

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:

	Pay Item	Unit of Measurement
(a)	Guardrail, Type_____	Foot
(b)	Metal Median Barrier.....	Foot
(c)	Guardrail Anchors, Type_____	Each
(d)	Guardrail End Pieces, Type_____	Each
(e)	Guardrail Transition.....	Each
(f)	Guardrail Connections	Each
(g)	Guardrail Terminals.....	Each
(h)	Extra for 8 foot Posts.....	Each
(i)	Guardrail Posts	Each

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 backfill00430.11
 Commercial grade concrete00440
 Reflective sheeting02910.30

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:

Pay Item	Unit of Measurement
(a) Concrete Barrier	Foot
(b) Concrete Barrier, Reflectorized	Foot
(c) Concrete Barrier, Tall.....	Foot
(d) Concrete Barrier, Tall, Reflectorized.....	Foot

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:

Pay Item	Unit of Measurement
____inch Glare Shields.....	Foot

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:

	Pay Item	Unit of Measurement
(a)	Delineators, Type _____	Each
(b)	Milepost Marker Posts	Each

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 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 be 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:

Pay Item	Unit of Measurement
(a) Removal of Existing Pavement Markings	Lump Sum
(b) Pavement Legend, Type ____ : Arrows	Each
(c) Pavement Legend, Type ____ : "ONLY"	Each
(d) Pavement Legend, Type ____ : "SCHOOL"	Each
(e) Pavement Legend, Type ____ : "SCHOOL CROSSING"	Each
(f) Pavement Legend, Type ____ : Railroad Crossing Markings	Each
(g) Pavement Legend, Type ____ : Bicycle Lane Symbols	Each
(h) Pavement Legend, Type ____ : Diamonds	Each
(i) Pavement Legend, Type ____ :	Each
(j) Pavement Line, Type ____	Square Foot

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:

Pay Item	Unit of Measurement
(a) Mono-Directional Crystal Type I Markers	Each
(b) Bi-Directional Yellow Type I Markers.....	Each
(c) White Type II Markers.....	Each
(d) Yellow Type II Markers	Each
(e) Mono-Directional Crystal Type I Markers, Recessed	Each
(f) Bi-Directional Yellow Type I Markers, Recessed	Each
(g) Multidirectional Crystal Type I Markers.....	Each
(h) Multidirectional Yellow Type I Markers	Each

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** - $\pm 3/4$ inch
- **Length of 2 foot skip stripe** - $\pm 1/2$ 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** - $\pm 3/4$ 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 $\pm 1/2$ 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** - $\pm 3/4$ inch
- **Length of 2 foot skip stripe** - $\pm 1/2$ 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** - $\pm 3/4$ 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.

00862.75 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

00862.80 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:

Pay Item	Unit of Measurement
Thermoplastic, Non-Profile, 90 mils, Extruded	Foot

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:

Pay Item	Unit of Measurement
(a) Pavement Line Removal.....	Foot
(b) Pavement Legend Removal	Each

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

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