared Identification of Vehicle Solids From Solvent-Type Paints</td>
<td>ASTM D 2621</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.

02210.20 Coating Materials for Timber - Coating shall be as specified.

02210.30 Coating Materials for Concrete:

(a) Concrete Sealers - Unless otherwise specified, concrete sealers shall meet the requirements of 02060.10.

(b) Solvent-based Coating Materials for Concrete:

(1) System One Primer:

- Generic Type: Single-component, moisture-cured polyurethane
- Vehicle Type: Moisture-cured polyurethane
- Solids: 50% minimum by volume
- Color: Close conformance to ODOT Formula 100-82 or Federal Standard 595B #26357, concrete gray. Color chips are available from the ODOT Materials Laboratory.
(2) System One Top Coating Material:

Generic Type: Single-component, moisture-cured, graffiti-resistant polyurethane
Vehicle Type: Moisture-cured polyurethane
Solids: 52% minimum by volume
Density: 8.25 lb/gal minimum
Color: Clear

(c) Water-Based Coating Materials for Concrete:

Generic Type: Exterior, water based, acrylic emulsion
Vehicle Type: 100% acrylic emulsion latex
Vehicle Content: 62.0% minimum by volume
Pigment Content in Dry Film: 38.0% maximum

Pigment Composition (by weight of pigment):
- Titanium dioxide 7.0% minimum
- Calcium carbonate 50.0% maximum
Fungicide: Mercury-free
Color: ODOT Formula 100-82 or Federal Standard 595B #26357
Solids: 58.0% minimum by weight
Density: 11.0 lb/gal minimum
Fineness: 4 minimum
Viscosity, Krebs Units (KU): 80 - 95 at 77 °F
Dry Time: 15 minutes to touch, 60 minutes to recoat
Geosynthetics and Slope Protection

Section 02320 - Geosynthetics

Description

02320.00 Scope - Geosynthetics will be accepted for use in various applications according to the provisions of this Section.

02320.01 Definitions - Geosynthetic terms are defined in 00350.01.

Materials

02320.10 Acceptance:

(a) General Requirements - All geosynthetics shall be:

- 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 - Woven or non-woven geotextiles shall:

- 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 - Geogrids shall be:

- 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 Geo-membrane Swale Liner

- Material shall be 40-mil High Density Polyethylene (HDPE) geo-membrane, textured on both sides or approved equal. An experienced firm regularly engaged in manufacturing textured HDPE shall manufacture the geo-membrane.

### (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.
02320.10(e)

(e) **City Check Tests** - The City reserves the right to sample and test products for compliance with pertinent requirements, according to 00165.02.

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 on the plans
- 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 Supported</th>
<th>Sediment Fence Geotextile Unsupported</th>
<th>Subgrade Geotextile</th>
<th>Embankment Geotextile</th>
<th>Pavement Overlay Geotextile</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>260</td>
<td>90</td>
<td>120</td>
<td>120</td>
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<tr>
<td>Machine Direction</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>2</td>
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<tr>
<td>Cross Machine Direction</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Grab Elongation (minimum)</td>
<td>ASTM D 4632</td>
<td>%</td>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
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<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>
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<tr>
<td>Puncture strength (minimum)</td>
<td>ASTM D 4833 or ODOT TM 816</td>
<td>lb</td>
<td>35</td>
<td>80</td>
<td></td>
<td></td>
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<tr>
<td>Apparent opening size (AOS) (maximum), U.S. Standard Sieve</td>
<td>ASTM D 4751 (CW-02215 Corps of Engr.)</td>
<td>in</td>
<td>No. 70</td>
<td>No. 70</td>
<td>No. 30</td>
<td>No. 30</td>
<td>No. 30</td>
<td>No. 30</td>
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<tr>
<td>Permittivity (minimum)</td>
<td>ASTM D 4491</td>
<td>s⁻¹</td>
<td>0.5</td>
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<tr>
<td>Ultraviolet stability (Retained Strength) (minimum)</td>
<td>ASTM D 4355 At 500 hours</td>
<td>%</td>
<td></td>
<td></td>
<td>70</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Asphalt retention (minimum)</td>
<td>ODOT TM 817</td>
<td>oz/ft²</td>
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<tr>
<td>Melting point (minimum)</td>
<td>ASTM D 276</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1 Slit film or slit 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>Values</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>
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<tr>
<td>Tensile Strength at 2% Strain</td>
<td>ASTM D 6637-01</td>
<td>lb/ft</td>
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<td>545</td>
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<tr>
<td>Rib Thickness</td>
<td>ASTM D 1777</td>
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<td>Flexural Stiffness</td>
<td>ASTM D 5732-95</td>
<td>mg-cm</td>
<td>750,000</td>
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<tr>
<td>Junction Efficiency</td>
<td>GRI:GG2-87</td>
<td>%</td>
<td>90</td>
<td></td>
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<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>
<td></td>
</tr>
<tr>
<td>Aperture Size Range</td>
<td>I.D. Caliper</td>
<td>inch</td>
<td>0.75 - 1.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 geo-membrane.
02320.23  DPE Sheet - 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></td>
<td></td>
</tr>
<tr>
<td>Strength at Break, lb/in-width</td>
<td>ASTM D 6693, Type IV</td>
<td></td>
</tr>
<tr>
<td>Strength at Yield, lb/in-width</td>
<td>Dumbell, 2 ipm</td>
<td></td>
</tr>
<tr>
<td>Elongation at Break, %</td>
<td>G.L. = 2.0 in</td>
<td>60</td>
</tr>
<tr>
<td>Elongation at Yield, %</td>
<td>G.L. = 1.3 in</td>
<td>84</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 percent 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 General - Fabricate gabion baskets from twisted or welded wire mesh. 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:

- Wire diameter tolerance limit: \( \pm 0.004" \)
- Tensile strength: \( \geq 60,000 \text{ psi minimum} \)
- Galvanizing: \( \geq 0.80 \text{ oz/ft}^2 \text{ minimum} \)

\(^1\) Tensile area includes galvanizing

Welded wire shall also conform to ASTM A 185 except that the weld shears shall be 600 pounds for 11 gage, and 800 pounds for 9 gage wires. All wire sizes are after galvanizing.

Tie wires and internal connecting wires shall be galvanized and no smaller than 13 1/2 gage. 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 gage, 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 gage 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/A 641M.

Materials

02340.10 Twisted Wire Mesh Gabion Baskets - Gabion panels of the twisted mesh style shall be manufactured from 11 gage with 9 gage 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 - Gabion panels of the welded mesh style shall be manufactured from 11 gage or 9 gage 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 gage panels. Gabions of square cross section (cubical-celled units) may be made with either 9 gage or 11 gage panels, except that within the same unit, panels of dissimilar wire sizes may not be mixed.

Galvanized 9 gage stiffeners, placed diagonally in the baskets at the vertical one-third 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 02340.10 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 gage 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 gage 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 gage 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 designing and fabricating 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.
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:

| 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 and/or trademark of the pipe manufacturer
2. Nominal pipe size
4. Resin Type
5. Manufacturer’s Standard reference.
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 it 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 manufacturers 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.

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 percent 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” to 36” 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 percent 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 two 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 two 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 three nor more than five 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 - Provide corrugated steel pipe, helical rib pipe, pipe arches and special sections conforming to the requirements of ASTM A 760/A 760M 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:

- Full-Circle Pipe - Fabricate helical rib pipe in full-circle cross section only.

- 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.

- 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).
(d) **Repair of Damaged Coating** - In addition to the methods given in ASTM A 760/A 760M 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 two 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.

(e) **Irrigation Pipe** - In irrigation pipe installations, where Type D coating (AASHTO M 190) is not specified, the Contractor will be permitted 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.

(f) **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 - Use 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 (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 (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>
</tr>
<tr>
<td>0.079</td>
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<tr>
<td>0.109</td>
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</tr>
<tr>
<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.

(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 permitted. 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** - Provide corrugated steel pipe for underdrains conforming to the requirements of ASTM A 760/A 706M Type III - Underdrain Pipes, except as modified in 02420.10(c) and (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** - Provide corrugated aluminum alloy pipe, helical rib pipe, pipe arches and special sections conforming to the requirements of ASTM B 745/B 745M, 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 ASTM B 745/B 745M 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° or greater total angle, use a three-piece section of approximately equal length and 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 permitted to furnish pipe with Type D coating.

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 ASTM B 745/B 745M. 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** - Provide corrugated aluminum alloy pipe for underdrains conforming to the requirements of ASTM B 745/B 745M 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 ASTM B 745/B 745M 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 - Use galvanized steel plates for structural plate pipe conforming to the requirements of ASTM A 761/ A761M.

(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 indicated on the drawings 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 - Provide aluminum alloy plates for structural plate pipe conforming to the requirements of ASTM B 746/B 746M. Fabricate according to 02430.10(b) through (d).
02430.90  **Bolts, Nuts, and Washers**  - Bolts, nuts and washers for use with galvanized steel structural plate pipe shall conform to the requirements of ASTM A 761/A 761M and be galvanized according to ASTM A 153/A 153M.

Bolts, nuts and washers for use with aluminum alloy structural plate pipe shall conform to the requirements of ASTM B 746/B 746M and be galvanized according to ASTM A 153/A 153M.

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 and miscellaneous concrete applications.

Materials

02440.10 Preformed Expansion Joint Fillers for Concrete - Use preformed expansion joint fillers for concrete conforming to the requirements of ASTM D 1752 or ASTM D 1751. Fillers conforming to ASTM D 1751, 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 five years. Unless otherwise specified or indicated, the Contractor may elect to furnish either type specified in this subsection.

02440.11 Poured Silicone Sealant - Use a two-component, low modulus, rapid-cure silicone sealant.

02440.14 Backer Rod - Use a closed-cell, non-gassing foam material backer rod from the CPL.

02440.15 Lubricant/Adhesive - Use a lubricant/adhesive that is a 100% solid, two-component, modified epoxy adhesive designed for bonding polychloroprene seals to concrete or steel.

02440.19 Steel Bridging Plate - Use a merchant quality steel bridging plate with a minimum thickness of 1/8 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. Sand blast the steel bridging plate prior to installation.

02440.20 Preformed Elastomeric Joint Seals - Use preformed elastomeric joint seals, compression joint seals and strip joint seals conforming to the requirements of ASTM D 2628.

02440.21 Elastomeric Concrete - 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 Poured Joint Filler - Use poured joint filler from the CPL and conforming to the requirements of AASHTO M 173 (ASTM D 1190).
02440.40 Rubber Gaskets for Concrete Pipe and Precast Manhole Section Joints:

(a) **Preformed Plastic Gaskets** - Use materials for tongue and groove or key lock manhole joints conforming to the requirements of ASTM C 990.

(b) **Rubber Gaskets** - Use materials for O-ring manhole and concrete pipe joints conforming to ASTM C 443/C 443M.

02440.50 Joint Materials for Concrete Precast Manhole Section Joints -

(a) **Mortar** - Use mortar conforming to the requirements of ASTM C 387.

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-Shrink Grout** - Use non-metallic cementitious commercial grout from the CPL that exhibits zero shrinkage according to ASTM C 827. Do not amend grout with cement or sand, or recondition it with water after initial mixing. Place or pack non-shrink grouts only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. Use a bonding agent compatible with the grout used. Do not use water as a substitute for the commercial bonding agent.

02440.60 Plastic Compound for Precast Manhole Section Joints - Use 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 - Use 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:
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 two days at 158 °F.
- **Tensile Strength after Aging** - The test specimen, after accelerated aging of seven 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 plus or minus 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.

**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 sump sections, metal frames, covers, grates and ladders.

Materials

02450.10 Precast Concrete Manhole Sections - Precast risers, cones and cover slabs for precast concrete manholes shall conform to the requirements of ASTM C 478/C 478M 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 - Precast rings and lids for precast concrete sumps shall be of portland cement concrete conforming to ASTM C 478/C 478M 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, Grates and Ladders - 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, M270/A 709/A 36, M 103/A 27</td>
<td>65, 36, 65 - 35</td>
</tr>
<tr>
<td>Manhole ladder rails</td>
<td>M270/A 709/A 36, M 227/A 663</td>
<td>36, 65</td>
</tr>
</tbody>
</table>

Fabricate steps for manholes and rungs for manhole ladders from structural steel having a minimum yield strength of 28,000 psi and galvanized according to ASTM A 123/A 123M.

As an alternate, steps for manholes may be steel-reinforced plastic conforming to ASTM C 478/C 478M and ASTM C 497. The steel shall be deformed reinforcing bar conforming to ASTM A 615/A 615M Grade 60, #4 minimum. The plastic material surrounding the reinforcing steel bar shall be injection molded, with a textured, non-slip surface and a minimum thickness over the steel of 1/16 inch. Voids in the plastic will be cause for rejection of the step.

Welding shall conform to AWS D1.1. Frames, covers and grates for use one with another shall have even and uniform bearings. Miscellaneous metal items and hardware shall conform to the appropriate requirements of Section 00560.
02450.40  **Damaged Zinc or Aluminum Coating** - Repair damaged zinc or aluminum coating according to 02420.10(d).

02450.50  **Acceptance** - Acceptance of manholes and inlets will be according to 00165.35 and this Section.
Section 02470 - Potable Water Pipe Materials

Description

<table>
<thead>
<tr>
<th>02470.00 Scope</th>
<th>This Section includes the requirements for various potable water pipe materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>02470.10 General</td>
<td>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).</td>
</tr>
</tbody>
</table>

Materials

<table>
<thead>
<tr>
<th>02470.20 Ductile Iron Pipe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Conformance Requirements</td>
</tr>
<tr>
<td>(b) Lining and Coating</td>
</tr>
<tr>
<td>(c) Flanged Pipe</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>02470.30 Steel Pipe 6 Inch and Larger:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Conformance Requirements</td>
</tr>
<tr>
<td>(b) Length and Diameter</td>
</tr>
</tbody>
</table>
(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 C203 (hot applied, cold tar enamel coating) or AWWA C214 (cold applied, tape coating) or AWWA C205 (cement-mortar protective coating). The hot applied, coal tar enamel coating (AWWA C203) shall consist of Type B primer, coal tar enamel, and glass-fiber outerwrap.

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 3/16 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.

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 pre-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>Size</th>
<th>Turns</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, and/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, ½ to 2 ½ inches in size, shall have bronze body with soft seat design and shall have female IPT ends with inlet ranging from ½ to 2 inches and outlet ranging from ¾ to 2 ½ inches. Orifice sizes range from 0.121 to 1.399 square inches. The valve shall have a temperature range of –20 deg F to 800 deg 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 - Pre-cast 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 Pre-cast 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)** - Cast iron valve (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 zero percent 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 six 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 Ball - 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 chloramines 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 percent 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 and 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 shall have the same length of existing meter, with the same 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 deg 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 deg 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. |
Section 02510 - Reinforcement

Description

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/A 706M or ASTM A 615/A 615M. Unless otherwise specified or shown, all reinforcing bars shall be Grade 60.

02510.11 Epoxy Coated Reinforcement:

(a) General - Epoxy coated reinforcement shall conform to the requirements of ASTM A 775/A 775M 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 ASTM A 615/A 615M, for Grades 40 and 60, or ASTM A 663/A 663M for Grades 70, 75, and 80.

02510.60  **Wire Reinforcement** - Wire reinforcement shall conform to the requirements of ASTM A 82. Deformed wire shall conform to the requirements of 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 ASTM A 416/A 416M, 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 ASTM A 421/A 421M.

02515.30 Bars, High Tensile Strength - High strength steel bars shall conform to the requirements of ASTM A 722/A 722M.

02515.40 Seven-Wire Strand Epoxy Coated Reinforcement - Epoxy coated reinforcement shall conform to the requirements of ASTM A 882/A 882M.

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 gage for 2 5/8 inch diameter and smaller ducts, and 24 gage 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 permitted, 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.

02515.80 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 ASTM A 6/A 6M.

(b) Steel Pipe Piles - 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/A 36M. 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.

Reinforce the tips of steel H-piles with approved cast steel points from the CPL. In addition, cast steel points shall meet the following:

The Cast steel points 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

Each cast steel 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.

Legibly mark or tag each cast steel point delivered to the Project site with the heat or lot number. If the heat or lot number cannot be read or if the mark or tag is missing, the point will be rejected. Submit certified mill test reports showing the physical and chemical properties of each heat or lot number.
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 five 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 three piles
- Drive the piles to ultimate capacity
- Pull piles and examine the points
- No damage to the cast steel points is discernible

(d) Steel Sheet Piles - Steel sheet piles shall conform to ASTM A 328/A 328M.

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 4,350 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 ASTM A 615/A 615M, 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 two 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/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 and Specifications 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 ASTM A 709/A 709M, Supplementary Requirement S83, Non-Fracture-Critical, T, Material; Toughness Tests and Marking, is mandatory for all non-fracture critical steel.

Supplementary Requirement S6 (ASTM A 709/A 709M, Supplementary Requirement S84), Fracture-Critical, F, Material; Toughness Testing and Marking, is mandatory for all fracture critical steel.

Supplementary Requirements S5 and S6 (S83 and S84) shall apply to all primary load carrying members and secondary members that are welded to primary members, but shall not apply to bearing devices. They shall apply to both temporary and permanent traffic and railroad bridges. Toughness requirements for all areas of Oregon shall be according to Zone 2 requirements.

Supplementary Requirement S9, 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 B of ASTM A 6/A 6M, 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:

- ASTM A 709, Grade 36
- ASTM A36
- 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 ASTM A 709/A 709M, Supplementary Requirement S83.

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

02530.30 **Copper Bearing Steel** - When copper bearing steel is specified for increased corrosion resistance, the steel shall contain not less than 0.20% copper by heat analysis.

02530.40 **Ultrasonic Inspection of Plate** - Ultrasonically inspect flanges for welded plate girders before fabrication according to ASTM A 578/A 578M except as follows:

- Inspect after the flanges have been stripped from the master plate.
- 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 may be performed in the plant or warehouse where the flanges are stripped.

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 expense to the Department.
02530.70   **Galvanizing** - Galvanizing shall be by the hot-dip process according to the following, as applicable:

- ASTM A 123/A 123M
- ASTM A 153/A 153M

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/A 123M.

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 and Specifications 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 ........................................ASTM A 668/A 668M, Class C
- Alloy steel forgings ............................................ASTM A 668/A 668M, Class G

02540.20 Steel Shafting - Steel shafting shall be cold-finished and shall conform to ASTM A 108, Grades 1016 - 1030, inclusive.

02540.30 Steel Castings - Steel castings shall conform to the following:

- Carbon steel castings.................................... ASTM A 27/A 27M, Grade 70-36
- Alloy steel castings ..........................ASTM A 743/A 743M, 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 arrises 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 30 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/A 47M, 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 ..................... ASTM B 22 Copper Alloy UNS No. C91100
- Copper alloy plates .................. 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 and Specifications 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" - 1 1/2" - ASTM A 563, Grade A, hex
- over 1 1/2" - 4" - ASTM A 563, Grade A, heavy hex

Galvanized Bolts:

- All - ASTM A 563, Grade 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 ASTM A 325, types as specified. 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 - ASTM A 563, Grade C, D, or DH, heavy hex

Type 1 Galvanized Bolts:

- All - ASTM A 563, Grade DH, heavy hex

Type 3 Bolts:

- All - ASTM A 563, Grade C3 or DH3, heavy hex
(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 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 Bolts:

(a) Carbon Steel Tie Rods and Anchor Bolts - Carbon steel tie rods and anchor bolts 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 Bolts - High-strength tie rods and anchor bolts 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 bolts shall conform to the requirements of the following, or equivalent:

Plain Carbon Steel Tie Rods and Anchor Bolts:

- All - ASTM A 563, Grade A, heavy hex

Galvanized Carbon Steel Tie Rods and Anchor Bolts:

- All - ASTM A 563, Grade DH, heavy hex

Plain Or Galvanized High-Strength Tie Rods or Anchor Bolts:

- All - ASTM A 563, Grade DH, heavy hex

(d) Washers - Washers for anchor bolts shall conform to ASTM F 436, Type 1.

02560.40 Galvanizing and Coating of Fasteners, Tie Rods, and Anchor Bolts:

(a) Galvanizing of Fasteners, Tie Rods, and Anchor Bolts - Hot-dip galvanize fasteners, tie rods, anchor bolts, nuts and washers according to ASTM A 123/A 123M or ASTM A 153/A 153M 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 bolts with appropriate galvanized nuts for assembly. Ship nuts in the same container consisting of bolts, tie rods, or anchor bolts.

Overtap nuts for galvanized fasteners, galvanized tie rods, and galvanized anchor bolts according to 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.

Testing

02560.60 Testing:

(a) **Rotational Capacity Test** - Test all high-strength fasteners, except anchor bolts 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 and/or washers with the hole size the same nominal diameter as the hole in the washer for the fastener to be tested. Allow three to five 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:

   \[ T = 0.25 \times PD \]

   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 three to five 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 and nuts after galvanizing, overtapping and lubricating. Coated bolts 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 one extra tie rod and/or anchor bolt per size per lot for check testing.

02560.70 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 must 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.

02560.80 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 General - Provide materials meeting the following requirements:

- Structural steel ................................................................. 02530.20
- Stainless steel sliding surfaces .................. ASTM A 240/A 240M, Type 304
- Flat brass rings for pot bearings ...................... ASTM B 36/B 36M, half hard
- Cap screws ............................................................. ASTM A 574 or ASTM F 835
- Bolts and nuts .................................................. ASTM A 325 and Section 02560
- Galvanized bolts, nuts, washers, cap screws,
  sole plates and base plates ................................. 02530.70 and 02560.40
- Polytetrafluoroethylene (TFE) ......Division II, Section 18 of the current AASHTO
  Standard Specifications for Highway Bridges
  Do not use reprocessed material.

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:

<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>2,500</td>
</tr>
<tr>
<td>Ultimate elongation, minimum, %</td>
<td>D 412</td>
<td>450</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat Resistance</th>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in durometer hardness, maximum points</td>
<td>D 573</td>
<td>+10</td>
</tr>
<tr>
<td>Change in tensile strength, maximum, % at 158 °F</td>
<td>70 hour</td>
<td>-25</td>
</tr>
<tr>
<td>Change in ultimate elongation, maximum, %</td>
<td>-25</td>
<td></td>
</tr>
</tbody>
</table>

Compression Set | ASTM Test Method | Value  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22 hours at 158 °F, maximum, %</td>
<td>D 395, Method B</td>
<td>25</td>
</tr>
<tr>
<td><strong>Ozone</strong></td>
<td><strong>ASTM Test Method</strong></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td>-------</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>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Adhesion</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond made during vulcanization, lb/in</td>
<td>D 429, Method B</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Low Temperature Test</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittleness at -40 °F</td>
<td>D 746, Procedure B</td>
<td>No Failure</td>
</tr>
</tbody>
</table>

**VIRGIN CHLOROPRENE:**

<table>
<thead>
<tr>
<th><strong>Physical Properties</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></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>2,500</td>
</tr>
<tr>
<td>Ultimate elongation, minimum, %</td>
<td>D 412</td>
<td>400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Heat Resistance</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in durometer hardness, maximum points</td>
<td>D 573, 70 hour</td>
<td>+15</td>
</tr>
<tr>
<td>Change in tensile strength, maximum, % at 212 °F</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td>Change in ultimate elongation, maximum, %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Compression Set</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>22 hours at 212 °F, maximum, %</td>
<td>D 395, Method B</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ozone</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Adhesion</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond made during vulcanization, lb/in</td>
<td>D 429, Method B</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Low Temperature Test</strong></th>
<th><strong>ASTM Test Method</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittleness 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></td>
<td></td>
</tr>
<tr>
<td>at 100% elongation</td>
<td>ASTM D412</td>
<td>2,000 min</td>
</tr>
<tr>
<td>at 200% elongation</td>
<td></td>
<td>3,700 min</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:

- Duck shall be highest quality cotton or cotton-polyester 50-50 blend, and weighing a minimum of 8 ounces per square yard.
- Cotton warp and filling yarn shall be two ply.
- Cotton-polyester warp and fill shall be single yarn with a minimum breaking strength by grab method of 150 pounds per inch of width warp, and 140 pounds per inch of width fill.
- 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 (TFE) surface is 2,000 psi. It shall not be greater than 0.04 when the maximum working stress for the TFE surface is 3,500 psi. Determine the coefficient according to requirements of subsection 18.8.3 of the AASHTO Standard Specifications for Highway Bridges.

(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 two 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 material 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 the following table:

<table>
<thead>
<tr>
<th>Properties</th>
<th>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 gage thick and conforming to ASTM A 1011/A 1011M, Grade 36 Type 1, or ASTM A 1008/A 1008M, 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.
(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 will 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 permitted. 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 18.2.5, Division II of the AASHTO Standard Specifications for Highway Bridges 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.

Test all completed bearings by compressive visual inspection as described in 02571.30(b).

Obtain an independent testing laboratory and test one standard test specimen of laminated pad as described in ASTM D 429, Method B, from each production lot for peel strength as described in 02571.30(c). Failure of individual bearings to pass the compressive visual inspection will be a cause for rejection of those individual bearings. Failure to pass the peel strength test requirements will be a cause for rejection of all bearings from that production lot. Replace rejected bearings with new acceptable bearings at no cost to the City. The Contractor shall bear the costs of providing the sample pad and all testing herein.

Mark all bearings in indelible ink or flexible paint with job number, lot number 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) **Compressive Visual Inspection** - Bring all bearings to a temperature of 73 °F plus or minus 10 °F and proof load individually for a compressive load of 1,500 psi. 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 and the laminate
- Three or more separate surface cracks which are each at least 0.08 inch wide and 0.08 inch deep

(c) **Peel Strength Test** - The bond between the elastomer and steel laminate shall be not less than 40 pounds per inch when tested according to ASTM D 429, Method B.

(d) **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).
Aggregates

Section 02610 - Special Filter Material

Description

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</th>
<th>Manufactured Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent Passing</td>
<td>Percent Passing</td>
</tr>
<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 02630-1
Grading Requirements for Dense-Graded Aggregate

<table>
<thead>
<tr>
<th>Separated Sizes</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>2 1/2&quot; - 0</td>
</tr>
<tr>
<td>3&quot;</td>
<td>100</td>
</tr>
<tr>
<td>2 1/2&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>2&quot;</td>
<td>–</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>–</td>
</tr>
<tr>
<td>1 1/4&quot;</td>
<td>55 - 75</td>
</tr>
<tr>
<td>1&quot;</td>
<td>–</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>–</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>–</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>–</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>30 - 45</td>
</tr>
<tr>
<td>No. 10</td>
<td>1</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:

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</td>
<td>AASHTO T 96</td>
<td>35.0% maximum</td>
</tr>
<tr>
<td>Degradation (Coarse Aggregate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing No. 20 sieve</td>
<td>ODOT TM 208</td>
<td>30.0% maximum</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>ODOT TM 208</td>
<td>3.0&quot; maximum</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>Percentage of Fracture by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Retained on 3/4&quot;, 1/2&quot;, and 1/4&quot; Sieves (two fractured faces)</td>
</tr>
<tr>
<td>Material Retained on No. 10 Sieve (one fractured face)</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<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.

Table 02640-1
Grading Requirements - Shoulder Aggregates
Separated Sizes

<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>

(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:

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>ODOT TM 208</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 testing the fine and coarse aggregates for portland cement concrete.

Materials

02690.10 General - 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. The maximum coarse aggregate size shall be 1 1/2 inch.

(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>1.00</td>
</tr>
<tr>
<td>Material passing No. 200 sieve</td>
<td>T 11</td>
<td>1.00</td>
</tr>
<tr>
<td>Wood particles</td>
<td>TM 225</td>
<td>0.05</td>
</tr>
</tbody>
</table>

1 For 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 will 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 Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>30.0% Maximum</td>
</tr>
<tr>
<td>Oregon Air Aggregate Degradation</td>
<td></td>
</tr>
<tr>
<td>Passing No. 20 sieve</td>
<td>30.0% Maximum</td>
</tr>
<tr>
<td>Sediment Height</td>
<td>3.0&quot; Maximum</td>
</tr>
</tbody>
</table>
(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 will be according to AASHTO T 2 and sieve analysis will be determined according to AASHTO T 27/T 11. PCC coarse aggregate shall conform to grading and separated sizes as follows:

1. Where indicated in Table 02690-1 below, 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 thereof shall be as in Table 02690-2:

<table>
<thead>
<tr>
<th>Table 02690-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Nominal Size of Aggregates</strong></td>
</tr>
<tr>
<td>1&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

2. The grading of each of the specified separated sizes of coarse aggregate shall conform to the following:

<table>
<thead>
<tr>
<th>Table 02690-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Separated Sizes</strong></td>
</tr>
<tr>
<td><strong>Sieve Size</strong></td>
</tr>
<tr>
<td>Percent Passing (by weight)</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
</tr>
<tr>
<td>3/8&quot;</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

*See 02690.20(b)*
(g) Grading and Separation by Sizes for Other Concrete - Sampling will be according to AASHTO T 2. Sieve analysis will be according to AASHTO T 27/T 11. Provide aggregates meeting the gradation requirements of Tables 02690-3 and 02690-4 below for structural concrete on projects with more than 100 cubic yards of concrete. Provide a CAgT to perform sampling and testing when required.

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>2&quot;</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>95 - 100</td>
<td>90 - 100</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>–</td>
<td>20 - 55</td>
<td>95 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>35 - 70</td>
<td>0 - 15</td>
<td>–</td>
<td>85 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>–</td>
<td>–</td>
<td>25 - 60</td>
<td>0 - 15</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>10 - 30</td>
<td>0 - 5</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
<td>–</td>
<td>0 - 10</td>
<td>–</td>
</tr>
<tr>
<td>No. 8</td>
<td>–</td>
<td>–</td>
<td>0 - 5</td>
<td>–</td>
</tr>
</tbody>
</table>

1 For 1 1/2 inch coarse aggregate use two or more separated sizes which when combined will 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>1&quot;</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90 - 100</td>
<td>90 - 100</td>
<td>100</td>
<td></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>–</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

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 %&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> 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 will 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 will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 68.

(g) **Sand for Mortar** - Sand for mortar shall conform to the requirements of this Section.

(h) **Grading** - Sampling will be according to AASHTO T 2. Sieve analysis will be determined according to AASHTO T 27/T 11. Provide aggregates meeting the gradation requirements of Table 02690-5 below 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 - 4&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> Table 02690-5

<sup>2</sup> The percentage of material passing the No. 200 sieve may be increased to 10% when the material is essentially free of fine particles.
1 Determine the fineness modulus according to AASHTO T 27/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/A 36M. The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be in the range of 0 - 0.04% or 0.15% - 0.25%.

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 in the range of 0 - 0.04% or 0.15% - 0.25%.
- 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 ASTM A 27/A 27M, Grade 65-35.

02810.50 Metal Thrie Beam Rail - Form metal thrie beam rail from galvanized steel. Galvanized steel beam shall conform to the requirements of AASHTO M 180, for Class A rail. The zinc coating shall conform to the requirements for Type II, AASHTO M 180, 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. 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 test requirements, Specifications and tolerances 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 boltholes, 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/A 36M and galvanized according to ASTM A 123/A 123M.

02820.30 Guardrail Hardware:

(a) General - 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 ASTM A 123/A 123M.

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/A 36M. After fabrication galvanize tubing and plate according to ASTM A 123/A 123M.

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/A 36M.

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be in the range of 0 - 0.04% or 0.15% - 0.25%.

02830.20 Steel Pipe - Steel pipe used for handrail members shall comply with ASTM A 53/A 53M or ASTM A 500.

02830.30 Incidental - 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.
Section 02840 - Pavement Marking Materials

Description

02840.00 Scope - This Section includes the requirements for striping paint, reflective beads, primers, adhesive and materials for thermoplastic pavement markings and pavement markers.

02840.01 Definitions:

(a) Entrance Angle - The angle in the horizontal plane between a ray from the light source to the marker and the normal to the leading edge of the marker face.

(b) Observation Angle - The angle between a ray from the light source to the marker and the returned ray from the marker to the measuring receptor.

Materials

02840.10 Striping Paint - Use striping paint from the CPL.

02840.20 Reflective Beads - Use traffic paint beads from the CPL or as recommended by the manufacturer of the material in which they will be used.

02840.50 Primers - The primer used over concrete or asphalt pavements shall be compatible for use with the pavement and marking material, and shall increase the bond of the marking material to the pavement. Use a primer approved by the manufacturer of the striping material being used.

02840.60 Pavement Markers:

(a) Type I Reflectorized - Provide reflectorized markers from the CPL, with one or two reflective faces as required to reflect incident light from the specified directions.

Markers provided for installation as recessed markers shall not be more than 4 inches wide in the dimension perpendicular to the direction of traffic.

(b) Type II Nonreflectorized - Use nonreflectorized markers from the CPL.

02840.61 Adhesive:

(a) Epoxy Adhesive - Use Type I or Type II adhesive from the CPL or that conforms to the requirements of AASHTO M 237, except that the viscosity of the individual components at 77 °F plus or minus 2 °F shall be 1,000 to 5,000 poise.
The methods of testing epoxy shall comply with AASHTO T 237 and the following field test:

Into an unwaxed 8 ounce paper cup discharge 8 ounce of mixed epoxy as prepared for application to the traffic marker. Permit the epoxy to thoroughly harden without any additional mixing. Split open the cast resin with a cold chisel and hammer. If the exposed face is of uniform color the epoxy is adequately mixed. If streaks of white or black epoxy are evident, the epoxy is inadequately mixed. Correct mixing equipment deficiencies before further use.

(b) Bituminous Adhesive:

(1) General - Use bituminous adhesives from the CPL and meeting the following requirements:

The bituminous adhesive shall be an asphaltic material with a homogeneously mixed mineral filler and shall be suitable for bonding markers to portland cement concrete, asphaltic concrete, and chip sealed road surfaces. Apply when road surface and marker temperatures are in the range of 40 °F to 160 °F. The adhesive properties shall not deteriorate when heated to and applied at temperatures up to 425 °F using either air- or oil-jacketed meters. The material shall not contain rubber polymers.

(2) Packaging and Labeling - Package the adhesive in silicone lined cardboard containers that will stack properly. The label shall show the product name, lot or batch number and manufacturer's name and address. Print "Bituminous Adhesive for Pavement Marker" in bold lettering on the label.

02840.70 Acceptance - Acceptance of pavement marking materials and adhesive will be according to 00165.35 and this Section.
Section 02850 - Delineators

Description

02850.00 Scope - This Section includes the requirements for support posts, target members, and flexible posts for delineators.

Materials

02850.10 Galvanized Support Posts:

(a) General - Fabricate the support member from hot-rolled steel sections meeting either of the requirements given in Table 02850-10.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Minimum Yield Strength, psi</th>
<th>Minimum Ultimate Strength, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot-rolled carbon steel - min. carbon content 0.32%</td>
<td>40,000</td>
<td>70,000</td>
</tr>
<tr>
<td>Hot-rolled rail steel ¹</td>
<td>50,000</td>
<td>80,000</td>
</tr>
</tbody>
</table>

¹ As defined in U.S. Department of Commerce Commercial Standard CS 150-48, rail steel products shall be rolled from standard tee-section steel rails. No other materials, such as those known by the terms "re-rolled", "rail steel equivalent", and "rail steel quality", shall be substituted.

The support posts shall be of channel section and of the nominal dimensions and weight per foot shown on the plans, subject to the manufacturer's tolerances in dimensions, and a tolerance in weight of 3.5% in any one shipment and 5% under for any one post, and a tolerance in length of 1 inch under and 2 inches over. The members shall be straight and free of sharp corners and rough or burred edges or surfaces.

(b) Multiple Punching - Support posts with holes in addition to those called for on the plans will be acceptable provided that the critical net width of the section measured on the frontal plane projection of the post is not less than 2 1/2 inches.

(c) Galvanizing - Galvanize support posts after fabrication according to ASTM A 123/A 123M.

(d) Acceptance - Acceptance of support posts will be according to 00165.35, 02850.10, and the following:

(1) Pretested Stock - A supplier may qualify an identified lot of support posts for use by the City by complying with the requirements of 02850.10. This lot may then be subdivided for shipment to several projects. Such sublots may be accepted on the basis of certification by the supplier that the identified lot of support posts had been qualified by the City’s Materials Laboratory.
(2) **Galvanized Support Posts** - If galvanized support posts are not from a qualified lot, furnish one post per 1000 posts, or any fraction thereof, for testing.

02850.20 **Target Members:**

(a) **General** - The target members shall be of aluminum alloy conforming to the requirements of ASTM B 209/B 209M, "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 manufacturers’ 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:

   - Two 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 one 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” x 13 3/4” 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, 02850.20 and the following:

(1) **Pre-tested Stock** - Target members may be qualified according to the method used in 02850.10(d), if the lot of target members comply with the requirements of 02850.20(a) through (d).

(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:

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>Number of Target Test Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1000</td>
<td>1 per 100 or fraction of 100</td>
</tr>
<tr>
<td>1000 - 10,000</td>
<td>10 plus 1 per 500 or fraction of 500</td>
</tr>
<tr>
<td>More than 10,000</td>
<td>30 plus 1 per 1000 or fraction of 1000</td>
</tr>
</tbody>
</table>

- 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 re-sampled 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.

02850.30 **Flexible Delineators:**

(a) **General** - Material for the above-ground portion of flexible delineators shall:

- Be flexible, durable plastic; resistant to impact, ultraviolet light, ozone, hydrocarbons and other effects of atmospheric weathering

- Exhibit good workmanship and be free of burns, discoloration, contamination and other objectionable marks or defects that affect appearances or serviceability
Material for the portion of Type 2 or Type 3 delineators to be installed below ground level shall either be the same as the portion above ground or other durable material suitable for firmly anchoring the post in the ground. If the portion installed in the ground is either iron or steel, galvanize it according to ASTM A 153/A 153M, Class B-2.

(b) Design Prequalification - All flexible delineators shall be from the CPL.

(c) Flexible Delineator Requirements:

(1) **Marking** - Mark the top of the post on the side away from traffic with the manufacturer's name, symbol or brand and the month and year of fabrication. The legend shall be at least 1/4 inch in height and shall be either die stamped or legibly stamped with permanent ink.

(2) **Dimensions** - The post shall have a width of 3 inches plus or minus 1 inch, facing traffic and long enough to provide the required height above the pavement surface while providing the required anchoring specified under (3) below.

The top 12 inches of Type 2 delineator posts shall have a uniformly smooth, flat surface at least 3 inches x 12 inches in size on which to mount the reflective material. The 3 inch x 12 inch surface may be slightly rounded provided the minimum brightness value is not significantly reduced.

The top 12 inches of Type 3 delineator posts shall be round in shape to provide for 360° reflectance.

(3) **Base Anchoring** - When permanently installed, the delineator post shall resist overturning, twisting and displacement from wind and impact forces, and be able to pass the impact resistance requirements of 02850.30(c)(8).

(4) **Color** - The delineator posts shall be either yellow in color or opaque white as designated. The yellowness index of the white posts shall not exceed 12 when tested according to ASTM E 313. The daylight 45°, 0° luminous directional reflectance shall be a minimum of 70 when tested according to ASTM E 1347. Yellow posts shall meet the requirements for Highway Color Tolerance Chart Color No. 13538 of Federal Standard 595.

(5) **Heat Resistance** - Condition one delineator post a minimum of two hours in an oven at 140 °F plus or minus 3 °F. Firmly grasp the heat-conditioned post at one end and hold vertically. Bring down the free end to make a tight 180° bend in the middle of the post with the viewing face on the outside of the bend. When released, the post shall straighten itself to within 1 inch of its original straightness within 30 seconds. Repeat the bend test three more times within three minutes of removal from the oven or return the post to the oven for one hour before completing the test.

(6) **Cold Resistance** - Condition two delineator posts a minimum of two hours at -5 °F plus or minus 3 °F in an environmentally controlled test chamber or cold box. If possible, perform testing in the environmental chamber.
a. **Bending** - Subject one cold conditioned post to a tight 90° bend at its midpoint four times with the viewing face on the outside of the bend. The post shall not be adversely affected and shall be capable of straightening itself after each bend to within 1 inch of original straightness within 60 seconds after being released. If the test is performed outside of an environmental chamber the first two bends shall be made within three minutes of removal from the cold box. Return the specimen to the cold box for one hour before making the last two bends, which shall also be made within three minutes of removal from the cold box.

b. **Impact** - Test one cold conditioned post, other than the one used in the test described in the previous paragraph, as follows:

Place the post in a horizontal position with the traffic face up and supported on cylindrical bearings approximately 6 inches in diameter, spaced 36 inches apart. Subject the post to five impact tests, concentrated at the midpoint of the post, by dropping a 1 inch diameter tup (weight approximately 2.37 pounds) a distance of 5 feet through a virtually frictionless vertical guide to impact the surface of the post. Cracking or splitting of the post constitutes failure. If a cold box is used, complete the test within two minutes of removal from the cold box or return the post to the cold box for one hour before completing the test.

(7) **Weatherometer** - Expose the delineator post material for 1000 hours in a weatherometer conforming to ASTM G 26, (Method 1, standard cam, 50 to 60% relative humidity, 145 °F black-panel temperature). Significant yellowing or darkening of the white posts, change of color of the yellow posts, or significant loss of pliability will be cause for failure.

(8) **Impact Resistance** - Manufacture delineator posts from impact-resistant material, and design so that an installed post is capable of self-erecting, remaining in position and serviceable after being subjected to a series of straddle hits by a typical sedan. The impacting vehicle shall suffer little or no damage during the impact test series.

Use five delineator posts in the impact tests, which shall be conducted when the temperature is 40 °F or above. The posts to be tested shall be complete with attached reflective material proposed for use and shall be installed according to the manufacturer's recommendations. The five posts shall withstand a series of 10 impacts head-on (90°) into the traffic face of the post at 35 mph and a series of five impacts at an angle of 75° to the traffic face of the post at 55 mph. Four of the posts must pass the test.

(d) **Acceptance** - Acceptance of flexible delineators will be according to 00165.35, 02850.30 and the following:

(1) **Pre-tested Stock** - Flexible delineators may be qualified according to the method used in 02850.10(d), if the lot of flexible delineators comply with the requirements of 02850.30.

(2) **Flexible Delineators** - If flexible delineators are not from a qualified lot, furnish two samples per 1000 posts, or any fraction thereof, for testing.
Reflective Sheeting - Reflective sheeting shall have the following minimum coefficient of retroreflection values:

<table>
<thead>
<tr>
<th>Entrance Angle</th>
<th>Observation Angle</th>
<th>Coefficient of Retroreflection $^1$ (cd/lx·m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4°</td>
<td>0.2°</td>
<td>250</td>
</tr>
<tr>
<td>+30°</td>
<td>0.2°</td>
<td>150</td>
</tr>
</tbody>
</table>

$^1$ Average cd/lx·m² according to Federal Standard 370

Mount the reflective sheeting on the posts as detailed on the plans by an approved positive means that has adequate strength to prevent loss of the reflective material during the life of the post.
Section 02910 - Sign Materials

Description

02910.00 Scope - This Section includes the requirements for backing, sheeting, legend, reflectors and hardware for sign installations.

Fabricate wood sign posts according to the requirements of 02110.40.

Materials

Backing

02910.10 Aluminum - The aluminum materials shall conform to the following requirements:

- Extruded aluminum shapes ........................................... ASTM B 221/B 221M
- Rolled or extruded structural shapes ...................... ASTM B 308/B 308M
- Aluminum sheet ................................................... ASTM B 209/B 209M
- Aluminum bars or rods ............................................. ASTM B 211/B 211M
- Aluminum sand castings............................................ ASTM B 26/B 26M

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&quot;</td>
<td>0.063&quot;</td>
</tr>
<tr>
<td>20&quot; through 30&quot;</td>
<td>0.080&quot;</td>
</tr>
<tr>
<td>31&quot; through 48&quot;</td>
<td>0.100&quot;</td>
</tr>
<tr>
<td>Over 48&quot;</td>
<td>0.125&quot;</td>
</tr>
</tbody>
</table>

02910.11 Plywood:

(a) General - Construct all plywood signs from 3/4 inch high-density overlay plywood or medium-density overlay plywood. Plywood shall be Douglas fir plywood, Grade B-B exterior or better, conforming to "Product Standard PS-1 for Douglas Fir Plywood" published by the U. S. Department of Commerce.
(b) **Overlay** - High-density and medium-density overlay shall be black or buff unless otherwise shown or specified. High-density and medium-density overlay shall conform to "Product Standard PS-1 for Douglas Fir Plywood".

(c) **Plywood Sealer** - Fill any voids in top or sides of panel with caulking compound after cutting plywood to size. Apply an approved plywood edge sealer tinted to match the color of the panel overlay material. The sealer shall be a medium oil alkyd primer.

**Sheeting**

02910.20 **Reflective and Retroreflective Sheeting** :

(a) **General** - Use reflective sheeting Type 1 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** - Provide quality compliance certification according to 00165.10(b).

02910.21 **Nonreflective Sheeting 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 00940.01. 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) Finish - The finishing clear coat applied to sign faces shall be compatible with the sheeting and shall conform to the requirements of the sheeting manufacturer.

(g) Acceptance - Furnish a quality compliance certificate according to 00165.10, certifying that the nonreflective sheeting furnished meets all the above requirements.

02910.31 Retroreflective Sheeting (Wide-Angle, Prismatic):

(a) General - The retroreflective sheeting for sign faces/finished signs shall have a smooth surface with distinctive interlocking diamond seal pattern and orientation marks visible from the face. Precoat the sheeting with a pressure-sensitive adhesive backing protected by a removable liner. The retroreflective sheeting (wide angle, prismatic) shall be one of the following types as shown or specified.

(1) Type A - Type A sheeting is a wide-angle retroreflective sheeting with optimized performance over a broad range of observation angles. Normal use is for surface mounted signs.

(2) Type B - Type B sheeting is a wide-angle retroreflective sheeting with optimized performance at narrow observation angles and with extended entrance angle performance. Normal use is for overhead mounted signs.

(b) Acceptance Sampling and Testing - The following documents of the issue in effect on the date the Project is advertised form a part of this Specification to the extent specified as follows:

(1) ASTM Standards:

- B-117 Method of salt spray (fog) testing.
- E-284 Standard Definitions of Terms Relating to Appearance of Materials.
- E-308 Computing the Colors of Objects by Using the CIE System.
- E-810 Standard Test Method for Coefficient of Retroflection ($R_A$) of Retroreflective sheeting.
(2) **CIE Publications** - CIE Publication Number 39-2, Recommendations for Surface Colors for Visual Signaling:

The adhesive shall require no heat for proper bonding when applied according to the manufacturer's recommendations to substrates 18 °C (65 °F) or above.

(3) **Test Methods:**

**a. Test Conditions** - Unless otherwise specified all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of:

- 73 °F ± 3 °F, and
- 50% ± 5% relative humidity for 24 hours before testing

**b. Test Panels** - Unless otherwise specified when tests are to be performed using test panels, apply the specimens of retroreflective material to smooth aluminum cut from ASTM B-209/B 209M, alloy 5052-H36, 5052-H38, 5154-H38, or 6061-T6 sheets in the following thickness:

- 0.020 inch
- 0.040 inch
- 0.063 inch

Degrease and lightly acid etch the aluminum before the specimens are applied. Apply the specimens to the panels according to the retroreflective sheeting manufacturer's recommendations.

**c) Photometric** - The retroreflective sheeting shall have the following daytime color specification limits *:

<table>
<thead>
<tr>
<th>Color</th>
<th>1</th>
<th></th>
<th>2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>0.305</td>
<td>0.305</td>
<td>0.355</td>
<td>0.355</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>0.487</td>
<td>0.423</td>
<td>0.545</td>
<td>0.454</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>0.690</td>
<td>0.310</td>
<td>0.595</td>
<td>0.315</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>0.078</td>
<td>0.171</td>
<td>0.150</td>
<td>0.220</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>0.030</td>
<td>0.398</td>
<td>0.166</td>
<td>0.364</td>
<td></td>
</tr>
<tr>
<td>Orange (new or weathered)</td>
<td>0.583</td>
<td>0.416</td>
<td>0.523</td>
<td>0.397</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>X</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>0.335</td>
<td>0.375</td>
<td>0.285</td>
<td>0.325</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>0.465</td>
<td>0.534</td>
<td>0.427</td>
<td>0.483</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>0.569</td>
<td>0.341</td>
<td>0.655</td>
<td>0.345</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>0.210</td>
<td>0.160</td>
<td>0.137</td>
<td>0.038</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>0.286</td>
<td>0.446</td>
<td>0.201</td>
<td>0.794</td>
<td></td>
</tr>
<tr>
<td>Orange (new or weathered)</td>
<td>0.560</td>
<td>0.360</td>
<td>0.631</td>
<td>0.369</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Type A sheeting may not be available in red.

### Reflectance Limit Y (%)

<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>40</td>
<td>–</td>
</tr>
<tr>
<td>Yellow</td>
<td>24</td>
<td>45</td>
</tr>
<tr>
<td>Red</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Blue</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Green</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Orange (new)</td>
<td>30</td>
<td>–</td>
</tr>
<tr>
<td>Orange (weathered)</td>
<td>20</td>
<td>45</td>
</tr>
</tbody>
</table>

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

### Maximum Spectral Radiance Factor

<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Weathered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>110%, min.</td>
<td>60%, min.</td>
</tr>
</tbody>
</table>

(1) **Color Test** - Determine conformance to color requirements by instrumental method according to ASTM E 1164 on sheeting applied to test panels and conditioned as in 4.1. Do the computations according to ASTM E 308 for the 2° observer.

(2) **Coefficient of Retroreflection (R_A)** - The coefficients of retroreflection (R_A) shall not be less than the minimum values specified in Table 02910-5 (Type A Sheeting), Table 02910-6 and Table 02910-6A (Type B Sheeting). Perform testing according to ASTM E 810 except that Table 02910-5 and Table 02910-6 values shall be met at 0° and at 90° orientation without averaging and the Table 02910-6A values shall be met using only the 45° orientation.

- Coefficients of retroreflection (R_A) shall be specified in units of candelas per lux per meter squared.
- The observation angles shall be 0.2° and 0.5°. Type A shall also be measured at 0.33° and 1.0° observation.
- For measurement, the datum mark (orientation arrow) shall be positioned horizontally for the 0° orientation and vertically for the 90° (preferred) orientation.
For screen printed transparent color areas on white sheeting, the ratios of the $R_A$ for the white to the $R_A$ for color, when measured at $0.2^\circ$ observation, $-4^\circ$ entrance, and $0^\circ$ orientation, shall be $5:1$ to $15:1$ for Red and not less than $5:1$ for Green and Blue when processed according to the sheeting manufacturer’s recommendations.

### Table 02910-5

**Type A Sheeting**

**Minimum Coefficient of Retroreflection ($R_A$)**

(cd/lx·m²)

(0° and 90° Orientation)

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>White</th>
<th>Yellow</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20</td>
<td>-4</td>
<td>430</td>
<td>350</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>0.20</td>
<td>+30</td>
<td>235</td>
<td>190</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>0.20</td>
<td>+40*</td>
<td>150</td>
<td>125</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>0.33</td>
<td>-4</td>
<td>300</td>
<td>250</td>
<td>33</td>
<td>15</td>
</tr>
<tr>
<td>0.33</td>
<td>+30</td>
<td>150</td>
<td>130</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>0.33</td>
<td>+40*</td>
<td>85</td>
<td>75</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>0.50</td>
<td>-4</td>
<td>250</td>
<td>200</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>0.50</td>
<td>+30</td>
<td>170</td>
<td>140</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>0.50</td>
<td>+40*</td>
<td>35</td>
<td>30</td>
<td>3.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1.00</td>
<td>-4</td>
<td>80</td>
<td>65</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>1.00</td>
<td>+30</td>
<td>50</td>
<td>40</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>1.00</td>
<td>+40*</td>
<td>20</td>
<td>17</td>
<td>2.0</td>
<td>0.7</td>
</tr>
</tbody>
</table>

* Measure the $40^\circ$ entrance angle at the $90^\circ$ orientation only.

### Table 02910-6

**Type B Sheeting**

**Minimum Coefficient of Retroreflection ($R_A$)**

(cd/lx·m²)

(0° and 90° Orientation)

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>White</th>
<th>Yellow</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Fluorescent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>-4</td>
<td>800</td>
<td>660</td>
<td>215</td>
<td>80</td>
<td>43</td>
<td>200</td>
</tr>
<tr>
<td>0.2</td>
<td>+30</td>
<td>400</td>
<td>340</td>
<td>100</td>
<td>35</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>0.2</td>
<td>+45</td>
<td>145</td>
<td>85</td>
<td>25</td>
<td>12</td>
<td>7.6</td>
<td>–</td>
</tr>
<tr>
<td>0.2</td>
<td>+50</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>50</td>
</tr>
<tr>
<td>0.2</td>
<td>+60 *</td>
<td>35</td>
<td>23</td>
<td>6.6</td>
<td>2.0</td>
<td>1.0</td>
<td>–</td>
</tr>
</tbody>
</table>
### Table 02910-6

**Type B Sheeting**  
**Minimum Coefficient of Retroreflection (R<sub>A</sub>)**  
(cd/lx·m<sup>2</sup>)  
(0° and 90° Orientation)

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>White</th>
<th>Yellow</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Fluorescent Orange</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>-4</td>
<td>200</td>
<td>160</td>
<td>45</td>
<td>20</td>
<td>9.8</td>
<td>80</td>
</tr>
<tr>
<td>0.5</td>
<td>+30</td>
<td>100</td>
<td>85</td>
<td>26</td>
<td>10</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>0.5</td>
<td>+45</td>
<td>75</td>
<td>60</td>
<td>18</td>
<td>6.0</td>
<td>2.8</td>
<td>–</td>
</tr>
<tr>
<td>0.5</td>
<td>+50</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>20</td>
</tr>
<tr>
<td>0.5</td>
<td>+60</td>
<td>*</td>
<td>30</td>
<td>20</td>
<td>6.4</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* Measure the 60° entrance angle at the 90° orientation only.

### Table 02910-6A

**Minimum Coefficient of Retroreflection (R<sub>A</sub>)**  
(cd/lx·m<sup>2</sup>)  
(45° Orientation)

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>-4</td>
<td>550</td>
</tr>
<tr>
<td>0.2</td>
<td>+30</td>
<td>130</td>
</tr>
<tr>
<td>0.5</td>
<td>-4</td>
<td>145</td>
</tr>
<tr>
<td>0.5</td>
<td>+30</td>
<td>70</td>
</tr>
</tbody>
</table>

(3) **Gloss Retention** - The retroreflective sheeting shall have an 85° specular gloss of not less than 50 when tested according to ASTM D 523.

(4) **Color Processing** - The retroreflective sheeting shall permit cutting and color processing with compatible transparent opaque process colors according to the sheeting manufacturer's recommendations at temperatures of 60 °F to 100 °F and relative humidities of 20% to 80%.

The sheeting shall be heat resistant and shall permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.
(d) **Adhesive** - Remove the protective liner attached to the adhesive by peeling without soaking in water or other solutions, and without breaking, tearing or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for four hours at 160 °F under a load of 2.5 pounds per square inch. The adhesive backing of the retroreflective sheeting shall produce a bond to support a 1.75 pound weight for five minutes without the bond peeling for a distance of more than 2 inches when applied to a test panel prepared as in 02910.31(b)(3)(b). Apply 4 inches of a 1 inch by 6 inch specimen to a test panel. Condition and then position the panel face down horizontally. Suspend the weight from the free end of the sample, and allow it to hang free at an angle of 90° to the panel surface for five minutes.

(e) **Durability:**

1. **Flexibility** - The retroreflective sheeting, with the liner removed and conditioned as in 02910.31(b)(3)(a), shall be flexible and show no cracking when slowly bent, in one second's time, around a 1/8 inch mandrel, with the adhesive contacting the mandrel, at test conditions. Spread talcum powder on the adhesive to prevent sticking to the mandrel.

2. **Impact Resistance** - The retroreflective sheeting, applied according to the sheeting manufacturer's recommendations to a test panel of aluminum alloy 6061-T6, 0.040" x 3" x 5" and conditioned as in 02901.31(b)(3)(a), shall show no cracking outside the impact area when the face of the panel is subjected to the impact of a 4 pound weight, with a 5/8 inch diameter rounded tip, dropped from a height necessary to generate an impact of 10 in·lb, at test temperatures of 32 °F and 72 °F.

3. **Resistance to Accelerated Outdoor Weathering** - The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after two years of unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, wash the panels in a 5% hydrochloric acid solution for 45° seconds, rinse thoroughly with clean water, blot with a soft clean cloth and bring to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than the values in Table 02910-7 (Type A Sheeting) and in Table 02910-8 (Type B Sheeting) when measured at 0° rotation, and the colors shall conform to the requirements of Table 02910-4. The sample shall:

- Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32 inch shrinkage or expansion.

- Where more than one panel of a color is measured, the coefficient of retroreflection \( (R_a) \) shall be the average of all determinations.

- For Type A Sheeting, be measured only at angles of: 0.2° observation, -4° entrance, and 0° rotation; and 1.0° observation, -4° entrance, and 0° rotation.

- For Type B Sheeting, be measured only at angles of 0.2° observation, -4° entrance, and 0° rotation.
Table 02910-7

Type A Sheeting
Minimum Coefficient of Retroreflection (Rₐ)
After Accelerated Outdoor Weathering
(cd/lx·m²)

<table>
<thead>
<tr>
<th>Color</th>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>cd/lx·m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>0.2</td>
<td>-4</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>-4</td>
<td>45</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.2</td>
<td>-4</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>-4</td>
<td>35</td>
</tr>
<tr>
<td>Blue</td>
<td>0.2</td>
<td>-4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>-4</td>
<td>1.3</td>
</tr>
<tr>
<td>Green</td>
<td>0.2</td>
<td>-4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>-4</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 02910-8

Type B Sheeting
Minimum Coefficient of Retroreflection (Rₐ)
After Accelerated Outdoor Weathering
(cd/lx·m²)

<table>
<thead>
<tr>
<th>Color</th>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>cd/lx·m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>0.2</td>
<td>-4</td>
<td>400</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.2</td>
<td>-4</td>
<td>330</td>
</tr>
<tr>
<td>Red</td>
<td>0.2</td>
<td>-4</td>
<td>107</td>
</tr>
<tr>
<td>Green</td>
<td>0.2</td>
<td>-4</td>
<td>38</td>
</tr>
<tr>
<td>Blue</td>
<td>0.2</td>
<td>-4</td>
<td>22</td>
</tr>
</tbody>
</table>

(4) Resistance to Heat - Apply the retroreflective sheeting to a test panel and condition as in 02910.31(b)(3)(a); measure according to 02910.31(c)(2) at 0.2° observation and -4° entrance angles at 0° orientation and exposed to 170 °F plus or minus 5 °F for 24 hours in a circulating-air oven. After heat exposure, the sheeting shall retain a minimum of 70% of the original coefficient of retroreflection at each orientation when measured at room temperature.
(5) **Resistance to Corrosion** - The retroreflective sheeting, applied to a test panel and conditioned as in 02910.31(b)(3)(a), shall show no loss of adhesion, appreciable discoloration or corrosion, and after cleaning shall retain a minimum of 80% of the original coefficient of retroreflection when measured at 0.2° observation, -4° entrance and 0° rotation angles, after 1000 hours exposure to a 5% concentration salt spray at 95 °F when tested according to ASTM B 117.

(f) **Warranty** - The reflective sheeting shall carry a manufacturer's warranty for a minimum of seven years from the date of fabrication. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that:

(1) The sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision, or

(2) The coefficient of retroreflection, after cleaning, is less than the minimums specified in Table 02910-7 (Type A Sheeting) or Table 02910-8 (Type B Sheeting). Make all measurements after sign cleaning.

The Agency will date all signs at the time of application. That date constitutes the start of the field performance obligation period.

Where it can be shown that performance requirements of the sheeting supplied and used according to manufacturer’s recommendations have not been met, the manufacturer shall bear the cost as follows for sheeting shown to be unsatisfactory during the:

- First five years, the manufacturer shall bear the cost of restoring the sign panel to its original effectiveness at no cost to the Agency for materials or labor, including removal and reinstallation if necessary.

- For the remaining two years, from the 61st to the 84th month, from the date of fabrication, the manufacturer shall furnish replacement sheeting required to restore the sign panel to its original effectiveness.

02910.32 **Reflectorized Removable Legend**-

(a) **General** - The letter and numeral design shall be the "E" modified version of the FHWA's standard rounded upper case, lower case, and capital letter alphabet.

Provide mounting holes within the frames to permit the use of the mounting hardware specified herein. 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) Sampling and Testing - Sample and test removable legend according to the following:

(1) Sampling - Submit sample letters of each size of removable legend used on the Project to the Engineer for testing. The number of samples submitted shall equal 5% of the letters of each size with a minimum of two letters of each size of removable legend submitted. Submit two samples of each size border material used on the Project. The letters submitted shall be letters used on the signs for the Project.

(2) Testing - Substitute sample letters for actual letters used on the Project signs. The Engineer will test the letters removed from the sign according to 02910.32(b). Failure of one letter or border sample will result in the rejection of the sign from which it came. If a sign is rejected, the Engineer may require the testing of all the remaining signs on the Project that contain removable legend. If additional testing is required, the Engineer will specify the letter to be tested from each sign. No more than two letters of each size of removable legend will be tested from each sign. Furnish the additional letters to the City at the Contractor's expense.

02910.33 Permanent Legends:

(a) General - Permanent legends consist of silver-white reflectorized screened, red reflectorized screened, black screened or cut-out silver reflective sheeting. The letters and numerals of all permanent legends shall conform to the design of the FHWA "Standard Rounded Capital Letter Alphabets".

(b) Reflectorized White Screened Legend - The transparent paste materials used for the reverse screening of reflectorized white legends and for the screening of reflectorized red legends shall conform to the recommendations of the manufacturer of the reflective sheeting.

(c) Retroreflectorized Silver Cut-out Legend - The material used for retroreflective cut-out legend shall conform to the requirements of 02910.20.

(d) Non-reflectorized Black Screened or Cut-out Legend - The screen process ink for non-reflectorized 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) Non-reflectorized Black Cut-out Legend - The material used for non-reflectorized cut-out legend shall conform to 02910.20.
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/B 211M, alloys 2024-T4 or 6061-T6 as the Contractor elects. Aluminum washers shall conform to ASTM B 209/B 209M, 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 ASTM A 153/A 153M.

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/B 316M. 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 Sheeting:**

(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 of electronic cuttable film shall not require the release of any volatile organic compounds.

(b) **Acceptance Sampling and Testing** - The following documents, of the issue in effect on the date the Project is advertised, form a part of this Specification to the extent specified as follows:

1. **ASTM Standards:**
   - B-209/B 209M Specification for Aluminum and Aluminum Alloy Sheet and Plate.
   - E-284 Standard Definition of Terms Relating to Appearance of Materials.
   - E-308 Computing the Colors of Objects by Using the CIE System.
(2) **CIE Publications** - CIE Publication Number 39-2 Recommendations for Surface Colors for Visual Signaling.


(4) **Test Methods:**

   a. **Test Conditions** - Unless otherwise specified all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of:

   - 73 °F ± 3 °F, and
   - 50%, ± 5%, relative humidity for 24 hours prior to testing

   b. **Test Panel** - Unless otherwise specified, when tests are to be performed using test panels the specimens of retroreflective and/or overlay film material shall be applied to smooth aluminum cut from ASTM B-209/B 209M Alloy 5952-H36, 5052-H38, 5154-H38, or 6061-T6 sheets in the following thicknesses:

   - 0.020 inch
   - 0.040 inch
   - 0.063 inch

   Degrease and lightly acid etch the aluminum before the specimens are applied. Apply the specimens to the panels according to the reflective sheeting and electronic cuttable film manufacturer's recommendations.

(c) **Photometric** - When electronically cuttable film is applied to retroreflective sheeting, the resulting color of the composite sheeting shall conform to Federal Specification FP-92, Section 718.01 and ASTM D 4956 for the appropriate retroreflective sheeting to which it is applied.

   1. **Color Test** - Determine conformance to color requirements by instrumental method according to ASTM E 1164 on sheeting applied to aluminum test panels. Perform the computations according to ASTM E 308 for the 2° observer.

   2. **Coefficient of Retroreflection (Ra)** - When electronically cuttable film is applied to retroreflective sheeting, the composite shall conform to the percentage retained of the minimum coefficient of retro-reflection specified by the City and the manufacturer for the retroreflective sheeting when the retroreflective sheeting is screen processed. The coefficient of retroreflection shall be determined in accordance with ASTM E 810.
• Coefficients of retro-reflection \( (R_A) \) shall be specified in units of candelas per lux per square meter.

• The observation angles shall be 0.2° and 0.5° unless otherwise specified.

• The entrance angles shall be -4° and 30° unless otherwise specified.

Retroreflective sheeting with datum marks shall be tested in the orientation specified by the manufacturer. If no datum mark is supplied, the sheeting shall be rotated to determine the minimum \( R_A \), which shall be reported without averaging.

(3) Gloss Retention - The electronic cuttable film shall have an 85° specular gloss of not less than 50 when tested in accordance with ASTM D 523.

(4) Color Processing - The electronic cuttable film shall permit cutting, weeding, masking with transfer tape, lifting, and application to retroreflective sheeting when used in accordance with manufacturer’s recommendations at temperatures between 65 °F and 95 °F and relative humidities between 30% and 70%. The film shall lay flat with minimal edge curl and be dimensionally stable.

(d) Adhesive - Remove the protective liner attached to the adhesive by peeling without soaking in water or other solution, and without breaking, tearing or removing any adhesive from the electronic cuttable film. The liner shall have a controlled release from the adhesive coated film sufficient to allow cutting without the film popping off from the liner while still allowing the liner to easily be peeled from the film.

Film with punched edges for use on sprocket fed knife over roll cutters shall be edge scored and weeded to remove film in the punched area as a means of eliminating adhesive build up on the sprockets.

(e) Resistance to Accelerated Outdoor Weathering - When electronic cuttable film is applied to retroreflective sheeting, the surface of the film shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after two years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, wash the panels in a 5% HCL solution for 45 seconds, rinse thoroughly with clean water, blot dry with a soft clean cloth and bring to equilibrium at standard conditions. After cleaning, the coefficient of retro-reflection shall not be less than the value specified by the City for the retroreflective sheeting when the retroreflective sheeting is screen processed. The sample shall:

• Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32 inch shrinkage or expansion

• Show "Good" color fastness or better when tested as in 02910.60(f)

Retained reflectivity shall be the same as the City Specification for screen processed retroreflective sheeting of the type being tested.
The electronic cuttable film shall not be removable from the retroreflective sheeting without damage.

Retroreflective performance measurements made after weather exposure shall be made only at angles of 0.2° observation and -4° entrance. Where more than one panel of a color is measured, the coefficient of retro-reflection shall be the average of all determinations.

(f) Colorfastness - Wet out one specimen, exposed and prepared as specified in 02910.60(e), with a mild detergent and water solution. Compare with a similarly treated unexposed specimen under natural (North sky) daylight or artificial daylight having a color temperature of 7600 °K. Evaluate the colorfastness as follows:

| Excellent | No perceptible change in color |
| Good      | Perceptible but no appreciable change in color |
| Fair      | Appreciable change in color |

Appreciable change in color means a change that is immediately noticeable in comparing the exposed specimen with the original comparison specimen. If closer inspection, or a change of angle of light, is required to make apparent a slight change in color, the change is not appreciable.

(g) Acceptance - If requested, furnish with each lot or shipment a quality compliance certificate according to 00165.10, certifying that the material supplied will meet all the requirements listed.

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, 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, 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 electronic cuttable films used with Type III, Type IV, and Type VII sheeting, provide a Warranty, for a Warranty period of 10 years, for restoring sign and panels and replacing sheeting cuttable film if the composite sheeting and cuttable film has failed as defined below.

For electronic cuttable films used with Type IX, sheeting, provide a Warranty, for a Warranty period of 12 years, for restoring sign panels and replacing sheeting with cuttable film if the composite sheeting and cuttable film 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 natural weathering or defects in materials or workmanship to the extent that:
• The sign shows discoloration, cracking, de-lamination, loss of adhesion, or

• The coefficient of retro-reflection is less than the following:

• 80% of minimum coefficient of retro-reflection 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 retro-reflection 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 1X sheeting.

All coefficient of retro-reflection measurements will be made after signs are cleaned.

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 seven years, the Manufacturer shall restore the sign panel to its original effectiveness at no cost to the City, including removal and re-installation if necessary

• For the remaining three years, (five years for Type IX sheeting) the manufacturer shall furnish replacement sheeting required to restore the sign panel to its original effectiveness at no cost to the City

When the City makes written notification to the Manufacturer of sheeting failure, the Warranty period will stop for the affected 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 material laboratory. That date is the start of the Warranty period.
Section 02920 - Traffic Signal Materials

Description

02920.00 Scope - This Section includes the requirements for materials used in construction of traffic signal installations with or without incidental street lighting.

Materials

02920.01 General - All materials shall conform to the standards and workmanship of 00960.01 and this Section. 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.

02920.02 Powder Coating - Powder coat materials according to the following:

(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 eight 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 eight 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.

Conduit and Junction Boxes

02920.10 Metal Conduit - Furnish metal conduit conforming to the following:

(a) Rigid Metal Conduit - Metal conduit and fittings shall be galvanized rigid metal manufactured of mild steel conforming to UL 6, Rigid Metal Electrical Conduit.

(b) Liquid-Tight Flexible Metal Conduit - Flexible conduits shall have a 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:

(a) Rigid Nonmetallic Conduit - Nonmetallic conduit shall be heavy wall, extruded, rigid polyvinyl chloride (PVC) conforming to UL 651, Schedule 80 Rigid PVC Conduit as shown, for 194 °F wire rated conduit.

(b) Liquid-Tight Flexible Nonmetallic Conduit - Liquid-tight, flexible nonmetallic conduit shall meet the requirements of Article 351 of the NEC and shall be UL listed.

02920.12 Conduit Fittings:

(a) 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.

(b) Expansion-Deflection Fittings - For rigid metallic conduit furnish water-tight expansion-deflection fittings according to NEMA 4, with an integral bonding jumper.

(c) Condulets - Condulets shall be malleable iron conduit body hot dip galvanized with cover and moistureproof gasket.

02920.13 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. 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. Drill conduit entrances into junction boxes and tap a minimum of three and one-half full threads for the size conduit used. Provide bosses where wall thickness is not sufficient for the minimum number of threads. 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. The following junction box lids have been approved for City of Portland projects:

- Christy galvanized steel with "SlipNOT Grip Plate" Grade 1 finish (COF = 0.95)
- Christy galvanized steel with "SlipNOT Grip Plate" Grade 2 finish (COF = 0.98)
- Christy “Synertech” polymer 20K cover (COF = 0.88)

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.

Use aluminum conductors as an option to copper only in overhead service drops and overhead illumination circuits where shown or specified; otherwise conductors shall be copper conforming to this section.

Place the number and size of conductors shown to service the electrical device. Unless otherwise shown, the conductors shall be sized according to requirements of the NEC.

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:**

**(a) Messenger Cable** - All messenger cable, unless otherwise specified, shall be 3/8 inch, seven-wire, conforming to ASTM A 475 utility grade, Class A coating, rated at 11,500 pounds. Where "figure eight" cable is permitted, such messenger cable shall be 1/4 inch seven-wire, Class A galvanized.

**(b) Tether and Stabilizer Cable** - Provide 1/4 inch common grade, or better, seven-wire stranded tether and stabilizer cable with Class A coating conforming to ASTM A 475.

**(c) Loop Feeder Cable** - Construct loop feeder circuits of two-conductor No. 14 AWG twisted pair shielded cable conforming with IMSA Specification No. 50-2.

When shown for traffic signal loop replacements, four-conductor loop feeder cable may be used, consisting of two twisted pairs of No. 16 or 18 AWG stranded wire, with polyethylene insulation and jacket, filled cable, and overall aluminum/mylar shield. When shown, construct loop feeder circuits of two-conductor No. 18 AWG twisted pair shielded cable conforming with IMSA Specification No. 50-2.

**(d) Interconnect Cable** - The interconnect cable shall:

- Comply with REA Specification PE-38 or PE-39
- Contain the number of wire pairs shown, and the individual conductors shall be No. 22 AWG solid and sequential length markings shall be included on the outer jacket.
- Be lashed to 3/8 inch messenger cable type for overhead installation
- Be PE-39 cable in underground installations
- Not be spliced
- Terminate on telephone style punch down blocks.
- Have an outer jacket that easily separates from the shield when stripped with a razor knife

**(e) Power Service Cable** - Power service conductors located on traffic signal spans shall be control cable or USE type RR wire.

**(f) Control Cable** - Provide control cable meeting IMSA Specifications 19-1 and 20-1. Outside jacket insulation shall be black in color.

Unless otherwise specified on the plans, individual conductors in control cables shall be No.14 AWG stranded copper wire. The control cable shall comply with all requirements of IMSA Specification 20-1 for span wire applications or applications exposed to sunlight and with all requirements of IMSA Specification 19-1 for cable which is not exposed to sunlight.
The straps used to attach control cable to messenger cable shall be heavy-duty UV resistant black plastic self-locking straps. The straps shall be approximately 5/16 inch in width. The straps shall have serrated gripping surfaces through a binding buckle, and when affixed shall remain securely tightened. The strap shall have a minimum tensile strength of 45 pounds when tested by a straight-line axial pull across the buckle. Test specimens shall be conditioned at 73.4 °F plus or minus 3.6 °F for at least four hours. Speed of testing shall be 1 inch per minute. The strength shall be the average of five test specimens. The following strap has been prequalified by the City and are considered acceptable straps:

- Tyton MS 3367-3

**g) Unshielded 4 Conductor Detection Cable** - Unshielded 4-conductor detection cable shall have four No.18 AWG stranded copper wire conductors with an outer jacket of black high-density polyethylene. Individual conductors shall be insulated with high-density polyethylene. The following cable has been approved for City projects:

- Belden Model 603425 "Vehicle Detection Cable"

02920.23 **Wire:**

(a) **THHN/THWN Wire** - THHN and THWN wires shall be flame-retardant, moisture and heat-resistant thermoplastic insulated copper wire, with outer nylon jacket cover. Provide THHN wire rated for 194 °F operation in dry locations and THWN wire rated for 167 °F operation in wet or dry locations. Wires shall be UL labeled as THHN or THWN wire according to the NEC.

(b) **XHHW Wire** - XHHW wire shall be flame-retardant, cross-linked synthetic polymer insulated copper wire. Wire shall be rated for 194 °F dry and 167 °F wet locations and be UL labeled as XHHW wire according to the NEC. Wire used for traffic signal loops shall be No. 14 AWG XHHW wire conforming to IMSA Specification No. 51-3.

(c) **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.

02920.24 **Eyebolts** - 3/4 inch diameter eyebolts shall meet the requirements of ASTM A 307.

02920.25 **Electrical Splice Materials** - Electrical wire splices and taps for illumination circuits shall be made using a silicon bronze split bolt connector to securely join the wires both mechanically and electrically. Splices located in junction boxes, pole bases or other similar locations shall be made moisture proof by using either a heat-shrink tubing with internal sealant or electrical insulating rubber tape over-wrapped with electrical vinyl plastic tape.

Splices that may be submersed in water shall be made using heat shrink tubing with internal sealant or other approved method.
Connections to factory equipment or luminaires shall be made according to the manufacturer's recommendations.

Heat-shrink tubing shall be a surface-irradiated tube listed UL 486, 194 °F, with 600 V inner melting wall or liner to provide a void-free encapsulated insulation. Tubing shall be flexible, abrasion resistant and nonflammable. An insulating rubber type tape shall be used when necessary to ensure the connection is void-free.

Insulating rubber tape shall be either an electrical grade, nondrying, rubber based, elastic-type putty for molding around the spliced connector or a rubber insulating tape conforming to ASTM D 4388.

Vinyl plastic tape shall be a minimum of 8.5 mil thick, flame-retardant, hot and cold weather resistant from 0 °F to 220 °F, and resistant to ultraviolet rays, moisture, abrasion, alcalis, acids and corrosion. Plastic tape shall conform to the requirements of ASTM D 3005, Type II and UL 510, Insulating Tape.

02920.26 In-Line Fuseholder:

(a) Slip Base Poles - The in-line fuseholder rated for 30 A at 600 V shall be designed to hold a 13/32 inch by 1 1/2 inch KTK type fuse. The case shall be rigid plastic with a threaded coupling for joining the two halves. When threaded together, the two halves shall completely enclose the fuse and exert pressure against a neoprene "O" ring to provide a waterproof seal. The load side 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 for copper wire. Insulate terminal ends using either heat shrink tubing or electrical insulating rubber tape over-wrapped with electrical vinyl plastic tape as specified.

(b) Fixed Base Poles - Each in-line fuse connector shall be supplied with a 10 A fuse. In-line fuse connectors to be used on two-phase lighting circuits shall be designed for two-pole fusing so both poles disconnect simultaneously from both phases of the line side. The connector shall have no exposed metal parts, except that the head of a stainless steel assembly screw may be exposed. Recess the head of the metal assembly screw a minimum of 5/16 inch below the top of a plastic boss surrounding the head. The connector shall be designed for compression connection to the line and luminaire conductors. Screw connection will not be allowed. The body of the connector shall be of substantial thickness and strength to resist breakage.

02920.28 Wye Connector - Each wye connector shall contain three terminal lugs, a bolt and a stop nut. Each lug shall provide a mounting hole by which the lugs shall be fastened together with the bolt and nut.
The tap housing and the Y housing shall be made of water-resistant synthetic rubber suitable for burial in the ground or for installation in the sunlight. The tap housing shall provide a section to form a watertight seal around a cable and a section to provide a watertight seal between itself and the Y housing at the point of disassembly. The Y housing shall provide sections to form a watertight seal for the tap housing. Each unit shall be supplied with sufficient silicone compound to lubricate the rubber housings for easy assembly.

Make all connector ends at the cable entrance moisture proof using either heat-shrink tubing or vinyl plastic tape.

Poles and Towers

02920.30 Wood Poles - All wood poles shall conform to the requirements on 02120.10 except that 40 to 45 foot Class 4 poles shall be used for street light only poles, 25 foot Class 5 poles shall be used for beacon only poles and 35 foot Class 3 poles shall be used for traffic signal wood strain poles.

02920.31 Illumination Poles:

(a) General - The design, fabrication and installation of metal strain poles and mast arm poles shall comply with all applicable portions of the “2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals” and shall conform to the requirements set forth in the plans. Design wind shall be 90 mph.

The design, fabrication and installation of metal standards shall conform to the requirements of the plans, Section 00960, 02530.20, and this Section.

The type of poles shown on the plans is for illustrative purposes only and is not representative of any manufacturer.

Identify all poles, arms and anchor bolts 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 bolt and bolt circle information.

All illumination poles with a resulting mounting height of 24' 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' 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.

(b) Aluminum Illumination Poles:

(1) General - Fabricate aluminum poles from one piece of seamless aluminum alloy tapered tubing conforming to ASTM B 241M, Alloy 6061-T6 or 6063-T6.

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 bolt covers shall be made of aluminum Alloy 43.

The surface finish shall be natural "satin" or andoized (Dark Bronze) aluminum, as specified.

(2) 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 according to 00165.35.

(c) Steel Illumination Poles - Steel sheet for poles and arms shall conform to ASTM A 595, Grades A or B, or approved equal. All other steel sheet and plate shall conform to AASHTO M 270/M 270, Grade 50, or approved equal. ASTM A 6/A 6M, supplement S18 regarding maximum tensile strength shall apply. The silicon content for steel, except base plates and small incidental and hidden pieces, shall be 0 - 0.04% or 0.15% - 0.25%. Prior to galvanizing, the pole manufacturers shall submit mill certificates verifying silica content to Engineer and the galvanizer.

Galvanize steel poles, mast arms, luminaire arms, fittings, bolts, nuts, miscellaneous hardware and appurtenances after fabrication according to ASTM A 123/A 123M or ASTM 153/A 153M, as appropriate.

Fabricate all pole and arm entrance fittings, including handholes, before galvanizing. All poles and arm entrance fittings shall be of the type shown or specified and shall be welded into the pole and/or arm. Grind all exposed butt-welds flush with the base metal before poles are galvanized.

The fabricator shall inspect welds as specified on Standard Drawings, which shall take precedence over the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

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.
The poles installed shall be as specified on the plan set or in the Special Provisions.

**(d) 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.

**02920.32 Traffic Signal Poles:**

**(a) General** - The design, fabrication and installation of metal strain poles and mast arm poles shall comply with all applicable portions of the "2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and shall conform to the requirements set forth in the plans. Design shall be for 100 mph 3 second gust, gust factor 1.14, 50-year recurrence interval, and fatigue category II, no galloping and truck speed of 55 mph.

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.

Aluminum standards will not be allowed. The silicon content for steel, except small incidental pieces, shall be in the range of 0 to 0.04%. All steel used in the metal pole assemblies including base plates, flange plates and gusset plates shall have a yield strength of 50ksi. All materials shall be of domestic origin. Submit mill certificates to the Project Manager verifying silicon content, materials origin and prefabrication strength.

Four standard anchor bolts each fitted with two hex nuts shall be furnished with each pole.

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 pole assemblies shall be galvanized. Where the specifications call for painting the poles, the poles shall be painted as described in 00960.48 of these special specifications.

Submit detail drawings of poles for approval prior to fabrications.

**(b) Design:**

- **Strain Poles** - All strain poles shall be furnished with pole tops.

- **Type 1 Strain Poles** - 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.
Type 1 strain poles shall be mounted on the footing shown on Standard Drawing D-200. This footing utilizes (4) 2 1/4 inches x 48 inches ASTM A307C anchor bolts on a 18” bolt circle. The base plate on the Type 1 strain pole shall be able to accommodate this bolt pattern as well as the "old standard," 1 3/4 inches diameter bolts on a 16 1/2 inches bolt circle. See D-103 for base plate detail.

**Type 2 Strain Poles** - 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.

Type 2 strain poles shall be mounted on the footing shown on Standard Drawing D-201. This footing utilizes (4) 2 3/4 inches x 60 inches ASTM A307C anchor bolts on a 20 inches bolt circle.

**Mast Arm Poles** - 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.

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.

There are three types of mast arm poles; Type 1, Type 2 and Type 3. Each type may have a single street light luminaire arm.

Type 1 mast arm poles shall be mounted on the footing shown on Standard Drawing D-200 and D-202. This footing utilizes (4) 2 1/4 inches x 48 inches ASTM A307C anchor bolts on a 18 inches bolt circle. See Standard Drawing D-103 for base plate detail.

Type 2 mast arm poles shall be mounted on the footing shown on Standard Drawing D-201 and D-205 (Type 2). This footing utilizes (4) 2 3/4 inches x 60 inches ASTM A307C anchor bolts on a 20 inches bolt circle.

Type 3 mast arm poles shall be mounted on the footing shown on Standard Drawing D-201 and D-205 (Type 3). This footing utilizes (4) 2 3/4 inches x 60 inches ASTM A307C anchor bolts on a 22 1/2 inches bolt circle.

All mast arms up to 40’ in length shall attach to the pole riser shaft using a flange plate connection as shown in detail on Standard Drawing D-102. All mast arms greater than 40’ in length shall attach to the pole riser shaft using a flange plate connection with reinforcing rings as shown in detail on Standard Drawing D-102A. 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 for single mast arms, and 3/8 inch thick gusset plates for dual arm poles with equal riser heights. 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 inches 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.

**c) 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.

**02920.33 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 bases 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. They shall be made of cast aluminum and shall conform to the City's Standard Drawings.

**(c) Pedestrian Signal Pedestals** - Pedestrian signal pedestal bases shall be a raised, frangible type and shall be constructed of cast aluminum. Bases shall include a removable access plate and a threaded connection for a 4-inch standard steel pipe pedestal.

**02920.34 Anchor Bolts** - Anchor bolts shall conform to 02560.30 and to the types and sizes shown.
Cabinets and Control Devices

02920.40 Cabinets:

(a) Illumination - 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 six stainless steel tamperproof fasteners. The nameplate shall be inscribed "Street Lighting" in letters approximately 3/8 inch high.

Construction of pedestal-type cabinets 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 at 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 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.

(b) Traffic Signal - 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 2530.70, or 8 gage 5052 - H32 powder-coated aluminum. Cabinet shall be weatherproof, rated as 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, Panelboards; and 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 condulet 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.

02920.41 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) Photocontrol Electronic Relay - The photocontrol electronic 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.

The photocell shall be a cadmium-sulfide photocell encapsulated for humidity protection, or a silicon junction-type photo-transistor.

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 control 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.

02920.42 Traffic Signal Control Devices:

(a) Signal Controllers - The traffic signal controllers and related equipment shall conform to requirements of the current edition of ODOT's Standard Specifications for Microcomputer Signal Controller, except as supplemented and/or modified by the Special Provisions.

(b) Flasher Mechanism (Remote from Controller Cabinet) - The remotely located flasher mechanism shall be a model 204 flasher.

02920.45 Vehicle Detection Devices:

(a) Inductive Loop Detector Amplifier for Model 170 Controller - The inductive loop-type detector unit shall be as specified in the current edition of ODOT's Standard Specifications for Microcomputer Signal Controller, except as supplemented and/or modified by the Special Provisions.

Lamps, Ballasts and Luminaires

02920.50 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 10 hours per start) as follows:

<table>
<thead>
<tr>
<th>Lamp Watts</th>
<th>ANSI Code</th>
<th>Minimum Initial Vertical Lumens</th>
<th>Minimum Horizontal Lumens</th>
<th>Minimum Average Lamp Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Pressure Sodium - Clear</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>S68MS-50</td>
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<td>4 000</td>
<td>24 000</td>
</tr>
<tr>
<td>70</td>
<td>S62ME-70</td>
<td>6 300</td>
<td>6 300</td>
<td>24 000</td>
</tr>
<tr>
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<td>9 500</td>
<td>24 000</td>
</tr>
<tr>
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<td>16 000</td>
<td>24 000</td>
</tr>
<tr>
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<td>22 000</td>
<td>24 000</td>
</tr>
<tr>
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</tr>
<tr>
<td>400</td>
<td>S51WA-400</td>
<td>50 000</td>
<td>50 000</td>
<td>24 000</td>
</tr>
</tbody>
</table>

**02920.51 Traffic Signal Lamps** - Vehicular signal lamps shall be rated for 130 V AC operation, and shall have a rated life of at least 8000 hours.

The light distribution and candle power intensity from the combination of lamp, reflector, and lens for signal heads shall conform to the current ITE Standards for Adjustable Face Vehicle Traffic Control Signal Heads.

The signal lamps shall be rated in either watts or lumens. The following are recommended signal lamp ratings. Certification of compliance with ITE standards shall be submitted on lamps rated for other than the recommended values.

<table>
<thead>
<tr>
<th>Indication</th>
<th>8 Inch Lens</th>
<th>12 Inch Lens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>watts</td>
<td>lumens</td>
</tr>
<tr>
<td>Red</td>
<td>See 02920.51(a)</td>
<td>See 02920.51(a)</td>
</tr>
<tr>
<td>Yellow</td>
<td>67 - 69</td>
<td>665</td>
</tr>
<tr>
<td>Green</td>
<td>See 02920.51(a)</td>
<td>See 02920.51(a)</td>
</tr>
</tbody>
</table>

Light center length for 12 inch signal lenses shall be 3 inches and for 8 inch signal, lenses shall be 2 7/16 inches or as recommended by the manufacturer. Lamps shall be designed to withstand vibration and intended for use in traffic signal heads. Each lamp receptacle shall be equipped with heat and moisture-resistant, thermoplastic-insulated, color-coded or marked leads of stranded wire of sufficient length to allow full movement of the hinged reflector without breaking the lighting circuits. Lamp sockets shall be of weatherproof molded construction and capable of withstanding, without deterioration, the temperatures encountered during operation. Design the sockets so the lamps will not become loose due to vibration.
(a) Traffic Signal Light Emitting Diode (LED) Modules - Traffic signal LED modules shall comply with current ITE specifications. Submittals shall include a report from an independent test laboratory that certifies full compliance of LED signal modules to the ITE specifications across the temperature range of -35°F Fahrenheit to +165°F Fahrenheit. All modules must conform to the City of Portland's requirements for wiring and termination.

Ball signal modules shall comply with the ITE VTCSH LED Circular Supplement specifications. Typical or nominal wattage shall not exceed 6 watts for the 12 inches Red Ball, 19 watts for the 12 inches Yellow Ball, and 9 watts for the 12 inches Green Ball.

Arrow signal modules shall comply with the ITE VTCSH Part 3 LED Vehicle Arrow Traffic Signal Modules specifications. Combined nominal wattage for the Red Arrow, Yellow Arrow and Green Arrow shall not exceed 23 watts.

Pedestrian signal modules shall comply with the ITE PTCSI Part 2; LED Pedestrian Traffic Signal Modules specifications. Combined nominal wattage for the Hand/Person Countdown pedestrian signal shall not exceed 19 watts. Combined nominal wattage for the Hand/Person pedestrian signal shall not exceed 15 watts.

02920.52 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.

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.

02920.53 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° 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 weathertight.

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.

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.

(b) Classification of Luminaire Light Distribution - Furnish the following distribution types as shown or specified.
(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:

Type I
Type II
Type III
Type IV
Type V

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:

Cutoff
Semicutoff
Noncutoff

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.

Signal Indication and Sign Material

02920.60 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.
(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 $22^\circ$ and a maximum viewing angle of $30^\circ$. 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 $-35 \, ^\circ F$ to $165 \, ^\circ F$.

(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.

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 four 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.

02920.64 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 dustproof and waterproof. 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 casting or in the plug.

The following make and model of vehicle signals have been prequalified by the City and are considered acceptable for signals which are not programmed visibility signals:

1. Traffic Control Technologies (TCT) Die-Cast Aluminum
2. Automatic Signal/Eagle Signal Die-Cast Aluminum with phenolic shell and brass socket
3. McCain Traffic Supply Die-Cast Aluminum
4. Peek Traffic Die-Cast Aluminum with aluminum frame for reflector support

If the head(s) that the Contractor proposes to supply on this project is not listed above, submit an actual sample of the head to the City for approval prior to installation.

Color code all leads inside vehicle signal heads red, 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 a 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 four 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-proof construction, so when closed if 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 gage. 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 gage 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 minimum 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.

02920.65 Pedestrian Signal Heads - All pedestrian signal heads shall be single-section and shall comply with the following:

(a) Signal Heads - All pedestrian signal indications shall be LED countdown pedestrian signals. The light source shall be:
• 16 inch by 18 inch module

• LED overlaid filled countdown style. Overlaid filled hand/man on the left with countdown on the right.

• Meet ITE standards for color and luminous intensity

• Countdown only in the flashing don’t walk phase

• Compatible with all other controller equipment

The message module shall consist of LEDs protected by a housing of rugged plastic and a polycarbonate plastic prismatic lens. The message module shall be equipped with two circuits, one for each of the "HAND" and "WALKING PERSON" symbol messages. Each of the solid state circuit shall energize the appropriate message when powered up from 120 volt 60 Hz source. Energy requirements for each message shall not exceed 13 watts per message.

Pedestrian signals shall be equipped with Z-crate type visors made of polycarbonate plastic having a depth of an inch and a half with members placed in such a manner as to permit optimum view of the signal message. Cables feeding pedestrian signals on steel poles shall run inside the pole from the entrance fitting, terminal cabinet or pole base directly into the clamshell mounting bracket.

The City has prequalified the following makes and models of countdown pedestrian signals:

1. Gelcore - Countdown Pedestrian Signal (PS7-CFF1-01A)
2. Dialite - Countdown Pedestrian Signal (430-6479-001)
3. Quixote - Countdown Pedestrian Signal (LEDP-HMC-001P)

If the head(s) that the Contractor proposes to supply on this project is not listed above, submit an actual sample of the head to the Engineer for approval prior to installation.

(b) Pedestrian Push Button - All push buttons shall be the "H" bracket style push buttons within an extruded aluminum bracket with signs placed directly on both sides of the extrusion.

The City has prequalified the following makes and models of push buttons:

1. Polara Bulldog Model RBDLM2-B
2. Dick Campbell Company Model 120-4EVR

If the push button(s) that the Contractor proposes to supply on this project is not listed above, submit an actual sample to the Engineer for approval prior to installation.
PART 03000 - MATERIALS

Section 03010 - Fencing Materials

Description

03010.00 Scope - This section consists of the test requirements, specifications and tolerances 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 gage or 15 1/2 gage with four-point barbs spaced at 5 inch intervals conforming to the requirements of 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 gage galvanized steel wire conforming to the requirements of ASTM A 116, Class 3 coating or 11 gage or 12 1/2 gage aluminum coated steel wire conforming to the applicable requirements of ASTM A 584. The 12 1/2 gage aluminum coated steel wire shall have the same coating thickness required for 11 gage steel wire in Table 2 of ASTM A 584.

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 any 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 gage 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" x 2 1/2" x 6', 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/A 53M, 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 ASTM A 702, except that galvanizing may conform to the requirements of ASTM A 123/A 123M. 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/A 641M. Either 9 1/2 gage or 10 gage 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 ASTM A 153/A 153M.

03010.70 Rock Protection Fences and Slope Protection Mat:

(a) Concrete in Footings and Anchors - The concrete for footings and anchors shall conform to requirements of Section 00440.

(b) Posts and Braces - Fence posts and braces for the rock protection fence shall be 3 1/2 inch nominal (4 inch outside diameter) pipe size, Schedule 40, hot-dip galvanized steel pipe conforming to ASTM A 53/A 53M Grade B. The posts shall have a hot-dip galvanized steel post cap securely mounted on the top, or be capped with a 1/4 inch steel plate welded in place to completely close the top of the post. Repair all cutting, welding and drilling as well as other damage to the galvanizing according to 02420.10(d).

(c) Cable - Cable shall be 3/8 inch diameter, 6x19 classification, galvanized wire rope with independent wire rope core made from extra improved plow steel. It shall have a minimum zinc coating of 0.20 ounce per square foot on all wires, and a minimum breaking force of 13,000 pounds.

Submit an 8 foot long sample of the cable for testing.

(d) Hardware - All rings shall be drop-forged steel, heat treated after forging. Lightweight wire rope thimbles weighing approximately 13.8 pounds per hundred shall be used with the 3/8 inch diameter cable. Galvanize all rings, thimbles, wire rope clips and U-bolts according to ASTM A 153/A 153M, Class C, except castings shall be Class A and forgings shall be Class B.

(e) Anchor Rods, Post Anchor Rods and Tie Rods - All rods shall be manufactured from steel meeting the requirements of ASTM A 36/A 36M and be galvanized according to ASTM A 153/A 153M. The eye of the rod may be drop forged or formed with a full penetration weld and shall develop 100% of the rod strength. Repair any damaged galvanizing according to 02420.10(d).

Post anchor rods and tie rods shall be sized as shown, and be continuously threaded. The dimensions shall be as shown on the plans, except the length of the tie rods shall be designated by the Engineer for each individual location as dictated by the slope at that location.
(f) **Hook Bolts and Spacer Blocks** - The hook bolts shall conform to the dimensions shown on the plans, be manufactured from steel meeting the requirements of ASTM A 36/A 36M, and be hot-dip galvanized according to ASTM A 153/A 153M after bending and threading. Fabricate spacer blocks to the dimensions shown and hot-dip galvanize according to AASHTO M 232M/M 232 (ASTM A 153/A 153M) after complete fabrication.

(g) **Spring Anchorage Assemblies** - Construct spring anchorage assemblies at both ends of each run of rock protection fence, except for barrier mounted fence. The anchorage assembly shall consist of anchor, anchor rod, anchor spring, spring holder, turnbuckle, wire rope clips and wire rope thimble. Hot-dip galvanize all components of the spring anchorage assembly, except the anchor spring, according to ASTM A 153/A 153M. Repair any damaged galvanizing according to 02420.10(d).

- **Concrete Anchors** - Concrete anchors may be precast or cast-in-place.

- **Anchor Rod** - Size the anchor rod as shown and manufacture from steel meeting the requirements of ASTM A 36/A 36M.

- **Anchor Spring** - The anchor spring shall be a helical, flat ended steel spring meeting the requirements of ASTM A 125. The spring shall have a free length of approximately 9 inches with a 1 1/8 inch pitch and shall develop a minimum compressed strength of 6,000 pounds. Furnish a test results certificate according to 00165.35 verifying the anchor spring conforms to ASTM A 125.

- **Spring Holder** - The spring holder shall consist of a cast-iron spring washer, 1 inch thick steel plate, four 3/4 inch bolts conforming to ASTM A 307 or SAE Grade 5, and a 3/4 inch eye bolt and bolt turnbuckle with 8 inch take-up, all dimensioned and assembled as shown.

- **Wire Rope Clips** - Wire rope clips shall have an 7/16 inch diameter for use with 3/8 inch diameter cable.

- **Thimbles** - Thimbles shall be lightweight, wire rope thimbles for use with 3/8 inch diameter cable.

(h) **Rock Bolt Post Foundations:**

1. **Rock Bolts and Stop Type Couplings** - Rock bolts shall be 3/4 inch diameter, continuously threaded, and include the expansion shell anchor complete with a keyhole bearing plate, grout tube, washer and nut. The rock bolts shall meet ASTM A 615/A 615M, Grade 70. All rock bolts shall have rolled threads.

   All bolts shall be free of any coating except at the coupling end. The bolts shall be completely fabricated at the point of manufacture under controlled shop conditions.

   Stop type couplings for connecting rock bolts to tie rods shall be 2 inches long and shall have a center stop so that each section is connected by an equal length of thread and shall be as strong as the bolt.
(2) **Grout** - All cement used in the grouting of rock bolts shall be Type III portland cement. The ratio of water to cement by weight shall be between 0.38 and 0.50. Add an approved fluidifying agent and commercial grade aluminum powder, or equal, to the grout in the proportion of 0.005% by weight of cement. Before injecting the grout, mix the mixture for a minimum time of three minutes by means of high-speed mechanical agitator and sieve through a 0.045 inch cloth sieve.

Use the grout as soon as possible after thoroughly mixing all ingredients, but in no event more than one hour after the addition of water to the cement, otherwise it shall be wasted. Use water meeting the requirements of Section 02020.

(3) **Keyhole Plates, Washers, and Nuts** - The keyhole plates, washers and nuts shall conform to ASTM F 432. The keyhole plates shall be 3/8 inch flat steel plates providing not less than 6 inch by 6 inch area for each bolt. Each keyhole plate shall be prefabricated with a 1 inch high, 3/8 inch thick post stabilizing collar. The beveled washers shall be steel or malleable iron. Machine washers shall be hardened steel. All nuts shall be the manufacturer's heavy-hexagonal type. Keyhole plates shall have provision for a grouting tube.

(4) **Lubricant** - Lubricant for threads shall be molybdenum disulfide grease.

(5) **Threads of Bolts and Nuts** - Protect the threads of bolts and nuts by a plastic tape or molded protector. Strip off just before installation.

(6) **Grouting Accessories** - Grout tubes, grout sealers and other grouting accessories for grouting rock bolts shall be of types recommended by the manufacturer and as approved.

(7) **Tests** - Test shall be made according to ASTM F 432 of the various parts that make up a rock bolt.

(8) **Contractor Furnished Data** - Furnish a test results certificate according to 00165.35 verifying conformance of the rock bolts to ASTM F 432.

(i) **Gabion Wire Mesh Fabric** - Use galvanized steel wire for gabion wire mesh fabric meeting the requirements of ASTM A 641/A 641M, with a nominal diameter of 0.120 inch, Class 1 coating and a minimum tensile strength of 60,000 psi. Maximum mesh size shall be approximately 4 3/4 inches with triple twist and hexagonal shape.

(j) **Hog Ring Fasteners** - Fabricate hog ring fasteners from 9 gage, zinc-coated steel wire conforming to ASTM A 116, Class 1.
03010.75 **Protective Fence Materials, On and Off Structures** - Provide certification according to the requirements of 00165.35 that the anchor system selected conforms to requirements shown on the plans.

- **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 recommendations.

- **Posts** - Modify posts to attach to the structure as shown.

- **Steel Plates, Angles, and Bolts** - Steel plates, angles, and bolts shall meet the applicable requirements of Section 02530 and galvanized according to 02530.70.

- **Chain Link Fabric, Ties, and Tension Wire** - Chain link fabric, ties, and tension wire shall conform to the requirements of 03010.30.

- **Pickets** - Pickets shall meet the requirements of 03010.31.

03010.80 **Acceptance** - Acceptance of fencing materials will be according to 00165.35 and this Section.
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