Oregon Standard Specifications for Construction

2008

Volume 2
(Technical Specifications)

The 2008 edition of the Oregon Standard Specifications for Construction consists of two volumes. Volume 1 contains Part 00100, the General Conditions, which include defined terms and describe the solicitation process and contractual relationships. Volume 2 contains Parts 00200 through 03000, the Technical Specifications, which describe the prosecution of the work.

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PART 00200 - Temporary Features and Appurtenances

PART 00300 - Roadwork

PART 00400 - Drainage and Sewers

PART 00500 - Bridges

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Section 00205 - Field Laboratory, Weighhouse, Etc.

Description

00205.00 Scope - This work consists of providing facilities for Agency use to perform testing, weighing and other necessary functions during the course of the Project.

Materials and Equipment

00205.10 Contractor-Furnished Field Laboratory - Provide a leveled field laboratory for Agency use in close proximity to the Contractor's plant at least five calendar days before aggregate production, paving, or processing work begins under the Contract, meeting the safety and health requirements of the Oregon Department of Consumer and Business Services, the Oregon Health Division, the State Fire Marshall, and the following minimum requirements:

- Length - 16 feet
- Width - 8 feet
- Ceiling Height - 7 feet
- Floor
- Insulation - Walls and ceiling - R-11
- Doors - At least one, 3 feet wide, all with locks
- Windows:
  - Four
  - Adequate for good lighting
  - Capable of being opened for adequate ventilation
  - One providing a view of the crushing or processing plant
- Interior Walls and Ceiling - White
- Counter - 20 feet long, 30 inches wide, 36 inches high, with a durable, smooth surface
- Sink - One deep double with adequate supply of cold potable, clear, running water
- Electrical Power System:
  - 120/240 V, single phase, 60 A service
  - Wired according to the National Electrical Code
- Electrical Service:
  - Continuous, 24 hours per day during crushing and aggregate mixing operations
  - For 24 hours following termination or interruption of operations
- Electrical Outlets - six duplex
- Electrical Light Fixtures - Enough to provide good overall lighting
- Heating and Air Conditioning - Adequate to provide suitable heating and cooling
- Exhaust Ventilation System - Adequate for all activities performed in the laboratory, including aggregate drying and vacuum extractions of AC
- Toilet - One, portable, for use by Agency employees

The site will be approved by the Engineer before work is to begin.

Remove the field laboratory when the Project is complete.

00205.11 Agency-Furnished Field Laboratory - Provide a level site for an Agency-furnished laboratory trailer at least five calendar days before aggregate production, paving, or processing work begins under the Contract, at a location in close proximity to the Contractor's plant. The site will be approved by the Engineer before work is to begin.

Employ a commercial hauler to bring the trailer to the Project, relocate at the site if necessary, and to return the trailer to its storage area. Employ a licensed electrician to connect and disconnect the power source. Provide an adequate supply of potable water, electricity, and a portable toilet for use by Agency employees, according to 00205.10.

00205.12 Weighhouse - When materials are weighed on platform-type scales or by other means and the Contractor chooses to have the Agency provide a weigher, provide a weatherproof weighhouse or other approved shelter for the weighperson. The weighhouse shall meet the safety and health requirements of the Oregon Department of Consumer and Business Services, the Oregon Health Division, the State Fire Marshall and the following minimum requirements:

- Length - 9 feet
- Width - 6 feet
- Ceiling Height - 7 feet
- Floor
- Protect Scale Recording Device and Agency's weigher from weather
- Provide space to store scale testing equipment
- Provide adequate shelf space
- Provide artificial lighting and good visibility throughout
- Provide adequate heat, as required
- Provide stool and other facilities for keeping records and performing other duties of the weigher
- Doors - At least one, all with locks
- Windows:
  - Capable of being opened for adequate ventilation, unless air conditioning is provided
  - One, facing the scale
  - One, at each end
  - Adequate size and position to permit view of loading operations and movements of hauling vehicles
- Toilet - One, portable, for use by Agency employees

Remove the weighhouse when the Project is complete.

Measurement

00205.80 Contractor-Furnished Field Laboratory - Contractor-furnished field laboratories will be measured on the unit basis.

00205.81 Agency-Furnished Field Laboratory - Agency-furnished field laboratory work described in 00205.11 will be measured on a unit basis for each Agency-furnished field laboratory required to be located at the Contractor's site of operations.

00205.82 Weighhouse - No measurement will be made for providing weighhouses.

Payment

00205.90 Contractor-Furnished Field Laboratory - The accepted quantities of Contractor furnished field laboratories will be paid for at the Contract unit price, per each, for the item "Furnishing Field Laboratory".

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

00205.91 Agency-Furnished Field Laboratory - The accepted quantities of performing the work described in 00205.11 will be made at the Contract unit price, per each, for the item "Agency-Furnished Field Laboratory".

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

00205.92 Weighhouse - No separate or additional payment will be made for providing weighhouses. Payment will be included in payment made for the appropriate items under which this item is required.

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 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00210.90 Payment - Payment for mobilization will be made at the Contract lump sum amount for the item "Mobilization".

The amounts paid for mobilization in the Contract progress payment will be based on the percent of the original Contract amount that is earned from other Contract items, not including advances on materials, and as follows:

- When 5% is earned, either 50% of the amount 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.

When the Contract Schedule of Items does not indicate payment for mobilization, no separate or additional payment will be made for mobilization. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00220 - Accommodations for Public Traffic

Description

00220.00 Scope - This work consists of maintaining facilities to accommodate public traffic through and within the Project for the life of the Contract. Public traffic includes motor vehicles, bicycles, and pedestrians.

00220.01 Beginning of Contractor's Responsibility - The Contractor's responsibilities for accommodating public traffic begin on the day any on-site work begins within the Project limits.

00220.02 Public Safety and Mobility - Provide for the safety and mobility of the public and:

- Be responsible for damages according to 00170.80.
- Conduct work at all times so that there is the least possible interference with or hazard to the traveling public and the affected community.
- Locate stockpile materials and park construction equipment and vehicles that are not in active use a minimum of 30 feet from the traveled way. If this is not possible, protect the stockpile materials, equipment, and vehicles, with barrier or as directed.
- Provide and maintain safe temporary access to business and residence driveways, temporary intersections, and temporary connections with roads, streets, and bicycle and pedestrian facilities.
- Provide approved protection and delineation between each work area and public traffic.
- Allow emergency vehicles immediate passage at all times.
- When included in the Contract Schedule of Items, use portable changeable message signs to provide appropriate work zone information to the public.
- For all sidewalk or sidewalk ramp closures, install signs as shown on the standard drawings. Mount signs between the panels of the type II barricade or, if installed on a single-post TSS, locate the signs behind type II barricades. Close the sidewalk at a point where there is an alternate way to proceed or provide an alternate pedestrian route. Pave the alternate pedestrian route surface or provide an approved, non-slip 36 inch minimum wide surface meeting the requirements of the Americans with Disabilities Act (ADA). If appropriate, delineate this route and protect pedestrians by placing pedestrian work zone delineation fencing. Fencing is 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. Provide alternate pedestrian routes that match existing facilities and provide additional TCM to meet the accessibility requirements in Part VI of the MUTCD.
- Do not impede the flow of traffic or close any lanes of traffic except as listed in 00220.40(e).
- Do not stop or hold vehicles on the traveled way, at intersections, or other connecting roadways within the Project limits for more than 20 minutes.
- Do not block driveways for more than two hours unless otherwise authorized in writing.
- Do not close any lanes until the area is signed according to the plans and the requirements of this Section and Section 00225
- Do not perform work which would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time.
- Do not use temporary steel plating within the roadway or shoulder having a pre-construction posted speed zone greater than 35 mph.

00220.03 Work Zone Notifications - Provide the following work zone notifications:

(a) Over-Dimensional Vehicle Restrictions - When a project restricts the width, length, height, or weight of vehicles through a work zone or detours trucks around a work zone, notify the Motor Carrier Transportation Division (MCTD) by using the web based electronic version of the "Highway Restriction Notice-Size and/or Weight" form (Form No. 734-2357) at least 28 calendar days before the restriction or detour takes effect.

(b) Closures - Submit to the Engineer, in writing, for approval, all proposed closure schedules, as follows:

- **Lanes** - A minimum of 7 calendar days before a lane closures begin.
- **Roads** - A minimum of 14 calendar days before closure. Also, notify in writing, all affected emergency services, school districts, and US Postal Service a minimum of 14 days before the any closure.
- **Bicycle and Pedestrian Facilities** - A minimum of 14 calendar days before a bike lane, sidewalk, and multi-use path closure. After receiving written approval, provide 48 hour public notification before the closure.

Construction

00220.40 General Requirements - Provide the following for public traffic in all construction areas:

(a) Traffic Nuisance Abatement - If loose rock or dust exists on roadway surfaces and shoulders, the Engineer may direct one or more of the following:

- Use flaggers or pilot cars and flaggers.
- Apply a fine spray of water to the surface as directed.
- Sweep paved surfaces with power brooms.

(b) Detours and Stage Construction - Construct and remove, if required, detours, stage construction roadways, shoulders, and temporary bridges, including accessory features shown or ordered.

(c) Driveways - Provide reasonable access as follows:

- Replace and maintain business accesses, driveways, approaches, crossings, and intersections as directed.
- 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 standard drawings.
- Do not excavate along both edges of the pavement adjacent to traffic at the same time. Before excavating at the edge of the pavement on the opposite side of the roadway, complete the construction to existing pavement elevation on the side which was excavated first.
- Remove the temporary wedge of aggregate material, if used, before placing permanent base material, and place it in the shoulder slope area or spread it uniformly over the subgrade.

(e) Lane Restrictions - Do not close any traffic lanes during the periods listed below:

(1) Weekdays:

- Between 7:00 a.m. and 9:00 a.m. and between 4:00 p.m. and 6:00 p.m. Monday through Thursday
- Between 7:00 a.m. and 9:00 a.m. Friday morning

(2) Weekends - Between 3:00 p.m. on Friday and midnight on Sunday.

(3) Holidays - Between noon on the day preceding a legal holiday or holiday weekend and midnight on a legal holiday or the last day of holiday weekend, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and midnight on the following Sunday.

For the purposes of this Section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

(4) Special Events - Between noon on the day preceding and midnight on the final day of the special event.

Maintenance

00220.60 Surface Maintenance Responsibilities - Provide adequately maintained accommodations at all times for public traffic through and within the Project according to this Section and Section 00225.

(a) During Construction - The responsibility for maintaining all surface during construction is as follows:

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

- Keep roads, streets, bikeways, sidewalks, multi-use paths, and shoulders being used by public traffic, free of debris, aggregate, dirt, mud, and other materials that impede traffic.

- Repair damage to surfaces caused by the Contractor's operations.
- Maintain all detour or stage construction surfacings not constructed as specified or directed.

Before winter shutdown begins, do the following:

- Provide paved traffic lanes at least 12 feet wide with two feet wide paved shoulders for each direction of traffic.
- Do not leave abrupt edges.
- Remove or cover temporary construction signs unless otherwise directed.
- Clean, install, and reinstall all necessary channelization and pavement markings, as directed.

If this winter shutdown work is not completed and in place, the Agency may do the work according to 00220.60(d).

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

- Maintain existing surfacings and shoulders that are being used by public traffic at the start of the Project which have not been damaged by Contractor operations.
- Maintain surfaces of detours and intermediate stage construction during the time they are being used by public traffic, but only if constructed according to the plans or as directed.
- Maintain existing surfaces and shoulders of detours located outside the Project limits during the time they are being used by public traffic.
- Sand icy pavements and remove the sand residue.
- Remove snow from traveled ways as required to accommodate public traffic.

The Agency may authorize the Contractor to perform this work according to Section 00196.

(b) During Suspensions - Maintain surfacings for which the Contractor is responsible according to 00220.60(a-1), the work according to 00170.80, and work zone traffic control according to Section 00225 during suspensions of the work as follows:

(1) Suspensions Due To Contractor Fault or Neglect - If the suspension is due to any cause within the control or responsibility of the Contractor, including failure to do the following:

- Perform any provisions of the Contract.
- Correct conditions unsafe for the general public, workers or Agency employees.
- Carry out orders given by the Engineer.

Then assume sole responsibility for making provisions for traffic acceptable to the Engineer, and be responsible for the costs of maintaining surfaces under traffic, the work, and work zone traffic control during the suspension.

(2) Suspensions Due To Other Causes - If the suspension is due to unforeseen circumstances, or causes not included in 00220.60(b-1), and if the suspension occurs within the Contract time or adjusted Contract time:

- Place uncompleted traveled ways, shoulders, driveways, approaches, connections, and detours necessary for traffic in a maintainable, acceptable condition. Be responsible for the work
- Be responsible for work zone traffic control.

The Agency will then assume responsibility for maintenance of the roadway surfaces during the suspension.

(c) Resuming Contract Work after Suspension - After any suspension do not resume Contract work until approved.

(d) Right of Agency 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, to the Contractor.

00220.70 Opening Sections To Traffic - When it is in the public interest the Engineer may order any portion of the work opened to traffic. If the portion opened to traffic has been finished in an acceptable manner, it will be designated as "accepted for traffic", and the Contractor will be relieved of maintaining it for legal, public traffic. If the portion of the work to be opened to traffic has not been finished in an acceptable manner, it shall be maintained under traffic by the Contractor in a condition serviceable and adequate for traffic until it is finished in an acceptable manner, except as provided in 00220.60(b).

Maintain portions of the work designated "accepted for traffic" as Extra Work if so ordered. Maintain portions of the work opened to traffic but not "accepted for traffic" at no additional compensation, except watering ordered to protect the work or to alleviate dust will be paid for as provided in Section 00340.

The "accepted for traffic" portion(s) of the work will:

- Be accepted only to the extent the Contractor is relieved of maintaining these portions for legal, public traffic after acceptance.
- Not entitle the Contractor to reduction of retainage.
- Not relieve the Contractor's responsibility for defective materials or work.
- Not relieve the Contractor's responsibility for damages to the work from causes other than legal, public traffic except as provided in 00170.80.
- Not constitute a waiver of any provision of the Contract.

If the Contractor delays the completion of shoulders, drainage structures, or other feature of the work, the Engineer may order all or any portion of the work to be opened to traffic. In this case, the Contractor shall be responsible for maintenance as described in 00220.60(a-1), during the period the work is opened to traffic until final acceptance. Conduct the remaining operations to cause the least obstruction to traffic, and pay all additional costs caused by the presence of traffic.

Measurement

00220.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00220.90 Payment - No separate or additional payment will be made for work performed under this Section, unless otherwise provided or pay items are provided under other Sections.

In addition, no payment will be made for costs incurred by the Contractor because of:

- Inconvenience, additional length of travel to conform to established traffic patterns and planned access features; or
- Compliance with laws governing traffic regulations and load limitations.

Costs anticipated because traffic will be using portions of the work will be included in the Contract prices for the various items of work involved.

Section 00225 - Work Zone Traffic Control

Description

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

00225.01 Abbreviations, Definitions, and Standards:

(a) Abbreviations:

ADT - Average Daily Traffic
TCD - Traffic Control Devices
TCM - Traffic Control Measures
TCP - Traffic Control Plan
TCS - Traffic Control Supervisor
TSS - Temporary Sign Support
PCMS - Portable Changeable Message Sign

(b) Definitions:

Traffic Control Devices (TCD) - Signs, signals, markings, and other devices placed on, over, or adjacent to a roadway used to regulate, warn, or guide public traffic by authority of a public body or official having jurisdiction.

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

Traffic Control Plan (TCP) - A written and drawn plan for providing the safe and efficient movement of public traffic through or around a work zone while protecting workers, incident responders, and equipment.

Work Zone - An area within highway construction, maintenance, or utility work activities which extends from the first warning sign to the last TCD.

(c) Standards - When designing, applying, installing, maintaining, inspecting, and removing traffic control devices, use and follow the most current versions in effect of the following:

- Oregon Department of Transportation's "Sign Policy and Guidelines for the State Highway System"
- The Manual on Uniform Traffic Control Devices (MUTCD)
- FHWA "Standard Highway Sign" manual
- ODOT "Oregon Temporary Traffic Control Handbook for Operations of 3 Days or Less" when directed by the Engineer only for mobile pavement marking operations or surveying work

00225.02 General Requirements - 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

TCM are required to those in place and immediately notify the Engineer. Immediately make changes as approved or directed, but do not place or remove devices without prior approval.

Work may be suspended as specified in 00180.70 or the TCM may be performed by the Agency if the Contractor fails to correct an unsafe condition. Costs for work performed by the Agency will be deducted from monies due the Contractor.

Install a 48 inch "TRUCKS" sign with an 18 inch "500 FEET" rider, approximately 500 feet before each point of access of all noncommercial stockpile sites, work zone staging area, material sources, waste areas, and plant set-up areas to a public roadway.

Install a 54 inch "TRUCKS LEAVING HIGHWAY 1500 FT" sign approximately 1,500 feet in advance of each entrance point to the work area. Install a 54 inch "TRUCKS ENTERING HIGHWAY 1500 FT" sign approximately 1,500 feet in advance of each exit point from the work area.

Do not allow construction vehicles to accelerate or decelerate in a travel lane open to traffic on a freeway or multi-lane facility. Do not use a flagger to allow construction vehicles to access an open traffic lane on a freeway or a multi-lane facility.

When a through road intersects the work zone, place a 48 inch "ROAD WORK AHEAD" sign in advance of the intersection at sign spacing "A" from the "TCD Spacing Table" shown on the standard drawings. These signs do not require sign flag boards, unless otherwise directed.

When paving operations create an abrupt edge, protect traffic by installing signing according the "2-Lane, 2-Way Roadway Overlay Area" detail shown on the standard drawings.

When a cold planed pavement surface is used by traffic, install a 48 inch "BUMP" sign at the transverse paving edge. Install a 48 inch "GROOVED PAVEMENT" sign in advance of the bump sign at sign spacing "A" from the "TCD Spacing Table" shown on the standard drawings. Face both signs toward incoming traffic and install them before opening the cold planed surface area to active traffic.

During flagging operations, monitor the length of traffic queues and when extended traffic queues develop, protect traffic by providing advance flagger(s) and signing according to the "Extended Traffic Queues for Advance Flagging" detail shown on the standard drawings.

00225.03 Traffic Control Outside Project Site - Provide TCM outside the Project Site when required.

00225.04 Regulations and Codes - All electrical equipment, materials, and work shall conform to NEC requirements and all other laws that apply.

00225.05 Contractor Traffic Control Plan - Submit for approval, the Contractor TCP in writing five days before the pre-construction conference. If modifying or if not using the Agency TCP, submit the following:

- 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 tourist-oriented directional (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.

Further TCP revisions will be subject to a Contract change order before implementation.

00225.06 Routing Traffic Over Surfacings - Control traffic being routed over surfaces as follows:

(a) Aggregates - When directed, control traffic over aggregate with flaggers or flaggers and pilot car(s).

(b) Asphalt Treated Permeable Base (ATPB) - When directed, control traffic over ATPB with flaggers or flaggers and pilot car(s).

(c) Asphalt Concrete - Control traffic over asphalt concrete as follows:

(1) Paving - When the longitudinal joint is greater than 1 inch in height, install additional TCD according to 00225.02. Complete the placing of HMAC and construction of paving joints according to 00745.61 and 00745.62.

(2) Cold Plane Pavement Removal - Complete the pavement removal according to 00620.40. When the area cannot be paved back during the same shift and the depth of pavement removal is greater than 1 inch, install additional TCD according to 00225.02.

(d) Oil Mats or Chip Seals - Control traffic over asphalt oil mats or chip seals with flaggers and pilot car(s), unless otherwise directed, until the entire surface has been swept or bladed after the aggregate was placed as tabulated below:

ADT	Minimum Pilot Cars
Over 1500	2
1500 and Less	1

(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.

Materials

00225.10 General - Evaluate the condition of TCD using the criteria shown in the most current version in effect of the American Traffic Safety Services Association (ATSSA) publication titled "Quality Guidelines for Work Zone Traffic Control Devices". Use new or acceptable TCD for all installations unless otherwise specified. Provide test results, quality compliance certificates, equipment lists, and drawings when specified. Acceptance will be by the QPL, test results, quality compliance certificates, equipment lists, drawings, and testing as necessary to assure compliance with the Specifications. After TCD have been installed and accepted on the Project, inspect and maintain the condition of the devices.

All work zone TCD shall comply with the crashworthy requirements of the National Cooperative Highway Research Program (NCHRP) Report 350.

00225.11 Temporary Signing - Furnish new or acceptable temporary signs and accessories meeting the following requirements:

(a) Signs - Use materials and fabricate signs conforming to Sections 00940 and 02910 and the following:

(1) Size and Shape - Use standard size and shape signs meeting the requirements of 00225.01(c) unless otherwise specified or ordered. Double-face signs will not be allowed except for the flagger "STOP/SLOW" paddle.

(2) Type - Use Type "O3", "O4" or "O5" signs, unless otherwise indicated in this Section or in the TCP. Fabricate these signs on one of the following materials:

- New sheet aluminum sign blanks.
- New extruded aluminum panels.
- Used 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.

(3) Folding or Turning Signs - Temporary signs on posts may be the folding or turning type as long as they can be locked when not in use so the sign message is not visible to any traffic.

(4) Roll-up Signs - Use roll-up signs with fluorescent orange roll-up sign sheeting from the QPL.

(b) Sign Supports:

(1) Wood Sign Posts - Use wood sign posts in the sizes and quantities as shown on the standard drawings and according to 02110.40, except posts may be untreated.

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

- Free standing.
- Capable of supporting signs in vehicle-caused turbulence and in winds common to the area where they are used. If additional ballast is required to maintain the signs in an upright position, use sandbags to anchor the sign support legs. Place a sandbag filled with loose sand (approximately 25 pounds) across the bottom of each leg as needed.

(3) Concrete Barrier Sign Supports - Use concrete barrier sign supports that meet the following:

- Conform to the standard drawings.
- Attach securely to the top of the concrete barrier.

(4) Temporary Sign Supports - Fabricate and use TSS as shown on the standard drawings and according to 02110.40, except posts may be untreated.

(5) Square Tube Sign Supports - Use square tube sign supports from the QPL and as shown on the standard drawings.

(c) Sign Covers:

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

- One-piece plywood.
- Other sign cover from the QPL.
- Large enough to completely cover the sign.
- Easy to attach to and remove from the sign without damaging the sign face.
- Black, non-reflective and opaque.

(2) Permanent Signs - Sign covers for permanent signs shall conform to Section 00941.

(d) Sign Flags - Sign flags shall be:

- Fluorescent red-orange.
- 16 inch square or larger.
- Made from an acceptable tightly woven fabric or plastic sheeting.

(e) Amber Flashers - Amber flashers shall:

- Be industry standard 8 inch traffic signal head with visors.
- Be visible the full width of the traveled way and shoulders 1,200 feet from the flashers.
- 110/120 volt or 12 volt, rechargeable, battery-operated.
- Provide a constant flash rate of one flash per second ± 10%.
- Provide an illuminated period of each flash of 30% ± 10% of each flash cycle.

(f) Sign Flag Boards - Use sign flag boards as shown on the standard drawings.

(g) Flashing Stop/Slow Paddles - Use flashing "STOP/SLOW" paddles from the QPL.

00225.12 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing - Furnish temporary barricades, guardrail, barrier, attenuators, pedestrian fencing, and accessories meeting the following requirements:

(a) Barricades - Use barricades from the QPL and as shown on the standard drawings.

(b) Guardrail - Use guardrail meeting the requirements of Section 00810 except posts may be untreated. Use guardrail terminals from the QPL and as shown on the standard drawings.

Reuse salvaged guardrail materials that comply with the requirements of 00810.15.

(c) Concrete Barrier - Use concrete barrier meeting the requirements of Section 00820, and have the same cross section, height, and loop configuration within individual runs and the following:

- Pin-and-loop concrete barrier as shown on the standard drawings (three ASTM A 36 loops, 32 inch height).
- Tall concrete barrier as shown on the standard drawings (two ASTM A 36 perforated C-shapes, 42 inch height).

Provide concrete barrier for temporary applications that are in acceptable condition, without cracks, chips, spalls, or corroded loops or C-shape connectors.

The concrete barrier shall have functioning scuppers, unless otherwise approved.

(d) Impact Attenuators - Furnish impact attenuators from the QPL and as shown on the standard drawings.

(e) Glare Shields - Use glare shields from the QPL that are a minimum 24 inches in height.

(f) Pedestrian Fencing - Use pedestrian work zone delineation fencing from the QPL.

(g) Reflective Barrier Panels - Use reflective barrier panels from the QPL.

00225.13 Temporary Traffic Delineation - Furnish temporary traffic delineation items and accessories meeting the following requirements:

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

(b) Conical Markers - Use conical markers from the QPL.

(c) Surface Mounted Tubular Markers - Use surface mounted tubular markers from the QPL.

(d) Plastic Drums - Use plastic drums from the QPL. Provide drums with type "OO" encapsulated lens reflective sheeting.

(e) Delineators - Use new delineators from the QPL or salvaged reflectorized delineators (W-1) or (Y-1), as appropriate, and conforming to the requirements of Section 00840 and the following:

(1) Guardrail - At guardrail locations, use Type 4 delineators.

(2) Concrete Barrier - At concrete barrier locations, use Type 5 delineators.

(f) Pavement Markers:

(1) Reflective Pavement Markers - Use new Type "1" reflective pavement markers from the QPL.

(2) Flexible Oiling Pavement Markers - Use new flexible oiling pavement markers from the QPL.

(3) Flexible Overlay Pavement Markers - Use new flexible overlay pavement markers from the QPL.

(g) Temporary Tape - Use temporary removable, temporary non-removable, and temporary non-reflective tape from the QPL.

(h) Striping:

(1) Paint - Use striping paint from the QPL.

(2) Beads - Use glass beads from the QPL.

00225.14 Temporary Illumination - Furnish materials for temporary illumination meeting the requirements of Sections 00960, 00970, 02920, 02926, and the temporary illumination plans.

00225.15 Traffic Signals - Furnish cable, guy wires, hardware, wood poles, wood pole foundations, and guy anchors that are able to support the dead load of the equipment shown and withstand a 100 mph, 3-second gust wind speed with an Importance factor (Ir) equal to 0.71 according to the 4th Edition AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

(a) Temporary Traffic Signals - Use materials for temporary traffic signals that conform to Sections 00960, 00990, 02120, 02920, 02925, and the following:

(1) General - Used materials are allowed if restored to new condition or have very minor wear that is undetectable without close inspection. Do not use permanent signal equipment as part of the temporary signal installation.

(2) Cable and Wire - Use all new cable and wire.

(3) Wood Poles - Use poles that are of acceptable condition without visible signs of deterioration or significant longitudinal splits. Poles shall have no more than 8 drilled holes for messenger and tether cable eyebolt attachments. Holes shall not be closer than 6 inches.

(4) Concrete - Use commercial grade concrete according to Section 00440.

(5) Traffic Signal Control Devices - The controller program, PROM and monitor programming will be furnished by the Agency. When the temporary signal is removed, return the PROM to the Agency.

(b) Portable Traffic Signals - Use new or like-new portable traffic signals from the QPL.

00225.16 Temporary Electrical Signs - Furnish electrical signs meeting the following requirements:

(a) Sequential Arrow Signs - Use trailer mounted type "C" sequential arrow signs from the QPL.

(b) Portable Changeable Message Signs - Use trailer mounted PCMS units from the QPL.

00225.17 Flagger Station Lighting - Furnish flagger station lighting from the QPL and meeting the following requirements:

- Illuminates the flagger so that the flagger is visible, and is discernable as a flagger, from a distance of 1,000 feet.
- Illuminates the flagger from above at a height of 18 feet $\pm$ 3 feet.
- The light is shielded from approaching traffic.

Equipment

00225.20 General - Equipment will be accepted based on compliance with the Specifications and the Engineer.

00225.27 Flaggers - Provide flaggers with the following:

(a) Flagger Equipment - Equip flaggers as follows:

- Clothing to cover the complete body except head, neck, and arms below the point of the shoulders.
- An ANSI Class II orange, yellow, strong yellow green or fluorescent versions of these colors, retroreflective vest, shirt, or jacket. The vest, shirt, or jacket shall be designed to identify the wearer as a person and be visible through the full range of body motions.
- A fluorescent yellow-green, orange, yellow, or bright white hardhat or baseball-style cap. Wear hardhats when there is danger of falling or flying objects or electrical shock or burns.
- A minimum 18 inch x 18 inch "STOP/SLOW" paddle made of rigid substrate and fabricated using type "R1"/"O4" sheeting, or a flashing STOP/SLOW paddle from the QPL. A 24 inch x 24 inch STOP/SLOW paddle is recommended for higher speed situations or where more conspicuity is desired.
- Portable, self-contained two-way radio and repeaters, as required, with a range suitable for communications throughout the Project.

(b) Flagger Station Lighting - Use flagger station lighting from the QPL and conforming to the following:

- Provide flagger illumination sufficient to ensure the safety of the flagger, motorists, and workers during flagging operations.
- Provide shielding to prevent light beams from being directed toward traffic.

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

- Clothing, vest, and, hard hat or cap equivalent to that of flaggers.
- Portable, self-contained two-way radio with a range suitable for the Project.
- Cellular telephone active 24 hours a day.
- A vehicle that is equipped with a roof or post mounted rotating amber light or strobe light that is visible for 360°.

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

- No smaller than a compact pickup truck.
- Four wheels.
- A"PILOT CAR FOLLOW ME" (G20-4-18) sign mounted in a conspicuous location on the rear of the vehicle.
- A roof or post mounted rotating amber light or strobe light that is visible for 360°.
- A two-way radio with a range suitable for the Project.

Labor

00225.30 General - Observe all laws concerning safety, health, and sanitation standards according to 00170.60. Provide flaggers, TCS, signal operators, and pilot car operators, to stop, direct, and maintain traffic control through the work zone.

00225.31 Qualifications - Use flaggers, TCS, signal operators, and pilot car operators that meet the following requirements:

- Have a valid 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 - The TCS shall possess a current ODOT "Oregon Certified Traffic Control Supervisor" card. A TCS with a current card from another State Department of Transportation or from the American Traffic Safety Services Association may obtain an Oregon Certified TCS card upon successful completion of ODOT's one-day Recertification Class.

The TCS duties include the following:

- Meets the requirements of 00225.31.
- Files his/her name and phone number with the Engineer and local police.
- Notify the Engineer of any corrections being made to the TCP when it is not functioning as required.
- Inspect TCD during each construction work shift for proper function, location, installation, message, cleanliness, and effect on the traveling public.
- Check post-mounted signs once a week. Inspect traffic control devices to be left in place for more than 24-hours during non-working hours immediately following initial placement of TCD. Conduct additional TCD inspections for extended periods, as requested. Check for effectiveness in both daylight and darkness.
- Review and inspect nighttime lighting and its effect on the traveling public.
- Make temporary revisions to the TCP in the event of an emergency. Immediately follow-up with and report any changes to the Engineer.
- Oversee all requirements of the Contract to ensure the convenience, safety and orderly movement of vehicular, bicycle, and pedestrian traffic.
- Have the documents listed in 00225.01 and applicable standards and specifications available on the Project at all times.
- Discussing proposed TCM and coordinating implementation of the TCP with the Engineer.

Coordinating all TCM, including those of subcontractors, suppliers, and any adjacent construction or maintenance operation.

- Coordinating the Project's activities (such as ramp closures, road closures, and lane closures) with appropriate police, fire control agencies, city or county engineering, medical emergency agencies, school districts, Postmaster and transit companies.
- Prepare and sign a daily Traffic Control inspection report. Submit the report to the Engineer no later than the end of the next working day. As a minimum, include the following items in the report:
  - When signs and TCD are installed and removed
  - Locations of signs and TCD
  - Revisions to the TCP (include copy of signed approval by the Engineer)
  - Lighting utilized at night
  - Observations of traffic conditions
  - When TCD are damaged or replaced
  - How TCD were damaged and by whom
  - Accidents or incidents occurring within the work zone
- The TCS may make minor revisions to the TCP to accommodate site conditions as long as the original intent of the TCP is maintained and the revision has been approved by the Engineer.
- Attending Project meetings specifically scheduled to discuss the TCP and TCM.
- Providing supervision over all TCM on a 24-hour per day basis.

Do not designate the Project superintendent as the TCS.

Maintain a 24-hour telephone number at which the TCS can be contacted. Make arrangements so that the TCS will be available on every working day, on call at all times, and available upon the Engineer's request at other than normal working hours. During non-work periods, the TCS, or authorized

representative, shall report to the Project site within 45 minutes after notification in the event of a work zone incident. The TCS shall have appropriate manpower, equipment, and material available at all times to expeditiously correct any deficiency in the TCM for the Project.

Notify the Engineer of an alternate TCS who can assume the duties of the assigned TCS in the event of that person's inability to perform. Alternate TCS shall be adequately trained and certified to the same degree as the assigned TCS. Notify the Engineer within 24 hours of designating the TCS for the following 24-hour period. Make succeeding notifications within 24 hours every time a subsequent TCS is appointed to the Project.

The on-duty TCS shall not act as a flagger except in an emergency.

Construction

00225.40 General - Install, inspect, move, operate, maintain, and remove temporary TCD according to the plans, these Specifications, and the following:

- Install, maintain, and move all TCD by working with the direction of traffic.
- Provide additional TCM, according to 00225.02, when necessary or directed.
- Turn, cover, or remove the existing TCD as directed when they are not necessary or conflict with temporary devices. Remove and obliterate, without damaging the wearing surface, all evidence of all temporary TCD when the Contract is completed.
- Remove TCD in a sequence reverse to 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.

Install all temporary signing according to the plans, Section 00940, the MUTCD, the "Sign Policy and Guidelines for the State Highway System", FHWA "Standard Highway Sign" manual and the following:

(a) Speed Signs - Use speed signs as follows:

(1) Advisory Speed Signs - Install the advisory Type "O4" speed signs as directed.

When advisory Type "O4" speed signs are used, cover the appropriate Type "W1" speed zone signs with sign covers according to Section 00941. Uncover them when the advisory Type "O4" speed signs are removed or covered. At the trailing end of the Project, install a Type "W1" speed zone sign with the original designated speed. If existing Type "W1" speed signs are 500 feet or less beyond the Project, additional signs are not required.

When there is no work on the Project or when directed, cover or remove the advisory Type "O4" speed signs and restore the original Type "W1" speed zone signs.

(2) Regulatory Speed Signs - Install and maintain the regulatory signs as directed and according to the "Temporary Speed Zone Order" signed by the State Traffic Engineer.

When regulatory Type "W1" speed signs are used, cover the appropriate Type "W1" speed zone signs with sign covers according to Section 00941. When there is no work on the Project or when

directed, cover or remove the regulatory Type "W1" speed signs and restore the original speed zone signs.

(b) Sign Supports:

(1) Wood Sign Posts - Except as provided in the following (2) through (5), mount all temporary signs on wood sign posts as shown and as shown on the standard drawings.

When sign posts are installed in rock, a shorter post may be used provided the post is installed in a buried concrete footing at least 12 inches in diameter and 2 feet deep.

(2) Portable Sign Supports - Use portable sign supports as follows:

- When signs are needed at a single location for no more than 48 consecutive hours.
- Position the support so the lowest point of the sign is at least 1 foot above the roadway surface.
- Install flags on signs according to 00225.41(c).
- Remove from road at end of each work shift when the condition is no longer in effect.
- Use with roll-up signs.
- Use ballast to prevent blow down.

(3) Concrete Barrier Sign Supports - Mount signs on concrete barrier so the:

- Lowest point of the sign is at least 7 feet above the roadway surface.
- Sign and post are held securely with a device that prevents blowdown.
- Sign can be turned and locked parallel to the flow of traffic when not in use.

(4) Temporary Sign Supports - Use TSS as follows:

- When signs are needed at a single location for more than 48 consecutive hours.
- When not practical to post mount due to location or when utility conflicts exists.
- Do not tip over TSS.
- Position the TSS's behind a type III barricade.
- When not in use, locate TSS outside the clear zone and turn away from traffic, or cover sign and retain the type III barricade for delineation.

(5) Square Tube Sign Supports - Square tube sign supports may be used as a substitute for wood sign posts. Install square tube sign supports as shown on the standard drawings.

(c) Sign Flag Boards and Sign Flags - Use two sign flag boards and flags as follows:

(1) Sign Flag Boards - Install two sign flag boards, as shown on the standard drawings, the plans, and 00225.02.

(2) Sign Flags - Install at least two sign flags above all signs mounted on portable sign supports. Mount flags so the entire sign is visible.

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

(e) Roll-up Signs - Roll-up signs may be used at a single location for no more than 48 consecutive hours.

(f) Inconsistent Temporary Signs - Ensure that all temporary signs are properly used and consistent with the work zone. When signage is no longer required for staging or shift work, do the following:

- Remove from the road all temporary signs, supports, and ballast.
- Turn or cover the signs so that the message is not visible to any traffic.
- Remove or cover the sign flag boards.
- Remove or cover flags with an opaque, black, reflective sheath.
- Remove or turn off amber flashers.

When it is determined only minor work remains on the Project and the work area does not encroach on the roadway or shoulder, do the following:

- Remove all temporary signs, supports, and ballast including the advance construction signs and sign flag boards.
- Provide signs for minor work on portable sign supports.

(g) Permanent Signing - Install the appropriate permanent signing as required before changing traffic control staging.

00225.42 Temporary Barricades, Guardrail, Barrier, Attenuators, and Pedestrian Fencing - Install temporary barricades, guardrail, barrier, attenuators, pedestrian fencing, and accessories as follows:

(a) Barricades - Use and place barricades as shown or as directed.

(b) Guardrail - Construct temporary guardrail as shown and according to Section 00810.

(c) Concrete Barrier - When placing barrier adjacent to a road, maintain a minimum of 24 inches from face of barrier to edge of traffic lane. Flare the leading end as shown in the table below and treat ends as shown on the plans.

Speed (mph)	Flare Rate
65	19:1
55	16:1
50	14:1
45	13:1
40	11:1

Pin or restrain temporary concrete barrier when the distance behind the barrier is limited to less than 3 feet. When pinning or restraining barrier, maintain a minimum of 1 foot between the back face of barrier and a drop-off or obstruction. Use the appropriate pinning or restraint detail shown on the standard drawings.

(d) Impact Attenuators - Assemble and install impact attenuators according to the manufacturer's recommendations and as follows:

- May be placed on pallets, which are no more than 4 inches high, as approved.
- Place and fill the modules with the weight of dry sand as shown on the standard drawings.
- Mix salt with the sand to the proportions recommended by the manufacturer or at least 5% by volume when no manufacturer recommendations are given.

- Attach an object marker to the lead module as shown on the standard drawings.
- Use attenuators designed for the original pre-construction posted speed.
- For narrow site systems, pin or restrain the first two barrier sections as shown on the standard drawings.

(e) Glare Shields - Install glare shields as shown or as directed and according to the following:

- Install at spacing recommended by the manufacturer.
- Install all glare shield blades vertical and true to line.
- Firmly attach the base plate anchor bolts to the concrete barrier to withstand a 1,000 pound vertical pull and to prevent horizontal and rotational displacement. Maximum spacing between anchor bolts on modular units shall be 30 inches.
- Repair any damage to the concrete barrier caused by the Contractor's operations at no additional cost to the Agency.
- Modular or single element glare shields that are installed in a continuous run shall be of the same manufacture and of like appearance throughout the entire installation.

(f) Temporary Pedestrian Fencing - Install temporary pedestrian work zone delineation fencing as shown or as directed.

(g) Reflective Barrier Panels - Install reflective barrier panels on temporary concrete barrier as shown or directed and as follows:

- Install two panels on each barrier section.
- Maintain a 4 foot gap between panels on each barrier section.
- Alternate silver-white and fluorescent orange color panels.
- Attach the panels to the face of the concrete barrier with a minimum of four anchors.
- Install the bottom edge of panels 20 inches above the bottom of the concrete barrier.

00225.43 Temporary Traffic Delineation - Install and remove 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 Markers - Install surface mounted tubular markers as shown or directed.

(1) Surface Mounted Tubular Marker Removal - Remove surface mounted tubular marker bases in a manner that leaves any remaining adhesive material with a textured surface condition similar to the texture of the surrounding top lift wearing course pavement surface. Make the surface dull and non-reflective. Remove adhesive from the pavement surface using a method that will not damage the pavement surface.

(c) Plastic Drums - Install plastic drums as shown or as directed.

(d) Delineators - Install traffic delineators as shown on the standard drawings or as directed. Install delineators on temporary concrete barrier and temporary guardrail as follows:

- Space on 50 foot centers. Closer spacing may be required as directed.
- Use yellow when installed on the left side of traffic.
- Use white when installed on the right side of traffic.
- Use bi-directional markers for median applications.
- Position to face oncoming traffic.

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

- Three single markers spaced 5 feet apart to simulate a 10 feet skip line with a gap of 30 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 markings are complete. Replace missing markers at no additional cost to the Agency. Remove the markers from the top lift of pavement within five days after the Contractor is notified of the placement of permanent markings through the work area. Remove the flexible paving markers without damaging the roadway surface, or cut the markers off within 1/8 inch of the roadway surface.

(1) Reflective Pavement Markers - Use reflective pavement markers when shown according to Section 00855. Establish alignment with control points at 200 foot intervals on tangents and at 50 foot intervals on curves.

(2) Flexible Oiling Pavement Markers - Use flexible oiling pavement markers just before applying asphalt for chip seals, sand seals, and oil mats. Remove marker covers before reopening the roadway to traffic.

If a segment of roadway is not completed when the roadway is reopened to traffic, install another set of markers just before the next application of asphalt.

(3) Flexible Overlay Pavement Markers - Use flexible overlay pavement markers as follows:

- On surfaces that do not require chip seals, sand seals, and oil mats.
- On underlying surfaces that temporarily carry traffic.
- When temporary striping is determined as not practical.

Install the markers before reopening the roadway to traffic. Remove the markers on underlying surfaces before placing the next surface layer.

(4) Existing Pavement Marker Removal - Remove and dispose of existing raised or recessed pavement markers as needed for Stage Construction or as directed. Remove the markers from permanent wearing course surfaces so the roadway surface is not damaged and a surface texture similar to that of the surrounding area remains. Make the surface dull and non-reflective. Remove adhesive from the pavement surface using a method that will not damage the pavement surface.

(f) Temporary Tape - Install temporary tape as shown and the following:

(1) Temporary Removable Tape - Install removable tape on existing surfaces or wearing course as shown or as directed. When staging across new bridge deck use temporary removable tape.

(2) Temporary Non-Removable Tape - Install non-removable tape on base courses as shown or as directed.

(3) Temporary Non-Reflective Tape - Install non-reflective tape over durable pavement markings to be retained as shown or directed.

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

(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 per gallon of paint. Apply 4 inch wide by 10 foot long stripes with 30 foot gaps for skip striping. Apply 4 inch wide, continuous stripe for edge line striping.

(2) Wearing Course - On pavement wearing courses use pavement markers or temporary removable tape to simulate lane lines. When a travel lane is adjacent to temporary concrete barrier, replace the edge line with temporary removable tape, as directed. When striping the edge line, use a continuous strip of temporary removable tape.

(3) Durable Permanent Pavement Markings - On pavement wearing courses apply temporary striping for lane line delineation until durable permanent pavement markings can be applied, unless otherwise directed. Reduce the application rate to a thickness of 10 mils wet, equivalent to 12 gallons per mile for a 4 inch wide solid stripe. Apply reflective elements at a rate of 5 pounds per gallon of paint. Only one application is required.

Place temporary striping directly adjacent to the final location of the durable permanent pavement markings. Place so that the durable permanent pavement markings can be aligned with the existing striping on the adjacent project. Removal of this striping is not required, if aligned as above.

When scheduled installation of durable permanent pavement markings will exceed, or will likely exceed, four weeks after placement of wearing surface, furnish and place temporary striping at the standard rate stated in 00225.43(g-1). Removal of this striping is not required, if aligned as above.

(h) Pavement Edge Delineation - Place tubular or conical markers to delineate the edge of pavement when construction work obscures the painted shoulder stripe (fog line) or when paving creates an abrupt or sloped edge drop-off 1 inch or more in height along the shoulder. Locate and maintain the markers as follows:

- Between existing delineators.
- Space markers as shown for traffic delineators on the standard drawings, except do not exceed 200 feet.
- Patrol daily and restore them to their proper position at least once in the early morning and once in the late afternoon until the tubular or conical markers are no longer required.

- Remove after a new edge stripe has been painted and new delineators are in place.
- Between traffic and abrupt edge.
- Place delineation immediately.

(i) Stripe and Legend Removal - When removing striping and legends for stage construction, remove them by sandblasting, hydro-blasting, steel shot blasting, or grinding so the pavement surface is not damaged below a depth of 1/8 inch. Remove durable markings and durable legends by steel shot blasting or grinding the pavement surface to a depth no greater than 1/8 inch, or other approved method so the pavement surface is not damaged. Do not use paint or asphalt to cover existing stripes. Repair any damaged surfaces to the Engineer's satisfaction at no additional compensation.

Do not use grinding to remove stripes from the wearing course or existing surfaces, unless the area is to be paved over during the Project.

Use vacuum shrouded equipment or other equally effective containment procedures.

Contain and collect all removed paint, durable markings, and spent abrasive and dispose of according to 00290.20.

Remove striping on pavement base courses when a change in striping is necessary and when the pavement will not be covered with an additional base course. Remove striping and pavement markers on the wearing course so that the permanent markings can be applied. Remove all remaining striping and pavement markers from the wearing course after the permanent markings have been applied, as directed.

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

00225.44 Temporary Illumination - Construct and remove temporary illumination according to the plans and Sections 00950, 00960, 00970, 02920, and 02925.

00225.45 Traffic Signals - Provide traffic signals according to the following:

(a) Temporary Traffic Signals - Construct, adjust, and remove temporary traffic signals according to the plans, Sections 00950, 00960, 00990, 02920, 02925, and the following:

(1) Removal - Remove the temporary traffic signal when directed. Remove all wood poles and guy anchors in their entirety. Abandon vehicle detector loops in place. Contractor furnished equipment remains the property of the Contractor.

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

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

(4) Suspension of Heads - Adapt signal mounting hardware as needed for mounting on wood poles.

(5) Testing and Turn-on - Certify that all traffic signal controllers and related control equipment for temporary signals have passed the Oregon Department of Transportation laboratory tests. Successfully tested controllers and related control equipment will be assigned permanent certification tags and will not require further environmental testing. Deliver controllers to the Traffic System Services Unit for functional testing.

(b) Portable Traffic Signals - Unless otherwise indicated in the TCP, provide and install portable temporary traffic signals as shown on the standard drawings and the following:

(1) Location and Set-up - Locate and set up portable temporary traffic signals according to the following:

- Locate the portable temporary traffic signal so that one vehicle signal head is directly over the traveled way with minimum vertical clearances of 17 feet.
- Provide conflict monitoring of green and yellow field indications.
- If there are indications in conflict or if there is operational failure, set the default to red flash.
- Hardwire interconnect the two units for timing and conflict monitoring.
- Provide cellular or other immediate methods of failure notification.

Do not install portable temporary traffic signals if driveways or road approaches are between the portable temporary traffic signals.

(2) Vehicle Detection - Provide vehicle detection at the stop line for each direction of traffic.

(3) Testing and Turn-on - Notify the Engineer 14 calendar days before turning on the portable temporary traffic signal. The Engineer will do the following:

- Inspect the installation and confirm the date and time the portable traffic signal is to be turned on.
- Notify the Contractor, in writing, with a list of deficiencies that need correction.
- Provide timing parameters to the Contractor for input into the portable temporary traffic signal.

Correct all deficiencies identified by the Engineer before turning on the portable temporary traffic signal. Do not change the timing parameters without the approval of the Engineer. Use flaggers to control traffic during initial turn on of the signal. The flaggers shall remain on standby for 2 hours after the signal is turned on and operating properly.

Correct deficiencies at no additional cost to the Agency.

(c) Existing Traffic Signals - Adjust existing traffic signals according to the plans and Sections 00950, 00960, 00990, 02920, and 02925.

00225.46 Temporary Electrical Items - Provide and install electrical resources as follows:

(a) Sequential Arrow Signs - Use the sequential arrow signs as follows:

- Install where the sign is visible from 1/2 mile minimum.
- 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:

- Install beyond the outside shoulder or behind existing barrier or guardrail.
- Install where the sign is visible from 1/2 mile minimum.

- Mount at a height of 7 feet from bottom of sign to ground.
- Entire message is displayed within 7.5 seconds.
- Use a maximum of two panels to display an entire message.
- 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 and Flagger Station Lighting - Use flaggers and flagger station lighting as follows:

(a) Flaggers - Locate flaggers far enough in advance of the work area to permit adequate time for the motorist to respond to the flagger's instructions. All flaggers, including advance flaggers, shall use a STOP/SLOW paddle. Do not use the roll-up STOP/SLOW paddle for non-emergency flagging operations.

During advance flagging operations, only display the SLOW face of the paddle by covering the STOP face of the paddle with black, opaque, nonreflective material.

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

Flagging stations shall be staffed continuously or until the Engineer determines flagging is no longer required.

(b) Flagger Station Lighting - Provide continuous flagger station lighting for nighttime flagging as follows:

- Locate the light equipment on the same side of the roadway as the flagger between 5 to 10 feet from the edge of the travel lane, on or beyond the roadway shoulder, or as directed.
- Place the flagger station lighting to direct the lighting away from the approaching traffic in the near lane at approximately a 15^{o} horizontal angle $\pm 10^{o}$ perpendicular to the centerline of the roadway.
- Aim all of the luminaires directly at the flagger.
- Increase the output wattage or number of luminaires as the luminance from, and number of, surrounding and background lights increases. Do not provide a total output more than 2,500 watts, unless otherwise directed.

00225.48 Traffic Control Supervisor - Supervise the safe operation of traffic control within the construction work zone.

00225.49 Pilot Cars - Operate pilot cars at a safe and prudent speed.

Maintenance

00225.60 Temporary TCD - Evaluate the condition of TCD and maintain them using the criteria shown in the current American Traffic Safety Services Association (ATSSA) publication titled "Quality Guidelines for Work Zone Traffic Control Devices". Except for electrical devices, replace all TCD that are in marginal or unacceptable condition with equal devices, in new or acceptable condition, within a time period agreed upon by the Engineer.

Electrical devices that are in marginal or unacceptable condition may be repaired instead of being replaced, as long as the repairs are satisfactorily completed within a time period agreed upon by the Engineer.

The replacement or repair of TCD, found to be in marginal or unacceptable condition, shall be made at no additional cost to the Agency except as in 00225.90(a-1).

Evaluate, maintain, repair or replace TCD, and perform other duties including the following:

- Keep the devices in proper position, clean, and legible at all times.
- Keep lights, reflectors, and flashers clean, visible, and operable during both daylight and darkness.
- Trim or remove vegetative growth or other materials so the devices can be seen.
- Verify, by inspection, the effectiveness of the installations at frequent intervals, both in daylight and darkness, at actual travel speeds.
- Repair, replace, or restore damaged or destroyed devices to maintain continuity and effectiveness.
- Maintain temporary TCD during suspensions of work the same as if work were in progress.

00225.61 Signs and Other Existing TCD - Maintain existing guide signs, warning signs, regulatory signs, specific service signs (business logos), tourist-oriented directional signs (TODS),and other existing TCD, in the same manner as temporary signs and devices associated with the Project.

00225.62 Temporary Concrete Barrier, Guardrail, and Attenuators - Maintain or replace materials and equipment as follows:

(a) Temporary Concrete Barrier and Guardrail - Immediately repair any concrete barrier segment or guardrail element that is damaged by the Contractor during or after placement. Repair it to the Engineer's satisfaction or replace it with an undamaged section at no additional cost to the Agency.

(b) Temporary Impact Attenuators - Complete repair of damaged 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 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.

00225.64 Illumination and Sign Illumination - Maintain existing illumination and sign illumination after adjusting or working on them until accepted.

Routine maintenance of existing illumination and sign illumination will be performed by the Agency at the Agency's expense before the Contractor works on them and after work on them is completed and accepted.

00225.65 Traffic Signals - Maintain or replace materials and equipment as follows:

(a) Temporary Traffic Signals - After successful turn-on, assume all maintenance of the temporary traffic signal installation until it is removed. After notification by the Agency, if the Contractor is not able to respond to a maintenance request, Agency electricians will make repairs at the Contractor's expense.

(b) Portable Traffic Signals - After successful turn-on, perform all required maintenance during operation of the portable traffic signal. Maintain a log for each portable traffic signal that contains at least the following information:

- Dates and times when service and maintenance is performed.
- A description of equipment that was serviced and a brief description of why the service was performed.
- All operational and equipment failures of the unit.
- Repairs made to the unit.
- Past operational history of the unit.
- All timing parameters input into the controller.

The log shall remain with the corresponding portable traffic signal at all times.

The Agency will not replace or repair any part of portable traffic signals.

If the portable traffic signal fails during operation for any reason, immediately provide flaggers to control traffic until the portable traffic signal is operational. If the portable traffic signal fails a second time within 30 calendar days of the first failure, remove it from the Project and control traffic with flaggers until a replacement portable traffic signal is installed, activated, and working properly. No additional payment will be made for flagging as a result of a portable traffic signal failure.

(c) Existing Traffic Signals - Maintain existing signals after adjusting or working on them until accepted.

Routine maintenance of existing signals will be performed by the Agency at the Agency's expense before the Contractor works on them and after work on them is completed and accepted.

00225.66 Portable Electrical Signs - Maintain and use the required portable changeable message signs and sequential arrow signs according to the manufacturer's recommendations, traffic control plans, and as required. Do not display or alter any sign message before it is approved.

While portable changeable message signs and sequential arrow signs are in use, have repair equipment and parts on the Project site, as recommended by the manufacturer.

When directed, repair or replace sequential arrow signs and portable changeable message signs that are damaged or destroyed before continuing work that requires use of the signs.

00225.67 Flagger Station Lighting - Maintain and use the required flagger station lighting according to the manufacturer's recommendation and as required.

When flagger station lighting is in use, have on the Project site, the following:

- Repair equipment and electronic components recommended by the manufacturer.
- At the beginning of each shift, have approved backup flagger station lighting available for immediate use in event of failure.
- Sufficient fuel to maintain continuous operation of the diesel generator.

Measurement

00225.80 Measurement - Work covered under this Section will be measured by one of the following methods:

- **Method "A" - Unit Basis** - Under this method, work zone traffic control measures will be measured according to 00225.80(a) through 00225.89.

- **Method "B" - Lump Sum Basis** - Under this method, no measurement of quantities will be made.

- **Method "C" - Incidental Basis** - Under this method, no measurement of quantities will be made.

(a) Quantity Limitations - The quantities for work zone traffic control measures (TCM) will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.
- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM, except temporary signing, temporary electrical signs, and portable temporary traffic signals, damaged by public traffic and replaced by the Contractor.

Temporary signing, temporary electrical signs, and portable temporary traffic signals damaged by public traffic and replaced or repaired by the Contractor will not be measured.

(b) Temporary Protection and Direction of Traffic - No measurement of quantities will be made for this work.

00225.81 Temporary Signing - The quantities of temporary signing and flashers will be determined as follows:

(a) Signs - Temporary signs will be measured on the area basis, upon delivery to the Project. The quantities will be limited to those in the approved TCP including speed zone signage. The sign area will be the nominal area determined by multiplying the width times the length. No deductions will be made for corners or irregular shapes.

Route markers and other signs fastened to the face of larger signs will be measured as separate signs.

(b) Amber Flashers - Amber flashers will be measured on the unit basis.

00225.82 Temporary Barricades, Guardrail, Barrier, and Attenuators - The quantities of barricades, attenuators, guardrail, and concrete barrier will be determined as follows:

(a) Barricades and Attenuators - Barricades, temporary impact attenuators, and moving temporary impact attenuators will be measured on the unit basis.

(b) Guardrail and Concrete Barrier:

(1) Guardrail - Temporary guardrail will be measured on the length basis, of each type complete and in place, determined by one of the following methods:

a. Count Method - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a "standard section" is defined as 12 1/2 feet of complete guardrail, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post and added to the total calculated length of the standard sections for each run.

b. Length Method - Measurement will be from center to center of end posts, along the line and grade of each run of each type.

(2) Guardrail Terminals, Transitions, and Bridge Connections - Temporary guardrail terminals, temporary guardrail transitions, and temporary bridge connections will be measured on the unit basis.

(3) Concrete Barrier - Temporary concrete barrier and moving temporary concrete barrier will be measured on the length basis, determined by one of the following methods:

a. Count Method - The laying length of a standard section, as shown on the applicable 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.

(c) Glare Shields - Glare shields and moving glare shields will be measured on the length basis, from center to center of the glare shield blades, as installed on concrete barrier for each run.

(d) Reflective Barrier Panels - Reflective barrier panels will be measured on the unit basis.

00225.83 Temporary Traffic Delineation - The quantities of 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 the unit basis.

Flexible pavement markers includes flexible oiling markers and flexible overlay markers.

(b) Temporary Tape - Temporary tape will be measured on the length basis, to the nearest foot, as follows:

(1) Removable Tape - Removable tape will be determined by measuring the actual length of the 4 inch wide tape complete and in place.

(2) Non-Removable Tape - Non-Removable tape will be determined by measuring the actual length of the 4 inch wide tape complete and in place.

(3) Non-Reflective Tape - Non-Reflective tape will be determined by measuring the actual length of the 6 inch wide tape complete and in place.

(c) Striping - Painted temporary striping on pavement base courses will be measured on the length basis, to the nearest foot, determined by measuring the actual length of 4 inch wide stripe complete and in place.

Temporary striping required for durable permanent pavement marking installation will be included in the measurement.

Skip intervals will not be included in the measurement.

Temporary striping will be measured on the length basis, of lines based on a nominal width of 4 inches. If the plans call for, or the Engineer requires, stripes other than nominal 4 inch width, the measurement will be adjusted by converting to equivalent length of nominal 4 inch width.

(d) Stripe Removal and Legend Removal - Stripe removal and legend removal will be measured as follows:

(1) Stripe Removal - Stripe removal for stage construction will be measured on the length basis, to the nearest foot, determined by measuring the overall length of 4 inch line removed. The quantity of stripe removal will be the computed length of lines removed based on a nominal width of 4 inches. For computation purposes, the following apply:

- The width of a line is the normal standard line width applied during original placement of solid no-passing lines, broken (skip) lines, edge lines, and any other lines normally 4 inches wide.
- The length of continuous lines is length of the line.
- The length of broken (skip) stripes is the standard length of a skip line normally painted during original placement of the lines 10 feet of paint per 40 feet of roadway length.

The length of standard 8 inch or 12 inch wide stripes will be adjusted by converting to equivalent length of 4 inch width line. No conversion or adjustment will be allowed for lines that are wider or longer due to improper placement or retracing deviations.

(2) Legend Removal - Pavement legend removal for stage construction will be measured on the area basis, of each legend removed and will be the nominal area determined by multiplying the width times the length of the legend. No deductions will be made for corners or irregular shapes.

00225.84 Temporary Illumination - No measurement of quantities will be made for temporary illumination.

00225.85 Traffic Signals - The quantities of traffic signals will be measured as follows:

(a) Temporary Traffic Signals - No measurement of quantities will be made for temporary traffic signals.

(b) Portable Traffic Signals - Portable traffic signals will be measured on the unit basis, for each complete system. A complete system consists of two portable temporary traffic signals and hardwire interconnect between them.

00225.86 Temporary Electrical Signs - The quantities of temporary electrical signs will be measured as follows:

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

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

00225.87 Flaggers and Flagger Station Lighting - The quantities of flaggers and flagger station lighting will be measured as follows:

(a) Flaggers - Flaggers will be measured on the time basis, of the actual number of hours flagging stations are staffed.

Flagging performed by a TCS will not be measured.

(b) Flagger Station Lighting - Flagger station lighting will be measured on the unit basis, where the devices are initially installed on the Project or on the time basis, of the actual number of hours the flagger stations are staffed and flagger station lighting is required.

No measurement will be made for the backup unit in event it is used or not.

00225.88 Traffic Control Supervisor (TCS) - The quantities of the TCS will be measured on the unit basis, and will be determined by a TCS construction work shift.

For the purpose of determining a TCS construction shift, a TCS construction work shift will be any work shift or portion of a work shift where any of the following operations occur:

- Full lane closures or lane shifts implemented on a daily basis on a freeway or highway with an ADT greater than 10,000.
- When TCS is called to respond to a traffic-related issue during non-work hours.
- Other construction operations as requested by the Engineer.

A maximum quantity of two TCS construction work shifts will be allowed for each 24 hour period. One TCS will be allowed for a construction work shift unless otherwise approved.

00225.89 Pilot Cars - The quantity for pilot cars will be measured on the time basis, of the actual number of hours pilot cars are operated.

Payment

00225.90 Payment - Work covered under this Section will be paid for by one of the following methods:

(a) Method "A" - Unit Basis:

(1) Pay Quantities - The accepted quantities, measured according to 00225.80(a) through 00225.89, will be paid for at the Contract lump sum amount or Contract unit price, per unit of measurement, for each of the pay quantities listed in the Contract Schedule of Items and in approved change orders.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the materials and TCD, and for furnishing all equipment,

labor, and incidentals necessary to complete the work as specified, except as covered in 00225.90(a-2).

All TCD damaged by public traffic and replaced by the Contractor, except temporary signing, temporary electrical signs, and portable temporary traffic signals, will be paid for at the Contract price for the pay items listed in the Contract Schedule of Items or in approved Contract change orders, unless otherwise specified. Replacement temporary impact attenuator component(s) will be paid for according to Section 00196. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.
- The damaged devices are disposed of to the Engineer's satisfaction.

No separate or additional payment will be made for:

- Moving and reinstalling signs, barricades, plastic drums, delineators, sequential arrow signs, and portable changeable message signs required by stage construction.
- Providing TCM, including flaggers, used at material sources and disposal sites that are outside the Contract limits unless specifically called for on the plans or in the Special Provisions.
- Providing portable signs when only minor work is required as indicated in 00225.41(f).
- TCD damaged or destroyed by Contractor's equipment or operations.

(2) Temporary Protection and Direction of Traffic - Temporary protection and direction of traffic will be paid for at the Contract lump sum amount for the item "Temporary Protection and Direction of Traffic" and will be for:

- Positioning all traffic control devices in proper locations at all times.
- Providing and furnishing electrical power.
- Cleaning up and removing devices destroyed or damaged by public traffic.
- Furnishing, placing, maintaining and removing temporary sign covers.
- Moving temporary concrete barrier to and from Contractor's stockpile areas.
- Moving temporary impact attenuators of any type to and from Contractor's stockpile areas.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers.
- Removing existing raised and recessed pavement markers.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers used to delineate the pavement edge because of edge line obliteration.
- Furnishing, installing, maintaining, moving, and removing pedestrian work zone delineation fencing.
- Moving and removing existing signs, specific service signs (business logos) and tourist-oriented directional signs (TODS) from their existing locations and reinstalling them on any type of support at new locations required by stage construction, as shown or directed.
- Moving, reinstalling, and removing existing post-mounted signs required by stage construction.
- Providing, surfacing, maintaining, removing, and restoring the alternate pedestrian route.

- Providing, moving, reinstalling, and removing guardrail end pieces and guardrail anchors as required by stage construction.
- Performing routine inspections of the TCD by the TCS.

(b) Method "B" - Lump Sum Basis - Work zone traffic control will be paid for at the Contract lump sum amount for the item "Temporary Work Zone Traffic Control, Complete".

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing materials and TCD, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

(c) Method "C" - Incidental Basis - When the Contract Schedule of Items does not indicate payment for work zone traffic control, all work zone traffic control will be considered Incidental and no separate payment will be made.

00225.91 Temporary Signing - The accepted quantities of temporary signing and appurtenances will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Signs	Square Foot
(b)	Amber Flashers	Each

Item (a) includes all signs, regardless of type.

No separate or additional payment will be made for flags, sign flag boards, or posts and other supports.

00225.92 Temporary Barricades, Guardrail, Barrier, and Attenuators - The accepted quantities of temporary barricades, guardrail, barrier, attenuators, and appurtenances will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Barricades, Type ___	Each
(b)	Temporary Guardrail, Type ___ Reflectorized	Foot
(c)	Temporary Guardrail Terminals, _____	Each
(d)	Temporary Guardrail Transition	Each
(e)	Temporary Bridge Connections	Each
(f)	Temporary Concrete Barrier, Reflectorized	Foot
(g)	Temporary Concrete Barrier, Tall, Reflectorized	Foot
(h)	Moving Temporary Concrete Barrier	Foot
(i)	Temporary Impact Attenuator, _____	Each
(j)	Moving Temporary Impact Attenuators, _____	Each
(k)	Temporary Glare Shields	Foot
(l)	Moving Temporary Glare Shields	Foot
(m)	Reflective Barrier Panels	Each

In item (a), the type of barricade will be inserted in the blank.

In items (b) and (c), the type of guardrail or terminal will be inserted in the blank.

Items (d) and (e) includes each device, regardless of size or type.

Items (f) and (g) includes Type 5 delineators. No separate or additional payment will be made for pinning or restraining barrier.

Item (h) includes moving temporary concrete barriers, regardless of size or type, from one location of actual use to another, and for removing and replacing Type 5 delineators on the barriers, as necessary.

In items (i) and (j), the type of attenuator, if applicable, will be inserted in the blank.

Item (j) includes each move of the device from one location of actual use to another.

Item (l) includes moving the devices from one location on the concrete barrier to another.

Item (m) includes panels installed on the concrete barrier and replacing damaged panels.

No separate or additional payment will be made for temporary impact attenuator replacements, replacement modules, cartridges, components, or replacement parts.

00225.93 Temporary Traffic Delineation - The accepted quantities of temporary traffic delineation will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Surface Mounted Tubular Markers	Each
(b)	Replace Surface Mounted Tubular Markers	Each
(c)	Temporary Plastic Drums	Each
(d)	Temporary Delineators	Each
(e)	Temporary Reflective Pavement Markers	Each
(f)	Temporary Flexible Pavement Markers	Each
(g)	Temporary Removable Tape	Foot
(h)	Temporary Non-Removable Tape	Foot
(i)	Temporary Non-Reflective Tape	Foot
(j)	Temporary Striping	Foot
(k)	Stripe Removal	Foot
(l)	Legend Removal	Square Foot

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

Item (b) includes furnishing new or refurbished devices to replace damaged or missing devices.

Item (e) includes temporary pavement markers having either one or two reflective faces.

Item (f) includes removing flexible pavement marker covers.

Item (k) includes removal of painted and durable stripes required for stage construction.

Item (l) includes removal of durable and non-durable legends required for stage construction.

Payment for items (g), (h), (i), and (j) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

No separate or additional payment will be made for mobilization to perform striping, stripe removal, legend removal, or for mobilization to place or remove temporary flexible pavement markers.

00225.94 Temporary Illumination - The accepted quantities of temporary illumination will be paid for at the Contract lump sum amount for the item "Temporary Illumination".

00225.95 Traffic Signals - The accepted quantities of traffic signals will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Traffic Signal	Lump Sum
(b)	Portable Traffic Signal	Each

Item (a) includes all required materials called for by the plans and Specifications.

Item (b) includes furnishing, operating, moving, and removing the signals and all required earthwork, bases, surfacings, and hardwire interconnects.

No separate or additional payment will be made for removing and replacing damaged portable traffic signals.

Flagging for initial turn-on and 2 hour standby time will be paid for under the flagger pay item.

00225.96 Temporary Electrical Signs - The accepted quantities of temporary electrical signs will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Sequential Arrow Signs	Each
(b)	Portable Changeable Message Signs	Each

Items (a) and (b) includes furnishing, operating, moving, and removing the signs and supports.

No separate or additional payment will be made for removing and replacing damaged signs.

00225.97 Flaggers and Flagger Station Lighting - The accepted quantities of flaggers and flagger station lighting will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Flaggers	Hour
(b)	Flagger Station Lighting	Each or Hour

Item (a) includes all necessary equipment, special apparel, flagging equipment, and two-way radios.

Workers performing flagging duties who are not properly equipped or attired will not be considered to be flaggers and will not be eligible for payment under this item.

Flaggers performing work other than flagging will not be considered flaggers and will not be eligible for payment under this item.

Payment for item (a) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

Item (b) includes furnishing, operating, moving, and removing the flagger station lighting.

No separate or additional payment will be made for back-up unit in event it is used or not.

00225.98 Traffic Control Supervisor - The accepted quantities of traffic control supervisor will be paid for at the Contract unit price, per each for the item "Traffic Control Supervisor".

Payment includes vehicle and equipment.

Payment for item "Traffic Control Supervisor" performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

00225.99 Pilot Cars - The accepted quantities of pilot cars will be paid for at the Contract unit price, per hour for the item "Pilot Cars".

Payment will be payment in full for fully operated pilot cars, two-way radios, the "PILOT CAR FOLLOW ME" sign, and the rotating amber light or strobe light mounted on the pilot car.

Payment for item "Pilot Cars" performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

Section 00240 - Temporary Drainage Facilities

Description

00240.00 Scope - This work consists of furnishing, installing, and removing temporary drainage facilities.

Construction

00240.40 General - Furnish and install temporary drainage facilities of sufficient capacity and strength to carry traffic over the facility, and water flow in or under the facility. Determine the actual size, strength and type of facility needed. The sizes of facilities shown on the plans are minimum only. Submit this determination and its basis to the Engineer for review. Do not install until approved.

Remove temporary drainage facilities when they are no longer needed. The facilities remain the property of the Contractor.

Measurement

00240.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00240.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Temporary Drainage Facilities".

Payment will be payment in full for furnishing, placing, maintaining, and removing temporary drainage facilities, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Section 00280 - Erosion and Sediment Control

Description

00280.00 Scope - This work consists of implementing structural and non-structural Best Management Practices (BMP) for the purpose of controlling soil erosion by wind or water and keeping eroded sediments and other construction-generated pollutants from moving off project sites.

Requirements described in these Specifications and shown on the plans are part of the project Erosion and Sediment Control Plan (ESCP) and are the minimum for all project construction sites and conditions. These Specifications cover all project activities performed under the authority and jurisdiction of the Agency, including material sources, disposal sites, and off-site mitigation areas unless specific project activities are excluded elsewhere in these Specifications or in other Agency approved documents controlling the work.

00280.01 National Pollutant Discharge Elimination System - Comply with Federal, State, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) 1200 Permit or Permits applicable to the project. A copy of the Agency's General Construction 1200 CA Permit, if applicable to the project, is available from the Agency. A local government 1200 CA Permit may also apply and some local agency requirements may be more stringent than these Specifications.

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

- A Contractor-developed, "construction" ESCP that incorporates the Agency's ESCP and all proposed modifications to it that fully complies with NPDES 1200 Permits applicable to the project.
- A narrative as described in the NPDES 1200 Permit and the Agency Erosion Control Manual.
- Implementation schedules for the ESCP based on each phase of the contractor's construction schedule.

An Agency-developed ESCP is typically furnished as part of a conventional contract plan set, which helps fulfill part of the ESCP requirement of the Permit. This initial ESCP, when adopted by the Contractor, may be used as the basis of the construction ESCP. Additional or revised erosion and sediment control features, not shown on the initial ESCP, may be required depending on the Contractor's methods of operation and schedule.

For each phase of the scheduled work, indicate on the ESCP all the BMP proposed and installed for erosion and sediment control to minimize clearing, stabilize exposed soil, divert or temporarily store flows, limit runoff from exposed areas, and filter transported sediment. Include all temporary slopes, constructed for staging or other reasons, which may not have been identified in the original contract plans. For assistance in preparing or modifying the ESCP, refer to the current Agency Erosion Control Manual.

Some ESCP required elements typically required by NPDES 1200 Permits:

(a) Narrative Site Description:

- Nature of the construction activity planned for the site
- Estimates of total site area and the areas of the site expected to be disturbed
- Soil types found on the site and their erosion potential
- The types of fill materials to be used
- Timetable for sequence of major construction events

(b) Site Map:

- All areas of development
- Drainage patterns
- Areas of soil disturbance, including pre-development and post-development elevation contours
- Areas used for storage of soils or wastes
- Areas where vegetative practices are to be implemented
- Location of all erosion and sediment control BMP or structures
- Location of all impervious structures and surfaces after project is completed
- Springs, wetlands, and other surface waters located on-site
- Boundaries of the 100 year floodplain, if determined
- Ordinary High Water line, if determined
- Location of storm drainage outfalls to receiving waters, if applicable
- Details of sediment and erosion controls
- Details of detention ponds, storm drain piping, inflow and outflow details

(c) Required BMP and Procedures for Erosion Prevention, Runoff Control, and Sediment Control:

- Construction entrances and parking areas
- Unpaved site roads such as haul roads
- Hauling saturated soils from the site
- Water washed from concrete trucks
- Correct installation of erosion and sediment control BMP (contract documents and agency references such as these Specifications may be cited as installation standards if applicable)
- Prompt maintenance and repair of BMP
- Clearing and grading practices to minimize area of exposed soil throughout the life of the project
- Schedule of phased clearing operations to limit soils to what can be stabilized
- Vegetative practices including preservation of existing vegetation, seeding, mulching, and buffer strips
- Preventing erosion of exposed areas
- Diverting flows from exposed slopes
- Limiting runoff from exposed areas
- Limiting sediment transport within work sites and keeping it from moving off of project areas
- Perimeter controls for all clearing and grubbing, both planned and installed
- Additional controls for wet season work and temporary work suspensions
- Sensitive areas such as wetlands
- Off site material source and waste areas
- Dust
- Emergency materials stockpiled on-site
- Storing flows, and filtering sediment
- Stockpiles

Ensure that the Contractor's construction ESCP and implementation schedules are prepared by an individual who meets qualifications of 00280.30. Furnish a signed copy of the ESCP with individual's name, title, state certifications, and employing firm if different than Contractor's firm.

Do not begin any site activities that have potential to cause erosion or sediment movement until the ESCP and implementation schedules are approved by the Engineer.

Keep a copy of the approved ESCP with updated changes on-site during all construction activities. During inactive periods longer than 7 calendar days, keep the ESCP on-site or provide a copy to the Engineer to retain.

Continually update the ESCP and schedules as needed for unexpected storm or other events to ensure that sediment-laden water does not leave the construction site. If there are approved changes, add them to the ESCP no later than 24 hours after implementation.

00280.03 Non-Agency Controlled Lands ESCP - For work on non-Agency controlled lands, in addition to the requirements of 00280.02, submit the following for review ten days before the preconstruction conference:

- A Contractor-developed ESCP for each unique site covered under project NPDES 1200 Permits.
- A description of how the ESCP will be implemented and monitored on these sites.
- A complete list of other applicable permits controlling work on these lands, whether the Agency is one of the permittees or not, and copies of the applicable permits.
- Proof that permits are not required from all pertinent federal, State, county, city, and local agencies
- Signed letter from the property owner that allows the Contractor access to the property. Include a statement in the letter that holds the Agency harmless for all consequences related to the Contractor's use of the property.
- Signed agreement with the property owner detailing the Contractor's operation, use of the property, and stating that Contractor will abide by permits, if any.

If the Contractor's operations require work on non-Agency controlled lands not presented at the preconstruction conference, or if changes to the Contractor's submitted ESCP are necessary, submit a new or revised ESCP to the Agency for approval before beginning work.

00280.04 Erosion and Sediment Control Manager - Designate and provide a representative as the Erosion and Sediment Control Manager (ESCM) who meets the qualifications of 00280.30.

Materials

00280.14 Erosion Prevention Materials:

(a) Plastic Sheeting - Furnish plastic sheeting slope protection, anchoring system, and toe protection meeting the following requirements:

- **Plastic Sheeting** - Minimum 6 mil thick polyethylene plastic sheeting.
- **Anchoring System** - Minimum 65 pounds, non-puncture type anchor weights with cords or ropes of adequate strength to support the weights on the slope or new or used chain link fence conforming to 03010.30.
- **Stakes** - Commercial grade metal posts with a weight of at least 1.35 pounds per foot.
- **Rock** - Class 50 riprap conforming to Section 00390.

(b) Chemical Soil Binder - Furnish a liquid stabilizing emulsion meeting the requirements of 00280.14(c).

(c) Chemical Dust Control - Furnish non-toxic materials with no adverse effect on soil structure or establishment and growth of vegetation. Furnish one of the following materials and apply as directed by the manufacturer's instructions:

(1) Liquid Stabilizer Emulsion - A tackifier of liquid and polyvinyl acetate polymers with emulsion resins containing not less than 55% total solids by weight. Do not use tackifiers containing polyacrylates or polyvinyl acrylics.

(2) Dry Powder Tackifier - A tackifier consisting of one or more active hydrocolloids from natural plant sources which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable and consists of a processed organic adhesive derivative of one of the following:

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

(d) Temporary Mulching - Furnish temporary and permanent seeding, fertilizing, and mulching meeting the requirements of Section 01030.

(e) Slope and Channel Liner Matting - Matting is organized according to categories from the Texas DOT/TTI Hydraulics and Erosion Control Laboratory. Furnish matting from the QPL that meets the following performance criteria categories:

- **Type A** - Slope protection mat for clay soil slopes 1V:3H or flatter.
- **Type B** - Slope protection mat for sandy soil slopes 1V:3H or flatter.
- **Type C** - Slope protection mat for clay soil slopes steeper than 1V:3H.
- **Type D** - Slope protection mat for sandy soil slopes steeper than 1V:3H.
- **Type E** - Flexible channel liner for shear stress from 0 to 2 pounds per square foot.
- **Type F** - Flexible channel liner for shear stress from 0 to 4 pounds per square foot.
- **Type G** - Flexible channel liner for shear stress from 0 to 6 pounds per square foot.
- **Type H** - Flexible channel liner for shear stress from 0 to 8 pounds per square foot.

Furnish check slot material and fasteners for matting meeting the following requirements:

(1) Check Slot:

- **Channel Application** - Compacted Class 50 riprap meeting the requirements of Section 00390.
- **Slope Application** - Compacted suitable native embankment material.

(2) Fasteners - U-shaped wire staples or heavy duty pins as follows:

- **Staples** - 14 gauge steel wire staples. 1 inch "U" width with a length of 6 inches minimum for cohesive soils and 8 inches minimum for non-cohesive soils.

- **Pins** - 3/16 inch diameter steel pin with a 2 inch diameter steel washer secured at the head of the pin with a length of 18 inches minimum for cohesive soils and 24 inches minimum for non-cohesive soils.

00280.15 Runoff Control Materials:

(a) Check Dams - Furnish check dam material meeting the following requirements:

- **Type 1: Aggregate** - Aggregate with maximum size between 6 inches and 3 inches meeting the requirements of 00330.16.

- **Type 2: Straw Bales** - Standard rectangular straw bales meeting the requirements of 01030.15.

- **Type 3: Biofilter Bags** - Minimum size 18 inch x 6 inch x 30 inch plastic mesh bags with 1/2 inch openings filled with approximately 45 pounds of clean, non-toxic 100% recycled wood product waste containing no fine materials or sediments, or as shown on the standard drawings for this device.

- **Type 4: Sand Bags** - Durable, weather-resistant bags woven tightly enough to prevent leakage of filler material. Fill bags with at least 75 pounds of firmly-packed fine PCC 3/8" - 0 aggregate, or round 3/8" - 3/16" pea gravel.

- **Type 5: Prefabricated System** - Prefabricated check dam system conforming to the manufacturer's recommendations and on the QPL.

- **Check Dam Stakes** - Stakes meeting the requirements of 00280.14(a).

(b) Diversion Dikes and Swales - Furnish diversion dike and swale materials meeting the following requirements:

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

- **Seeding, Fertilizing and Mulching** - Permanent or temporary seeding, fertilizing and mulching meeting the requirements of Section 01030.

(c) Temporary Drainage Curbs - Furnish temporary drainage curb material meeting the following requirements:

- **Type 1 Curb** - Concrete drainage curb meeting the requirements of 00480.10.

- **Type 2 Curb** - Asphalt concrete drainage curb meeting the requirements of 00480.10.

- **Type 3 Curb** - Sand bags meeting the requirements of 00280.15(a).

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

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

00280.16 Sediment Control Materials:

(a) Construction Entrances - Furnish materials meeting the following requirements:

- **Aggregate** - Aggregate with a maximum size between 6 inches and 3 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).

(b) Tire Wash Facility - Furnish tire wash facility materials meeting the following requirements:

- **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.

(c) Sediment Fence - Furnish sediment fence materials meeting the following requirements:

- **Geotextile** - Geotextile meeting requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
- **Posts** - Furnish the following posts for the types of fence shown:
  - **Sediment Fence, Supported** - Commercial grade metal posts with a weight of at least 1.35 pounds per foot.
  - **Sediment Fence, Unsupported** - Minimum 1 1/2 inch x 1 1/2 inch x 48 inch untreated wood posts (wood stain is acceptable).
- **Wire Mesh -** For supported sediment fence, furnish galvanized wire mesh with 2 inch x 2 inch openings, horizontally and vertically self-supporting prior to fastening to posts, a minimum tensile strength of 70 ksi, and meeting the requirements of ASTM A 82.

(d) Inlet Protection - Furnish inlet protection materials meeting the following requirements:

- **Wire Mesh** - Wire mesh materials as follows:
  - **Type 1 Inlet Protection** - Wire mesh meeting the requirements of 00280.16(c).
  - **Type 2 Inlet Protection** - 19 gauge steel-wire mesh with 3/8 inch x 3/8 inch openings.
- **Geotextile** - Type 1 sediment fence geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
- **Aggregate** - Aggregate with maximum size between 4 inches and 1 inch meeting the requirements of 00330.16.

- **Stakes** - Stakes meeting the following requirements:
  - **Type 1 Inlet Protection** - Commercial grade metal posts with a weight of at least 1.35 pounds per foot.
  - **Type 4 Inlet Protection** - Minimum 1 inch x 2 inch x 18 inch wooden posts.
- **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).
- **Prefabricated Filter Inserts** - Prefabricated filter inserts manufactured specifically for collecting sediment in drainage inlets and listed on the QPL. Include handles and fasteners sufficient to keep the insert from falling into the inlet during maintenance and removal of the insert from the inlet.
- **Concrete Masonry Units** - Nominal 8 inch x 8 inch x 16 inch, 29 pound concrete masonry units (CMU).
- **Sod** - Grass sod meeting the requirements of 01040.19(h).
- **Reinforcing Steel** - No. 4 rebar commercial grade reinforcing steel.

(e) Sediment Barriers - Furnish sediment barriers and sediment barrier stakes meeting the following requirements:

- **Type 1: Straw Bales** - Standard 45 to 65 pound rectangular straw bales that are wire-bound or string-tied meeting the requirements of 01030.15(b).
- **Type 2: Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).
- **Type 3: Fiber Rolls (Wattles)** - Fiber rolls made of straw meeting the requirements of 01030.15(b), except use only rice or coconut straw material. Wrap the straw to a minimum density of 2.75 pounds per cubic foot in tubular plastic netting meeting the following requirements:
  - 8 inch to 10 inch diameter size
  - Minimum strand thickness of 0.003 inch
  - Knot thickness of 1/16 inch
  - Weight of 0.35 ounces per foot ±10%
  - Made from 85% high density polyethylene, 14% ethyl vinyl acetate, and 1% color for UV inhibition
- **Type 4: Sand Bags** - Sand bags meeting the requirements of 00280.15(a).
- **Type 5: Brush Barrier** - Maximum 6 inch diameter woody debris brush or topsoil strippings for brush barriers. Provide type 1 sediment fence geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
- **Type 6: Filter Berm** - Aggregate with maximum size between 4 inches and 1 inch meeting the requirements of 00330.16. Provide subgrade geotextile meeting the requirements of Section 02320. Provide "Level B" geotextile documentation according to 02320.10(c).
- **Type 7: Prefabricated Barrier System** - Prefabricated barriers manufactured specifically for temporarily obstructing the flow of sediment-laden water and listed on the QPL.

- **Stakes** - Sediment barrier stakes as follows:
  - **Biofilter Bags** - Use minimum 1 inch x 2 inch x 18 inch wood stakes.
  - **Brush Barrier** - Use minimum 1 inch x 2 inch x 18 inch wood stakes.
  - **Straw Bales** - Use minimum 1 1/2 inch x 1 1/2 inch x 36 inch wood stakes.
  - **Fiber Rolls** - Use minimum 1 inch x 1 inch x 24 inch wood stakes.

(f) Sediment Mat - Furnish sediment mat from the QPL.

(g) Temporary Scour Basin - Furnish class 100 riprap for temporary scour basins meeting the requirements of Section 00390.

(h) Temporary Sediment Trap - Furnish sediment trap materials meeting the following requirements:

- **Geotextile** - Type 2 drainage geotextile meeting the requirements of Section 02320. Provide "Level B" documentation according to 02320.10(c).
- **Aggregate Base** - 1 1/2" - 0, 1" - 0, or 3/4" - 0 aggregate for aggregate base meeting the requirements of Section 00641.
- **Aggregate** - Aggregate with maximum size between 6 inches and 3 inches meeting the requirements of 00330.16.

Labor

00280.30 Erosion and Sediment Control Manager - Designate and provide an ESCM with the following minimum qualifications:

- Experience in all major disciplines of highway construction.
- Knowledgeable in principles of and practice of erosion and sediment controls.
- Skilled in assessing site conditions and effectiveness of erosion control BMP used.
- Successful completion of erosion control formal training sponsored by the Agency or acceptable to the Engineer.
- Responsible participation in construction of at least one Agency project with erosion control.
- Authority to immediately mobilize necessary personnel to correct and modify erosion control BMP as required.

Duties typically required of ESCM include:

- Manage and ensure proper implementation of the ESCP.
- Accompany the Engineer during field review of the ESCP prior to construction activities.
- Monitor rainfall on and in the vicinity of the Project site.
- Monitor water quality in receiving streams in the vicinity of the Project site.
- Inspect erosion and sediment control on active construction sites weekly.
- Inspect erosion and sediment control on inactive sites every two weeks.
- Inspect erosion control BMP on all active and inactive sites at least daily during rainy periods when 5/8 inch or more of rain has fallen within a 24 hour period.

- Mobilize crews to make immediate repairs to BMP or install additional BMP during working and non-working hours.
- Record actions taken to clean up significant amounts of sediment.
- Report potential permit violations to the Agency in a timely manner.
- Regularly update the approved Erosion Control Monitoring form.
- Update the ESCP monthly and within 24 hours after changes or major BMP modifications are implemented.
- Prepare a contingency plan in preparation for emergencies and the rainy season.
- Accompany the Engineer on inspections and, if required, on inspections by representatives of regulating agencies.

Provide the ESCM name, description of experience and training, qualifying certifications, and contact phone number ten days before the preconstruction conference. If changes in the appointment of the ESCM occur during the term of the Contract, provide written notice to the Engineer within five calendar days.

Construction

00280.40 Installation - Install erosion and sediment control BMP as shown and according to the most current edition of the ODOT Erosion Control Manual. Install these BMP before performing clearing, grading, or other land-altering activities. Ensure that sediment laden water does not leave the Project boundaries, enter drainage systems or waterways, or violate applicable water standards.

Included in this work are both non-structural BMP, such as limiting clearing of vegetation, and structural BMP such as various kinds of physical devices or materials like sediment fences. BMP may be temporary or they may be permanent when required to continue functioning after the Contract ends. Coordinate temporary erosion control BMP with permanent BMP and all related project work.

Provide continuous erosion prevention and sediment control throughout the period the Contractor is responsibilities for project sites under the Contract as determined by the Engineer. Take all reasonable steps to minimize or prevent any erosion and transport of sediment. Install and maintain all erosion and sediment control BMP to function as required. If planned or installed BMP are not effective, modify or change them so they are effective. Effective functioning is defined as preventing erosion, controlling runoff, or controlling sediment in each location where a measure is needed so all erosion-related impacts of site construction are fully mitigated as required.

00280.41 Work Restrictions - The following work restrictions apply:

(a) Disturbance Limits - Flag all construction site-clearing limits with high visibility flagging and do not disturb areas outside the flagging limits. Maintain the flagging during Project construction.

(b) Perimeter Controls - Perimeter controls include sediment fences, ditches, filter berms in flatter areas, and other methods for channeling flows. Install all appropriate perimeter controls before beginning any ground disturbing activities, especially at critical locations such as stream banks, the toe of fill or cut slopes, and sites near the two-year flood elevation.

(c) Wet Season Work and Temporary Work Suspension - Wet season work is defined as work between October 1 and May 30. Update the ESCP and schedule for work proposed during the wet season to ensure that all appropriate controls, including work suspension controls, are implemented and maintained. Submit the updated ESCP and schedule to the Agency and receive approval before beginning any work during the wet season. The Agency may not approve work on critical sites with high erosion potential if controls are not properly installed or have a likelihood of failure.

During the wet season, limit excavation and bare ground activities to only that required for immediate operations. Stabilize soil stockpiles at the end of each workday by diverting flows, placing covers, or installing sediment barriers at the stockpiles.

(d) Disturbance Restrictions - If soil erosion and sediment resulting from construction activities is not effectively controlled, the Agency will limit the amount of disturbed areas to that which can be effectively controlled. Implement erosion and sediment control BMP at the earliest practicable time. Install all erosion and sediment control devices according to the approved ESCP and schedule. If the Contractor fails to control erosion, the Agency will stop all construction work according to 00180.70.

00280.42 Stabilization - Protect exposed soils from erosion by water, wind, or vehicles when required by permits or directed by the Engineer. At a minimum, stabilize soil areas as follows:

(a) Soil Exposure Limitations:

- **Statewide (Entire Year)** - Within seven days of exposure, stabilize all areas within 100 feet of waterways, wetlands, or other sensitive areas using methods that do not rely solely upon germination to control erosion.
- **West of the Cascades (Entire Year)** - Stabilize all other areas within 14 days of exposure.
- **East of the Cascades (October 1 through April 30)** - Stabilize all other areas within 14 days of exposure.
- **East of the Cascades (May 1 through September 30)** - Stabilize construction areas in stages based on site conditions, weather, and as determined by the Engineer.

(b) Temporary Stabilization - Temporarily stabilize exposed soils:

- Every 14 days or more frequently of needed or directed.
- Upon approval, active work areas scheduled for re-disturbance may be left unstabilized for 14 day periods if erosion by wind, water, or vehicles is not occurring or imminent.
- A minimum of one day before expected rain events.
- During wet periods and when not actively raining, at the end of each day.
- As an emergency measure when rain is falling on unprotected areas.
- When wind or vehicle traffic is visibly causing more than minor dust.
- Soil surfaces at finish grade when working outside the permanent seeding dates.

Temporary stabilization includes, but is not limited to, chemical soil binders, mulching and tacking, erosion control matting, plastic sheeting, and temporary seeding or other BMP required to achieve the necessary stabilization.

Document all implemented BMP on the ESCP. Ensure that permanent slope stabilization is achieved before removing temporary BMP.

(c) Permanent Stabilization - Permanently stabilize exposed soil surfaces at finished grade. Permanent stabilization methods include, but are not limited to, seeding, mulching, structural surface coverings such as riprap, and vegetative stabilization. Permanent stabilization includes stabilization of temporary structures such as detours and staged earthwork. Immediately perform permanent stabilization at each completed excavation and embankment area except for areas that are scheduled to be redisturbed.

If seeded areas are not sufficiently stabilized by an established stand of vegetation according to 01030.60, or if the soil surface is not sufficiently protected with temporary stabilization BMP by November 1 of each year, do the following:

- Use BMP necessary to redirect water flows away from disturbed areas.
- Re-grade disturbed areas to finish grade.
- Apply permanent seeding at the original specified rate.
- Apply temporary mulching or matting.

If areas for temporary stabilization are too steep or lack access for effective straw mulch application, apply, upon approval, another effective measure such as chemical soil binder.

Incorporate permanent erosion control features into the Project at the earliest practicable time. Use temporary erosion control features for the following situations:

- To correct conditions that occur during construction activities that were not foreseen during the design stage of the Project.
- That are needed prior to installing permanent erosion control features.
- To temporarily control erosion that develops during normal construction activities.

Where potential for erosion exists and if construction permits, construct permanent erosion control features immediately after clearing and grubbing and grading operations are complete. If permanent erosion control BMP are not practicable to construct, furnish and install temporary erosion control BMP.

00280.43 Area Preparation - Prepare areas according to 01040.48(d) and track all fill slopes at finished grade steeper than 1V:3H and flatter than 1V:1.5H so that track impressions run parallel to slope contours. Maintain at least 1 3/8 inch tall track grousers.

00280.44 Erosion Prevention BMP - Install erosion prevention BMP as shown and according to the following:

(a) Plastic Sheeting - Place plastic sheeting on disturbed, temporary slopes or stockpiles where immediate protection is required and mulching or other methods of soil stabilization are not feasible. Temporary slopes include vertical excavations for retaining walls and other temporary soil excavations and embankments related to structural work.

Cover exposed soil with plastic sheeting and secure tightly using an anchoring system of sand bags, chain link fence, or other approved methods. Do not allow the anchoring system to puncture the plastic sheeting. Trench plastic sheeting at the top of slope and secure adequately to keep in place during any conditions that can be reasonably expected in the area. Direct runoff away from areas above plastic sheeting to prevent undermining. Control runoff from plastic sheeting so water discharges into protected drainage.

(b) Chemical Soil Binder - Hydraulically apply a liquid stabilization emulsion at the following rates unless the manufacturer recommends a greater rate of application:

- **Long Term Control of Exposed Soil Surfaces** - Apply 35 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 20 parts water.

- **Steep Slopes with Raveling Small Rock** - Apply 45 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 10 parts water.

(c) Chemical Dust Control - Apply appropriate dust control for wind or equipment-caused erosion according to the following:

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

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

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

Watering for dust control may also be covered under Section 00340.

(d) Temporary Mulching - Evenly apply dry mulch and tackifier material to form a cohesive surface cover that is resistant to displacement by wind and water. In areas not accessible to heavy equipment, mulch by hand or by other approved methods. Areas not prepared according to 01040.48(d) will require greater rates of application at no additional cost to the Agency.

(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 per acre of dry mulch. Place straw mulch so that it is loose enough for sunlight to penetrate and air to circulate, but dense enough to shade the ground, reduce water evaporation, and materially reduce soil erosion. Anchor using hydraulically applied tackifier, crimping disc, or sheep's-foot roller approved by the Agency 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 the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at the rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.

- **Dry Powder Tackifier** - Apply at 80 pounds per acre with 2,000 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 or more than 6 inches wide, and rounded to prevent withdrawing the straw from the soil. Use a roller with enough weight to incorporate the straw sufficiently into the soil providing a uniform surface cover.

(e) Slope and Channel Liner Matting - Ensure that the matting is installed according to the plans, these Specifications, or the manufacturer's recommendations, whichever is more stringent. Within 25 feet of water resources or as indicated, install only matting that is fully biodegradable (photodegradable is not acceptable).

(1) Area Preparation - Remove all materials (vegetation, rocks, wood, etc.) larger than 2 inches in size. Smooth the surface and remove undulations sufficient to allow the matting to be placed in complete contact with the soil.

(2) Seeding - Apply seeding to all disturbed areas, including the area where matting is required, according to one of the following:

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

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

c. Single Application - Matting and Seed:

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

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

(3) Matting Placement - Apply matting loosely so it is in complete contact with the soil to prevent erosion occurring beneath it. Apply mat and fasteners as shown. Construct check slots on all channel applications and on slope applications when shown or specified.

00280.45 Runoff Control BMP - Install runoff control BMP as shown and according to the following:

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

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

- **Type 2: Straw Bales** - Straw bales are not acceptable for use as check dams except in emergency situations and when approved at each location. If straw bales are used as check dams, replace with another acceptable check dam as soon as practicable but no longer than seven calendar days.

- **Type 3: Biofilter Bags** - Place aggregate in ditch section and extend check dam with biofilter bags sufficient to direct flow over aggregate weir. Aggregate weir may be replaced with additional biofilter bags if approved.

- **Type 4: Sand Bags** - Place aggregate in ditch section and extend check dam with sand bags sufficient to direct flow over aggregate weir. Aggregate weir may be replaced with additional sand bags if approved.

- **Type 5: Prefabricated System** - Install prefabricated systems according to the plans, Special Provisions, and the manufacturer's recommendations. Field fabricated systems are not acceptable.

(b) Diversion Dikes and Swales - Construct diversion dikes and swales above the cut slope to divert runoff from undisturbed areas away from disturbed slope areas. Convey runoff to an undisturbed area and discharge in a non-erosive manner.

Construct diversion dikes and swales at the toe of fill slopes to divert and convey sediment laden water to a sediment control facility. Compact dike material according to the Agency Manual of Field Test Procedures.

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

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

(d) Temporary Slope Drains - Construct watertight slope drains and extend as the embankment height increases. Construct temporary slope berms at the top of embankment slopes to direct water into the drains until permanent drainage structures are completed.

(e) Flow Spreader - A flow spreader is a device that receives channeled runoff and uniformly disperses it along the length of the spreader. It may be constructed of clean aggregate in a berm or trench or lumber or similar materials. Place the flow spreader to discharge water into a stabilized area at non-erosive velocities. See the plans for details and locations of this device.

00280.46 Sediment Control BMP - Install sediment control BMP as shown and according to the following:

(a) Construction Entrances - Install construction entrances at every point of access onto paved surfaces.

When construction entrances are in use and mud and dirt tracking is still evident, take additional steps to eliminate tracking by hosing off tires before vehicles leave the site, or by modifying construction techniques or work operation. Perform tire washing on gravel pads. Use silt-trapping structures to collect and drain wash water before it leaves the construction site.

(b) Tire Wash Facility - Excavate the area for installation of the tire wash facility. Install subgrade geotextile, aggregate base coarse, reinforced concrete, and water as shown.

(c) Sediment Fence - Construct supported (mesh and metal posts) and unsupported (no mesh) as follows:

- When installing geotextile and mesh, or geotextile alone, use a continuous roll of geotextile cut to the length of the barrier to avoid joints.
- Manufacturer's factory seams are acceptable. Field sewn seams are not acceptable.
- Drive posts into undisturbed soil as shown.
- Securely fasten the geotextile (and mesh) to the upslope side of the posts. Securely fasten each end of the geotextile (and mesh) to the end posts.
- Use stitched loops over posts for unsupported 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.

(d) Inlet Protection - Construct inlet protection that directs flows through the control and into the inlet.

- **Type 1: Sediment Fence** - Install supported sediment fence around the perimeter of the inlet according to 00280.46(c).

- **Type 2: Geotextile/Wire Mesh/Aggregate** - Place wire mesh over the inlet grate. Place sediment fence geotextile over the wire mesh and perimeter area near the inlet. Install aggregate over the geotextile fabric.

- **Type 3: Prefabricated Filter Inserts** - Install prefabricated filter inserts according to the plans, Special Provisions, and manufacturer's recommendations. Prefabricated inserts with provisions for overflow are allowed only when accompanied by additional BMP to prevent the potential of sediments entering project storm systems. Field fabricated inserts are not allowed.

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

- **Type 5: Masonry** - Install concrete masonry units around the perimeter of the inlet. Place sediment fence geotextile around the outside perimeter, up the outside face, and on the top of masonry units. Place aggregate over the geotextile fabric and flush with the top of masonry units.

- **Type 6: Sod** - Install sod around the perimeter of inlets within 36 hours of harvest of the sod.

(e) Sediment Barriers:

- **Type 1: Straw Bales** - Straw bales are only acceptable for use as short-term emergency containment. Receive approval before each use of straw bales and remove within 30 calendar days of installation unless directed to replace with new bales.

- **Type 2: Biofilter Bags** - Place and arrange biofilter bags as shown or directed.

- **Type 3: Wattles** - Place and arrange wattles as shown or directed.

- **Type 4: Sand Bags** - Place and arrange sand bags as shown or directed.

- **Type 5: Brush Barrier** - Place brush barrier as shown or directed. Place woody debris in a linear pile.

- **Type 6: Filter Berm** - Place and arrange filter berms as shown or directed. Place rock in an evenly spread, trapezoidal berm.

- **Type 7: Prefabricated Barrier System** - Install prefabricated barrier systems according to the plans, Special Provisions, and manufacturer's recommendations. Field fabricated systems are not allowed.

(f) Sediment Mat - Place sediment mats a minimum of 20 feet downstream of work areas. Install mats individually or in groups on the stream bottom. Remove the mats not later than 48 hours after stream activities are complete. Remove them from the Project site, or if approved, place them on the stream bank and cover with permanent seeding.

(g) Temporary Scour Basin - Construct temporary scour basins at the outfall ends of temporary slope drains or as shown.

(h) Temporary Sediment Trap - The trap may be formed by constructing a berm or by partial or complete excavation. Direct the discharge flow to a stabilized conveyance outlet or level spreader.

00280.47 Work Quality - Protect areas according to 01030.49.

00280.48 Emergency Materials - Provide, stockpile, and protect emergency materials on-site for unknown weather or erosion conditions. A list of emergency materials will be listed in the Special Provisions. Replenish emergency materials as they are used.

The emergency materials are in addition to the other erosion control materials required to implement and maintain the ESCP.

Remove all unused emergency materials from the Project site at the completion of the Project.

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 Agency issues notification of acceptance of stabilization. All maintenance and repairs are at no additional cost to the Agency.

00280.61 Ineffective Controls - If a control feature does not function effectively, immediately repair, replace, or provide additional devices. Devices repaired, replaced, or added due to improper installation, insufficient maintenance, or damage from Contractor operations will be made at no additional cost to the Agency.

00280.62 Inspection and Monitoring - Ensure that regular site inspection and monitoring is performed according to the schedule and record keeping requirements of the NPDS permit.

(a) Inspection - Perform general site inspection, complete all applicable parts of the ODOT Erosion Control Monitoring Form, and submit the Form to the Agency as follows:

- Weekly for active sites
- Every two weeks for inactive sites
- When direct by the Engineer

(b) Rainfall - Furnish and install a rain gauge at the Project site. Notify the Agency if 1/2 inch or more of rainfall occurs within a 24 hour period. As soon as practicable, but not later than 24 hours, after 1/2 inch or more of rainfall occurs, including weekends and holidays, inspect the entire Project to determine the condition of all erosion and pollution control devices.

(c) Monitoring Receiving Stream - Observe and record color and turbidity or clarity within 30 feet upstream and downstream of locations where surface waters from the construction site enter the receiving stream. Note whether sheen and floating matter are present or absent. Describe any apparent color and the clarity of the discharge, and any observable difference in comparison with the receiving stream.

If a significant permit noncompliance or serious water quality issues occur which may endanger health or the environment, verbally report to the Engineer within 24 hours and submit a written report within 5 calendar days.

00280.63 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 Agency.

(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%.

(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.

(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 - Restabilize 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.

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 and materials 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 - Regrade removed sediment into slopes or remove and dispose of off-site according to 00290.20. Do not flush sediment-laden water into waterways or drainage systems.

Measurement

00280.80 Measurement - Quantities of work performed under this Section will be measured according to the following:

(a) Lump Sum Basis - No measurement of quantities will be made for lump sum items.

(b) Unit Basis - Unit basis items will be measured on the unit basis, of each device or location where the device is constructed or placed.

(c) Length Basis - Length basis items will be measured on the length basis along the line and grade of the item or device constructed or placed.

- Flow spreaders and diversion dikes and swales will be measured along the long axis.
- Sediment barrier, when measured on the length basis, will be measured along the long axis of the barrier regardless of type.

- Temporary slope drains will be measured from the beginning of the metal end pieces to the end of the drain. Measurement will be made when each installation is at its maximum length.

(d) Area Basis - Area basis items will be measured on the area basis along the ground surface, and computed to the square foot or acre as applicable.

(e) Limitations - The quantities of emergency materials listed in 00280.48 of the Special Provisions are included in the items listed in the Contract Schedule of Items.

Payment

00280.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Erosion Control	Lump Sum
	Erosion Prevention	
(b)	Plastic Sheeting	Square Yard
(c)	Chemical Soil Binder	Acre
(d)	Chemical Dust Control	Acre
(e)	Temporary Mulching	Acre
(f)	Matting	Square Yard
	Runoff Control	
(g)	Check Dam	Each
(h)	Temporary Diversion Dike/Swale	Foot
(j)	Temporary Slope Drain	Each or Foot
(j)	Flow Spreader	Foot
	Sediment Control	
(k)	Construction Entrance	Each
(l)	Tire Wash Facility	Each
(m)	Sediment Fence, _____	Foot
(n)	Inlet Protection	Each
(o)	Sediment Barrier	Each or Foot
(p)	Sediment Mat	Square Yard
(q)	Temporary Scour Basin	Each
(r)	Temporary Sediment Trap	Each

Item (a) includes:

- providing the Erosion and Sediment Control Manager
- developing, revising, and documenting the ESCP
- mobilization
- monitoring activities
- furnishing, stockpiling, protecting, restocking, and removing emergency materials
- preparing Project for winter shut-down

- inspecting, maintaining, and removing erosion control devices
- restoring, mulching, tacking, and seeding all disturbed ground, work, and storage areas not otherwise covered

When only item (a) is listed in the Contract Schedule of Items, no separate or additional payment will be made for modifications or additions to the BMP that become necessary for permit compliance during construction.

Partial payments for item (a) will be made as follows:

- When the initial Contractor developed ESCP, narrative, and schedule are complete and accepted, and the initial erosion control devices are installed 25%
- When 50 percent of the Contract is complete, excluding advances on materials 25%
- When 75 percent of the Contract is complete, excluding advances on materials 25%
- At completion of the Contract and all erosion control devices are either removed from the Project site or are fully functioning as permanent BMP..... 25%

Item (b) includes protecting exposed slopes with plastic sheets, anchoring devices, and toe protection maintenance.

Item (f) includes preparing the slope surface and stabilizing exposed soil with erosion matting material.

Items (g), (n), and (o) includes the biofilter bags, sand bags, and sediment fence as applicable.

Emergency materials that are incorporated into the Project will be paid for under the appropriate items listed in the Contract Schedule of Items.

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

No separate or additional payment will be made for:

- removing and disposing of sediment build-up behind sediment fences and sediment barriers
- removing and reinstalling required appurtenances to modify temporary slope drains as the embankment slopes are changed
- constructing and removing temporary slope berms
- applying dust control
- erosion control for work outside the construction limits including but not limited to borrow pits, haul roads, disposal sites, and equipment storage sites

Section 00290 - Environmental Protection

Description

00290.00 Scope - This Section describes the Contractor's duties and obligations with respect to protection of the land, waters, air, wildlife, and other environmental resources of the State.

Comply with all applicable federal, State, and local environmental, health, safety, and other laws, acts, statutes, regulations, administrative rules, ordinances, orders, and permits, as they may be amended from time to time (referred to in this Section as "Laws"). Comply with all applicable Laws, whether or not specifically referenced in this Section or elsewhere in the Contract.

Federal, State, and local agencies known to have enacted ordinances and regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract are listed in 00170.01.

If any provision of these Specifications appears to conflict with one or more Laws, the more stringent requirement shall apply, unless the Engineer directs otherwise in situations where these Specifications are more stringent.

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

All penalties assessed against the Agency because of the Contractor's violation of Laws referenced above, or permits applicable to the Project, will be withheld from the progress or final payments according to 00195.50(e).

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

00290.10 Staging and Disposal Sites - Locate staging areas and disposal sites in previously improved or disturbed sites, including existing roadways, pullouts, turnouts, parking lots, and storage yards that have been compacted, graveled and paved, unless otherwise approved, in writing, by the Engineer.

00290.11 Water Conservation - Minimize use of water by maintaining equipment, immediately fixing water line and container leaks, ensuring water valves are turned off promptly, and using recycled water when feasible.

00290.20 Waste, Hazardous Waste, and Hazardous Substances - Comply with all applicable federal, State, and local Laws as they pertain to the storage, handling, management, transportation, disposal, and documentation of waste, hazardous waste, and hazardous substances.

(a) Hazard Communication - Ensure the following documents are readily available on-site to employees, subcontractors and inspectors:

- Material Safety Data Sheets (MSDS) for all hazardous substances stored or used on-site.
- Written hazard communication program, including employee training documentation.

The Oregon Occupational Safety and Health Division (OR-OSHA) provides guidance to meet these requirements in their publication "Hazard Communication: A Safe-Work-Practice Guide".

(b) Fuel Storage - Store fuel according to the current edition of the International Fire Code and all applicable federal, State, and local Laws.

If total fuel and petroleum storage, in containers 55 gallons or larger, exceeds 1,320 gallons, comply with the applicable spill prevention control and countermeasures (SPCC) requirements of 40 CFR 112. If applicable, submit the professional engineer stamped SPCC plan, 10 days before the preconstruction conference. Comply with the plan and keep a copy on-site and readily available. The SPCC plan may be combined with the Pollution Control Plan required under 00290.30(b).

(c) Waste Management:

(1) General - Prepare a hazardous waste determination for all waste generated on-site to determine whether the waste is classified as hazardous waste, universal waste, excluded waste, waste water, or solid waste. The Agency may provide initial analytical results for some wastes such as lead-based paint and asbestos containing material. Conduct additional testing necessary for waste characterization and disposal using an Oregon Environmental Laboratory Accreditation Program (ORELAP) accredited laboratory, under chain of custody procedures.

Segregate all demolition debris according to its intended end use (reuse, recycle, or dispose). If required, store in designated areas in a manner that prevents contamination to soil and water and prevents fugitive dust emissions. Remove all waste materials recovered from the site unless otherwise approved, in writing. Retain disposal and recycling facility receipts for wastes generated on-site for at least one year after completion of the Project. Provide copies of the receipts to the Engineer within seven calendar days of the disposal or recycling.

Dispose of noxious weeds and Specified Weeds according to Section 01030.

Do not reuse demolition material, coated or treated materials, or concrete and masonry materials in waters of the State or U.S.

(2) Clean Fill - Clean fill, as defined by OAR 340-093-0030(13), becomes the property of the Contractor at the place of origin.

(3) Reuse, Recycle, and Dispose of Materials - Waste materials become the property of the Contractor at the place of origin. Unless prohibited by Law, treat waste materials according to the following priority:

- Reuse demolition debris on-site.
- Recycle demolition debris.
- If it is not feasible to reuse or recycle, ("feasible" is defined as a facility that is capable of handling the material, will take the material and the cost of transportation plus the cost to reuse or recycle the material is equal to or less than the costs of disposal) dispose of waste material according to the following:

a. Burnable Materials - Dispose of burnable material, that cannot be reused or recycled, according to 00290.30(c-3).

b. Woody Matter - Woody matter may be burned according to 00290.30(c-3) or may be chipped to a size of no more than 3 inches in any direction then uniformly spread over selected landscape areas, as directed, in loose layers not more than 3 inches thick. Burying wood, stumps, or other woody material is not allowed.

c. Preserved and Coated Wood - Dispose of chemically preserved wood, pressure treated wood, and wood coated with latex paint that does not contain lead according to the following:

- Reused whole.
- Provided to others to reuse.
- Burned as fuel at an energy recovery facility with a DEQ or LRAPA stationary source permit.
- Delivered to a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

Dispose of wood coated with lead-containing paint at a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

Test wood as required by the receiving facility.

d. Concrete and Masonry - Concrete and masonry, when not recycled, may be reused to fill basements or be buried in embankments on-site, provided that the materials are broken into pieces not exceeding 15 inches in any dimension, and placed so that:

- No part of any piece is within 2 feet of the top, side or end surface of the basement, embankment, or other structures.
- The fill or embankment is constructed and compacted according to 00330.42 and 00330.43.

If the Engineer provides written approval, concrete may be reused as aggregate if it meets the requirements of Section 02610 through Section 02690.

e. Disposal on Agency-Owned Lands - Do not dispose of waste materials on Agency-owned or Agency-controlled lands, except when shown, specified, or allowed in writing to be used as fill. If allowed, place waste materials only at specified locations, as directed.

f. Off-Site Disposal - Dispose of waste at an energy recovery facility with a DEQ or LRAPA Stationary Source Permit, at a permitted landfill, or at other waste disposal facilities as required depending on that type of waste.

Subject to local zoning codes and the requirements of 00280.03, materials that meet the definition of clean fill may be placed on other properties in a manner consistent with environmental requirements, and with written permission of the property owner. Furnish the Engineer a copy of the signed agreement with the owner before placement of the clean fill material. Do not place the clean fill material at locations that are visible from a public highway, road, or street unless the site is zoned and licensed for landfill.

(d) Hazardous Waste Management - Determine the generator category for the Project, based on the amount and type of hazardous waste generated. Use the following definitions. If they differ from current Laws, use the current Laws.

- **Conditionally Exempt Generator** - A conditionally exempt generator (CEG) generates 220 pounds or less of hazardous waste per month or 2.2 pounds or less of acutely hazardous waste per month and accumulates up to 2,200 pounds hazardous waste or 2.2 pounds acutely hazardous waste on-site.

- **Small Quantity Generator** - A small quantity generator (SQG) generates 220 pounds to 2,200 pounds hazardous waste per month, can accumulate up to 13,200 pounds hazardous waste on-site (or more with a permit), and ship hazardous waste off-site within 180 days of generation.

- **Large Quantity Generator** - A large quantity generator (LQG) generates more than 2,200 pounds hazardous waste per month or more than 2.2 pounds acutely hazardous waste per month, has no accumulation limit, but ship all hazardous waste off-site within 90 days of generation.

In addition to current Laws, comply with the following:

- If the Project generator category is SQG or LQG, or if it requires a hazardous waste identification number, obtain a Resource Conservation and Recovery Act (RCRA) site identification number from the DEQ. Pay all fees and complete the RCRA application form as follows:
  - List the Contractor as the Site Contact, the Site Operator, the Hazardous Waste Form Contact, and the Hazardous Waste Fee Contact.
  - List ODOT as the Site Location, the Land Owner, and the Legal Owner.
  - Fill in the Comments section with the following statement:

    "[Contractor name] is responsible for the following: All hazardous waste management on site for the duration of this construction project, for delivery of the waste to a permitted recycling or disposal facility, and for all forms and fees associated with the hazardous waste management including cancellation of the RCRA site identification number at the end of the Project. ODOT is the owner of the waste and maintains long term responsibility for the waste as required by RCRA, excluding all wastes generated solely from materials brought to the site by the Contractor, which remain the property of the Contractor."
  - The Contractor may sign hazardous waste manifests for the off-site shipment of hazardous wastes as the "offeror" rather than as the "generator".
- Maintain all required waste management records, including monthly hazardous waste generation records, manifests, recycling and disposal receipts, test results, and annual DEQ reports. Submit monthly records to the Engineer by the fifteenth day of the following month and submit DEQ reports to the Engineer concurrently with DEQ. Keep copies for at least three years following completion of the Project and resolution of any regulatory violations or citations.
- If the quantity of hazardous waste projected to be generated meets the requirements for a CEG, store hazardous wastes on-site for no more than 180 days.
- If the quantity of hazardous waste projected to be generated meets the requirements for a SQG or for a LQG, prepare a Hazardous Waste Contingency Plan according to 40 CFR 265.51. Maintain a copy of the Contingency Plan on-site at all times during construction activities, readily available to employees and inspectors.
- If the project is SQG or LQG, retain a Certified Hazardous Materials Manager (CHMM) in good standing and with experience managing the hazardous wastes associated with the Project to oversee waste management at the site.
- All employees involved in the handling and management of CEG hazardous waste shall comply with the federal and State Laws for hazardous waste management. All employees involved in the handling of SQG and LQG hazardous waste shall be trained according to federal and State Laws. For LQC hazardous waste projects, keep employee training records on-site and readily available.

- If the quantity of hazardous waste generated in a month changes the generator category, immediately implement the requirements for the new category and comply with them for the remainder of the year. Complete the new documentation and training requirements within 30 calendar days of the change.
- Ensure hazardous waste containers are clearly and visibly labeled with the contents and accumulation start date, compatible with the contents and in good condition. Store them in a designated weather-protected area that is secured from public access, has secondary containment adequate to contain a release, and has sufficient aisle space to safely maneuver containers and respond to spills (minimum 30 inches).
- If hazardous waste will be treated on-site, obtain approval from DEQ and the Engineer for each specific treatment or recycling process, treat wastes within accumulation tanks or closed containers that meet RCRA requirements, conduct treatment within the storage time for the applicable generator category, maintain current copies of all required notifications and waste analysis plans readily available on-site and request DEQ technical assistance prior to starting any on-site recycling or treatment.

(e) Hazardous Substance Transportation - Comply with the following requirements for transportation of hazardous substances and hazardous waste:

- Train all employees involved in transportation and shipping as required by US DOT.
- Use drivers who have a commercial driver's license with a hazardous materials endorsement when required.
- Ship hazardous wastes from SQG and LQG projects using a DEQ registered hazardous waste transporter under a hazardous waste manifest.
- Ensure shipments are appropriately packaged and labeled, and vehicles are appropriately placarded.
- Submit copies of the completed manifests and documentation to the Engineer and retain copies for at least one year.

(f) Unexpected Contamination - If, during construction, unanticipated hazardous substances are discovered that threaten the health and safety of workers, the public, or the environment, do the following:

- Immediately remove all affected employees and secure the area to prevent access.
- Notify the Engineer immediately and provide written notification within 24 hours, setting forth a description of the hazardous substances encountered.

The Engineer will attempt to resolve the unanticipated situation expeditiously according to 00140.40. Delays to work due to the discovery of unexpected contamination shall be considered for exclusion from Contract time according to 00180.50(e).

(g) Spills and Releases - Obtain a response agreement with a professional on-call spill response team. The professional on-call spill response team, identified in the PCP, agrees to be available and respond to spills that cannot be cleaned up with on-site resources. A professional spill response team is a company or section of a company specifically dedicated to hazardous materials emergency spill response, insured, and bonded for hazardous materials cleanup, and employing experienced personnel certified according to 29 CFR 1920.120.

In the event of a spill or release of a hazardous substance or hazardous waste or any other material, do the following:

- Immediately commence response actions to protect human health and the environment. Follow the PCP, SPCC and Contingency Plan, as appropriate. If any of the provisions in these plans conflict, implement the actions providing the greatest protection of public health and safety and the environment.
- If the spill can not be safely contained and cleaned up with on-site resources, activate the professional on-call spill response team.
- Immediately notify the Engineer.
- If the quantity released exceeds the State or Federal reportable quantities, or if the release impacts or threatens to impact any surface water body, immediately notify DEQ by the Oregon Emergency Response System (OERS) at 1-800-452-0311 and the EPA and USCG through the National Response Center (NRC) at 1-800-424-8802 (Federal reportable quantities or spills impacting or potentially impacting water only). If the quantity released is unknown, proceed with OERS and NRC notifications. Reportable quantities are listed at 40 CFR 302.4 and OAR 340-142-0040 to OAR 340-142-0050.
- Conduct cleanup of the released material according to all applicable Laws and DEQ requirements. Cleanup to background levels unless otherwise agreed to by the Agency in writing.
- Provide a written report to the Engineer, using the DEQ Spill/Release Report form, within 10 calendar days of completing spill response, but no more than 30 calendar days after the initial event. If the spill was reported to DEQ, submit the report to DEQ concurrently. Include a description of how future releases will be prevented.

00290.29 Health and Safety - Comply with all applicable health and safety Laws as they pertain to the hazardous substances and wastes used, stored and generated on-site. If any of these requirements are in conflict, the more stringent requirements apply.

00290.30 Pollution Control - Prevent, control, and abate pollution of the environment. Comply with new or amended environmental pollution Laws, not contemplated at the time of bid preparation, according to 00140.50 and ORS 279C.525.

(a) Pollution Control Measures - Comply with the following requirements:

(1) General:

- Allow no pollutant of any kind (e.g., petroleum products or fresh "green" concrete) to come in contact with an active flowing stream or waters of the State and U.S.
- Comply with the erosion prevention and sediment control requirements of Section 00280 and all applicable DEQ NPDES 1200 Permit requirements.
- Do not cause turbidity to waters of the State and U.S. outside of regulated levels.

(2) Materials and Waste Management:

- Store construction equipment, materials and debris in a manner that prevents contamination of water and soil and prevents fugitive dust.
- Store hazardous substances in the original containers or labeled compatible containers according to State Fire Marshal's regulations, International Fire Code and product MSDS.
- Locate areas for storing fuels and other potentially hazardous materials at least 150 feet away from any waters of the State and U.S. or storm inlet, unless otherwise approved by the Engineer.

- Dispose of material waste according to 00290.20.
- Do not use treated timbers within any waters of the State and U.S.

(3) Equipment Fueling, Repair and Maintenance:

- Promptly correct or repair operational procedures, leaks, or equipment problems that may cause pollution at the Project Site. If soils or other media become contaminated as a result of operational procedures or equipment problems, remove and dispose of them according to applicable Laws and 00290.20(g).
- Locate areas for parking, refueling and servicing mobile equipment and vehicles at least 150 feet away from any waters of the State and U.S. or storm inlet, unless otherwise approved by the Engineer.
- For large equipment that is not easily moved, prevent fuel and operating fluids from reaching any waters of the State and U.S. or storm inlet by, at a minimum, using spill containment systems designed to completely contain potential spills during all refueling and equipment repair operations.

(4) Equipment Cleaning and Washouts:

- Inspect and clean all equipment prior to operating it within 150 feet of any waters of the State and U.S. or storm inlet. Check for fluid leaks and remove all external oil, grease, weed seed, and dirt.
- Do not discharge untreated wash and rinse water into the any waters of the State and U.S. or storm inlet.
- Establish wash areas that contain all fluids and debris, at least 150 feet from any waters of the State and U.S. or storm inlet, such that untreated waste water does not impact those systems.
- Clean concrete equipment in washout areas that contain all fluids and debris. Recycle washout materials into fresh mixes or dispose of according to applicable permits.

(5) Off Site Tracking:

- Limit water leakage from trucks carrying saturated soils to less than 1 gallon per hour before allowing them to leave the Project Site.
- Remove all loose dirt and debris from trucks prior to leaving the Project Site.

(6) Other Spill Prevention and Response Measures:

- Inspect heavy equipment, storage containers, staging areas and other potential sources of hazardous substances daily to identify and prevent potential releases.
- If flooding of the Project site is expected to occur within 24 hours, evacuate areas used for staging, access roads, or storage and remove materials, equipment, and fuel.
- Immediately contain and repair leaking equipment or containers and cleanup any releases according to 00290.20(g).
- Maintain hazardous material containment kits and spill containment kits on-site to facilitate the cleanup of hazardous material spills on dry-land and/or waters of the State and U.S.

(b) Pollution Control Plan (PCP) - Develop and submit a PCP to prevent pollution related to Contractor operations for approval 10 calendar days before the preconstruction conference. Maintain a copy of the PCP on-site at all times during construction activities, readily available to employees and inspectors. Ensure that all employees comply with the provisions of the PCP.

Include the following information in the PCP:

- Identify a professional on-call spill response team.
- Identify all contractor activities, hazardous substances used and wastes generated.
- Describe how hazardous substances and wastes will be stored, used, contained, monitored, disposed of and documented. Include pollution prevention, spill response, waste reduction, dust prevention, off site tracking prevention, washout facility design, vehicle and equipment fueling and maintenance procedures, employee training and emergency contact information.
- Include the waste determination results from 00290.20(c-1). Provide reuse, recycle, and disposal options, the reason for selecting that alternative, and estimated quantities for each reuse, recycle, and disposal option.
- Include or refer to the SPCC plan and the hazardous waste contingency plan, if required.
- Include scaled site plans showing locations for hazardous substance storage, spill response equipment, communications equipment and fire suppression equipment.

A "Pollution Control Plan Contractor Packet" is available from the Agency.

(c) Air Pollution Control Measures - Comply with ORS 468, ORS 468A, OAR 340-014, OAR 340-200 through OAR 340-268, and all other applicable Laws.

(1) Vehicle and Equipment Idling - Establish truck staging areas for diesel-powered vehicles located where truck emissions have a minimum impact on sensitive populations, such as residences, schools, hospitals and nursing homes.

Limit idling of trucks and other diesel powered equipment to five minutes, when the equipment is not in use or in motion, except as follows:

- When traffic conditions or mechanical difficulties, over which the operator has no control, force the equipment to remain motionless.
- When operating the equipment's heating, cooling or auxiliary systems is necessary to accomplish the equipment's intended use.
- To bring the equipment to the manufacturer's recommended operating temperature.
- When the outdoor temperature is below 20 °F.
- When needed to repair equipment.
- Under other circumstances specifically authorized by the Engineer.

(2) Dust Control and Permitting - Prevent airborne dust and fugitive dust emissions from construction activities including rock, concrete, and asphalt crushing operations and obtain permits according to 00160.70. Do not use oil, waste, waste water, or other illegal materials as dust suppressants.

(3) Burn Restrictions - Burn wastes only if open burning is allowed by State, LRAPA, and local burning Laws. Obtain and comply with all required permits including DEQ permits required by OAR 340-264-0010 through OAR 340-264-0020, LRAPA permits, and local fire district permits. Provide copies of all permits to the Engineer prior to burning. Do not conduct burning within

riparian areas. Conduct burning at locations where existing structures will not be damaged and where smoke will not impact traffic. Do not burn the following materials on-site:

- Rubber products
- Tires
- Plastic
- Wet garbage
- Petroleum and petroleum treated materials
- Asphalt or industrial waste
- Any material that creates dense or noxious odors
- Painted materials
- Asbestos, mercury or PCB containing materials or equipment
- Hazardous wastes
- Scrap wiring or electrical equipment
- Painted or treated wood

Buildings intended for demolition may be burned by the local fire department for training purposes. Contact the local fire department for applicable restrictions.

00290.32 Noise Control - Comply with ORS 467, OAR 340-035, all other applicable Laws, and the following construction noise abatement measures:

- Do not perform construction within 1,000 feet of an occupied dwelling 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 un-muffled exhausts is prohibited.
- Use equipment complying with pertinent equipment noise standards of the EPA.
- Do not drive piling or perform blasting operations within 3,000 feet of an occupied dwelling 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 all occupied dwellings by placing material stockpiles between the operation and the affected dwellings, or by other means approved by the Engineer.

If a specific noise impact complaint occurs during the construction of the Project, one or more of the following noise mitigation measures may be required, at no additional cost to the Agency, 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.

00290.34 Protection of Fish and Fish Habitat - 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 hazards to the safety and propagation of fish and shellfish in waters of the State and U.S.

(a) Regulated Work Areas - Perform work within regulated work areas only within the regulated in-water work periods. Do not allow equipment to enter any waters of the State or U.S. or the regulated work area except as allowed in permits issued for the Project.

The regulated work area, if any, will be identified in the Special Provisions.

(b) Prohibited Operations - Except where allowed by the Contract or 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 waters of the State and U.S.
- Use treated timbers within the regulated work area
- Impede adult and juvenile fish passage, including intermittent streams

00290.36 Protection of Wildlife and Wildlife Habitat - Comply with the Laws of the Oregon Department of Fish and Wildlife and U.S. Fish and Wildlife Service. Conduct operations to avoid any hazards to the safety and propagation of wildlife.

(a) Migratory Birds - Comply with the Migratory Bird Treaty Act (16 U.S.C. 703-712) which protects most species of birds in Oregon and prohibits the removal of nests containing eggs and dependent young. Migratory birds include most birds in Oregon, except pigeons, house sparrows, and starlings. Except where allowed by the Contract and by permit, do not disturb a migratory bird nest containing eggs or dependent young, or the surface the nest is built on.

If migratory bird nests are encountered that contain eggs or dependent young, stop all actions that may disrupt the nest and contact the Engineer. Do not resume work, that may disrupt nesting, until approved by the Engineer.

(b) Bats - Avoid destruction of bat colonies as shown.

00290.38 Protection of Plants - Plant habitats to be protected will be shown with the plant habitat boundaries flagged by the Engineer . Avoid destruction of plant habitats by ensuring construction personnel, equipment, and associated pollutants, including sediment, chemical contaminants, discharge water, non-native grass and weed seed, do not enter the habitat.

00290.40 Protection of Forests - - Obtain necessary permits according to ORS 477.625 and ORS 527.670, and comply with the Laws of any authority having jurisdiction for protection of forests.

00290.41 Protection of Wetlands - Comply with and require that all the Contractor's employees, agents, and subcontractors on the Project Site comply with the following:

- Clean Water Act Section 404 (33 U.S.C. 1344); Federal Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. 403 et seq.).

- ORS 196.800 to ORS 196.990 (Oregon Removal-Fill law).
- ORS 390.805 to ORS 390.925 (Oregon Removal and Filling in Scenic Waterways law).
- All other applicable Laws governing preservation of wetland resources.

For the purposes of this Section, "wetland" or "wetlands" shall be understood to include wetlands as defined in 00110.20, as well as other jurisdictional waters of the State and U.S.

Willful violation of permit conditions and applicable laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to, the offender's sole liability for all costs associated with site restoration, maintenance and additional mitigation work required by federal or State authorities.

(a) Identifying Wetlands - Wetlands known to be on the Project Site will be shown and identified either as "permanently filled or excavated" or as "temporarily impacted". Wetlands to be protected will be shown as "no work zones".

(b) Disturbing Wetlands - If wetlands are shown, meet with the Agency Wetland Specialist, the Engineer, and inspector on-site prior to moving equipment onto the site or beginning any work, to ensure that all parties understand the locations of wetlands and the measures that shall be taken to protect them.

Ensure protection of no work zones as follows:

- Fence off no work zones using pedestrian safety fence or approved equivalent.
- Except as authorized by the Engineer for the purpose of installing or maintaining approved wetland protective measures, keep all persons, equipment and materials off no work zones.
- The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

Install all site protection for wetlands required by the Plans and Special Provisions prior to staging equipment or starting work near the site(s).

The Engineer may suspend work until the Contractor, Engineer, Agency Wetland Specialist, and other required federal and State personnel, if any, meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before work resumes.

00290.50 Protection of Cultural Resources - Comply with all Laws governing preservation of cultural resources. Cultural resources may include, but are not limited to, dwellings, bridges, trails, fossils, and artifacts.

If cultural resources are encountered on the Project area or in material sources, and their disposition is not addressed in the Special Provisions, do the following:

- 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 do the following:

- Contact the Agency Archaeologist, to arrange immediate investigations.
- 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 - Comply with and require that all the Contractor's employees, agents, and subcontractors on the Project Site comply with all Laws applicable to the preservation and protection of sensitive cultural sites. The existence of any sensitive cultural sites affecting the Project, and the mandatory preservation and protection measures applicable to the sites, are determined according to the Laws including, but not limited to the following:

- National Historic Preservation Act (NHPA) of 1966, Section 106, codified in 36 CFR Part 800 (Protection of Historic Properties).
- ORS 97.740 to ORS 97.760, ORS 97.990(5), and ORS 97.990(6) (Indian Graves and Protected Objects).
- ORS 358.905 to ORS 358.955 (Archaeological Objects and Sites).
- ORS 390.235 to ORS 390.240 (Archaeological Sites and Historical Material).

Ensure protection for sensitive cultural sites according to the following:

- Except as authorized by the Engineer for the purpose of installing or maintaining approved sensitive cultural site protective measures, keep all persons, equipment, and materials off known sensitive cultural sites.
- Install all sensitive cultural site protection required by the plans and Special Provisions prior to staging equipment or starting work near the site(s).
- Instruct all Contractor and subcontractor personnel to regard the locations of these sites and their contents as confidential.

The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

If sensitive cultural sites are known to be on the Project, additional information will be provided in the Special Provisions.

(a) Disturbing Known Sensitive Cultural Sites - Willful violation of Laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to the offender's sole liability for all costs associated with monitoring, recovery, site restoration or other archaeological work required by Tribal, federal, and State authorities. Costs can exceed $100,000.

The Engineer may suspend work until the Contractor and the Engineer meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before work resumes.

(b) Disturbing Unknown Sensitive Cultural Sites - If the Contractor finds a previously undiscovered sensitive cultural site, immediately cease all activities at that site, follow procedures listed in 00290.50, and notify the Engineer. If the Contractor inadvertently disturbs unknown sensitive cultural sites, but immediately ceases all activities and follows the procedures listed in 00290.50, the Agency, 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 Agency nor the State shall be required to indemnify the Contractor for such costs resulting from, arising out of or relating to the willful misconduct, negligence or other wrongful acts attributable to the Contractor or other persons on the Project site.

Delays to work due to new cultural resource finds will be considered for exclusion from Contract time according to 00180.50(e).

Work required for monitoring and site restoration for newly discovered sensitive cultural sites encountered by the Contractor will be paid according to Section 00197.

Measurement

00290.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00290.90 Payment - The accepted quantities for work performed under this Section will be paid for at the Contract lump sum amount for the item "Pollution Control Plan".

Partial payments will be made as follows:

- When the initial PCP is approved 20%
- When 30 percent of the Contract is complete, excluding advances on materials 20%
- When 60 percent of the Contract is complete, excluding advances on materials 20%
- When 90 percent of the Contract is complete, excluding advances on materials 20%
- At completion of the Contract and all waste is removed from the Project site and all reports, receipts, and documents have been submitted 20%

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

Payment includes, but is not limited to, the following:

- Contractor's Pollution Control plan (PCP)
- Spill Prevention Control and Countermeasures (SPCC) plan
- Hazardous Waste Contingency plan
- Hazardous waste determination
- Determination of generator category
- The Certified Hazardous Materials Manager
- The Professional on-call Spill Response Team

PART 00300 - ROADWORK

Section 00310 - Removal of Structures and Obstructions

Description

00310.00 Scope - This work consists of removing and disposing of man-made materials and cleaning up areas they occupy. See Section 00501 for removal of bridges..

00310.01 Areas of Work - Perform removal work in the same areas as specified in 00320.01.

If a building to be removed lies partly within the right-of-way, remove the entire building unless otherwise shown or directed.

00310.02 Exclusions - Removal work does not include removal or disposal of materials which are:

- Designated to remain.
- Included in earthwork as given in 00330.41.
- Specifically indicated by the Specifications, plans, or Special Provisions to be removed incidental to other items of work under the Contract.
- Owned or controlled by third parties.

Construction

00310.40 Restrictions on Removal Work:

(a) Guardrail, Median Rail, and Concrete Barrier - In those areas where guardrail, median rail, or concrete barrier are to be removed and replaced with new or salvaged rail or barrier, do one of the following:

- Install the new or salvaged units the same working shift the existing unit is removed.
- Protect the area with temporary, precast concrete barrier units with appropriate end treatment satisfactory to the Engineer, until the new or salvaged unit is installed.

(b) Milepost Markers - Throughout construction, protect and maintain all milepost markers affected by the work at locations visible to the traveling public. This may require removing and relocating the milepost markers to maintain visibility throughout construction. When construction is completed, reinstall the milepost markers in their original location in a manner satisfactory to the Engineer, unless new milepost markers are to be installed according to Section 00840.

00310.41 Removal Work:

(a) General - Where an abutting structure or a part of a structure is to be left in place, make cuts that protect remaining structures and allow for specified connections.

(b) Guard Rail Posts - Remove posts completely and backfill holes with selected granular backfill material meeting the requirements of 00330.14.

(c) Drainage Structures - Remove drainage structures, such as box culverts, down to a depth 2 feet below ground, slope or waterway bed. Remove culverts, sewers, siphons, and other conduits according to 00330.41(a-7).

(d) Materials Within Construction Areas:

(1) General - Remove materials within construction areas entirely or break down the materials to an elevation at least 2 feet below subgrade or slope surface as allowed below.

(2) Bituminous Treated Surfaces - Scarify and break up existing bituminous treated surface when it lies under subgrade and is not salvaged. Incorporate the scarified material into the embankment. Pieces of existing pavement shall not exceed 15 inches in any dimension.

(3) Concrete Floors, Slabs and Walls - Before placing material in basements or over concrete slabs, remove or break through the floors, slabs, and walls so no fragments of the floors, slabs, and walls have a dimension in excess of 15 inches and there is no protruding reinforcement.

(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.

00310.43 Disposal of Material - Dispose of materials according to 00290.20(c).

00310.44 Earthwork in Connection with Removal - Excavation required to perform removal of structures and obstructions will be considered Incidental to the removal work, unless it is within the measurement limits for an excavation Contract pay item.

Backfill holes according to 00330.45. The backfill will be measured for payment according to 00330.82, when there is an embankment measure basis pay item for earthwork and that material is used for backfilling, otherwise no separate payment will be made for this work.

Maintenance

00310.60 Repair of Damages - Repair promptly any breakage or damage to materials or items not intended to be removed. Complete replacement of the affected materials may be required if the Engineer determines it is necessary. Make all repairs and replacements at no additional cost to the Agency.

Measurement

00310.80 Measurement - The quantities of removal of structures and obstructions work performed under this Section will be measured according to the following:

- **Lump Sum Basis** - Under this method, no measurement of quantities will be made.
- **Separate Item Basis** - Under this method, the quantities of work performed on a separate item basis will be measured as follows:
  - **Length and Area** - The length or area of the structure or item actually removed, will be measured along the line and grade of the structure or item for each continuous structure or item removed. Measurement will be by the foot and be limited to the neat lines shown or directed. Area will be calculated to the square yard.
  - **Each** - Items will be measured on a unit basis of units removed.

Payment

00310.90 Payment - The accepted quantities of work done under this Section will be paid for at the lump sum basis or separate item basis according to 00310.91 and 00310.92 as applicable.

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

No separate or additional payment will be made for barriers used for temporary protection where guardrail, median rail, or concrete barriers have been removed.

No separate or additional payment will be made for protecting and maintaining milepost markers and reinstall them at their original location.

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

00310.91 Lump Sum Basis - The accepted quantities of removal work done on a lump sum basis will be paid at the Contract lump sum amount for the following items:

	Pay Item	**Unit of Measurement**
(a)	Removal of Structures and Obstructions	Lump Sum
(b)	Removal of _____	Lump Sum

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

In item (b), the specific kind or description of removal work will be inserted in the blank.

00310.92 Separate Item Basis - The accepted quantities of removal work done on a separate item basis will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Removal of Pipes	Foot
(b)	Removal of Curbs	Foot
(c)	Removal of Walks and Driveways	Square Yard
(d)	Removal of Surfacings	Square Yard
(e)	Removal of Inlets	Each
(f)	Removal of Manholes	Each

Item (d) includes the removal of all surfacings, except for walks and driveways, as defined in 00110.20 under "Existing Surfacings".

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 - Remove and dispose of noxious weeds and Specified Weeds according to Section 01030 prior to beginning clearing of trees and other vegetation.

Cut trees and brush so they fall into the areas specified to be cleared.

Cut off tree stumps, not required to be grubbed under 00320.41 as follows:

- Flush with the ground surface if within the clear zone.
- No higher than 4 inches above the ground surface if between the clear zone and the clearing line.

Remove all evidence of clearing matter and debris. This work includes removal of:

- Sod, weeds and dead vegetation.
- Down timber, brush and other vegetation.
- Sticks and branches with diameters greater than 1/2 inch.
- Dead trees, down timber, stumps, and specified trimmings from areas where live trees and other vegetation are designated to remain.

(b) Preserving and Trimming Vegetation:

(1) Within the Work Areas - Avoid injuring vegetation designated to remain in place. Preservation of this vegetation includes protection and special care.

(2) Outside the Work Areas - Avoid injuring any vegetation. Confine operations which may injure vegetation to areas that have no vegetation or to the work areas.

Remove hazardous, dead and damaged trees outside the clearing limit as directed.

(3) Tree Trimming - Trim trees 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.

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 at the place of origin. Dispose of this matter and debris according to 00290.20(c).

00320.43 Backfilling Holes - Except in areas to be excavated, backfill holes remaining after grubbing operations with clean fill (see 00290.20(c-2)) according to 00330.45.

Measurement

00320.80 Measurement - The quantities of clearing and grubbing work performed under this Section will be measured according to the following:

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

- **Area Basis** - Under this method, measurement will be the ground surface, limited to the areas shown or directed.

Payment

00320.90 Payment - The accepted quantities of clearing, grubbing, disposal, and cleanup work will be paid for 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.

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00330 - Earthwork

Description

00330.00 Scope - This work consists of excavation, ditching, backfilling, embankment construction, grading, leveling, borrow, and other earth-moving work required in the construction of the Project, excepting such work specifically included and provided for as:

- A pay item elsewhere in the Contract Specifications.
- Incidental work in the detailed Specifications for other Contract pay items.

The term "earthwork" will be used as a general term to designate the work included within the scope of this Section.

00330.01 Lines, Grades, and Cross Sections - All earthwork shall conform to the lines, grades and cross sections established.

Roadbed cross sections shall be subject to variation from the typical sections shown on the plans, if directed, to:

- Provide superelevation on curves.
- Take care of special conditions at intersections and elsewhere.
- Balance earthwork quantities.

00330.02 Definitions:

Abandoned Pipes and Miscellaneous Matter - Sewers, pipes, conduits, logs, timbers, concrete and other structures, materials, objects, and matter encountered in the work, excepting only items identified for removal or preservation.

General Excavation - All excavation covered by this Section, except foundation, toe trench, and borrow excavation.

Overbreak - Material beyond and outside of the slope limits established by the Engineer, which becomes displaced or loosened during excavation and is excavated.

Selected Materials - Those materials with pertinent characteristics that are preserved and sorted as directed from specified excavations and handled for specific uses.

Stone Embankment Material - Rock used in specific embankment applications including buttresses, inlays, shear keys, and erosion control applications.

00330.03 Basis of Performance:

(a) General - Except as provided in 00330.00, all earthwork shall be performed on either an excavation basis or on an embankment basis. The basis of performance for each earthwork pay item will be indicated in the Special Provisions and the Contract Schedule of Items.

(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) Agency Furnished Borrow - Use materials obtained from Agency 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 Agency-controlled lands. Acquire at Contractor's own expense. The provisions of 00160.60 and 00160.80 shall apply.

Materials

00330.10 Selected Materials - When the Contract contains a pay item "Extra for Selected _____ Material", furnish the material from required excavations. The Specifications for the selected materials will be in the Special Provisions, if different than specified in these Specifications. If other provisions of this Section call for selecting or sorting material for various parts of the work, select and sort the materials to meet the directed requirements.

00330.11 Selected Topsoil - Furnish topsoil selected for use according to 00330.10 meeting the requirements of 01040.14.

00330.12 Borrow Material - Furnish borrow materials for general embankment construction with soil that is free of unsuitable materials or other characteristics detrimental to the construction of firm, dense and sound embankments. Furnish borrow materials for other uses meeting 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. Reclaimed glass meeting the requirements of Section 02695 may be substituted for selected granular backfill.

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. Reclaimed glass meeting the requirements of Section 02695 may be substituted for selected stone backfill.

00330.16 Stone Embankment Material:

(a) Requirements - An unweathered, hard, angular, durable, free draining material, visibly well graded from coarse to fine with the maximum size between 15 inches and 3 inches. Rock fragments larger than 15 inches but not larger than 36 inches may be included if placed as directed in 00330.42(c-2).

If the 1" - 0 portion exceeds 10% of the total volume by the Engineer's visual examination, the 1" - 0 material will be randomly sampled for testing. The wet sieve test, according to AASHTO T 11,

will be performed on the sampled material. The amount of material passing the No. 200 sieve shall not exceed 5.0% by weight.

(b) Control Sample - Provide, at a location acceptable to the Engineer, in close proximity to the Project, at least a 5 cubic yards sample of stone embankment meeting the gradation specified. This sample will be used as a frequent reference for judging the gradation of the material supplied.

(c) Sampling and Testing Assistance - If the Engineer visibly determines the material furnished justifies sampling and testing, dump and check the gradation of two random loads of stone embankment material. Provide a sorting site, mechanical equipment and labor to assist in checking gradation at no additional cost to the Agency.

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 115 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, exerting a dynamic force of at least 30,000 pounds per impact and operating at a frequency of at least 1,000 vibrations 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
- CDT

Construction

00330.40 General:

(a) Quantities - Quantities and locations of earthwork materials indicated on the plans are approximate only. Make sure there is enough suitable material available to complete embankments and other required fillings before disposing of any excavated materials. Make up any shortage of materials caused by premature disposal at no additional cost to the Agency.

The Agency 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 Section 00150 and Section 00170, protect existing surfacings of all types which are to remain in place from being damaged or fouled with undesirable material. Repair or replace damaged or fouled surfaces as directed at no additional cost to the Agency.

(c) Avoidance and Correction of Detrimental Operations - Perform all operations involved in excavating, hauling and placing of earthwork materials so no damage or detriment to the completed or partially completed work results. At all times provide sufficient drainage of completed or partially completed earthwork to prevent damage or loss due to rainfall, surface water or any other cause. In all cases, take proper precautions to ensure that embankment construction and filling does not move, endanger or cause undue strain or stress to any structure or adjacent ground. Temporary and final

embankment slopes within any cross section shall not be constructed steeper than the slope staked for that cross section.

Recondition or remove unstable materials resulting from improper operations, inadequate drainage or over watering, and restore or replace with stable material at no additional cost to the Agency.

00330.41 Excavations - Perform excavation of earthwork as indicated on the plans, as directed and according to the following:

(a) General:

(1) Selection and Sorting of Excavated Materials - All materials available from excavations, including borrow materials, are subject to selection and separate handling for their best utilization in various parts of the work. Select the types of materials to be used according to 00330.42, 00330.44, 00330.45, 00330.47, the Special Provisions, and as directed. Select and sort excavated materials, as necessary, to meet Contract requirements.

(2) Selected Topsoil - Stockpile and place selected topsoil according to 01040.43.

(3) Unsuitable Materials - Unsuitable materials encountered in required excavations shall be classed as waste material and disposed of according to 00330.41(a-5).

(4) Excess Materials - If the quantities of excavated materials are greater than required to construct embankments and to do all filling and backfilling, the remaining materials shall be classed as waste materials and be disposed of according to 00330.41(a-5).

(5) Waste Materials - Waste materials under 00330.41(a-3) and 00330.41(a-4) become the property of the Contractor at the point of origin. Unless otherwise specifically allowed and subject to the requirements of 00280.03, dispose of waste materials outside and beyond the limits of the Project and Agency controlled property according to 00290.20(c). Do not dispose of any materials on any wetland, either public or private or within 300 feet of any river or stream.

(6) Excavation of Existing Surfaces - Unless otherwise specified, earthwork includes excavating, hauling and depositing of existing surfacings which are within the limits of the excavation work.

If an abutting roadway or structure, or part of a roadway or structure, is to be left in place, make cuts according to 00310.41(a).

(7) Abandoned Pipes and Miscellaneous Matter - Remove and dispose of abandoned pipes and miscellaneous matter encountered in the work as a part of the earthwork, unless otherwise specified.

Remove ends of remaining abandoned pipe or portions of other miscellaneous matter remaining exposed in slopes or at subgrade after excavation work to at least 2 feet back of the finished slope or below subgrade.

Place a watertight cap or plug in the inlet ends of remaining abandoned pipes. Leave outlet ends open. Place free draining cover material and/or take other measures as directed to allow for free passage of drainage at remaining outlet ends. Shape and finish the affected area so no evidence of their existence is apparent upon completion of the work.

(8) Ditches, Channel Changes, Approaches, Connection, Etc. - Perform excavations to construct ditches, channel changes, approach roadways, road connections, and other items, as required.

(9) Excavation Below Grade:

a. 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.

b. 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.

c. 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 and bring the entire cut slope area to 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 called for by the plans. 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 an Agency 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 is necessary and is not included in the Contact Schedule of Items, perform blasting according to following:

(1) General - Use blasting methods that do not shatter or loosen backslopes, that produces smooth and uniform excavation slopes at the specified slope angles, and satisfactorily loosens the rock for excavation. Do not use tunnel blasting methods.

(2) Methods - Follow the requirements of 00335.40(b) through 00335.40(h) and 00335.43.

00330.42 Embankment, Fills, and Backfills - Consider the nature, characteristics, and qualities of the materials to be selected before performing embankment, fill, and backfill work. Select and use excavated materials in various parts of the work according to 00330.41(a). Use all materials originating from required excavations, as far as practical, in the formation of embankments and subgrade, and for bedding, backfilling and other purposes shown on the plans, as directed, and according to the following:

(a) Embankment Foundation Preparation - In addition to the excavation and replacement of unsuitable materials as provided in 00330.41(b), and before constructing embankments, prepare the areas on which embankments are to be constructed as follows:

(1) Unstable Areas - Where the embankment foundation will not support hauling or compaction equipment and only if directed, place an initial layer of selected materials. Place the initial layer by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the equipment and not greater than 3 feet, unless otherwise authorized. Do not place the initial layer higher than 3 feet below subgrade. Commence consolidation of the initial layer by routing construction equipment uniformly over the entire layer. The initial layer shall meet the compaction requirements of 00330.43 except for layer thickness. Subsequent layers shall meet all requirements of 00330.43.

(2) Ends of Abandoned Pipe - Place a watertight cap or plug in the inlet ends of remaining abandoned 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 called for by the plans or as directed.

(4) Backfilling Inside Roadbed Limits - Break up concrete or asphalt floors, slabs, or walls, as specified in 00310.41(d), before backfilling or placing embankment. Backfill basements, trenches and holes within embankment limits with selected stone backfill material. Backfill material placed in basements may include pieces of broken concrete and masonry not exceeding 15 inches in any dimension provided they are placed and compacted according to 00330.42(c). The broken concrete and masonry shall not have protruding reinforcement.

(5) Existing Surfacings - Scarify and break up existing surfacings according to 00310.41(d) before placing embankment material.

(6) Roughen Ground Surface - Break up, roughen or scarify the ground surface if the slope is 1V:5H, or less, to positively bond embankment materials with the existing ground with benching allowed 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 no additional cost to the Agency.

(c) Embankment Construction:

(1) General - Except as provided in 00330.42(a-1), do not construct embankments or fillings when the embankment material, the foundation or the embankment on which it would be placed is frozen, not stable or not compacted, unless otherwise directed.

Make roadbed embankment slopes as smooth, safe and sightly as practical with the materials used to construct the embankments.

Route hauling equipment over the full width of embankments. Traveling over the same areas repeatedly will not be allowed unless approved by the Engineer as unavoidable.

Place embankments and all fillings in nearly horizontal layers not more than 8 inches thick, except as provided in 00330.42(c-2). Compact each layer separately and to the density required in 00330.43.

Place slope berms, if required, according to 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 allowed 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) Embankment Slope Protection - Construct outer portions of embankments exposed to erosion by stream flow or other erosive action with rock fragments, or other desirable materials, if directed, and such are available in the excavations. Also, if directed, place similar material as a protective layer on the outside of the regular embankment slopes as embankment widening. Placement shall closely follow construction of the embankment when directed. Protective materials placed as embankment widening need not be compacted but shall present a reasonably smooth surface, resistant to washout or slippage.

(4) Embankments for Approaches, Connections, Etc. - Construct embankments as required and as directed to provide a complete Project. Construct according to 00330.42(c) and 00330.42(d).

(5) Embankment Construction Around Minor Structures - Backfill prior excavations in the vicinity of curbs, walks, driveways, inlets, manholes and other such minor structures with selected general backfill, or selected granular backfill material as directed with no particles larger than 1 inch and that is compatible with the adjacent material, unless otherwise specified. The material shall have a moisture content as specified in 00330.43, be placed in layers according to 00330.42(c-1), and compacted according to 00330.43.

(6) Embankment Construction at Pipes - Before installing any pipes with 72 inch or smaller, inside nominal diameter that will protrude above the existing ground surface:

- Provide temporary drainage at no additional cost to the Agency, unless provided for in Section 00240.
- Construct specification embankments at least five pipe diameters each direction from the pipe centerline and to a height equal to the following:
  - 12 inches minimum above the outside top of pipe elevation.
  - A higher height if called for on the plans or directed.
- Then trench, bed, and install the pipe, and backfill around all pipes according to 00445.45.

(7) Embankment Construction at Bridge Ends - At the ends of bridges and for a distance of at least 100 feet from the bridge, place and compact the embankments before beginning bridge construction, unless otherwise directed. Unless the embankment is constructed according to 00330.42(c-8), provide and place selected stone backfill material, meeting the requirements of 00330.15 when such is available from excavations, in all embankments within 100 feet of bridges, or as directed.

(8) Engineered Fills - In areas designated on the plans as "Engineered Fills", place selected stone backfill material in maximum 8 inch lifts from the existing ground up to the base of granular structure backfill. Compact to 95% maximum density according to 00330.43.

If the existing ground line is within the limits of the granular structure backfill, subexcavate the area beneath the footing in order to place the full depth of granular structure backfill shown or specified.

Place the granular structure backfill, meeting the requirements of 00510.13, in maximum 6 inch lifts and compact to 100% maximum density from the top of the selected stone backfill to the footing elevation shown. The thickness and extent of these materials shall be according to the details shown or as directed.

The foundation compaction requirements in 00330.43 shall be subject to the higher requirements of this provision. Compact according to the percentages required above.

(d) Stone Embankment - If the Contract plans or Specifications require embankments, or parts of embankments, to be constructed of stone embankment material, furnish and place the stone embankment material according to this provision and as directed. Furnish materials from Contractor provided sources which conform to the requirements of 00330.16, unless otherwise specified.

Construct these embankments according to the other provisions of 00330.42, unless otherwise specified or directed, and as follows:

- Material placed in the upper 1 foot of embankments or within 1 foot of a culvert or other structure, shall not be more than 3 inches in size.
- If placement in water is allowed, construct the first layer of embankment to an elevation 2 feet above water. Continue thereafter as specified or directed.
- Some rock fragments larger than 15 inches, but not larger than 36 inches may be placed provided they are placed and compacted according to 00330.42(c-2-c).

00330.43 Earthwork Compaction Requirements:

(a) General - Compact natural ground, embankment foundations, foundations for structures, each layer of embankment, fills, and backfills, the upper 1 foot of roadbeds in cuts and other earthwork which is to support any part of the roadbed prism according to this subsection.

Unless otherwise specified, compact in place the entire surface of each layer of all specified materials with a minimum of 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 allowed, as required to ensure intimate contact between the backfill material and the structure or fragment and provide thorough compaction.

(b) Moisture-Density Testable Materials:

(1) Test in-place materials for compaction according to the MFTP.

(2) In-place materials shall meet the following moisture content, density, and deflection requirements, each of which has equal weight and each of which shall be satisfied:

a. Moisture Content - Moisture content at the time of compacting the materials shall be prepared to within minus 4% to plus 2% of optimum moisture content. Material which does not contain sufficient moisture to obtain proper compaction shall be wetted and thoroughly mixed as directed. Material containing an excess of moisture shall be dried by manipulation, aeration, drainage or other means before being compacted.

b. Density - After compaction of each layer the density shall be at least:

- 95% of maximum density in roadbed cuts, to a depth of 1 foot below established subgrade elevation.
- 95% of maximum density in embankments, fills, backfills, and specified portions of existing ground.

c. Deflection Requirement - In addition to moisture-density testing, conduct at least one deflection test according to ODOT TM 158 for each 3 feet, or portion of 3 feet, of embankment placed. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

Conduct deflection tests, witnessed by the Engineer, on the finish grade of all subgrades. During placement of subbase or base aggregates or HMAC, if deflection is observed, remove the HMAC, base and subbase aggregates and correct the deflecting areas at no additional cost to the Agency.

Provide a signed test report to the Engineer at the end of each shift after completing the required testing. At no additional cost to the Agency, remove and replace embankment constructed thicker than 3 feet that was not deflection tested.

(c) Non-Moisture-Density Testable Materials - When material is not moisture-density testable because rock fragments in the material prevent moisture-density testing, place and compact the material as follows:

- Place non-moisture density testable material in nearly horizontal layers with thickness not exceeding 12 inches.
- Water or aerate the material to ensure each layer can be compacted to form a dense mass, free of pumping.
- Compact each layer uniformly with a minimum of four full coverages using a smooth drum vibratory roller.
- Conduct at least one deflection test according to ODOT TM 158 for each layer of embankment placed. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

(d) Small, Irregular Fill Areas - The density requirements of 00330.43 do not apply to irregular fill areas that have a total volume of no more than 150 cubic yards 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 surface.

00330.44 Buttress, Inlay, or Shear Key - Remove the designated materials and construct the buttress, inlay or shear key as follows:

(a) Preparation - Do not start excavation for each segment until a stockpile of stone embankment material is immediately available at or near the site. Locate the stockpile at a site approved by the Engineer. The size of the stockpile shall be sufficient to fill one excavated segment.

(b) Sequence of Construction - Excavate the area according to 00330.40 and 00330.41 to provide a backslope to the lines, slopes and details indicated on the plans or as directed. Excavate and backfill in segments to minimize aggravating stability conditions. Each segment shall not exceed 75 feet in length as measured across the top of each open excavation segment, unless otherwise specified or directed.

(c) Unsuitable Materials - Sort and dispose of unsuitable materials as waste material according to 00330.41(a-5).

(d) Foundation - Excavate to a depth of at least 5 feet into firm, stable, undisturbed materials as shown on the plans or as directed. Remove soft or loose materials. The Engineer will verify sufficient excavation into firm, stable, undisturbed materials in each segment before allowing the backfill. Where called for in the plans or as directed, place riprap geotextile against the excavated backslope. Remove water from the excavation before placing stone embankment material.

(e) Drainage - Provide drainage as shown or as directed.

(f) Placement of Stone Embankment - After excavation of each segment according to 00330.44(b) and 00330.44(d), place the stone embankment material to fill the excavated segment before excavating the next segment. Backfill all segments on the same day they are excavated. Place and manipulate the stone embankment material in the buttress, inlay or shear key to provide a dense and well-filled mass to the lines, slopes and cross-sections indicated on the plans or as directed.

00330.45 Filling of Holes - Backfill holes outside the limits of required excavation or embankment construction that result from grubbing and removal work, basements, trenches and other such holes as directed. Smooth and shape to blend with the surrounding area. If the basis of performance is the excavation basis, no separate payment for this work will be made. If the basis of performance is the embankment basis, payment for this work will be made according to 00330.94.

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 included in the Contract Schedule of Items. Select and sort the materials obtained from required excavations 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 no additional cost to the Agency when caused by any of the following:

- Embankment foundation conditions or pre-existing subsurface conditions that were reasonably anticipated in the Contract.
- Contractor's method and manner of operations.
- Contractor's failure to perform or to protect the work according to plans and Specifications.

(2) Agency 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 or 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.

00330.71 Daily Progress Reports - For projects that have more then 2,500 cubic yards of embankment material, regardless of the basis of performance, (excavation or embankment), provide daily progress reports documenting the quantities of materials placed and a summary of tests performed. Use report forms approved by the Agency. Submit the reports to the Engineer at least weekly.

Measurement

00330.80 Measurement - The quantities of earthwork will be measured as follows:

- Volume basis, computed by the average end area method from cross section measurements, or by other methods of equivalent accuracy. When the Special Provisions so state, corrections for curvature will be made.
- Volume basis, of materials handled and placed in the work as required and as directed.

Measurement will only be for those items listed in 00330.93 and 00330.94 that are actually included as an item in the Contract Schedule of Items.

Structure excavation will be measured according to 00510.80(b).

Materials subexcavated from beneath footings as required by 00330.42(c-8) will be measured according to 00510.80(b).

Granular structure backfill will be measured according to 00510.80(d).

Watering of materials required by 00330.46 will be measured according to 00340.80.

00330.81 Excavation Basis Measurement - When measurement of earthwork 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.
- Materials removed below subgrade in roadbed excavations according to 00330.41(a-9) and 00330.91(d).
- Overbreak determined to be unavoidable according to 00330.41(a-10).

The following earthwork 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 will not be measured separately.

00330.82 Embankment Basis Measurement - When measurement of earthwork is on the embankment basis, the materials will be measured in their final embankment position. Measurement will be limited to the lines, grades, and slopes of the original ground contours after clearing and grubbing and compaction is performed according to 00330.43(a) before embankment construction begins.

The quantities of embankment measured for payment will include the volumes of materials used to backfill excavations below subgrade and holes when shown 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 to 00170.80 or 00170.82.
- Any additional quantities required due to compaction efforts that are required in 00330.43.
- Slide materials paid for as Extra Work.
- Any materials for which payment is made for completed embankments or backfills under other Contract provisions.

The following earthwork items will be measured on the embankment basis:

- Embankment In Place
- Stone Embankment
- Extra For Selected _____ Material

Excavations, including cutbank rounding, overbreak whether avoidable or not, and foundation benching, required or necessary to perform earthwork on the embankment basis, and retrieval or removal of cobbles and boulders according to 00330.42(c-2-a) will not be measured separately.

When an excavation basis item is included in the Contract Schedule of Items and selected materials are obtained from the excavation for use as "Extra for Selected _____ Material", measurement will be made for both items.

Payment

00330.90 Payment - The accepted quantities of earthwork performed under this Section will be paid for at the Contract unit price, per unit of measurement, for each item that appears in the Contract Schedule of Items.

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

Structure excavation will be paid for according to 00510.90(b).

Materials subexcavated from beneath footings as required by 00330.42(c-8) will be paid for according to 00510.90(b).

Granular structure backfill will be paid for according to 00510.90(d).

Watering of materials required by 00330.46 will be paid for according to 00340.90.

Slide removal and repair work determined under 00330.49(d-2) to be Agency responsibility will be paid for as Extra Work under Section 00196.

No separate or additional payment will be made for work that is required to be done under these Specifications that does not appear as a separately listed item in the Contract Schedule of Items.

No separate or additional payment will be made for blasting done according 00330.41(e) unless a blasting item is listed in the Contract Schedule of Items.

00330.91 Kinds of Pay Excavation - The kinds of pay excavation on the Project will be indicated by the items listed in the Contract Schedule of Items and are defined as follows:

(a) Ditch Excavation:

- Limited to the lines, grades, and cross sections shown or established with bottom widths of 8 feet and less that lie outside of and separate from roadbed cross sections.
- Includes canals, channels, and inlet, outlet, diversion, drain, and other open ditches to carry water.

(b Foundation Excavation:

- Limited to the lines, grades, and cross sections shown or established.
- To remove soft materials for preparation and stabilization of areas below embankments.

(c) Toe Trench Excavation:

- At the toe of riprap slopes as shown and elsewhere as directed to provide a suitable foundation toe trench on which to place riprap geotextile or filter blanket, and riprap material.

(d) General Excavation:

- Other than ditch, trench, structure, foundation, toe trench, and borrow excavation.
- Includes cut ditches, borrow ditches, and roadside ditches in the roadway section as staked or established, or shown as being a part of the typical roadway cross sections.
- Includes other ditches with bottom widths greater than 8 feet.
- Includes unsuitable material excavated below subgrade in roadbed excavations according to 00330.41(a-9), when determined that such excavation is neither more nor less difficult to remove than the material above subgrade in the whole of the cut. When determined that such excavation is either more or less difficult to remove than the material above subgrade in the whole of the cut, payment will be according to Section 00196.

(e) Borrow Excavation:

- Obtained from specifically designated and authorized sources lying outside of, separated from, independent of, and beyond the roadway cross sections, unless otherwise directed.

00330.92 Kinds of Incidental Earthwork - No separate or additional payment will be made for the following:

- Removal of overburden from pits and quarries.
- Excavation of rock and other material for use in surfacings or structures.
- Excavation for haul roads.
- Other excavation (borrow excavation excepted) which is not directly a part of the finished work.
- Blend tops of cutbanks with adjacent ground according to 00330.41(a-11).
- If shown on the plans.
- Overbreak, except on excavation basis earthwork and the Engineer determines that overbreak was unavoidable.
- Foundation benching performed according to 00330.42(a-7).
- Rock excavated below the excavation plane established by 00330.41(a-9) and the specified backfill required to fill up to the excavation plane, to the satisfaction of the Engineer.
- Smooth and maintain foundations, roadbeds, and haul roads.
- Material handled, removed, placed, or used contrary to Specifications or directions.
- Rehandling and reshaping of materials previously excavated, except where called for in the Specifications, Plans, or Contract change orders.
- Excavation for forms to construct curbs, gutters, walks and other similar structures unless specified.
- The volume of any free water or liquid.
- Hauling, moving, or transporting earthwork materials.
- Removal of excess moisture according to 00330.42(b).
- Retrieval or removal of cobbles and boulders according to 00330.42(c-2-a).
- Constructing outer portions of embankment with suitable material for slope stabilization.

00330.93 Excavation Basis Payment - When listed in the Contract Schedule of Items, the following items will be paid for on the excavation basis:

	Pay Item	Unit of Measurement
(a)	Ditch Excavation	Cubic Yard
(b)	Foundation Excavation	Cubic Yard
(c)	Toe Trench Excavation	Cubic Yard
(d)	General Excavation	Cubic Yard
(e)	Borrow Excavation	Cubic Yard

These items include excavating, selecting, handling, hauling, placing, and compacting the materials as specified.

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

	Pay Item	Unit of Measurement
(a)	Embankment In Place	Cubic Yard
(b)	Stone Embankment	Cubic Yard
(c)	Extra For Selected _____ Material	Cubic Yard

Item (a) includes excavating, selecting, handling, hauling, placing, and compacting of the materials as specified and all other costs incurred in furnishing required embankment materials.

Item (b) includes furnishing, selecting, handling, hauling, placing, and compacting the material as specified.

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

Item (c) includes preserving, sorting, stockpiling, and handling of the specified selected materials as described in 00330.41(a-1) and 00330.41(a-2), selected and placed according to 00330.42, 00330.47 and the Special Provisions.

Unless a specific pay item in the form of item (c) appears in the Contract Schedule of Items, no separate or additional payment will be made for preserving, sorting and handling selected materials. However, earthwork materials obtained from excavations and incorporated into specified embankments will be paid for at the applicable item, if listed in the Contract Schedule of Items.

Excavation of unstable material that is below subgrade in roadbed excavation areas, according to 00330.41(a-9), will be paid for according to 00195.20.

Section 00331 - Subgrade Stabilization

Description

00331.00 Scope - This work consists of excavating and disposing of unstable materials in excavation areas only and placing subgrade geotextiles, stone embankment, and aggregate backfill to the lines and grades as shown or directed.

Materials

00331.10 Materials - Furnish materials meeting the following requirements:

Aggregate Base 02630
Aggregate Subbase ..... 00641.10(b)
Stone Embankment 00330.16
Subgrade Geotextile, Certification Level B..... 02320
Water 00340

00331.16 Acceptance of Backfill - The backfill material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00331.20 General - Provide all equipment necessary to perform the work according to Sections 00330, 00340, 00350, and 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 Measurement - The quantities of subgrade stabilization will be measured on the area basis of subgrade surface area stabilized to the full depth as shown. The surface area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Payment

00331.90 Payment - The accepted quantities of subgrade stabilization will be paid for at the Contract unit price, per square yard, for the item "_____ inch Subgrade Stabilization".

The depth of stabilization will be inserted in the blank.

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

No separate or additional payment will be made for excavation, geotextile, stone embankment or aggregate backfill material, or water.

Section 00335 - Blasting Methods and Protection of Excavation Backslopes

Description

00335.00 Scope - This work consists of excavating in rock using controlled blasting methods to achieve smooth, uniform and unfractured backslopes, and produce a free surface or shear plane in the rock along the specified excavation backslope, and production blasting to facilitate excavation.

00335.01 Definitions:

Buffer Row - In multiple row blasts in which perimeter control blasting techniques are used, the first row of production holes immediately adjacent to and drilled along a plane parallel to the perimeter control blast line. The buffer row is located between the production holes and the perimeter controlled blast line.

Perimeter Controlled Blasting - The use of explosives and blasting accessories in carefully spaced and aligned drill holes. Perimeter controlled blasting techniques include presplitting and trim (cushion) blasting.

Presplitting - A perimeter control blasting method in which the perimeter row of blast holes are drilled along the plane of the specified final excavation backslope and which utilizes reduced drill hole spacing and reduced diameter explosives decoupled from the drill hole wall, and whose initiation precedes the initiation of the adjacent production holes by a minimum of 25 milliseconds.

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

Trim (Cushion) Blasting - A perimeter control blasting method in which the initiation of the perimeter row of blast holes drilled along the plane of the specified final excavation backslope follows the initiation of the adjacent production holes within 25 to 75 milliseconds, if production holes are being employed in the blast.

Materials

00335.10 Materials - Furnish all explosives and blasting caps that are no more than one year old. Each blasting cap period shall come from one lot number.

Construction

00335.40 Blasting Methods:

(a) General - Use methods in making excavations that do not shatter or loosen the backslopes and that produce smooth and uniform excavation slopes at the specified slope angles. These include:

- **Perimeter Controlled Blasting** - Use on the entire length of cut section in rock or cemented materials which have backslopes of 1V:0.75H or steeper, even if the main excavation can be ripped.

- **Production Blasting** - Blasting in the mass of rock to be excavated shall be designed to control flyrock, minimize ground vibration and air blast, and result in loosened and fragmented in-place rock of a size that can be removed, transported, or crushed to produce specified products. Lay out production blast holes in a consistent pattern that does not affect the perimeter control blast holes. Where production blast holes are made adjacent to highways

with specified closure restrictions, the volume of material blasted shall not exceed the Contractor's ability to remove the blasted material from the adjacent highway within the specified closure time.

(b) Safety and Flyrock Control - Use techniques that effectively limit and control flyrock. Clear the site of all boulders or other material as directed prior to beginning blasting work. Following every blast, observe the entire blast area for a minimum of five minutes before reentering or commencing work in the area.

Be responsible for the storage, transportation, and handling of explosives, their use, and the results of all blasting operations according to 00170.94.

Cover all blast areas that are within 200 feet of residences, facilities or above ground utilities using appropriate blast containment mats or an approved equivalent method.

Discontinue blasting operations, as directed, if it is apparent that the methods employed are not producing acceptable results or the safety of the public, the Contractor's employees or adjacent property is being jeopardized.

(c) Preblast Survey - Offer, in writing, to perform a preblast survey for owners and occupants of all buildings, structures, and utilities within the distance of the blast specified in 00335.40(d). If the offer is accepted, use an Agency approved survey form, signed and completed by an independent third party, and submitted to the Engineer and Contractor at least 72 hours before blasting begins. Deliver a copy of the survey form and copies of any photos taken to the owners and occupants.

(d) Blasting Notification - Notify all owners and occupants of buildings, structures, and utilities that are within the following distances of the blasting areas:

- 300 feet for shots using less than 50 pounds of explosives per time delay of 15 milliseconds.
- 600 feet for shots using between 50 and 250 pounds of explosives per time delay of 15 milliseconds.
- 1,250 feet for shots using more than 250 pounds of explosives per time delay of 15 milliseconds.

Provide notification, in writing, once, at least 48 hours before blasting begins, and again on the day the blasting operations occurrence.

(e) Blasting Plan - Provide a separate blasting plan for each cut that requires blasting, prepared by a person qualified and experienced in blasting work. Each plan shall cover individual major rock cut areas or rock production from a material source. Similar minor rock cut areas of less than 50 cubic yards, as well as utility and culvert trenches, may be covered as a group in one generalized blasting plan.

Submit the blasting plans for the Engineer's review at least seven calendar days before beginning drilling and blasting work for excavations of 3,000 cubic yards or smaller, and 14 calendar days for drilling and blasting work requiring any perimeter controlled blasting and or excavations of more than 3,000 cubic yards.

The blasting plans will be reviewed for conformance with the Specifications and any concerns will be discussed with the Contractor. Submit any proposed changes to the blasting plans in writing to the Engineer for review before implementation. Submittal of blasting plans is for quality control and record keeping purposes.

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

Each blasting plan shall contain the full details of the drilling and blasting patterns, vibration, flyrock, and noise reduction methods, blast area security measures and traffic control that the Contractor proposes to use, and the following information:

- Station limits of proposed shot.
- Removal of overburden.
- Plan and cross section diagrams of proposed drill pattern for controlled and production blast holes including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height and sub drill depth. Accurately draw to scale and show each cut area to be blasted.
- Loading diagram showing the type, amount and specific gravity of explosives, primers, and initiators, and location depth, and type of stemming.
- Initiation sequence of production and controlled blast holes including delay times and delay system.
- Manufacturer's product data sheets for all explosives, primers and initiators to be used in the work.

(f) Blasting Test Sections - Demonstrate the adequacy of each proposed blasting plan by means of test shots in each cut or excavation before beginning full scale blasting. Do not proceed with remaining drilling and blasting until acceptable test blast results have been demonstrated to the satisfaction of the Engineer.

In areas where perimeter controlled blasting techniques are being employed, drill and blast short representative test sections not exceeding 100 feet in length. Excavate a section not less than 20 feet wide exposing the full height of the lift for examination. In areas where no perimeter controlled blasting techniques are being employed, determine effectiveness of the test section based on the material placement, cut slope stability, fragmentation and control of ground vibration, air blast and fly rock.

Do not drill ahead of the test blast area, except as provided in 00335.41(a-6), until the test section has been evaluated. The Contractor may be directed to use test section lengths less than 100 feet.

If the results of the test shots are unacceptable revise the methods, techniques and procedures, at no additional cost to the Agency, so that the results achieved will be acceptable. No further drilling and blasting will be allowed until the revised methods are reviewed according to 00335.40(e) and verified by additional test shots.

If, during the progress of the work, the methods of drilling and blasting do not produce acceptable results within the tolerances specified, drill, blast and excavate additional test sections until a technique is determined that will produce acceptable results.

(g) Blasting According to Plan - After the Engineer has reviewed the blasting plan and determined that test sections have demonstrated acceptable results, perform all perimeter controlled and production blasting according to the plan that produced acceptable results. Notify the Engineer when any changes in conditions or results are observed. On the day of each blasting occurrence and before detonation of the blast, the supervisor or blasting specialist in charge shall certify, in writing, that the shots being carried out are consistent with the reviewed blasting plan.

(h) Blasting Report - Submit a blasting report detailing the blast outcome within 48 hours of making each blast. Include in the report the following:

- Drill logs, drilling remarks, loading, and timing variables used in the blast.
- All blast monitoring documentation.
- A comment section that includes the Contractor's evaluation of the blast performance.
- All damage incurred and details of all neighbor's complaints or comments.

00335.41 Controlled Blasting Methods:

(a) Presplitting:

(1) Attach mechanical devices to all drilling equipment used to drill the presplit holes to determine, within an accuracy of 1°, the angle at which the drill steel enters the rock.

(2) Do not drill presplit holes more than 3 inches in diameter.

(3) Start presplit drill holes along the presplit line within 3 inches of the dimensions shown on the blasting plan. Holes located beyond this tolerance will be rejected. Completely fill the rejected holes with stemming material at no additional cost to the Agency. Drill new presplit holes with the proper spacing. Rejected holes will not be measured for payment.

(4) Control the drilling operations to ensure that presplit hole alignment does not vary from the plane of the planned slope by more than 9 inches either parallel or normal to the slope. Presplit holes exceeding these limits will not be paid for unless, in the Engineer's opinion, satisfactory slopes are being obtained.

(5) The length of presplit holes for any individual lift shall not exceed 30 feet unless the Contractor can demonstrate to the Engineer's satisfaction that hole alignment can be maintained within the above tolerances. Upon satisfactory demonstration, and with written permission of the Engineer, the length of holes may be increased to a maximum of 60 feet. If more than 5% of the presplit holes are misaligned in any one lift, reduce the height of the lifts until the 9 inch alignment tolerance is met.

(6) Drill presplit holes a minimum of 30 feet longitudinally beyond the limits of the production holes to be detonated or to the end of the cut. Unless otherwise allowed by the Engineer in writing, remove all overburden, including any loose or decomposed rock, before drilling the presplitting holes.

(7) When the cut height will require more than one lift, a maximum offset of 18 inches between lifts will be allowed to allow for drill equipment clearance. Adjust the slope angle of lower lifts to compensate for drill offsets and any drift which may have occurred in upper lifts.

(8) Use only explosives manufactured specifically made for presplitting in the presplit holes. The maximum diameter of explosives used in presplit holes shall not be greater than half the diameter of the presplit hole. Bulk ammonium nitrate and fuel oil (ANFO) will not be allowed in the presplit holes.

(9) Determine that the presplit hole is free of obstructions for its entire depth before placing charges. Exercise all necessary precautions so the placing of the charges will not cause caving of material from the walls of the holes.

(10) Detonation of explosives in each hole in a presplit shot may be delayed, providing the hole-to-hole delay is no more than 25 milliseconds.

(b) Trim (Cushion) Blasting - When the horizontal distance from the new proposed slope face to the existing rock face is less than 15 feet, the Contractor may trim blast instead of presplitting. The requirements in 00335.41(a) for presplitting also apply to trim blasting, by changing the words presplit and presplitting to trim blasting. If trim blasting burdens are less than 6 feet or zones of weakness in the rock are observed, submit a hole loading diagram that reflects the site conditions.

(c) Buffer Row - Locate the buffer hole line a minimum of 3 feet away from the perimeter control blast line, or 1 foot for every inch of buffer hole diameter, whichever is greater. Space buffer row holes 3 to 5 feet center to center. The explosive load in buffer holes shall not exceed 50% of the full explosive load that could be placed in a 3 inch production hole. Initiation of the buffer holes shall be on a delayed sequence toward a free face.

00335.42 Production Blasting - Do not drill any row of production blast holes closer than 6 feet to the perimeter controlled blast line. Where necessary to minimize damage to the rock backslope, a row of buffer holes may be drilled between the perimeter controlled blast line and the production blast holes. Except for the bottom lift, do not extend production holes below the bottom of the controlled blast holes. Do not exceed 6 inch diameter for production holes. Detonate production holes on a delay sequence documented in the blasting plan.

00335.43 Scaling - Remove all loose, hanging, or potentially dangerous rock on the excavated surface by scaling during the completion of the excavation of each lift. Do not begin drilling the next lift until this work has been completed, as directed.

Scale the slopes throughout the Contract at the frequency required to remove loose or overhanging material.

Use a suitable standard steel mine scaling rod to hand scale the slopes. Other methods such as machine scaling, hydraulic splitters or light blasting may be used instead of, or to supplement, hand scaling, if allowed.

Measurement

00335.80 Measurement - The quantities of perimeter controlled blast holes will be measured on the length basis and will be determined by dividing the cut slope surface area by the perimeter controlled blast hole spacing. The cut slope surface area will be determined by cross section measurement from the top of the blasted rock to the finished ditch bottom elevation.

The quantities shown in the Contract Schedule of Items have been computed from a theoretical plan length using 30 inch hole spacing. The actual quantities will depend on field conditions and results from blasting test sections.

Payment

00335.90 Payment - The accepted quantities of perimeter controlled blast holes will be paid for at the Contract unit price, per foot, for the item "Perimeter Controlled Blast Holes".

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

No separate or additional payment will be made for blasting, scaling, or loosening materials for excavation.

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00340 - Watering

Description

00340.00 Scope - This work consists of furnishing and applying water or combinations of water and additives for:

- Compacting and preparing roadbed excavations, roadbed embankments, backfills, subgrades, subbases, bases and surfacings.
- Preventing or alleviating dust nuisance originating within the highway right-of-way and the Project limits, which is not caused by Contractor operations at the Contractor's plants or plant setups.
- Other watering when ordered, except for Extra Work.

00340.01 Definitions:

Additives - Emulsified asphalt, magnesium chloride or other materials added to water for the purpose of aggregate binder or dust control.

00340.02 Exclusions - Watering which is specified as Incidental and included in payment for other items or parts of work is excluded from measurement under this Section.

Materials

00340.10 Water - Furnish water free of silts and other matter harmful to the quality of the material to which it is applied or with which it is mixed.

Comply with Chapter 537 of the "Oregon Water Laws", which is administered by the Water Resources Department, covering the appropriation of water.

Most adjudicated water may be limited to agricultural uses, so it should not be assumed that there will 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 QPL and mix according to the manufacturer's recommendations.

(b) Magnesium Chloride - When required, furnish Magnesium Chloride ($MgCl_2$) in brine solution at 28% to 35% concentration by weight.

Equipment

00340.20 Watering Equipment - Perform uniform and controlled application of watering by one or more of the following methods:

- Tank trucks equipped with spray bars
- Hose and nozzle
- Wetting materials in stockpile or in excavation areas before excavating
- Other means, as directed

The use of splash boards will not be allowed without prior approval. When required, provide a metering device for water measurement.

Construction

00340.40 Watering:

(a) General - Make all necessary arrangements to obtain water and pay all costs involved in its procurement. Maintain an adequate supply of water at all times.

Perform watering only when and where directed at an approved rate and manner of application. Water at any hour of the day, and on any day of the week, as directed, for proper performance or protection of the work and for alleviation of dust nuisance.

(b) Use of Additives - If an additive is combined with water in the watering work, mix it in the proportions and manner specified, and use in the work as directed.

Maintenance

00340.60 Avoidance of Detrimental Operations - Avoid wasting water or watering detrimental to other work. Cease such operations until corrective measures are directed.

Measurement

00340.80 Measurement - The quantities of water will be determined by the following methods:

- Weight or volume, or both
- In tanks or tank trucks of predetermined capacity
- By approved meters

Measurement will be M-gallons (1,000 gallons = 1 M-gallon) not including the additives used in the watering as specified or ordered. For conversion purposes, water weighs 8.34 pounds per gallon or 62.4 pounds per cubic foot. Only quantities acceptably used in the work, as specified, will be measured.

Quantities of additives combined with water for watering purposes will be determined separately from the water and will be measured on the volume basis in gallons.

Payment

00340.90 Payment - The accepted quantities of water and additives will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Watering	M-Gallon
(b)	_____ in Watering	Gallon

Item (a) includes furnishing and developing the water supply, hauling and applying the water.

In item (b), the name of the additive will be inserted in the blank.

Item (b) includes furnishing the specified additive, for combining and mixing it with the water, and for all extra costs involved in the use of the additive in the watering work not included in item (a).

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

No separate or additional payment will be made for obtaining permits, water rights, or any other costs related to complying with the "Oregon Water Laws".

When the Contract Schedule of Items does not indicate payment for work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

00340.91 Quantity Variations - Payment for watering items performed beyond 25% of the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

Section 00344 - Treated Subgrade

Description

00344.00 Scope - This work consists of treating the upper layer of subgrade with water and either lime, chloride, or portland cement to form a stabilized course of material at the locations and to the lines, grades, thicknesses, and cross section shown or directed.

00344.01 Definitions:

Treated Subgrade - Subgrade which is improved by the addition of soil stabilizing materials.

Materials

00344.10 Soil Stabilizing Materials - Furnish soil stabilizing materials meeting the following requirements:

Material	Type	Grade
Hydrated Lime	AASHTO M 216, Type 1	Grade A
Granular Quicklime (CAO) for grading and hydroxide content, with minimum 85% Calcium Hydroxide	AASHTO T 27 and T 219 sieve; max. 15% passing No. 100 sieve	100% passing 3/8"
Calcium Chloride AASHTO T143, testing	AASHTO M 144, sampling	–
Sodium Chloride	AASHTO M 143	–
Portland Cement	AASHTO M 85	Conform to Portland Cement in Section 2010

Store materials according to 00165.75.

00344.11 Water - Furnish water meeting the requirements of Section 00340.

Construction

00344.40 Preparation - Before starting subgrade work, including backfill, complete all underground work contemplated in the area of the subgrade. This requirement includes work by the Contractor, by the owner or by others. Drain all depressions or ruts which contain water.

00344.41 Addition of Stabilizing Material - Apply stabilizing materials at a uniform rate as specified using equipment and methods that will ensure uniformity of distribution. The use of blade graders to distribute lime will not be allowed. Allow only equipment that is used for watering, applying and mixing the stabilizing material to pass over the material until after it is mixed into the soil. Add water, if necessary, during mixing operations to provide optimum moisture content.

00344.42 Mixing - Perform mixing operations until the treated subgrade material is uniform and free of streaks or pockets and all material, other than stones, will pass a 1 inch sieve. Do not allow the content of stabilizing material to vary by more than plus or minus 1% from the amount specified.

00344.43 Finishing - Immediately after mixing the treated subgrade, grade the mixture to specified line, grade and cross section and compact the mixture to the specified density. Compact and finish within 12 hours after compaction begins. If the Contractor has not compacted and finished the material within 12 hours, loosen the mixture and add stabilizing material and water as directed. Remix the freshened material, regrade and recompact, at no additional cost to the Agency. During compaction, maintain the mixture at proper grade and cross section and at optimum moisture content.

00344.44 Curing - Limit traffic over treated subgrade to equipment which do not cause any damage to the subgrade and which do not visibly deflect, ravel or wear the surface. Keep the finished surface moist and protect from rutting, spalling, displacement and disfiguration for a period of seven days, or until a subsequent course of material is placed which will prevent drying of the mixture by evaporation or absorption.

00344.45 Compaction:

(a) Achieve the required density of treated subgrade materials as specified in 00330.43(b).

(b) Compact the subgrade until it is firm and unyielding. Unyielding means no more than 1/4 inch deflection of the subgrade when proof-rolled with a fully loaded 10 to 12 cubic yard dump truck. Test and proof-roll within 24 hours prior to placing base material on the subgrade.

(c) Over-excavate areas of visible deflection to a depth of 12 inches or more below subgrade, as directed. Place fabric, backfill the over-excavated subbase area up to the subgrade elevation with a single lift of 1 1/2" - 0 crushed rock and compact. Apply the compactive effort until the density of the top 6 inches of the subbase rock is as specified in 00641.44(a). In addition, proof-roll these areas to verify they are firm and unyielding as specified above.

(d) Notify the Engineer if the specified compaction is not attained. The Contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternative material be used. Do not proceed with finishing or compaction of the subgrade until the Contractor is able to compact the material to the satisfaction of the Engineer.

00344.46 Tolerances:

(a) Rework areas found to be deficient in thickness by more than 1/2 inch, and add fresh stabilizing material in an amount equal to one-half the original amount.

(b) Finish the surface of the treated subgrade so that it does not vary by more than 1/2 inch from the established grade and cross section at any point. When tested with a 12 foot straightedge, the maximum variation of the finished surface from the testing edge is 1/2 inch.

Measurement

00344.80 Measurement - The quantities of treated subgrade will be measured on the area basis, measured along the lines and grades of the area actually treated.

The quantities of soil stabilizing materials will be measured on the dry weight basis. Packaged materials will be accepted at the net weight shown by the manufacturer, subject to periodic verification and approval. Provide a certificate with each shipment together with a certified copy of the weight of each delivery. Measurement of stabilizing material will not include any which is lost, displaced, used in reworking, used in restoration work or used contrary to direction.

Payment

00344.90 Payment - The accepted quantities of treated subgrade and soil stabilizing materials will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Treated subgrade, ___ inches Thick	Square Yard
(b)	Lime	Ton
(c)	Portland Cement	Ton
(d)	Calcium Chloride	Ton
(e)	Sodium Chloride	Ton

In item (a), the depth of the treated subgrade will be inserted in the blank.

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

No separate or additional payment will be made for:

- draining water from the subgrade
- soil stabilization work
- smoothing the subgrade in preparation for staking
- blading, shaping and compacting the subgrade, including roadbed materials, to final line, grade and cross section

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.

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 manufacturer's 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 Agency, 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 Materials - Furnish materials meeting the requirements of 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:

Application	Minimum Overlap Requirements (Inch)
Drains	12
Embankment Stabilization	24
Pavement Overlays	*
Riprap and Rock Buttresses	24
Roadbed Subgrade Stabilization	24

* 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:

Seam Type (See Plans)	Minimum Seam Allowance (Inch)
Flat or Prayer Seam, Type SSa-1	1 1/2
"J" Seam, Type SSn-1	1
Butterfly-folded Seam, Type SSd-1	1

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 allowed 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 Agency. 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:

	Maximum Drop Height (Feet)	
Size of Rock	**Onto Geotextile Material**	**Onto an Aggregate Cushion Blanket**
Greater than 200 pounds	0	3
200 pounds or less	3	3

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 QPL.
- 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 per square yard, or as recommended by the geotextile manufacturer or as directed.

If using emulsions, increase the application rate 50% or as directed. Some underlying surfaces may require a higher application rate. Within street intersections, on steep grades or in other zones where vehicle speed changes are commonplace, reduce the normal application rate by 20% or as directed.

The target width of the sealant application shall be the geotextile width plus 6 inches. Apply the sealant only as far in advance of the geotextile installation as appropriate to ensure a tacky surface at the time of geotextile placement. Place the geotextile the same day as the sealant. Do not allow traffic on the sealant. Clean excess asphalt from the road surface.

(5) Geotextile Placement - Place the geotextile into the sealant using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding from the water (break) before placing the geotextile.

Slit wrinkles or folds exceeding 1 inch and lay flat. Shingle-lap not more than 6 inches in the direction of the paving. Broom 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.

Measurement

00350.80 Measurement - The quantities of each geosynthetic installation will be measured on the area basis along the lines and grades of the surface area actually covered as shown or as required, except for drainage applications.

The quantities of drainage geotextile will be measured on the area basis, computed by multiplying the length of the trench where geotextile is used by the perimeter of the trench as determined from the neat lines shown, or as directed.

Payment

00350.90 Payment - The accepted quantities for geosynthetics will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Drainage Geotextile, Type ____	Square Yard
(b)	Embankment Geotextile	Square Yard
(c)	Riprap Geotextile, Type ____	Square Yard
(d)	Subgrade Geotextile	Square Yard
(e)	Pavement Overlay Geotextile	Square Yard

In items (a) and (c), the type of geotextile will be inserted in the blank.

Item (e) includes preparation work, sealant, and geotextile.

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

No separate or additional payment will be made for constructing laps, seams, joints, and patches unless the Engineer orders additional amounts over the minimum. For laps wider than the minimum or specified width, payment will be made for the added lap width at the Contract unit price.

If the Engineer orders geosynthetics with properties more stringent than specified, a price adjustment will be allowed only for the difference in material cost.

Section 00360 - Drainage Blankets

Description

00360.00 Scope - This work consists of furnishing and placing drainage blanket material to the lines, grades and dimensions shown on the plans or as directed.

Materials

00360.10 Sand Drainage Blanket - Furnish sand drainage blanket material meeting the following gradation limits determined by AASHTO T 27 and AASHTO T 11:

Sieve Size	Percent Passing
No. 10	95 - 100
No. 40	50 - 100
No. 60	20 - 40
No. 200	0.0 - 5.0

00360.11 Granular Drainage Blanket - Furnish granular drainage blanket material that is clean, free draining, durable crushed or uncrushed rock, meeting the following gradation limits determined by AASHTO T 27:

Sieve Size	Percent Passing
6"	100
4"	90 - 100
1/2"	60 - 80
No. 10	0 - 10
No. 100	0 - 5

Granular drainage blanket material will be accepted without testing if the Engineer visually determines the material meets the above requirements.

00360.12 Reclaimed Glass - Reclaimed glass meeting the requirements of Section 02695 may be used as a substitute for sand drainage blanket and granular drainage blanket material.

00360.15 Quality Control - Provide quality control according to Section 00165.

Equipment

00360.20 General - Use equipment capable of hauling, spreading and compacting the material to specified density without segregation.

If drainage blanket material is used to drain areas described in 00360.41, hauling with end dump trucks and spreading with bulldozers and other appropriate equipment will be allowed.

Labor

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

- CEBT
- CAgT
- CDT

Construction

00360.40 Planned Locations - On prepared excavations or embankments constructed as shown on the plans or as directed, place the drainage blanket as follows:

- Spread and compact to required depth with no layer exceeding 3 feet.
- If a subsurface drain system is installed immediately under or adjacent to the drainage blanket, place the drainage blanket directly against the subsurface drain system.
- Prevent contamination of drainage blanket material.

00360.41 Other Locations - When used to drain an unstable or wet area, excavate or trench the existing low areas as directed for positive drainage before placement of drainage blanket material.

00360.42 Compaction and Density Requirements - Compact the drainage blanket according to 00330.43.

Measurement

00360.80 Measurement - The quantities of sand and granular drainage blanket material will be measured on the volume basis in place and will be limited to the neat lines, grades, and dimensions shown or directed, or on the weight basis.

Payment

00360.90 Payment - The accepted quantities of sand and granular drainage blankets will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Sand Drainage Blanket	Cubic Yard or Ton
(b)	Granular Drainage Blanket	Cubic Yard or Ton

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

Section 00370 - Finishing Roadbeds

Description

00370.00 Scope - This work consists of the following:

- **Within Roadbed Cross Section** - Trimming, shaping, and finishing the subgrade, ditches, slopes, and other graded surface areas to the lines, grades, cross sections, and condition specified.

- **Outside Roadbed Cross Section** - Obliterating surfacings by removing existing paved surfaces, and loosening, breaking up, and spreading the existing bases lying outside the new roadbed cross section and blending into the adjacent terrain.

If existing paved surfaces and bases are to be excavated and removed, then performance, measurement, and payment of the work will be according to Section 00330.

Construction

00370.40 Within Roadbed Cross Section - After the roadbed earthwork has been substantially completed, do the following:

(a) Subgrade:

- Remove vegetative growth.
- Excavate unstable subgrade material, and backfill according to 00330.41(a-9).
- Trim and shape the entire subgrade to be free of ruts, depressions and irregularities.
- Compact all fills according to 00330.43.
- Finish the surface to within a tolerance of plus or minus 3/4 inch or as directed.

(b) Ditches:

- Remove all litter, debris and obstructions.
- Trim and shape to neat lines all ditches, channels and canals provided for waterways.

(c) Slopes:

- Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
- Make roadbed embankment slopes as smooth, safe and sightly as practical with the materials used to construct the embankments.
- Trim and shape all excavation and embankment side slopes.

(d) Structure Sites:

- Clean out all sewers, culverts, drains, and their appurtenances constructed under the Contract.
- Remove all extraneous matter in the vicinity of bridge ends, culvert ends, inlets, walls, and other areas.
- Trim and shape the cleaned areas.

(e) Disposal of Materials - Dispose of all materials removed in 00370.40(a) through 00370.40(d) according to 00290.20.

00370.41 Outside Roadbed Cross Section - Remove existing paved surfaces, if any, loosen the remaining bases and surfacings by scarifying, plowing, vibrating, rolling and/or other means, to a depth of at least 12 inches, or to solid rock, whichever is the lesser depth.

- Break the loosened materials into fragments having no dimension greater than 3 inches, unless the aggregate in the original material exceeds that size.
- Spread and mix the loosened and broken materials, and blend them into the adjacent terrain as directed.

Maintenance

00370.60 Maintenance - Maintain the finished work in its finished condition until final completion of the Contract work, or until it is covered with a subsequent course of material placed under the Contract.

Measurement

00370.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00370.90 Payment - The accepted work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Finishing Roadbeds	Lump Sum
(b)	Obliterating Surfacings	Lump Sum

Item (a) includes trimming, shaping and finishing the subgrade, ditches, and slopes, including areas occupied by approach roads, road connections, interchanges, ramps, frontage roads, multiple lanes, and any other areas on which earthwork is performed under this Contract.

Item (b) includes removing existing paved surfaces, and loosening, breaking up, spreading, and mixing the old bases lying outside the new roadbed cross section and blending into the adjacent terrain.

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

Excavation of unstable subgrade material and backfill will be paid for according to 00330.90.

When the Contract Schedule of Items does not indicate payment for the work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 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 - Furnish riprap geotextile meeting the requirements of Section 02320.

00390.11 Riprap Requirements:

(a) General - Furnish rock for loose riprap meeting the following requirements:

- Meet the test requirements of 00390.11(b).
- Be angular in shape. Thickness of a single rock shall not be less than 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 - Furnish the rock meeting the following test requirements:

Material Test	Requirement
Apparent Specific Gravity (AASHTO T 85)	2.50 Min.
% Absorption (AASHTO T 85)	6.0 Max.
Degradation (ODOT TM 208A)	
Passing No. 20 Sieve	35.0% Max.
Sediment Height	8" Max.
Soundness (AASHTO T 104)	
Average Loss of 2 1/2" - 1 1/2" and 1 1/2" - 3/4" fraction after 5 alternations	16.0% Max.

(c) Gradation Requirements - Grade loose riprap by class and weight of rock according to the following:

Class 50	Class 100	Class 200	Class 700	Class 2000	
		Weight of Rock (Pounds)			Percent (by Weight)
50 - 30	100 - 60	200 - 140	700 - 500	2000 - 1400	20.0
30 - 15	60 - 25	140 - 80	500 - 200	1400 - 700	30.0
15 - 2	25 - 2	80 - 8	200 - 20	700 - 40	40.0
2 - 0	2 - 0	8 - 0	20 - 0	40 - 0	10.0 - 0

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 Agency.

00390.12 Grouted Riprap - Furnish rock for grouted riprap meeting the requirements of 00390.11, and furnish the Portland cement grout meeting the requirements of 02080.40.

00390.13 Filter Blanket - Furnish filter blanket materials meeting the following requirements according to riprap class:

Riprap Class	Filter Blanket
Class 2000	16 inch layer of Class 50 riprap conforming to 00390.11
Class 700	9 inch layer of 6" - 0 stone embankment meeting the test requirements of 00330.16
Class 200	6 inch layer of 4" - 0 stone embankment meeting the test requirements of 00330.16
Class 100	No filter blanket required
Class 50	No filter blanket required

Construction

00390.40 Preparation - Remove brush, trees, stumps and other organic material from slopes to be protected by riprap and dress to a smooth surface. Remove all unsuitable material to the depth shown or directed and replace with approved material. Compact filled areas as specified in Section 00330.

Provide riprap protection as early as the structure foundation construction permits. Prepare the surfaces to be protected as shown. Maintain the trench slopes, riprap geotextile or filter blanket until the riprap is placed.

00390.41 Riprap Geotextile - If required, install riprap geotextile according to the requirements of Section 00350 and as shown or directed.

00390.42 Filter Blanket Construction - If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation. The surface of the finished layer shall be reasonably even.

00390.43 Riprap Backing - When allowed in the Special Provisions or indicated on the plans, the Contractor shall have the option of placing either riprap geotextile or a filter blanket behind the riprap. Install the backing according to 00390.41 or 00390.42.

00390.44 Riprap:

(a) General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.

(b) Loose Riprap - Place riprap on the prepared area:

- With a clam-shell, orange-peel bucket, skip or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed.
- To its full course thickness in one operation.
- According to 00350.43, if riprap is placed on geotextile.
- By methods that do not cause segregation of riprap or displace the underlying material.
- To produce a compact riprap protection in which all sizes of material are placed in their proper proportion.
- With some hand placing, or rearranging of individual stones by mechanical equipment, or some other approved means to provide a smooth finished surface.

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

(c) Keyed Riprap - After placing loose riprap material according to 00390.44(a) and 00390.44(b), key the riprap into place by slapping the surface with a piece of armor plating (approximately 4 feet x 5 feet in size weighing approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.

(d) Grouted Riprap - Place loose riprap material according to 00390.44(a) and 00390.44(b). If the depth specified for grouting is more than 12 inches, place the riprap in lifts of 12 inches or less and grout each lift before placing the next lift. Construct and grout the succeeding lifts before the grout in the previous lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the plans. If a rough surface is specified, brush the stone until 25% to 50% of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8 inch of the surface.

Provide weep holes through the riprap as shown or as directed.

Place and cure grout according to 00440.40(d) and 00440.40(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 Agency.

Measurement

00390.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Filter Blanket - Filter blanket will be measured on the area basis of the finished surface, limited to the neat lines shown or directed.

(b) Riprap Backing - Riprap backing will be measured on the area basis of the finished geotextile or the filter blanket surface, limited to the neat lines shown or directed.

(c) Riprap - Riprap will be measured on the volume basis in place or on the weight basis.

When measurement of riprap is on the volume basis in place and the Engineer determines that this basis is impractical, the pay volume will be determined by loose measure in the hauling vehicles on the basis that 1.00 cubic yard, vehicle measure, is equivalent to 0.70 cubic yard in place.

(d) Riprap Basins - Riprap basins will be measured on a unit basis of basins constructed.

Payment

00390.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Filter Blanket	Square Yard
(b)	Riprap Backing	Square Yard
(c)	Loose Riprap, Class ___	Cubic Yard or Ton
(d)	Grouted Riprap, Class ___	Cubic Yard or Ton
(e)	Keyed Riprap, Class ___	Cubic Yard or Ton
(f)	Riprap Basins	Each

In items (c), (d), and (e), the class of riprap will be inserted in the blank.

Item (d) includes the grout.

Riprap geotextile will be paid for according to 00350.90, except when it is included in item (b).

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

Section 00396 - Shotcrete Slope Stabilization

Description

00396.00 Scope - This work consists of constructing pneumatically applied shotcrete stabilization blankets onto slope surfaces at locations shown or as directed.

00396.01 Definitions, Standards, and Requirements:

Requirements - Design the shotcrete mix and be responsible for the quality of shotcrete used in the work.

Shotcrete - Either dry-mixed or wet-mixed material composed of portland cement, fine and coarse aggregate, water and reinforced with either welded wire fabric or steel fibers.

Standards - Construct shotcrete according to these Specifications and applicable sections of the latest edition of the American Concrete Institute's "Guide to Shotcrete" (ACI 506).

Materials

00396.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510.10
Cement (Type I or II)	02010.10
Chemical Admixtures	02040
Coarse Aggregate	02690.20
Curing Materials	02050.10
Fine Aggregate	02690.30
Grout	02080.20
PVC Pipe	02410.70
Water	02020
Welded Wire Fabric	02510.40

00396.11 Prepackaged Product - Premixed and prepackaged concrete products, with or without steel fibers, manufactured as a shotcrete product may be used for on-site mixed shotcrete if the materials meet this specification and if approved.

00396.12 Aggregates - Combined fine and coarse aggregates shall meet the following grading requirements as determined by AASHTO T 27:

Sieve Size	Percent Passing (by Weight)
1/2"	100
3/8"	90 - 100
No. 4	70 - 85
No. 8	50 - 70
No. 16	35 - 55
No. 30	20 - 35
No. 50	8 - 20
No. 100	2 - 10

00396.13 Steel Fiber Reinforcement - If steel fiber reinforced shotcrete is required, the steel fibers shall:

- Be between 1/2 inch and 1 1/2 inches long.
- Meet the requirements of ASTM A 820 Type 1, Deformed.
- Have a length to diameter ratio of less than 80.
- Have a minimum tensile strength of 160,000 psi.

Only steel fibers manufactured specifically for use in shotcrete applications will be allowed. The steel fiber content shall not be less than 100 pounds per cubic yard of shotcrete.

00396.14 Acceptance Sampling and Testing:

(a) General - Prepare shotcrete test panels on vertically supported open face molds. The molds shall:

- Have internal dimensions of at least 18 inches x 18 inches x 4 inches.
- Be rigid, nonabsorbent and nonreactive with cement.

Place the shotcrete in the molds utilizing the same shotcrete mix, air and water pressure, and nozzle tip that will be used in the actual placement of shotcrete on production surfaces. Protect the panels for at least 24 hours or until final set has taken place.

(1) Preproduction Testing - Prepare at least two test panels for each mix design for testing. Cure the test panels in a manner similar to the anticipated field conditions. Provide a copy of the mix design and the compressive strength test results to the Engineer at least seven calendar days before starting any production work. Do not begin production shotcrete work until satisfactory test results are obtained.

(2) Production Testing - Prepare, in the presence of the Engineer, at least two test panels daily for each nozzleperson during shotcrete operations, plus one test panel shot whenever the nozzle equipment is changed during the daily work period. Cure the shotcrete panels under the same conditions as the production shotcrete.

(b) Compressive Strength Tests:

(1) Compressive Test Cores - Obtain 3 inch diameter test cores from the cured shotcrete test panels prepared according to 00396.14(a-1) and 00396.14(a-2). Use a 3 inch inside diameter core bit to obtain cores.

(2) Shotcrete Compressive Strength - The shotcrete cores shall attain 2,500 psi compressive strength at seven calendar days (1,800 psi at three calendar days) as determined by AASHTO T 22. The production testing cores obtained by the Contractor will be tested by the Agency.

(c) Failure Of Shotcrete - If any shotcrete section is deficient in any of the specified criteria, remedy that section as directed at no additional cost to the Agency. The remedies may include, but are not limited to, removal and replacement of the deficient section.

Equipment

00396.20 General - Provide mixing equipment capable of thoroughly mixing the materials in sufficient quantity to maintain uniform and continuous application.

00396.21 Pump System - The pump system that conveys premixed shotcrete ingredients shall deliver a uniform and continuous flow of material, without segregation or loss of the ingredients.

00396.22 Air Compressor - The air compressor shall be capable of providing:

- A supply of clean air adequate for maintaining sufficient nozzle velocity for all parts of the work and for the simultaneous operation of a blow pipe for clearing away rebound.
- A minimum of 250 cubic feet per minute per operating nozzle.

00396.23 Dry-Mix Delivery Equipment - Dry-mix delivery equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and deliver a continuous stream of uniformly mixed material to the discharge nozzle. Equip the discharge nozzle with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and be convenient to the nozzleperson. Provide greater water pressure than the operating air pressure at the discharge nozzle to assure that the water is thoroughly mixed with the other materials. Use steady, nonpulsating water pressure. Regularly inspect and replace equipment parts, especially the nozzle liner and water ring, as necessary or directed.

When prepackaged material is used, predampening (also referred to as premoisturizing) equipment shall be used.

00396.24 Wet-Mix Delivery Equipment - Wet-mix delivery equipment shall be capable of discharging the premixed materials into the delivery hose and delivering a continuous stream of uniformly mixed material to the discharge nozzle. Follow the manufacturer's recommendations on the type and size of nozzle to be used, and on cleaning, inspection and maintenance of the equipment.

Labor

00396.30 Qualifications - At least seven calendar days before beginning shotcrete work, provide written evidence that the on-site supervisor, nozzle operator, and delivery equipment operator have performed satisfactory work in similar capacities elsewhere for a sufficient length of time to be fully qualified to perform their duties.

The on-site supervisor shall have not less than two year's full-time experience as a shotcrete nozzle operator. The nozzle operator and delivery equipment operator shall have served at least one year of full-time apprenticeship on similar applications with the same type of equipment. Before starting shotcrete work, the nozzle operator shall, in the presence of the Engineer, demonstrate their ability to apply shotcrete on a mold for a test panel according to 00396.14. The nozzle operator, before permission is given to place shotcrete in permanent construction, shall make one satisfactory test panel for each mix used during the course of the work.

Construction

00396.40 Surface Preparation - Before applying shotcrete to rock surfaces, remove all loose material and vegetation and clean with air, water jets or other approved means. Remove loose material from soil surfaces with air jets.

Do not place shotcrete on any surface which is frozen, spongy or where there is free water. Dampen the surface before applying shotcrete.

00396.41 Shotcrete Blanket Thickness Control - Control shotcrete blanket thickness by installing noncorrosive pins, nails or other gauging devices normal to the face so that they protrude the required shotcrete thickness outside the face. Place the pins on a maximum 5 foot square pattern. When welded wire fabric reinforcement is used, place at least a 1 inch cover of shotcrete over the wire fabric.

00396.42 Anchor Bars - Clean and blow clear all drilled holes before installing the anchor bars. Fill drilled holes using a grout tube extending to the bottom of the hole.

00396.43 Welded Wire Fabric - Place welded wire fabric as shown or directed. Overlap sheets at least 8 inches and secure with tie wire.

00396.44 Weep Holes - Do not drill holes larger than 3 inches in diameter. Install the drain pipe before applying shotcrete. Extend the end of the pipe 1 inch to 3 inches outside the slope. Protect pipe ends during shotcreting and clean weep holes after shotcrete is placed.

00396.45 Batching and Mixing Shotcrete:

(a) Dry-Mix Process - Batch cement/aggregate mix by weight or volume. Predampen the dry-mix after it flows out of the packaging but before it flows into the main hopper in order to ensure that the premix will flow at a uniform rate. Do not use predampened cement/aggregate mix in the work if it is allowed to stand more than 45 minutes.

(b) Wet-Mix Process - Batch and mix wet-mix shotcrete according to ASTM C 94.

00396.46 Batching and Mixing Steel Fibers - Determine the procedure for adding steel fibers to the shotcrete. Obtain Engineer's approval. Demonstrate the procedure in the field for approval before production operation begins. If fibers are added at the nozzle, uniformly distribute the fibers throughout the mortar matrix without isolated concentrations. If fibers are added to the dry or wet mix process, use a screen having a mesh of 1 1/2 inch to 2 1/2 inches to prevent any fiber balls from entering the shotcrete line, unless it is demonstrated that fiber balls are not being formed without a screen. Do not add fibers to the dry or wet mix at a rate faster than can be blended with the other ingredients without forming balls or clumps. Bulk fibers that have a tendency to tangle together shall pass through a vibrating screen or be sifted into the mix so they enter it as individual elements and not as clumps.

00396.47 Shotcrete Application - Apply shotcrete from the lower portion of the area to the top so rebound does not accumulate on the portion of the surface that still has to be covered. Hold the nozzle at a distance and at an angle approximately perpendicular to the working face so rebound material will be minimal and compaction will be maximized. Shotcrete shall emerge from the nozzle in a uniform and continuous flow. When, for any reason, the flow becomes intermittent, divert the nozzle from the work until uniform and continuous flow resumes. A nozzleperson's helper, equipped with an air blowout jet, shall attend the nozzleperson at all times during the placement of shotcrete to keep the working area free from rebound.

Do not work rebound material into the finished product. Rebound is defined as the shotcrete constituents which fail to adhere to the surface to which the shotcrete is being applied. Do not salvage it or include it in later batches.

Shooting will be suspended if:

- High wind prevents the nozzleperson from proper application of the material.
- The temperature is below 40° F.
- External factors, such as rain, wash cement out of the freshly placed material or cause sloughs in the work.

Taper construction joints over a distance of at least 12 inches to a thin edge. Thoroughly wet the surface of such joints before any adjacent section of shotcrete is placed. Do not use square construction joints.

Remove dummy areas, sags, or other defects and replace with a new layer, at no additional cost to the Agency. Replace any fabric reinforcement that is damaged with lapped and tied wire fabric.

Allow previous layers of shotcrete to take initial set before applying additional layers of shotcrete. Clean all loose material before applying additional layers.

00396.48 Finishing and Curing - Leave the shotcrete surface in a natural gun finish.

Apply Type 2, white-pigmented curing compound immediately after gunning to cure the shotcrete. Keep shotcrete surfaces from freezing for at least seven calendar days after application. Any curing compound in contact with exposed welded wire fabric, anchor bars and previous shotcrete surfaces shall be sandblasted before placing subsequent shotcrete.

Measurement

00396.80 Measurement - The quantities of shotcrete will be measured on the area basis along the finished shotcrete surface area.

Payment

00396.90 Payment - The accepted quantities of shotcrete will be paid for at the Contract unit price, per square yard, for the item "Shotcrete Slope Stabilization".

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

Section 00398 - Rock Slope Stabilization and Reinforcement

Description

00398.00 Scope - This work consists of furnishing and installing rock slope stabilization and reinforcement items as shown or specified in close conformity to the lines, grades, and dimensions shown or established.

Definitions

00398.02 Definitions:

Barrier Mounted Rock Protection Screen - A system of screening and concrete barrier designed to intercept small falling rocks.

Post-Supported Rock Protection Screen Behind Barrier/Guardrail - A gabion wire mesh screen placed at the highway shoulder edge and supported by posts up to 8 feet high to intercept rocks generally less than 2 feet in diameter.

Post-Supported Wire Mesh Slope Protection - Gabion wire mesh suspended above the ground with support posts and draped over a rockfall slope area. Post-supported wire mesh is used to intercept occasional falling rock generally less than 2 feet in diameter from slopes above the installation and the draped portion is used to prevent rocks from reaching the travel lanes.

Rock Reinforcing Bolts - Steel rods inserted into predrilled holes in rock and tensioned to a required load and bonded in place with grout.

Rock Reinforcing Dowels - Untensioned steel rods inserted into predrilled holes in rock and bonded in place with grout or polyester resin.

Rockfall Net System - A proprietary rockfall system constructed of interlocking steel rings or interlaced cable panels suspended from wide-flange support posts and incorporating braking elements. The system is designed to withstand high energy rockfall with minor maintenance required.

Wire Mesh Slope Protection - Gabion wire mesh draped over a rockfall slope area and anchored with soil or rock anchors. Wire mesh is used where rocks are generally less than 2 feet in diameter and to prevent rocks from reaching travel lanes.

00398.03 Rockfall Net System Submittals - Submit unstamped working drawings, field construction manuals, and product brochures prepared by the manufacturer of proprietary rockfall net systems, as necessary, according to 00150.35. Submit this information at least 30 calendar days before beginning fabrication or construction of the rockfall net system. Do not begin installation prior to receipt of the Engineer's written approval.

(a) Working Drawings - Provide working drawings that included at least the following information:

- **General Notes** - Necessary information on the design and construction of the rockfall net system.
- **Materials and Quantity Summary List** - All items of each net system.
- **Plan and Elevation Views** - The net system alignment and offsets to construction centerline, locations of support posts and footings, all end, lateral, top and bottom support ropes, anchor ropes and braking elements, net height, and section lengths.

- **Typical Sections** - Net system footings, footing-to-post connections, net connections, anchor type, retaining rope and braking element connections, and anchor locations.

- **Structural and Geometric Details** - The following minimum structural and geometric details:

    - Footing and leveling pad details
    - Rock and soil footing details
    - Anchor details
    - End, lateral, and intermediate support rope details
    - Support column details, including column plate details, breakaway connections and cable guide assemblies

(b) Field Construction Manual - Provide a field construction manual, prepared by the manufacturer of the proprietary rockfall net system, including step-by-step directions for constructing the rockfall net system.

00398.04 Rock Reinforcing Bolts and Rock Reinforcing Dowels Submittals - Submit a detailed work plan to the Engineer 10 calendar days prior to the preconstruction conference. Include the following:

- Construction schedule and sequence.
- Drilling methods and equipment.
- Components for rock reinforcing bolts and rock reinforcing dowels, couplers, bearing plates, rock reinforcing bolt mechanical anchorage system (if used), flat washers, and beveled washer specifications including the manufacturer’s data sheets.
- Drill hole diameter.
- Grout mix or polyester resin from the QPL or approved equal, including manufacturer's data sheets. Include the procedures for placing the grout and resin.
- Corrosion protection, either galvanizing or epoxy coating, for the rock reinforcing bolts and rock reinforcing dowels.
- Installation, stressing procedures, torque wrench, test jack, and pressure gauge to be used.
- Calibration data for each torque wrench, test jack, and pressure gauge to be used. An independent testing laboratory shall have performed the calibration tests within 60 calendar days of the date submitted. The torque wrenches shall have a capacity at least 20% greater than the rock reinforcing bolt manufacturer's recommended torque to achieve the design and test loads. The torque wrench shall have an accuracy of at least ± 2% of the full-scale reading, and a resolution of at least 1% of the full-scale reading.

The Engineer will respond within 21 calendar days after receipt of the work plan. Do not proceed with the work until the Engineer has approved the work plan in writing.

Materials

00398.10 Anchors:

(a) Steel Anchor Bolts - Furnish 1 inch diameter continuously threaded or deformed, Grade 75 steel anchor bolts, complete with keyhole plate, grout tube, washer and nut, meeting the requirements of AASHTO M 31 (ASTM A 615). Provide anchor bolts made of one continuous bar. Welding and couplers will not be allowed. Galvanize all steel anchor bolts according to AASHTO M 232 (ASTM A 153). Provide grout tubes, grout sealers, and other grouting accessories for grouting anchor bolts of type recommended by the manufacturer and as approved.

(b) Steel Plates, Washers, and Nuts - Furnish steel plates, washers, and nuts for steel anchor bolts meeting the requirements of ASTM F 432. Provide 3/8 inch flat steel plates that provide not less than 6 inch by 6 inch area for each bolt. Provide steel or malleable iron beveled washers and hardened steel machine washers. Provide heavy-hexagonal type nuts. Galvanize all plates, washers, and nuts according to AASHTO M 232 (ASTM A 153), Class C, except castings shall be Class A and forgings shall be Class B.

(c) Wire Rope Anchors - Furnish cable for wire rope anchors meeting the current requirements of Federal Specification RR-W-410 and ASTM A 1023. Provide general purpose, 3/4 inch diameter, 6 x 19 IWRC, galvanized wire rope, with the wire rope core made from extra improved plow steel. Minimum breaking force shall be 58,800 pounds. Attach ferrules to the cable to prevent pullout of the cable from the encapsulating concrete during testing as described in 00398.42(e). Galvanize all ferrules and thimbles according to AASHTO M 232 (ASTM A 153).

(d) Concrete - Furnish concrete for anchors, support posts, and brace footings meeting the requirements of Section 00440 except the minimum strength shall be 4,000 psi.

(e) Cement Grout - Furnish non-epoxy cement grout for anchors in rock from section 02080.20 of the QPL, or an approved equal. Follow the manufacturer's recommendations for water-cement ratio, mixing and set times.

(f) Polyester Resin - Furnish high strength (HS) or low strength (LS) polyester resin for post anchors in rock from section 00535 of the QPL, or an approved equal.

00398.11 Posts, Braces, and Appurtenances - Furnish 4 inch outside diameter, Schedule 40, hot-dip galvanized post and braces made from steel pipe according to ASTM A 53, Grade B. Furnish 4.5 inch O.D. pipe size (to accommodate post), Schedule 40, hot-dip galvanized post sleeves made from steel pipe according to ASTM A 53, Grade B. Furnish post caps, strap clamps, bolts, and nuts that are hot-dip galvanized according to AASHTO M 232 (ASTM A 153). Repair all cutting, welding, and drilling as well as other damage to the galvanizing according to 02420.10(d).

00398.12 Top Horizontal Support Rope and Support Post Retaining Rope - Furnish top horizontal support rope and support post retaining rope of the sizes shown and meeting the current requirements of Federal Specification RR-W-410 and ASTM A 1023. Provide Type 1, general purpose, Class 2, 6 x 19 IWRC, galvanized wire rope, with the wire rope core made from extra improved plow steel.

00398.13 Hardware - Furnish all rings and eyes of drop-forged steel that has been heat treated after forging. Furnish wire rope thimbles and clips that are sized for the wire rope shown. Galvanize all rings, eyes, thimbles, wire rope clips, U-bolts and miscellaneous hardware according to AASHTO M 232 (ASTM A 153), Class C, except castings shall be Class A and forgings shall be Class B.

00398.14 Wire Mesh Materials:

(a) Gabion Wire Mesh Fabric - Furnish gabion wire mesh fabric meeting the requirements of ASTM A 975, Style 1, 8 by 10 mesh type with Class 3 coating, soft temper.

(b) PVC Coated Gabion Wire Mesh Fabric - Furnish PVC coated gabion wire mesh fabric meeting the requirements of ASTM A 975, Style 3, 8 by 10 mesh type with Class 3 coating, soft temper. The color of the PVC coating shall be approved by the Engineer.

(c) Gabion Wire High Tensile Steel Fasteners and Lacing Wire - Furnish 11 gauge high tensile steel fasteners meeting the requirements of ASTM A 975 and ASTM A 764. Provide Class 3 zinc coating according to ASTM A 641. Install the fasteners as shown and as recommended by the manufacturer. Provide minimum panel to panel connection strengths meeting the requirements of ASTM A 975.

If stainless steel fasteners are required for corrosive environmental conditions, provide them according to ASTM A 313, Type 302.

Provide lacing wire with the same coating material as the gabion wire mesh fabric furnished on the order and conforming to ASTM A 641 and ASTM A 975. If PVC coating is required, provide the same color as the gabion wire mesh fabric.

00398.15 Rock Reinforcing Bolts and Rock Reinforcing Dowels - Furnish rock reinforcing bolts, rock reinforcing dowels, and all hardware that is galvanized or epoxy coated prior to installation. Cement grout or polyester resin will not be a allowed as a substitute for the required protective coatings.

(a) Rock Reinforcing Bolts - Provide rock reinforcing bolts, including mechanical anchorage system, plates, washers, and nuts from section 00398 of the QPL or an approved equal. If mechanical anchorage is not selected, use a rock reinforcing bolt system from a manufacturer regularly engaged in the manufacturer of rock reinforcing bolts.

Provide grout tubes, grout sealers, and other grouting accessories for grouting rock reinforcing bolts of types recommended by the manufacturer and as approved.

(b) Rock Reinforcing Dowels - Provide rock reinforcing dowels, plates, washers, and nuts from a manufacturer regularly engaged in the manufacturer of rock reinforcing dowels. Provide grout or polyester resin meeting the requirements of this Section.

If polyester resin is selected, use a proven non-shrink polyester resin for rock reinforcing dowels capable of permanently developing the bond and internal strength between the rock reinforcing dowel and rock. Use a single speed cartridge system to anchor the dowel in rock. Select the cartridge diameter as recommended by the manufacturer to ensure complete encapsulation of the rock reinforcing dowel and satisfactory in-hole mixing. Select a polyester resin with a gel time which is consistent with rapid installation. Polyester resin to be incorporated into the rock reinforcing dowel installation shall be within the shelf-life period stated by the manufacturer. Provide samples of the polyester resins for testing upon request of the Engineer. Store polyester resins according to the manufacturer's recommendations.

00398.16 Rockfall Net Systems - For proprietary rockfall net systems, provide products from the selected company according to the company’s specifications and these applicable material Specifications. If there is a conflict between the company’s specifications and the Agency's Specifications, the Agency's Specifications will take precedence. Obtain all materials for the selected proprietary rockfall net system from the same company. Use only one proprietary rockfall net system on the Project unless different proprietary rockfall net systems are specified.

Equipment

00398.20 Anchor, Bolt, and Dowel Equipment - Provide all equipment necessary to establish the steel bolt anchors, wire rope anchors, rock reinforcing bolts, and rock reinforcing dowels in the holes at the locations and depths shown and by the Engineer, and to tighten nuts, eyes and other hardware to the required tension according to the instructions of the manufacturer subject to the approval of the Engineer.

Provide and maintain in good working condition the necessary torque wrenches and related equipment for the installation of steel bolt and wire rope anchors, rock reinforcing bolts, and rock reinforcing dowels.

Labor

00398.30 Measurement Assistance - Furnish labor, at no additional cost to the Agency, to assist with the measurement of actual quantities of wire mesh slope protection, post-supported wire mesh slope protection, and shotcrete slope stabilization placed on the slopes.

00398.32 Rock Reinforcing Bolts and Rock Reinforcing Dowels Personnel Qualification - Furnish personnel skilled in the installation of rock reinforcing bolts and rock reinforcing dowels. Experience shall be relevant to anticipated rock conditions and size of rock reinforcing bolts and rock reinforcing dowels being installed. The on-site supervisor and drill operator shall have no less than two years of demonstrated experience in rock reinforcing bolt and rock reinforcing dowel installation. Submit experience documentation to the Engineer 10 calendar days prior to the preconstruction conference. Include current reference names and phone numbers, project names, locations, and the year of actual construction.

The Engineer will respond within 21 calendar days after receipt of the submittal. If, after checking references submitted by the Contractor, it is in the judgment of the Engineer that the proposed employees are not qualified; they will not be allowed to work on the Project. Do not proceed with the work until the Engineer has approved the submittal in writing.

Construction

00398.40 Lines, Grades, and Preparation Work - Clear, grub, and prepare the area of slope protection. Remove all shrubs, brush, snags, downed timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with construction. If directed, preserve trees and geographic features at the top of the wire mesh and cable mesh by varying the post and anchor locations to miss them.

Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil or rock. Do not disturb the original ground at the sides and bottom of the excavation.

Dispose of materials, including excess excavation, according to 00290.20.

00398.41 Rock Slope Protection - Construct the kinds and types of rock slope protection at the locations shown or directed. Verify existing ground elevations, anchor locations, footing locations, elevations, and alignments prior to construction. The Contractor may encounter a variety of foundation conditions during construction of the rock slope protection items. Be prepared to install rock slope protection items in all types of materials including soil, mixed rock and soil, and solid rock.

00398.42 Support Posts, Sleeves, Braces, and Footings - Space support posts equidistant at intervals not exceeding those shown. Measure the interval parallel to the grade of the post line and in the line of the posts from center to center of the posts. Set the end support posts at the beginning and end of each continuous length and at abrupt changes in vertical and horizontal alignments. Place all support posts in a vertical position, plumb and in line unless otherwise directed.

Securely fasten diagonal braces to the end support posts or intermediate support posts as shown. Excavate and place concrete as shown for the brace footing.

Dimension, place, backfill, and strike off support post sleeves according to 00398.45.

00398.43 Centralizers - Install centralizers that adequately support the bolt or cable in the center of the hole and place within 1 foot of each end of the anchor according to the following:

(a) Wire Mesh Slope Protection - Use centralizers in all anchor holes.

(b) Post-Supported Wire Mesh Slope Protection - Use centralizers in all end anchor holes.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Use centralizers in all end anchor holes.

00398.44 Anchors in Solid Rock - Where solid rock is encountered without an overburden of soil, install steel anchor bolts and wire rope anchors according to the following:

(a) Wire Mesh Slope Protection - 6 feet into the solid rock or as shown for all anchors.

(b) Post-Supported Wire Mesh Slope Protection - 3 feet into solid rock or as shown for post anchors. 6 feet into solid rock or as shown for end anchors and support post retaining rope anchors.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - 6 feet into solid rock or as shown for all anchors.

Place grout according to the manufacturer's recommendations and as directed.

00398.45 Anchors in Soil and Mixed Soil and Rock - Where an overburden of soil, loose rock, or surfacing materials covers solid rock, install the anchors according to the following:

(a) Wire Mesh Slope Protection - 6 feet for all anchors. If solid rock is encountered before this depth is reached, install anchors in the solid rock according to 00398.44(a) unless otherwise directed.

(b) Post-Supported Wire Mesh Slope Protection - 3 feet for post anchors. 6 feet for end anchors and support post retaining rope anchors. If solid rock is encountered before these depths are reached install anchors in the solid rock according to 00398.44(b) unless otherwise directed.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - 6 feet for all anchors. If solid rock is encountered before these depths are reached install anchors in the solid rock according to 00398.44(c) unless otherwise directed.

Place grout according to the manufacturer's recommendations and as directed.

Dimensions of footings shall not be less than shown and shall fill the excavated areas. Moisten the sides of the excavation to a depth of 2 inches and remove all loose soil and rock in the hole prior to placement of concrete. If the hole is overexcavated fill the entire cavity with concrete. Place the concrete with contact against firm soil at the sides and bottom and tamp around the steel anchor bolts, wire rope anchors, or post sleeves while the steel anchor bolts, wire rope anchors, or post sleeves are held firmly in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water.

Allow concrete to cure for at least five calendar days before the support ropes and retaining ropes are attached and subjected to strain.

00398.46 Anchor Testing - Anchors shall have a minimum pullout capacity of 20,000 pounds per foot. Field verify pullout capacity by testing not less than 25% of the total number of anchors installed. The Engineer will determine which anchors will be tested. Replace failed anchors at no additional cost to the Agency.

Perform testing against a temporary yoke or load frame. Do not allow any part of the yoke or load frame to bear within 3 feet of the anchor. Determine applied test loads with either a calibrated pressure gauge or a load cell. Use pressure gauges or load cells commonly used in the testing of rock bolts and anchors.

A pullout test consists of loading the anchor assembly to the minimum pullout capacity. The anchor is acceptable if it sustains this load for 10 minutes with no loss of load.

00398.47 Gabion Wire Mesh Installation - Install gabion wire mesh so that the bottom of the fabric rests on the slope as shown and according to the following:

(a) Wire Mesh Slope Protection - Place gabion wire mesh with the fabric curl toward the slope. Loop the fabric over the top horizontal support rope and attach to itself with high tensile steel fasteners or lacing wire as shown. Do not tension the fabric in any direction. It is to remain loose to increase its dampening effect on rolling rocks.

Lap the gabion wire mesh fabric as shown. If horizontal laps are needed, overlap the lower fabric so it is on top and away from the slope to avoid the possibility of falling material hanging up. Locate the bottom of the fabric so material dislodged under the fabric can drain freely from the bottom, yet will not flow or bounce onto the roadway. Secure the ends of all lacing wires to the fabric with a minimum of 1.5 turns.

(b) Post-Supported Wire Mesh Slope Protection - Place gabion wire mesh for post supported wire mesh slope protection according to 00398.44(a). In addition, adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Attach the gabion wire mesh to the support posts and top horizontal support rope as shown. Lap the gabion wire mesh fabric as shown. Do not tension the fabric in any direction. Adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

00398.48 Top Horizontal Support Rope and Support Post Retaining Rope Attachment - For post-supported wire mesh slope protection and post-supported rock protection screen behind barrier/guardrail, install top horizontal support ropes on the posts as shown. Ensure that the top horizontal support rope will move freely in the U-bolt hangers. Use one continuous length of cable for each complete section of screen. Attach the top horizontal support rope to the end anchors as shown. Tension the rope so that when the gabion wire mesh fabric is in place, it will be fully supported. Take up additional tension with turnbuckles. Ensure that a minimum of 4 inches of take-up remains in the turnbuckle when full tension has been applied.

In addition, for post supported wire mesh protection, install the post retaining ropes to the anchors and support posts as shown. Tension the ropes with the turnbuckles so that the cable is taut but does not bend the support post toward the slope when the gabion wire mesh fabric is installed. Ensure that a minimum of 2 inches of take-up remains in the turnbuckle when full tension has been applied.

00398.49 Barrier Mounted Rock Protection Screen - Install concrete barrier according to Section 00820 and as shown. Attach protective screen to the concrete barrier as shown.

00398.50 Rock Reinforcing Bolts and Rock Reinforcing Dowels - Protect rock reinforcing bolts and rock reinforcing dowels at all times from damage and corrosion. Corrosion, pitting or damage to the rock reinforcing bolt may be cause for rejection. Damage includes, but is not limited to, abrasions, cuts, nicks, welds, and weld splatter. Prior to installation, remove all mill scale, flaking rust, and grease.

Drill holes to the diameter and depth recommended by the manufacturer. Unless otherwise directed, align drill holes normal to the rock face or as specified. Clean the drill holes of all drill cuttings and debris prior to installing the rock reinforcing bolts and rock reinforcing dowels and install and proof test as follows:

(a) Rock Reinforcing Bolts:

(1) Installing Bolts - Install and tension each rock reinforcing bolt to the design load before grouting. Conduct proof testing of each bolt as described below. Place grout in the drill hole to ensure the filling of the entire space between the bolt and sides of the drill hole, and the full encapsulation of the bolt. If necessary, control leakage of grout into rock seams using accepted methods and as directed. Pump the grout to the far end of the drill hole and continue pumping until grout is forced out of the de-airing tube at the face of the hole. After testing and grouting, cut the bolt off, if necessary, so that no more than 3 inches extends beyond the nut.

(2) Proof Testing Bolts - Tension each production rock reinforcing bolt installed to 120% of the design load using a calibrated hollow ram hydraulic jack. Hold that tension for a minimum of 10 minutes. The Engineer will analyze the rock reinforcing bolt test results and determine whether the rock reinforcing bolt is acceptable. If no loss of load occurs in this time period, the rock reinforcing bolt is accepted. If a rock reinforcing bolt fails this test, the rock reinforcing bolt will be rejected and a replacement bolt installed in a separate hole adjacent to the failed bolt. Test the new rock reinforcing bolt. The Engineer may require additional proof testing if any rock reinforcing bolts fail. No additional payment will be made for failed rock reinforcing bolts or for additional proof testing.

After tensioning and testing, lock off at 100% of the design load and grout the bolt. Carry out grouting within three days of tensioning the rock bolt to provide corrosion protection and lock the tension stress permanently into the system.

(b) Rock Reinforcing Dowels:

(1) Installing Dowels - Place the grout mix or resin cartridges in the drill hole according to the manufacturer's recommendations. Ensure that resin cartridges are placed at a sufficient spacing to cause excess resin to be forced out the face of the hole when the rock reinforcing dowel is spun into place. Failure of resin to be extruded from the face of the hole may be cause for rejection of the bolt installation. After installation of the plate and nut, torque the nut to a nominal 100 foot-pounds to ensure proper seating against the rock surface. Conduct proof testing of rock reinforcing dowels as described below. After testing, cut the bolt off, if necessary, so that no more than 3 inches extends beyond the nut.

(2) Proof Testing Dowels - Proof test at least 10%, but not less than three each, of installed rock reinforcing dowels. The proof test shall be conducted by the Contractor and the Engineer will interpret the results. Tension the rock reinforcing dowel to 10 kips with a calibrated hollow ram hydraulic jack. Hold the load for 10 minutes with no loss of load. A rock reinforcing dowel will be considered to have failed if any movement of the dowel occurs. The Engineer may require additional proof testing beyond the 10% if any rock reinforcing dowels fail. Replace failed rock reinforcing dowels with a separate rock reinforcing dowel installed in a separate hole. No additional payment will be made for failed rock reinforcing dowels or for additional proof testing.

00398.51 Rockfall Net Systems - Provide for a field representative from the selected proprietary rockfall net system to be present at the start of the rockfall net system construction. Supervisory personnel of the Contractor, the company field representative, and any subcontractors who are involved in the construction of the rockfall net system shall meet with the Engineer for a rockfall net system preconstruction conference. At this conference, discuss methods of accomplishing all phases of the work required to construct the rockfall net system. If all representatives are not in attendance the rockfall net system preconstruction conference and start of net construction will be rescheduled.

In addition to the rockfall net system preconstruction conference, the company field representative shall be available as needed during the construction of the rockfall net system to provide instructions and

recommendations, and to assist the Contractor or Engineer. Follow instructions and recommendations of the representative if approved by the Engineer.

Measurement

00398.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Wire Mesh Slope Protection - Wire mesh slope protection will be measured on the area basis, along the surface area of wire mesh fabric on the slope.

(b) Post-Supported Wire Mesh Slope Protection - Post-supported wire mesh slope protection will be measured on the area basis, along the surface of the wire mesh from center to center of end posts.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Post-supported rock protection screen behind concrete barrier and guardrail will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.

(d) Barrier Mounted Rock Protection Screen - Barrier mounted rock protection screen will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.

(e) Rock Reinforcing Bolts and Rock Reinforcing Dowels - Rock reinforcing bolts and rock reinforcing dowels will be measured on the length basis, along the entire length of each rock reinforcing bolt and rock reinforcing dowel (embedded and protruding).

(f) Rockfall Net Systems - Rockfall net systems will be measured on the length basis, from center to center of end posts along the line and grade of each separate run.

Payment

00398.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Wire Mesh Slope Protection	Square Foot
(b)	Post-Supported Wire Mesh Slope Protection	Square Foot
(c)	Rock Protection Screen Behind Concrete Barrier and Guardrail	Foot
(d)	Barrier Mounted Rock Protection Screen	Foot
(e)	Rock Reinforcing Bolt	Foot
(f)	Rock Reinforcing Dowel	Foot
(g)	Rockfall Net System	Foot

Item (d) includes the concrete barrier.

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

No separate or additional payment will be made for rock and soil anchors, wire rope, rail, concrete, grout, polyester resin, steel posts, and hardware.

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 sewer pipe of nominal inside diameters not exceeding 72 inches. Perform excavation for major structures and conduits with a nominal inside diameter or width greater than 72 inches according to Section 00510.

Trench excavation does not include earthwork covered under any other section, or any earthwork that may be specifically included and provided 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, without drilling, blasting or splitting, of masses of rock having one or more dimensions of 3 feet or greater.

Common Excavation - The removal of all material not classified as rock excavation.

Flexible Pipe - For the purpose of these Specifications, potable water pipes and pipes constructed of corrugated metal, PVC, and polyethylene are considered flexible pipes.

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 top of the bedding to a point 8 inches, minimum, above the top outside of the pipe barrel for the full width of the trench.

Rigid Pipe - For the purpose of these Specifications, pipes constructed of concrete and ductile iron are considered rigid pipes.

Rock Excavation - Excavation of solid ledge rock that, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring or breaking up with power-operated tools.

The term "Rock Excavation" indicates a method of removal and not a geological formation.

Surface Removal - The removal of surface material such as topsoil, sod, pavement, sidewalks, or gravel, that requires different equipment or methods than those used for trench excavation.

Trench Backfill - Furnishing, placing, and compacting material other than Controlled Low-Strength Material (CLSM) 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 either common 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.

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 allowed only when necessary to ensure firm foundations and when such variations will not be detrimental to the work.

Materials

00405.10 General - Materials may be native or imported, as specified.

00405.11 Trench Foundation - Where additional excavation is required due to groundwater or other unstable conditions so that the native material cannot support the pipe, furnish one of the following materials for trench foundation:

- Selected general backfill conforming to 00330.13.
- Selected granular backfill conforming to 00330.14.
- Selected stone backfill conforming to 00330.15.
- Other approved material.

00405.12 Bedding - If groundwater is present in the bedding zone, use 3/4" - 0 aggregate bedding. If groundwater is not present, and unless otherwise specified, furnish one of the following materials for bedding the pipe:

- 3/8" - 0 PCC fine aggregate conforming to 02690.30(h).
- Commercially available 3/4" - 0 aggregate.
- No. 10 - 0 sand drainage blanket material conforming to 00360.10.
- Reasonably well graded, from maximum size to dust, sand with 100% passing the 3/8 inch sieve.
- Commercially available 3/8" - 0 or No. 10 - 0 sand.
- A continuous cradle of concrete conforming to Section 00440. Acceptance of the concrete will be by visual inspection.

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, furnish either:

- 1" - 0 or 3/4" - 0 base aggregate conforming to 02630.10, or
- Commercially available 1" - 0 or 3/4" - 0 aggregate.

00405.14 Trench Backfill - Furnish the following materials where shown or required:

(a) Class A Backfill - Use native or common material that, in the opinion of the Engineer, meets the characteristics required for the specific surface loading or other criteria of the backfill zone.

(b) Class B Backfill - Use granular material consisting of gravel or crushed rock meeting the requirements of Section 00641. Designated size shall be 1" - 0 or 3/4" - 0.

(c) Class C Backfill - Use clean sand with no particle size larger than 1/4 inch.

(d) Class D Backfill - Use pit run or bar run material, well graded from coarse to fine. The maximum dimension shall be 3 inches.

(e) Class E Backfill - Use Controlled Low-Strength Material (CLSM) conforming to Section 00442.

00405.15 Quality Control - Provide quality control according to Section 00165.

Labor

00405.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CAgT
- CDT

Construction

00405.40 General - 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 excavations in, or adjacent to, natural stream beds. Comply with 00290.30(a). Restore the streambed according to 00405.46(f).

(c) Partial Embankment Construction for Exposed Pipe - Construct partial embankment according to 00330.42(c-6) and the plans, before excavating trenches.

(d) Temporary Handling of Water - 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.

(b) Open Trench Limit - Limit the length of open trench to 100 feet, or as allowed. Related resurfacing shall be completed within 800 feet of the open trench limit.

(c) Trench Width - Keep the trench width at the ground surface to the minimum necessary to install the pipe in a safe manner, but not less than 24 inches. 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 Standard Drawings for minimum trench widths for various diameter pipes. 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. Keep the top of the trench within right-of-way or permit limits.

(d) Trench Grade - Excavate trenches to the lines and grades shown or as established, with proper allowance for pipe thickness, pipe bedding and 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 at no additional cost to the Agency. Place the material over the full width of the trench, in compacted layers not exceeding 6 inches.

(e) Disposal of Excess Material - Place excavated material at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, or interfere with the function of existing drainage facilities.

Make arrangements for and dispose of all excess material not required elsewhere on the Project in an approved manner, at no additional cost to the Agency, and according to 00330.41(a-4).

(f) Trench Protection - Provide the materials, labor and equipment necessary to protect trenches at all times. Provide safe working conditions in the trench and protect the work, existing property, utilities, pavement, and the public. The method of protection shall be according to the Contractor's design. The Contractor may elect to use any combination of shoring, overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the work, provided the method meets with the approval of the Engineer and complies with all applicable local, state, and federal safety codes.

Be responsible for damages resulting from improper removal of shoring or from failure to shore.

(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 on the Standard Drawings. Excavate and remove the overburden and expose the rock to allow the Engineer to measure the rock prior to removal.

If using explosives, comply with the requirements of 00170.94. Prior to blasting, obtain the approval of the Engineer and the appropriate permits. Provide all tools and devices required for loading and using explosives, blasting caps and accessories. When blasting rock in trenches, cover the area to be shot with blasting mats or other protective material to prevent the scattering of rock fragments outside of the excavation.

00405.43 Dewatering - Promptly remove and dispose of all water entering the trench during the time the trench is being prepared for the pipe laying, during the laying of the pipe 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.

00405.44 Trench Foundation - 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 material conforming to 00405.11. Place the trench foundation material in 6 inch layers and compact according to 00330.43 except compact selected stone backfill material in 12 inch layers. Bring the trench foundation 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.

00405.46 Backfilling - Backfill with material conforming to 00405.13 and 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.

Test for density according to 00330.43.

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 Section 00330.

(b) Pipe Zone - Place the materials 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. Before placing backfill material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4% to plus 2% of optimum moisture content.

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 allowed within the pipe zone.

(c) Trench Backfill - The following requirements apply in the trench backfill area and in the pipe zone, except where in conflict with the requirements of 00405.46(b):

(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 Agency.

(2) Class A, B, C, or D Backfill - Backfill the trench above the pipe zone in successive lifts. Do not allow the backfill to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. Modify the method of compaction as necessary to protect the pipe.

Compact the top 3 feet of trench backfill material within the roadway and shoulders, and within a 2V:1H slope line projected from each subgrade shoulder, to not less than 95% of maximum density. Compact all other trench backfill material to not less than 90% of maximum density.

Determine the maximum density by AASHTO T 99. If the specified compaction is not obtained, the Contractor may be required to use a modified compaction procedure or reduce the thickness of lifts. If approved materials meeting the Specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density or direct that alternate materials be used. Do not proceed with excavation and pipe laying operations until the backfill can be compacted to the satisfaction of the Engineer.

If the material is not density testable, the Engineer will observe each layer for deflection or reaction under the compaction equipment to verify that no soft or pumping areas remain. Compact until there is no perceptible deflection under the compaction equipment.

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 crushed aggregate material, or asphalt concrete if directed, until final pavement replacement is complete and accepted.

(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.

(d) Ponding or Jetting of Backfill Materials - Ponding or jetting will not be allowed within roadbed lateral limits. Ponding or jetting will be allowed outside roadbeds when approved by the Engineer in writing.

Use Class C or D trench backfill material at no additional cost to the Agency. Provide drainage at the bottom of the trench to remove water from the jetting operation. Compact to the density and deflection requirements of 00405.46(c).

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.

(e) Temporary Trench Plating - When temporary steel plates are installed over a street cut, they shall be capable of carrying at least an MS-18 loading. Place steel plates with a minimum of 12 inches bearing on all sides of a cut. Anchor steel plates to minimize shifting. Shim the edges of all steel plates with cold mix asphalt.

(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.

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 additional cost to the Agency.

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, and Sidewalk - Use saws to cut portland cement concrete pavement, curbs 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. When roadways will receive a pavement overlay as part of the Project or following trench resurfacing, bituminous pavement to be removed may be cut by wheel cutter, jack hammer, or other approved methods.

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.

Where the width changes in areas of asphalt pavement re-surfacing, cut the transition between the different widths at 45 degrees. 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 degrees, 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 pipe line 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.

Measurement

00405.80 Measurement - Except for rock excavation, boulder excavation, and trench foundation, no measurement of quantities will be made for work performed under this Section.

Imported topsoil will be measured according to 01040.80.

00405.81 Rock Excavation and Boulder Excavation - The quantities of rock excavation and boulder excavation will be measured as follows:

(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:

- **Length** - Length will be the horizontal distance measured along the centerline of the trench excluding manholes, inlets, and other structures.

- **Width** - Width will be the width of the rock removed but will not be greater than the outside diameter of the pipe bell plus 12 inches.

- **Depth** - Depth will be measured at 30 foot intervals, or as specified, along the centerline of the trench. The depth will not be greater than 6 inches below the outside bell of the pipe.

Rock excavation for manholes, inlets, and other structures will be computed from the rock excavated to a depth 6 inches below the bottom of the structure and an area within a line parallel with, and 12 inches outside of, the actual dimensions of the manhole, inlet, or structure.

No separate measurement will be made for the following:

- 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) Boulder Excavation - Boulder excavation will be measured on the volume basis. Measurement will be made in the field by the Engineer after removal of each boulder from the excavation but prior to removal from the site. Each boulder removed will be measured for length, width, and height. The volume of each boulder will be determined as the product of 85% of each of the three measured dimensions.

00405.82 Trench Foundation - The quantities of unsuitable trench foundation will be measured on either the weight basis or the volume basis as follows:

- **Weight Basis** - Trench foundation will be measured on the weight basis. The quantity of replacement foundation material will be based on weigh tickets from scales meeting the requirements of Section 00190. Present weigh tickets to the Engineer for signature on the day the material is delivered.

- **Volume Basis** - Trench foundation will be measured on the volume basis, computed using the following dimensions:

  - **Length** - Length will be the horizontal distance measured along the centerline of the trench. Measurement will be continuous through manhole or structure locations.

  - **Width** - Width will be the nominal inside diameter of the pipe plus two times dimension "B" from "Table A" shown on the standard drawings.

  - **Depth** - Depth will be the vertical distance from the top of the underlying surface (following excavation of unsuitable material) to the bottom of the pipe bedding. The depth will be measured at intervals of 30 feet, or as specified, along the centerline of the trench and the average depth between points will be used for the volume computation.

Payment

00405.90 Payment - The accepted quantities of rock excavation, boulder excavation, and trench foundation will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Rock Excavation	Cubic Yard
(b)	Boulder Excavation	Cubic Yard
(c)	Trench Foundation	Ton or Cubic Yard

Item (c) includes removal of unsuitable material and replacement as necessary to provide a stable foundation for the pipe.

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.

Imported topsoil will be paid for according to 01040.90.

No separate or additional payment will be made for:

- trench excavation
- trench backfill
- saw cutting
- trench protection
- pipe bedding
- pipe zone material
- dewatering

Section 00406 - Tunneling, Boring, and Jacking

Description

00406.00 Scope - This work consists of installing conduits, pipes, casings, linings, and sleeves by tunneling, boring, and jacking without excavating the overlying surface.

00406.01 Descriptive Terms:

Tunneling - Tunneling includes all methods by which an underground passageway is excavated and lining materials are brought in and placed.

Boring - Boring includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place and in which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation equipment.

Jacking - Jacking includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

Materials

00406.10 Pipe Bedding and Pipe Zone Material - Furnish pipe bedding and pipe zone material meeting the requirements of Section 00405.

00406.11 Pipe - Furnish pipe materials meeting the strength, class, and type specified or shown.

00406.12 Casing - Furnish casing of a size to permit proper construction to the required lines and grades. Furnish casings that are made of smooth steel pipe or concrete pipe suitable for the purpose intended. Optionally, the casing may be constructed of galvanized, standard-offset, tunnel liner plate with gauge and section modulus as approved.

The class of casing specified is based on the superimposed loads and not on the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor.

When pressure grouting is specified, equip jacked casings 36 inch diameter and larger with nipples installed at the springline and the crown, at 10 foot centers.

00406.13 Grout - Furnish grout for filling the annular space between the carrier pipe and the casing pipe of one part portland cement, five parts sand, and seven parts 3/8 inch maximum size rounded aggregate by volume, or as approved.

Furnish grout for pressure grouting outside jacked carrier or casing pipe of one part portland cement and three parts sand by volume, or as approved.

00406.14 Sand - Furnish sand for filling the annular space between the carrier pipe and the casing pipe of clean, sharp, and well graded so that 100% passes the No. 8 sieve, and between 10% and 35% passes the No. 50 sieve, or as approved.

Construction

00406.40 Excavation - Excavation for work under this Section is unclassified and includes whatever materials are encountered to the depths shown or required.

00406.41 Required Submittals - Before beginning the work, submit the following to the Engineer according to 00150.35:

(a) Tunneling - Submit the following stamped working drawings:

- Tunnel shaft bracing design and dimensions
- Tunnel support details
- Method of backpacking tunnel supports
- Design of bracing to prevent lining from shifting or flotation
- Backfill material or pressure concrete mix design, placement method and equipment
- Poling plate dimensions and details, when required

(b) Boring and Jacking - Submit the following unstamped working drawings:

- Jacking pit construction
- Casing or conduit
- Jacking head
- Excavation method
- Tee or wye installation
- A substitute design for any part of the system that is changed as a result of the jacking or boring operation
- Bracing to prevent pipe shift and flotation, if placed in a casing, and the materials, method and equipment for backfilling
- Backfill material or pressure grout mix, placement method and equipment

Submit for review the following stamped working drawings:

- Jacking pit bracing
- Any structure that is required because of the particular method or procedure used by the Contractor

00406.42 Tunneling - Construct the pipe on a firm subgrade, thoroughly compacted and true to grade. If the material in the bottom of the tunnel is ledge rock, extend excavation of the tunnel to a depth below the bottom of the pipe, and provide a bedding of crushed aggregate or concrete as specified in Section 00405. Restore to grade any excavation made below grade without approval by backfilling with approved bedding material, at no additional cost to the Agency.

00406.43 Boring and Jacking - Boring or jacking may be allowed in lieu of the open trench method or tunneling with approval of the Engineer. Jack or bore all conduit, casings, pipe or sleeves to the required line and grade.

Equip the leading section of pipe or casing with a jacking head. Perform all excavation entirely within the jacking head.

Should loss of surrounding material occur during the jacking or boring operation, backpack or grout the voids before the completion of the shift. Fill or backpack all voids with grout or granular material as approved.

00406.44 Concrete Pipe - Protect the driving ends of concrete pipe against spalling and other damage. Protect intermediate joints by the installation of sufficient bearing shims to properly distribute the bearing stresses. Remove all sections of conduit showing signs of failure and replace with new sections, or with approved cast-in-place sections, which are adequate to carry the loads imposed on them.

00406.45 Smooth Steel Casing - Join sections of smooth steel casing to be jacked or bored by welding the joints with a continuous weld for the full circumference, or by other approved means. Provide joints capable of resisting the jacking or boring forces.

Brace pipe installed in casing to prevent shifting or flotation. Fill the void between the casing and the pipe with grout or other material, as specified or approved.

00406.46 Grouting Voids Outside Casing - On pipes 36 inch or larger, fill completely the void space between the tunnel and the casing or liner plate with approved grout. After the casing or carrier pipe has been jacked or tunneled into position, fill with grout under pressure, through the grout holes provided, to fill all voids outside the pipe using the following sequence:

- Grout at the springline hole at one end and pump the grout until it appears in the grout hole at the crown.
- Grout through the opposite springline hole until the grout appears at the hole in the crown.
- Grout through the hole at the crown until the 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.
- Repeat the sequence until the full length of the pipe has been grouted.

Provide a continuous color video recording of the grout placement, to provide documentation that grout was properly placed according to the above Specifications. On the video, identify the location of the grouting operation in relationship to the end of the casing, tunnel or liner plate.

00406.47 Cradles for Cased or Tunneled Pipe - Where cradles are shown, provide a strapped cradle under the barrel of the carrier pipe. The barrel shall bear continuously on the cradles.

00406.48 Placing Fill in Casing - Where shown, completely fill the annular space between the pipe and the casing, tunnel liner or tunnel wall with approved grout or sand to prevent pipe 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.

00406.49 Railroad Crossings - Perform all work in railroad rights-of-way according to the railroad permit.

Measurement

00406.80 Measurement - No measurement of quantities will be made for tunneling, boring, or jacking work, or for casing or conduit used to install pipe.

Where tunneling, boring, jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, measurement will be made as originally bid.

The quantities of pipe installed by tunneling, boring, or jacking will be measured according to the appropriate items under which this work is required.

Payment

00406.90 Payment - The additional effort required to install conduits, pipes, casings, linings, and sleeves by tunneling, boring, or jacking (other than under a railroad) will be paid for at the Contract lump sum amount for the item "Tunneling, Boring, and Jacking".

If tunneling, boring, 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.

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.

Tunneling, boring, or jacking under a railroad will be paid for according to 00445.91.

Pipe will be paid for according to the appropriate items under which this work is required.

Section 00410 - Pipe Lining

Description

00410.00 Scope - This work consists of rehabilitating existing pipes by furnishing and installing pipe liners by pipe bursting and lining, slip lining, and cured-in-place lining as shown.

00410.01 Definitions:

Pipe Bursting and Lining - Breaking and expanding the diameter of an existing pipe and inserting a new pipe inside the broken pipe.

Cured-In-Place Pipe (CIPP) - Inserting a resin impregnated lined tube into an existing pipe, expanding it, and curing it to form a new lined pipe.

Gravity Pipe - Pipe designed to convey fluids under conditions where the hydraulic gradient and free-water surface are coincident.

Slip Lining - Inserting a new pipe inside an existing pipe.

00410.03 Submittals - Submit the following to the Engineer for review and approval 10 calendar days prior to the preconstruction conference:

- Catalog cuts, specifications, dimensioned drawings, installation details, and sketches.
- Manhole connection and service connection details.
- A detailed written narrative of the pipe lining construction procedure and sequence.
- Bypass pumping plan. Include an emergency response plan for the sewage bypass pumping system to divert the flows in the event of a failure of the bypass pumping system. In addition, submit the plan again at least 20 calendar days prior to pipe installation.
- The pipe fusion equipment operator technician's experience and verifiable references.
- The pipe insertion equipment operator technician's experience and verifiable references.
- The pipe bursting and insertion equipment operator technician's experience and verifiable references.

Furnish a certificate of compliance for all high density polyethylene (HDPE) pipe and fittings furnished confirming that the materials supplied conform to the specified requirements. Include certified laboratory testing data confirming satisfactory results were obtained on a sample of the pipe to be provided under the Contract.

00410.04 CIPP Submittals - In addition of the submittals described in 00410.03, submit the following for CIPP 10 calendar days prior to the preconstruction conference:

- Documentation showing the installer meets the installation qualifications listed in 00410.31.
- Certification by the lining system manufacturer that the installer is fully licensed and certified as competent to perform the work.
- Proof of certification that manufacturing and installation processes operate under a quality management system which is third-party certified to ISO 9000 or other recognized organization standards.
- Manufacturer's certification of successful previous CIPP installation in the United States of proposed product of 1,000,000 feet or 4,000 manhole-to-manhole segments.

- Certification from the manufacturer that the materials meet the requirements of these specifications and intended use. Certification of test results confirming that the liner and resin meet the minimum chemical resistance requirements according to ASTM F 1216 and ASTM F 1743.
- Catalog data, and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of system components of the tube and resin system. Include manufacturer's recommendation for handling, storage, insertion, curing, trimming, finishing, and repair of damaged liner.
- A list of the key qualified personnel who are assigned to and will work on this project and Certification of worker training for installing CIPP liners.
- Flow diversion plan for the mainline including service laterals (if applicable).
- Detailed method for samplings, including recommended location and size of each sample, method of removal, and method of liner repair including a procedure to repair the cured liner when core/plate samples are taken.
- Calculations for the volume of resin to be used for each segment including the calculated amount of excess resin necessary to account for liner material properties, changes in the resin's physical and chemical characteristics due to polymerization and the structural condition of the gravity pipe.
- Detailed description of the wet out process. Include tube and resin manufactures wet out recommendations including the roller gap, material feed speed and vacuum requirements for each liner size and thickness. If wet out occurs off-site, provide certification by the person in responsible charge that the entire wet out process including handling and delivery to the site followed the defined procedures.
- Detailed narrative description and sketches to describe all proposed manhole preparation, modification, preservation, and restoration activities.
- A letter identifying the cleaning methods Contractor plans to employ to remove sediment, debris, grease, scale, encrustation, mineral deposits, and roots throughout the gravity pipe to be lined and in the structures to be repaired. The letter shall include a detailed explanation of the cleaning process and a schedule of activities, references where Contractor has used the identified cleaning method successfully in the past and a list of the actions to mitigate any impact to the public during the cleaning operation.
- A plan for the process of removing resin impregnated uncured liner from the host conduit, including protection of the host system from escaping resin.
- Independent third party test results for the gravity CIPP product for approval supporting the structural performance (short-term and long-term) of the product. Test samples shall be prepared so as to simulate installation methods and trauma of the product.
- Statement of experience of the manufacturer's representative(s) who will be on site during the work.
- Resin manufacturer installation procedures including curing and cooling temperature and time requirements and sequences.

Submit to the Engineer for review, 14 calendar days prior to fabricating the CIPP tube, a stamped design of the proposed CIPP liner according to 00150.35. Provide a design meeting the requirements of 00410.06. Detailed calculations shall confirm the liner thickness for the proposed resin system. List all assumptions, design criteria, and material characteristics whether they are based the information in the specification, plans, and Agency provided materials or not.

Submit to the Engineer property owner notification records five calendar days prior to beginning installation.

Submit a log of the actual volume of resin used prior to Second Notification.

00410.06 CIPP Design Parameters - Follow the design considerations of ASTM F 1216 and meet the following conditions and parameters:

Condition	Parameter
Service Life	Greater than 50 year
Pipe Conditions	Fully deteriorated
Load Conditions	
Soil	*
Traffic	*
Groundwater Elevation	*
Design Thickness	Calculate and express this thickness as the absolute minimum thickness that will be acceptable (Minimum thickness allowed is 1/4 inch)
Pipe Ovality	*
Modulus of Soil Reaction	*
Enhancement Factor	*
Long-term Flexural	
Strength	50% of initial (ASTM D 790)
Modulus of Elasticity	50% of initial (ASTM D 790)
Maximum Deflection	5%
Minimum Factor of Safety	2.0
Resin Migration Allowance	10% maximum
Allowable Deformity	*

* These parameters will be listed in the Special Provisions.

Design the CIPP wall thickness to withstand all imposed loads, including live loads and, if applicable, hydrostatic pressure. Include considerations for ring bending, deflection, combined loading buckling and ovality in the design of the CIPP.

Materials

00410.10 Pipe - Furnish 8 inch to 12 inch nominal size HDPE pipe meeting the requirements of ASTM D 3035 and 02410.65 and having a minimum SDR of 17. At the date of installation, the HDPE materials shall not be more than 6 months old from the date of manufacture.

00410.11 CIPP Tube - Furnish CIPP tube that consists of one or more layers of absorbent non woven felt fabric meeting the requirements of ASTM F 1216, Section 5.1, ASTM F 1743, Section 5.2.1 and the following minimum standards:

Characteristic	Test Method	Polyester Resin	Vinylester and Epoxy Resins
Flexural Strength	ASTM D 790	4,500 psi	5,000 psi
Flexural Modulus of Elasticity	ASTM D 790		
Short-term		250,000 psi	400,000 psi
Long-term		125,000 psi	200,000 psi

Fabricate the tube to a size that when installed, conforms to the internal circumference and length of the original pipe. Make allowance for circumferential or longitudinal stretching during inversion.

Provide flexible tubing exhibiting the following characteristics:

- Be homogeneous across the wall thickness containing no intermediate or encapsulated elastomeric layers.
- No part of the tube shall be less than 100 percent saturated by resin.
- Shall have a relatively uniform thickness that when compressed at the installation pressures will equal or exceed the calculated minimum design thickness.
- Shall not contain material that may cause delamination in the cured CIPP.
- Shall be coated with an impermeable, flexible material on the outside layer of the tube (before inversion).
- Seams shall be stronger than the non-seamed felt material.

00410.12 CIPP Resin - Furnish CIPP resins meeting the requirements of ASTM F 1216, Section 5.2 and ASTM F 1743, Section 5.2.3. The resin installed CIPP liner system shall produce a CIPP that will comply with the structural requirements specified and be inert with respect to the flow media in the gravity pipe.

Provide resin that is compatible with the rehabilitation process, is able to cure in the presence or absence of water, and has an initiation temperature for cure as recommended by the resin manufacturer. Provide a general purpose or enhanced strength unsaturated, thermosetting, polyester, vinylester, or epoxy resin and a catalyst system compatible with the installation process.

Use a sufficient quantity of resin for tube impregnation to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. Use a serial vacuum impregnation process. Use a roller system to uniformly distribute the resin throughout the tube.

Color the resin with a pigment compatible with the resin system, as specified by the resin manufacturer, and reviewed by the Engineer. Submit documentation from the resin manufacturer specifically describing the chemical characteristics of the resin system, including allowable mixing, impregnation, and handling time, transportation and storage time, and recommended curing cycle including temperatures, pressures, and times.

The resin manufacturer's documentation shall also include maximum allowable time for handling the impregnated tube prior to insertion and the maximum allowable elapsed time from insertion to exotherm. If remedial measures are available to extend either of the maximum allowable times indicated above, without affecting the physical properties of the resin, the resin manufacturer shall describe these measures and the time limits beyond which even these measures will not prevent alteration of the physical properties of the resin.

Equipment

00410.20 Pipe Bursting, Fusion, and Pipe Assembly Equipment - Use equipment, approved by the pipe manufacturer and the Engineer, designed for pipe bursting, slip lining, and butt fusion welding. Do not use copper or copper-alloy heating faces.

Labor

00410.30 Personnel Qualifications - Operate butt fusion equipment with technicians who have been certified by the pipe manufacturer and who have a minimum of two years experience of butt fusion welding eight inch or larger diameter pipe liners.

Operate pipe bursting and insertion equipment with technicians who have a minimum of three years experience in the installation of HDPE pipe using slip lining technology and pipe bursting lining technology as appropriate.

00410.31 CIPP Personnel - Perform CIPP installations with installers who are qualified, fully licensed, and certified by the manufacturer of the CIPP product system to be used on the Project. In addition, the installer shall have installed at least 50,000 feet of the CIPP product system.

Provide a manufacturer's representative with a minimum of two years experience with continuous in line mixing, wet out, and curing of CIPP in gravity pipes.

The manufacturer's representative shall be on-site during the initial CIPP wet out and cure. At other times when the representative is not on-site, provide the telephone number of a manufacturer's representative who is available on a 24 hour basis throughout the Project duration.

Construction

00410.40 General - Handle and store all HDPE pipe to ensure that the pipe is not cut, gouged, scored, or otherwise damaged. Store the pipe so that it is not deformed axially or circumferentially. Before installing the pipe, inspect all liner pipe to verify its condition with the Engineer. Cut out and remove from the site liner pipe segments with cuts, gouges, or scoring in the pipe wall exceeding 10% of the wall thickness. File a pipe condition inspection report with and receive approval from the Engineer prior to installation.

For CIPP rehabilitation, remove all existing lateral taps that protrude into the existing pipeline prior to beginning cleaning.

00410.41 Pipe Joining - For approval of butt fusion welds, submit three qualification samples for each size of pipe liner to be welded. Make samples using the same materials, equipment, and methods to be used on the Project. Construct the test welds in the presence of the Engineer. Joint strength shall be equal to that of the adjacent pipe and the pipe bead (1/8 inch to 3/16 inch in height) and be uniform and continuous around the entire circumference of the pipe, both inside and outside.

Use only cotton or other non-synthetic cloths to clean the inside and outside of pipe liner ends before welding.

Join sections of HDPE pipe liner in continuous lengths on-site above ground. Use butt fusion methods according to ASTM D 2657, Section 8 and the recommendations of the pipe liner manufacturer. Follow the cold weather procedures at all times. Electrofusion may be used for field closures as necessary when appropriate fusion equipment can be utilized in a trench type environment. For end sections or tail pipe, utilize electrofusion couplings.

00410.42 Pipe Cleaning - Flush and clean all parts of the existing gravity pipe system to remove all debris and obstructions. In addition, for host pipes repaired by CIPP, remove all mineral deposits, encrustation and grease. Cleaning methods may include washing with high-pressure water, mechanical removal, sandblasting of the walls, entry with hand tools, or other methods as approved by the Engineer. Do not use chemicals without written approval of the Engineer.

Conduct work that prevents blockage and minimizes surcharging in the sewer manholes and connecting sewer pipelines. Promptly repair damage to existing facilities as a result of the Contractor's work at no additional cost to the Agency.

00410.43 Pre-Installation Video Inspection - After cleaning, inspect the existing gravity pipe by video inspection according to 00445.74 using personnel trained in locating breaks, obstacles, and service connections by video inspection. Prepare printed inspection reports that show the location in relation to

an adjacent manhole of each infiltration point observed during inspection. In addition, note other points of significance such as locations of gravity pipe service connections, unusual conditions, roots, storm gravity pipe connections, sags, collapsed pipe sections, and broken pipe. Provide the video and inspection reports to the Engineer for review at least seven calendar days prior to beginning CIPP installation, pipe bursting, and slip lining operations. Some conditions noted in the inspection report may need to be corrected before continuing with the gravity pipe rehabilitation.

00410.44 Receiving Pits and Insertion Pits - Locate all pits to suit the specified pipe lining operation. Use existing manholes where practical. Remove manhole inverts, benches, and channels to permit access for installation equipment. Enlarge the input and output pipe openings if required to accommodate the maximum outside diameter size of the insertion equipment. Do not put undue stress on existing structures. Reinstall inverts and reconstruct benches and channels after pipe liners have been installed.

In areas where new manholes are not being installed or existing manholes are not available, excavate and restore pits at no additional cost to the Agency. This may include providing a new manhole if an existing manhole is removed or damaged.

00410.45 Property Owner Notification - Notify all affected parties in writing 24 hours prior to beginning pipe liner installation. When work has been stopped for at least seven calendar days, notify all affected parties again 24 hours prior to resuming work. Make personal contact with any party that cannot be reconnected within the time stated in the written notice. Before entering private property, obtain permission from the property owner.

When it is necessary to shut down a private service lateral to perform the rehabilitation work, notify all the affected parties one week prior to and again 24 hours prior to the shutdown. Gravity pipe service shall not be out of service for more than eight hours and not between 6:00 p.m. and 8:00 a.m.

00410.46 Bypass Pumping - Provide a standby bypass pump on-site. Provide bypass pumping consisting of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances, and bypass piping required to maintain existing flows and services. Notify the Engineer 24 hours prior to commencing the bypass pumping operation.

Pump the flow in an enclosed hose or pipe that is adequately protected from traffic, and redirect the flow into a sanitary gravity pipe system for sewage flow and into a storm gravity pipe for storm drainage flow. Dumping, spilling, backup, or free flow of sewage on private property, gutters, streets, sidewalks, or into storm gravity pipes is not allowed. The Contractor is liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, return flow to the replaced gravity pipe and remove all temporary equipment.

Pump out or otherwise positively drain all locations, a minimum of once every 24 hours, where the gravity pipe service is disconnected from the main gravity pipe for more than one day. Use more frequent pumping in locations where flows exceed the capacity of temporary storage provided.

Bypass or contain all gravity pipe service lateral connections from the time of disconnection to the time of reconnection by means of mechanical pumps and manifold system or by a bladder tank system, capable of holding adequate sewage from each gravity pipe service connection for a period of 24 hours. Empty or pump each bladder each 24 hour period and properly dispose.

Equip pump engines in a manner that keeps the pump noise to a minimum and comply with 00290.32.

Make temporary tie ins and remove the bypass plugs between the relined section and the existing system at the end of each working day.

00410.47 Sags in Line Repair - If the pre-installation video inspection reveals a sag in the existing gravity pipe greater than one-half the diameter of the existing pipe, install replacement pipe such that it has an acceptable grade without sags. Take necessary measures to eliminate these sags by replacing the pipe, or digging a sag elimination pit and bringing the bottom of the pipe to a uniform grade in line with the existing pipe invert, or by other measures that are acceptable to the Engineer.

00410.48 Point Repairs - Repair the pipe where point repairs are shown. If the pre-installation video inspection reveals an obstruction that cannot be removed by conventional gravity pipe cleaning, upon approval from the Engineer, make a point repair to uncover and remove or repair the obstruction prior to lining. Point repairs not shown will be paid for as Extra Work when approved by the Engineer.

00410.49 Installation:

(a) Pipe Bursting and Lining - Break existing pipe by utilizing a constant tension system with a hydraulic or pneumatic bursting device that breaks away the pipe. A static "cone cracking" method may be used, but only by advancing the mole bursting head with a "solid steel tow rod" pulled by a constant tension hydraulic pulling wrenching system. The advancement of the bursting mole head with a chain is not allowed. The void created by the bursting device shall be of sufficient size to accommodate the HDPE pipe. Install the HDPE pipe immediately after the void has been formed by bursting. Continue pipe bursting and lining without interruption from one manhole to another manhole unless the Engineer allows otherwise. Extend the HDPE pipe 12 inches into the manhole or concrete structure past the inside wall to allow for pipe initial contraction/relaxation after installation.

(b) Slip Lining - Excavate, expose, and isolate all service line connections prior to replacing the existing gravity pipe.

Connect a fabricated pulling head to the leading end of the HDPE pipe that is positioned on rollers. Connect a power winch cable to the pulling head so the HDPE pipe can be pulled into the existing gravity pipe. Extend the HDPE pipe 12 inches into the manhole or structure past the inside wall to allow for pipe initial contraction/relaxation after installation.

(c) CIPP - Install CIPP according to ASTM F 1216 Section 7, ASTM F 1743 Section 6, and the manufacturer's recommendations.

(1) General - Where practicable, liners may be installed in continuous runs through manholes where there are two of more continuous gravity pipe segments requiring lining, especially to connect several short segments with continuous lining.

Do not allow the temperature of water discharged from processing liners to exceed the level allowed by State or local requirements.

Furnish one additional operational robotic cutter assembly train and key spare components on-site on a continuous basis as a "stand-by" unit in the event of primary equipment breakdowns.

(2) Pipe Liner End Seal - Install a joint seal at the ends of the new pipe liner to the rehabilitated host pipe connection to prevent water movement between the two systems. Apply a cementitious grout at this joint if the pipe liner fails to provide a tight seal because of broken or misaligned pipe at the liner ends. The grout shall be compatible with the pipe liner material, provide a watertight seal and be subject to the approval of the Engineer. Perform sealing at no additional cost to the Agency.

00410.50 Service Line Reconnection:

(a) Pipe Bursting and Lining and Slip Lining - Reconnect all service line connections after the pipe air tests have been performed and accepted. Connect service lines to the HDPE pipe using electrofusion saddle type fittings.

(b) CIPP - Reconnect all service line connections after the liner has been fully cured and air tests have been performed and accepted. Use an approved internal cutting device and television camera to restore service connections to the full diameter of the service.

00410.51 Manhole and Structure Connections:

(a) Pipe Bursting and Lining and Slip Lining - After completing the HDPE pipe installation, allow a minimum of 12 hours to elapse to allow the pipe to stabilize prior to making connections to manholes and structures. Install a water stop or flange adapter, at each connection, that is fused and seated perpendicular to the pipe liner axis around the pipe liner exterior, and grouted into the concrete structure or manhole wall to create a watertight seal.

(b) CIPP - Seal all holes and voids in manhole and structure walls immediately surrounding the new liner with a hydrophilic rubber joint seal and chemical grout.

Finishing, Clean Up and Testing

00410.70 General - After completing each manhole to manhole section and prior to connecting service lines, 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. Conduct air tests according to 00445.72(c). Plug the ends with gasketed caps or plugs securely fastened or blocked to withstand test procedures. If the tested section is acceptable, reconnect service lines using electrofusion saddle type fittings.

00410.72 Post-Installation Video Inspection - After completing each manhole to manhole section of pipe liner installation, service reconnections, finish work, and final cleaning, perform a video inspection of the pipe and make a written report according to 00445.74. Provide printed reports and the original video to the Engineer.

Notify the Engineer at least 48 hours in advance of post-installation video inspection. The Engineer may observe the inspection. Inspect all completed work, including detailed inspection of all service line reconnections, and as directed.

00410.74 Repairs - For CIPP, repair leaks and remove and repair wrinkles, blisters, dry spots in resins, and other defects in the finish pipe as directed and at no additional cost to the Agency.

00410.75 Warranty - Furnish a Warranty for the CIPP according to 00170.85(b-1), for a Warranty period of one year. The Warranty period will start at the issuance of the Third Notification.

For purposes of the Warranty, the CIPP will be deemed to have failed when:

- Leakage through the liner or between liner and pipe is detected
- Reduction of the liner thickness is more than 10 percent
- There is any separation of the liner from the existing pipe

The Warranty shall recite that, upon written notification by the Agency, that the CIPP or portions of the CIPP have failed, the Contractor will repair and replace the liner or portions of the liner within 6 months of the Agency's written notification.

Provide materials and use procedures to repair and replace failed liners that meet the specifications in effect at the time of original installation, or if no longer available, use current CIPP specifications.

Measurement

00410.80 Measurement - Work performed under this Section will be measured according to the following:

(a) Pipe Liners - The quantities of installed pipe liners of the various kinds, types, and sizes will be measured on the length basis. The length will be measured, with no deduction for structures or fittings, along the pipe flow line from center to center of manholes, inlets, structures, special sections, or the ends of pipe, whichever is applicable.

(b) Sag Repair - The quantities of sag repair will be measured on the length basis, to the nearest foot.

(c) Point Repairs and Service Line Reconnections - The quantities of point repairs and service line reconnections will be measured on the unit basis, regardless of size.

(d) Video Inspection - The quantities of video inspection will be measured on the length basis, to the nearest foot. The length will be measured, with no deduction for structures or fittings, along the pipe flow line from center to center of manholes, inlets, structures, special sections, or the ends of pipe, whichever is applicable. Measurement will be made twice, once for pre-installation video inspection and again for post-installation video inspection.

Payment

00410.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Pipe Bursting and HDPE Liner, _____ inch.	Foot
(b)	HDPE Liner, _____ inch	Foot
(c)	CIPP Liner, _____ inch	Foot
(d)	Sag Repairs	Foot
(e)	Point Repairs	Each
(f)	Service Line Reconnection	Each
(g)	Pipe Lining Video Inspection	Foot

In items (a) and (b), the nominal size of the new HDPE liner pipe will be inserted in the blank.

In item (c), the nominal size of the existing pipe will be inserted in the blank.

Item (g) includes pre-installation video inspection and post-installation video inspection.

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

No separate or additional payment will be made for additional testing, cleaning, and video inspection required as a result of correction of unsatisfactory work.

Section 00420 - Salvaging Pipe

Description

00420.00 Scope - This work consists of removing, cleaning, and stockpiling or relaying culvert pipe and other pipe.

Acceptable pipe, parts and special sections will be referred to as "salvaged".

Materials

00420.10 Materials - Furnish joint materials, connecting bands, and other materials required in relaying pipe meeting the requirements of to the Specifications for the type of pipe and materials involved. Salvaged material may be used if approved.

Construction

00420.40 Trench Excavation - Excavate and backfill trenches to remove pipe and to relay salvaged pipe according to Section 00405.

00420.41 Removal of Pipe - Excavate materials over the pipe, and remove, disassemble and clean the exposed pipe without damaging the pipe. Acceptable partial sections of pipe may be cut off for reuse.

00420.42 Stockpiling - Stockpile salvaged materials not used on the Project as directed.

00420.43 Relaying - Install salvaged materials at the locations, in the quantities designated, and conforming to Specifications for new installations. As directed, cut sections of salvaged pipe to obtain the length required for relaying. Make connections to new pipe, inlet and outlet structures, salvaged or new end sections, or other special sections as provided in the Specifications for new pipe installations.

Measurement

00420.80 Measurement - The quantities of salvaged pipe will be measured on the length basis, regardless of size, kind, or type that is removed, cleaned, and stockpiled or relaid. Stockpiled pipe will be measured from end to end of each pipe. Relaid pipe will be measured according to Section 00445.

The maximum depth to flow line for each run of relaid pipe will be determined along the pipe centerline, by measuring vertically from the flow line to the surface of the original ground, paved surface or subgrade and slopes of other excavations, whichever is less.

Payment

00420.90 Payment - The accepted quantities of salvaged, stockpiled, and relaid pipe will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Salvaging and Stockpiling _____ Pipe	Foot
(b)	Salvaging and Relaying _____ Pipe, _____ Depth	Foot

In item (a), the nominal diameter of pipe will be inserted in the blank.

In item (b), the nominal diameter of the pipe will be inserted in the first blank, and the maximum flow line depth "5 feet", "10 feet", "20 feet", "over 20 feet" will be inserted in the second blank.

00420.90

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 removing, cleaning, transporting, and stockpiling or relaying the pipe or for excavation or backfill.

Section 00430 - Subsurface Drains

Description

00430.00 Scope - This work consists of constructing subsurface drains to the lines and grades shown or established using drain pipe, special filter material or granular drain material, and drainage geotextile.

00430.01 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 Agency.

00430.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00430.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete	00440
Delineators	00840
Drainage 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
Protective Coatings	02420.20
Special Filter Materials	02610.10

Furnish wire mesh that is commercial quality 1/4 inch galvanized metal screening.

00430.11 Granular Drain Backfill Material - Furnish granular drain backfill material of 1 1/2" - 3/4", 1 1/4" - 3/4", or 3/4" - 1/2" crushed or uncrushed rock or gravel meeting the requirements of 02690.20(d) and the following gradation requirements:

	Percent Passing (by weight) Designated Sizes		
Sieve Size	**1 1/2" - 3/4"**	**1 1/4" - 3/4"**	**3/4" - 1/2"**
2"	100		
1 1/2"	95 - 100	100	
1 1/4"	–	90 - 100	
1"	–	–	100
3/4"	0 - 15	0 - 15	90 - 100
1/2"	0 - 2	0 - 2	0 - 15
1/4"	–	–	0 - 3

Construction

00430.40 General - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, according to Section 00405 and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install a Type W-1 delineator at each outlet protection block as shown.

00430.41 Foundations in Unyielding Material - Excavate rock, hardpan or other unyielding materials a minimum of 3 inches below established grade of the pipe exterior to place special filter material or drain backfill material.

00430.42 Laying Pipe - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

00430.43 Joining Pipe - Fasten pipes together with appropriate coupling fittings or bands as specified for the type of pipe used. Close upstream end of pipe with plugs suitable to prevent entry of soil materials.

00430.44 Contact Surfaces, Aluminum to Concrete - Coat aluminum pipe and aluminum coated steel pipe that contact portland cement concrete with asphalt mastic according to Section 00445.

00430.45 Inspection - The installation will be inspected after the pipe is laid and joined and before backfilling. Remove and reinstall or replace any pipe found to be out of alignment, unduly settled or damaged.

00430.46 Backfilling:

(a) Special Filter Material - After the pipe is installed and inspected, place up to 12 inches of uncompacted special filter material above the top of the pipe. Above this, place approved backfill material or special filter material, as directed, and compact according to Section 00405.

(b) Granular Drain Backfill Material - Drainage geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

Measurement

00430.80 Measurement - The quantities of subsurface drain pipes of the various kinds, types, and sizes will be measured, with no deduction for fittings and special sections, along the pipe flow line from end to end of pipe.

The quantities of subsurface drain outlets will be measured on the unit basis.

Drainage geotextile will be measured according to 00350.80.

Delineators will be measured according to 00840.80.

Trench resurfacing will be measured according to 00495.80.

Payment

00430.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	_____ Inch Drain Pipe	Foot
(b)	Subsurface Drain Outlets	Each

In item (a), the nominal diameter of pipe will be inserted in the blank.

Item (b) includes furnishing and installing pipe, constructing outlet protection blocks, connecting pipe to inlets, and excavating and disposing of excess materials.

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

Drainage geotextile will be paid for according to 00350.90.

Delineators will be paid for according to 00840.90.

Trench resurfacing will be paid for according to 00495.90.

No separate or additional payment will be made for trench excavation, backfill, special filter material, or granular drain backfill material or for fittings and special pipe sections.

Section 00432 - Wearing Surface Drains

Description

00432.00 Scope - This work consists of constructing wearing surface drains and outlets to the dimensions, lines, and grades shown and directed.

Materials

00432.10 Aggregate - Furnish aggregate for wearing surface drains meeting the applicable requirements for the coarse aggregate used in the open-graded HMAC wearing course on the Project.

00432.11 Asphalt Cement - Furnish asphalt cement meeting the applicable requirements for the asphalt cement used in the open-graded HMAC wearing course on the Project.

00432.12 Broadband Limits - Furnish 3/4 inch ATPB for the wearing surface drain material.

00432.14 Acceptance of Drain Material - Acceptance of the wearing surface drain material will be visual by the Engineer at the point of placement.

00432.15 Drain Outlets - Furnish non-perforated 3 inch PVC Schedule 40 pipe meeting the requirements of 02410.70.

Furnish commercial quality 1/4 inch mesh galvanized metal screening for the end of each outlet pipe.

Furnish concrete for protection blocks at drain outlets meeting the requirements of Section 00440.

Equipment

00432.20 Compactors - Provide compactors meeting the applicable requirements of 00745.24.

00432.22 Planing Machines or Grinders - Provide planing machines or grinders capable of loosening pavement material to the dimensions, lines, and grades shown.

The equipment shall produce a trench with clean, vertical sides.

Construction

00432.40 Season and Temperature Limitations - Place wearing surface drain material within the limitations for open-graded HMAC specified in 00745.40.

00432.41 Scheduling - Construct wearing surface drains before placing the open-graded HMAC wearing surface. Place the open-graded HMAC wearing surface no more than four weeks after construction of the drains.

00432.42 Preparation of Underlying Surfaces - Thoroughly clean the wearing surface drain trench, and treat with emulsified asphalt tack coat conforming to Section 00730.

00432.43 Hauling, Depositing, and Placing - Haul, deposit, and place the wearing surface drain material in a manner acceptable to the Engineer.

00432.44 Compaction - Compact the wearing surface drain material as specified in 00745.49(d) for open-graded HMAC.

Do not crush the outlet drain pipe during compaction.

00432.45 Disposal of Materials - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of the material according to 00290.20 unless special sites are specified in the Special Provisions.

Maintenance

00432.60 Correction of Defects - Correct defects in material and work according to 00745.60.

Finishing

00432.70 Pavement Smoothness - The surface of the finished trench shall meet the applicable requirements of 00745.70.

00432.75 Correction of Pavement Roughness - Correct pavement roughness according to 00745.75.

Measurement

00432.80 Measurement - The quantities of wearing surface drains will be measured on the length basis, for each continuous run of wearing surface drain, excluding wearing surface drain outlets.

The quantities of wearing surface drain outlets will be measured on the unit basis, by actual count.

Payment

00432.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Wearing Surface Drains	Foot
(b) Wearing Surface Drain Outlets	Each

Item (a) includes removing and disposing of existing materials.

Item (b) includes the protection block, drain pipe, and rodent screen.

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

Section 00435 - Prefabricated Vertical Drains

Description

00435.00 Scope - This work consists of furnishing and installing prefabricated vertical drains at locations and according to details shown or directed.

Materials

00435.10 Drains - Furnish new prefabricated vertical drains from the QPL or that meet the requirements of these specifications.

00435.11 Core - Furnish a continuous plastic core material with grooved channels, a pattern of protruding studs, or mesh-type materials fabricated to promote drainage along the axis of the vertical drain. Furnish vertical drain material meeting the requirements of ASTM D 638 and ASTM D 4716.

00435.12 Jacket - Furnish the jacket material meeting the following requirements:

- Be a synthetic, non-woven geotextile capable of resisting all bending, punching and tensile forces imposed during installation.
- Not crack, peel or otherwise become damaged during installation.
- Be sufficiently rigid when embedded to withstand lateral earth pressures and to ensure vertical flow capacity through the core.
- Allow free passage of pore water to the core without passage of soil material or piping.

Test the jacket material in both saturated and dry conditions. It shall conform to the following:

	Requirement	
Test	**Specification**	**Minimum Value**
Grab Tensile	ASTM D 4632	80 pounds
Trapezoidal Tear	ASTM D 4533	25 pounds
Puncture Strength	ASTM D 4833	50 pounds
Burst Strength	ASTM D 3786	130 psi
Permeability	ASTM D 4491	0.05 mm/sec.

00435.13 Assembled Drain - Furnish assembled drains meeting the following requirements:

- Be resistant against wet rot, mildew, bacterial action, insects, salts, acids, alkalis, solvents and any other significant ingredients in the groundwater.
- Be band-shaped (rectangular cross section) with an aspect ratio (width divided by thickness) not exceeding 50.
- Have a minimum equivalent diameter of 2 inches using the following definition of equivalent diameter:

$$d_w = \frac{(a+b)}{2}$$

d_w = diameter of a circular drain equivalent to the band shaped drain
a = width of the band shaped drain
b = thickness of the band shaped drain

00435.14 Acceptance Requirements - Each shipment of prefabricated vertical drain materials shall be accompanied by a manufacturer's Quality Compliance Certificate according to 00165.35.

Submit three samples of any proposed splices for approval at least 21 calendar days before the installation of any drains.

Identify the drain materials with labels or tags that include the manufacturer's name, lot or control number, individual roll number and date of manufacture.

Equipment

00435.20 General - Install prefabricated vertical drains using a mandrel or sleeve that:

- Has a maximum cross-sectional area of 10 square inches.
- Is sufficiently stiff to prevent wobble or deflection during use.
- Protects the prefabricated vertical drain material from tears, cuts and abrasion during installation.
- Has an anchor plate or similar arrangement at the bottom to prevent soil from entering the drain during its installation, and to anchor the drain tip at the required depth at the time of withdrawal. Use anchors conforming to the dimensions of the mandrel or sleeve.

Construction

00435.40 Prefabricated Vertical Drain Installation Requirements:

(a) Acquisition and Storage - During shipment and storage, wrap the drain in heavy paper, burlap or similar heavy-duty protective covering and protect it from sunlight, mud, dirt, dust, debris and other detrimental substances.

Material damaged during shipping, unloading, storing or handling will be rejected.

(b) Proposed Installation Details - Submit full details on the material, equipment, sequence and method proposed for prefabricated vertical drain installation to the Engineer for review at least 14 calendar days before beginning trial prefabricated vertical drain installation.

(c) Trial Installation - Before production installation of prefabricated vertical drains, demonstrate that material, equipment and methods produce a satisfactory installation, at permanent installation sites. Install at least five trial drains totaling approximately 250 feet at locations designated.

(d) Production Installations - The Engineer's approval of the method or equipment used to install the trial drains does not necessarily constitute acceptance for the remainder of the Project. If at any time the Engineer determines that the method of installation or equipment does not produce satisfactory prefabricated vertical drains, alter the method or equipment as directed to comply with the plans and specifications.

(e) Installation Procedure - Prefabricated vertical drains will be located, numbered and staked by the Engineer.

- Preserve stakes and protect field instrumentation equipment. Stakes and instrumentation damaged by the Contractor will be repaired or replaced by Agency forces. The cost of repair or replacement will be deducted from monies due the Contractor. Do not work in the affected area until repair or replacement has been made.

- Locate the prefabricated vertical drains within 6 inches of the staked locations. Prefabricated vertical drains more than 6 inches from the staked locations, damaged or improperly installed, will be rejected and abandoned in place without payment. Rejected drains will be replaced at no additional cost to the Agency.
- Install prefabricated vertical drains in the presence of the Engineer's representative.
- Provide the Engineer with a suitable means to determine the depth of the drains at any time during installation and the final length installed at each location.
- Plumb equipment for installing prefabricated vertical drains before installing each drain. Do not deviate from the vertical more than 0.2 foot in 10 feet during installation of the drains.
- Install prefabricated vertical drains using a mandrel or sleeve inserted into the soil using a continuous push static weight or vibration while keeping disturbance of the subsoil to a minimum. Installation by driving will not be allowed. Jetting techniques will be allowed only after receiving written approval from the Engineer. The mandrel or sleeve penetration rate shall normally be between 0.5 and 2 feet per second.
- Install the prefabricated vertical drains from the designated working surface to the depth shown or as directed.
- Perform the installation without damaging the drain while advancing or retracting the mandrel or sleeve. Alternately raising or lowering the mandrel while advancing will not be allowed. Retract the mandrel or sleeve after each drain is installed. Raising the mandrel will be allowed only after completing a drain installation.
- Cut off completed prefabricated vertical drains neatly 1 foot above the designated working surface.

(f) Obstruction Clearance Procedures - Satisfactory installation may require clearing man-made or natural obstructions that prevent the proper insertion of the mandrel or sleeve and installation of prefabricated vertical drains.

Where obstructions are encountered:

- Immediately notify the Engineer before completing the drain and before installing other drains.
- Upon the Engineer's approval, attempt to install a drain adjacent to the obstructed location.
- Based on the results of this attempt and when directed, attempt to install a second offset drain within 2 feet horizontally of the obstructed drain, or if directed, implement obstruction clearance procedures and install the drain at the specified location.

The Contractor may use augering, spudding or other approved methods to loosen the soil and remove any obstruction material before installing prefabricated vertical drains. Do not penetrate more than 2 feet into the underlying compressible soil.

If augering, use augers with a minimum outside diameter equal to the largest horizontal dimension of the mandrel sleeve, shoe or anchor, whichever is greatest. The maximum outside diameter of the auger shall not be more than 3 inches greater than the minimum outside diameter.

00435.41 Splicing - Splice prefabricated vertical drain material by stapling to ensure structural and hydraulic continuity of the drain. Overlap the jacket and core a minimum of 6 inches at each splice.

A maximum of one splice per drain installed is allowed.

Measurement

00435.80 Measurement - The quantities of prefabricated vertical drains and obstruction clearance will be measured on the length basis as follows:

(a) Prefabricated Vertical Drains - The length of drains will be the distance the installation mandrel tip penetrates below the specified surface plus the required cutoff length above the designated working surface.

(b) Obstruction Clearance - The length of obstruction clearance will be the length from the designated working surface at the time of installation to the depth penetrated by the auger or spud, or if directed, to the bottom of the obstruction.

Obstruction clearance will be measured for payment only when authorized by the Engineer.

Payment

00435.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Prefabricated Vertical Drains	Foot
(b)	Obstruction Clearance	Foot

Item (a) includes trial installations and splices.

Item (b) includes pre-augering, spudding or performing other acceptable methods to clear obstructions so that prefabricated vertical drains may be satisfactorily installed, including disposing of any surplus preaugered or obstruction clearance materials.

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

No separate or additional payment will be made for:

- unacceptable trial drain installations
- drains that are not installed and anchored to the required depth
- clearing obstructions caused by the Contractor or obstructions within 2 feet of the specified surface
- prefabricated vertical drains placed in excess of the designed length unless additional lengths are directed by the Engineer
- prefabricated vertical drains installed more than 6 inches from the staked location, damaged or improperly installed

Section 00440 - Commercial Grade Concrete

Description

00440.00 Scope - This work consists of furnishing, placing and finishing commercial grade concrete (CGC).

Materials

00440.10 Materials - Furnish materials meeting the following requirements:

Admixtures 02040
Aggregates 02690
Bonding Agents 02070
Cement 02010
Curing Materials 02050
Grout 02080
Modifiers 02030
Water 02020

00440.11 Proportions - Furnish, in writing to the Engineer, the proportions by weight of the following materials before using any CGC:

- air entraining admixtures
- cement
- each size of aggregate
- fly ash
- other admixtures
- water

00440.12 Properties of CGC - Furnish a workable CGC mixture that is uniform in composition and consistency, and has the following characteristics:

- **Entrained Air** - 4.0% to 7.0%
- **Slump** - 5 inches or less
- **Compressive Strength** - Minimum 3,000 psi at 28 days
- **Temperature** - Minimum 50 °F to maximum 90 °F

00440.13 Field-Mixed Concrete - CGC may be field mixed for work items listed in 00440.14(a).

00440.14 Acceptance Sampling and Testing:

(a) General - Acceptance sampling and testing will be based on samples obtained at the site of placement from the discharge of the delivery vehicle. All sampling and testing shall be performed by a QCT.

CGC mixture may be accepted visually for the following items of work:

Work Item	Section
Electrical Conduit Backfill	00960
Fence Post Footings	01050
Guardrail Anchors	00810
Irrigation System Thrust Blocks	01120
Mailbox Support Footings	01070
Outlet Protection Blocks	00430
Square Tube Sign Support Footings	00930

(b) Delivery Tickets - Send a delivery ticket with each load of CGC recording the source, day, time of batch, size of load, and quantity of individual constituents in the load. A delivery ticket will not be required for field-mixed concrete.

(c) Plastic CGC - Acceptance of plastic CGC will be based on tests performed by the QCT according to the MFTP and 00440.12.

(d) Hardened CGC - Acceptance of the hardened CGC will be according to 00440.12. Cast one set of cylinders per 20 cubic yards, with a maximum of one set per day.

00440.15 Quality Control - Provide quality control according to Section 00165.

Labor

00440.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CSTT
- QCT

Construction

00440.40 General:

(a) Mixing - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mixture.

(b) Placing - Place CGC according to the appropriate Sections in which CGC is required and the following:

- Place using the best common practices to avoid segregation.
- Vibrate and spade to achieve a dense homogeneous concrete, free of voids and rock pockets.
- Place within 90 minutes after batching and mixing.

(c) Forms - Provide forms for CGC according to the appropriate Sections in which CGC is required and best common practices. Place to the lines and grades shown or directed.

(d) Weather - Do not place CGC when the air temperature is below 35 °F without approval.

Protect CGC from freezing if the air temperature is expected to drop below 35 °F during the first five calendar days after placement.

(e) Curing - Cure CGC by covering with wet burlap, canvas, sand, or other acceptable material, and keep moist for a minimum of seven calendar days.

Curing compounds may be used except on concrete surfaces or reinforcement that will come in contact with adjacent concrete pours. Use curing compounds according to the following:

Section	Item	Type 1 or 1-D (Clear)	Type 2 (White-Pigmented)
00480	drainage curbs	*	*
00599	slope paving curbs and berm paving	Yes	No
00759	walks, sidewalk ramps, driveways, surfacings, curbs, and islands	*	*
* Use Type 2 except when the Engineer requires Type 1 or 1-D			

Apply curing compounds at a rate of not be less than 1 gallon per 150 square feet.

00440.41 General Surface Finish - Give concrete surfaces a general surface finish, according to 00540.53(a), in addition to the finish specified for a particular item of work.

00440.42 Replacement or Price Reduction - Remove concrete represented by cylinders that fail to meet the minimum strength requirement and replace at no additional cost to the Agency. If the Engineer determines that the low-strength concrete is suitable for the purpose intended, the Contractor may accept a price reduction established by the Engineer instead of removal and replacement.

Measurement

00440.80 Measurement - No measurement of quantities will be made for CGC.

Payment

00440.90 Payment - No separate or additional payment will be made for CGC. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00442 - Controlled Low Strength Materials

Description

00442.00 Scope - This work consists of furnishing and placing controlled low-strength materials (CLSM).

00442.01 Definition - Controlled low-strength material is highly flowable lean concrete mix; a mixture of fly ash, cement, fine aggregates, water and admixtures, if necessary.

Materials

00442.10 Materials - Furnish materials meeting the following requirements and as modified in the Special Provisions:

Admixtures	02040
Fly Ash	02030.10
Portland Cement	02010.10

00442.11 Fine Aggregates - Furnish fine aggregates that are commercial quality concrete sand.

00442.12 Proportioning of CLSM Mixture - Furnish the following, to the Engineer, prior to using any CLSM on the Project:

- Written certification of proposed CLSM materials proportions and compressive strength.
- 28-day cylinder reports from a trial CLSM batch based on above certification. Include evidence that compressive strength requirements for specific applications are met.

00442.13 Compressive Strength - CLSM shall attain a 28-day compressive strength of 100 psi - 200 psi.

00442.14 Acceptance - Acceptance will be based on the Engineer's review and approval of written certification and trial batch cylinder reports as required by 00442.12.

Measurement

00442.80 Measurement - No measurement of quantities will be made for CLSM.

Payment

00442.90 Payment - No separate or additional payment will be made for CLSM. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00445 - Sanitary, Storm, Culvert, Siphon, and Irrigation Pipe

Description

00445.00 Scope - This work consists of constructing or reconstructing culvert, siphon, sanitary sewer, storm sewer, and irrigation pipes in the kinds, sizes, and lengths and at the locations shown 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:

Aluminum, Concrete, Steel and Polyethylene - The basic material of the pipe

Concrete Block - Encasements, thrust blocks, anchor blocks, plugs and cutoff diaphragms

Culvert - Concrete, corrugated metal, ductile iron or polyethylene pipe

Flexible Pipe - Pipes constructed of corrugated or spiral rib metal, PVC, and polyethylene. For the purposes of these Specifications, all potable water pipes are considered to be flexible pipes.

HDPE - High Density Polyethylene

Irrigation Pipe - Gravity or low-pressure transmission pipe. Refer to Section 01120 for sprinkler-type irrigation pipe.

Joint - The place where the ends of sections or modified sections of pipe contact one another

Metal - Aluminum and steel

Pavement - Pavement as defined in Section 00110, as well as driveways, curbs, gutters, walks, dikes, walls and other similar asphalt or portland cement concrete structures

Pipe - All pipe, regardless of kind, size, shape or use

Plain - Unreinforced concrete

PVC - Polyvinyl Chloride

Rigid Pipe - Pipes, other than potable water pipes, constructed of concrete and ductile iron

Sanitary 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

Siphon, Storm Sewer, and Irrigation Pipe - Concrete, PVC, HDPE, ductile iron or metal pipe

Steel - The base metal for galvanized sheets and aluminum coated sheets

00445.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its installation and other limits will be shown on the plans or on a "Pipe Data" sheet in 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 is approved and is made at no additional cost to the Agency.

00445.03 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

00445.10 General - The manufacturer or fabricator shall furnish appropriate 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. Furnish caps or plugs with each fitting, outlet or stub as required, with the same type gasket or joint as the pipe.

For sanitary sewers provide tee or wye fittings in the main of the same materials as the pipe. 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 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 - Furnish materials meeting the following requirements:

Commercial Grade Concrete in Blocks	00440
Corrugated or Spiral Rib Aluminum Alloy Pipe	02420.40
Corrugated or Spiral Rib Steel Pipe and Pipe Arches	02420.10
Corrugated Polyethylene Pipe	02410.60
Ductile Iron Pipe	02420.11
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 HDPE	02410.65

(a) Pipe Anchors - Use pipe anchors conforming to the Standard Drawings and as shown. Metal bands shall conform to the material Specifications for the metal pipe to which they are attached.

(b) Slip Joints - Construct slip joints according to the details shown. The outer sleeve and tapered section shall conform to the material Specifications for the metal pipe with which they are installed.

(c) Safety End Sections - Use safety end sections conforming to 02420.10 and the Standard Drawings. Provide safety bars unless otherwise indicated on the plans.

(d) Cleanouts - Construct cleanouts of the same materials as the adjacent pipe.

(e) Tracer Wire - Use 12-gauge stranded or solid copper insulated high molecular weight polyethylene (HMW-PE) tracer wire. The HMW-PE insulated cover shall be green and a minimum 45 mil thick. The wire shall be UL rated for 140 °F.

(f) Fittings for Concrete Pipe - Where fittings are fabricated by inserting a stub into a hole cut in the pipe, grout with a non-shrinking grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

(g) Solid Wall Polyethylene Pipe - Use solid wall polyethylene pipe with a minimum SDR of 26.

00445.12 Asphalt Mastic - Furnish the asphalt mastic specified in 00445.47 for aluminum and concrete contact surfaces that consists of a mixture of asphalt, mineral stabilizer, and fillers meeting the requirements of AASHTO M 243 or ASTM D 4586. An approved product from the QPL may be used.

00445.15 Quality Control - Provide quality control according to Section 00165.

Labor

00445.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CDT

Construction

00445.40 General - Construct culvert, siphon, sanitary sewer, storm sewer, and irrigation 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 for pipes 72 inches and less in diameter and Section 00510 for pipes over 72 inches in diameter.

(b) Line and Grade - Centerline and grade control will be established prior to the start of construction. The Special Provisions will indicate whether it will be done by the Agency or the Contractor.

Do not vary from established line and grade by more than 1/32 inch per inch of pipe diameter. Variance shall not exceed 1/2 inch, subject to the following limitations:

- The variation does not result in a level or reverse sloping invert.
- The variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 1/64 inch per inch of pipe diameter, or 1/2 inch maximum.

(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.

(d) Laying Pipe on Curves - Lay pipe on horizontal or vertical curves as shown or approved. When deflecting the pipe from a straight line, either in the vertical or horizontal plane, or when long radius curves are shown, the amount of deflection allowed shall not exceed that recommended by the pipe manufacturer.

(e) 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.

(f) Installation of Sanitary Sewer Service Tees and Wyes - Provide a compacted base of pipe bedding material under all tees, wyes and branch fittings, extending to the springline of the fittings.

Cap all service lines for sanitary sewers with watertight plugs or caps suitable for resisting the pressures of hydrostatic or air testing.

The maximum line or grade change accomplished with any one fitting shall not exceed 45 degrees and shall be accomplished with long radius curves or bends.

(g) Pipe Anchors - Construct metal or concrete pipe anchors as specified or as shown. Install anchors on runs of pipe located on slopes 20% or greater.

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.

00445.42 Laying Pipe - Begin pipe laying at the downstream end of the pipe line with the lower segment of the pipe in contact with the shaped bedding throughout its full length and as follows:

- **Elliptical Pipe** - Place with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the pipe.
- **Flexible Pipe** - Place with longitudinal laps or seams at the sides. At circumferential lap joints, place pipe so that the downstream piece is outside.
- **Paved Invert or Partially Lined Pipe** - Place with longitudinal centerline of paved segment coinciding with flow line.
- **Rigid Pipe** - Place with bell or groove ends facing upstream.
- **Round Elliptically Reinforced Concrete Pipe** - Place so that the manufacturer's marks designating the top and bottom of the pipe are within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

00445.43 Placing and Joining Pipe:

(a) General - Lay pipe proceeding upgrade with spigot ends in the direction of flow. Assemble joints according to 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.

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 - Lay elliptical reinforced pipe so that the top or bottom marks are not more than 5 degrees from vertical. Provide all rigid non-reinforced pipe entering or leaving manholes with flexible joints within 18 inches of the manhole structure and placed on firmly compacted bedding.

(c) PVC Pipe - Install PVC pipe and fittings according to 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.

(d) Polyethylene Pipe - Install solid wall HDPE and corrugated polyethylene pipe and fittings according to the manufacturer's recommendations.

Assemble and join solid wall HDPE pipe at the site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints are not allowed. 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.

Provide joints for corrugated polyethylene pipe made with either bell and bell or bell and spigot coupling.

(e) Metal Pipe - Install metal pipe and fittings according to the manufacturer's recommendations.

(f) Pipe Joints - Construct field joints, suitable for testing, for siphons, sanitary sewers, irrigation, and other installations as specified.

Construct watertight field joints for storm sewers and culverts with elastomeric joint material. Test joints according to 00445.72.

(g) Inspection - After the pipe is laid and joined, and before any backfilling over it, the installation will be inspected. Take up and relay or replace any pipe found to be out of alignment, unduly settled, or damaged.

00445.44 Strutting Metal Pipe - When the plans or Special Provisions call for metal pipe to be installed in a tied or strutted condition, place the ties or struts before backfilling, conforming to the details shown. Strutting with timber is not allowed in pipe furnished with paved inverts or with centrifugally applied bituminous inner linings. Remove the ties and struts after the embankment over the pipe is completed and compacted.

00445.45 Backfilling:

(a) General - After the pipe is installed and inspected, backfill pipe zone and trench according to Section 00405 for pipes 72 inches and less in diameter, and according to Section 00510 for pipes over 72 inches in diameter.

(b) Exposed Pipe - When the top 25% of the pipe is exposed above the top of the trench, place and compact embankment materials in layers according to the requirements of the plans for the Pipe Zone.

Do not cross any pipe with tractors or other heavy equipment until it has been bedded and backfilled as specified, and is protected by at least a 4 foot cover of compacted fill.

(c) Elliptical Pipe - Where elliptical shaped metal pipe is furnished, place backfill in a manner that will maintain a vertical elongation between 4% and 6% greater than the indicated normal diameter, and fill up to the minimum cover above the top of the pipe indicated on the fill height table included with the plans.

When elliptical shaped metal pipe 48 inches and larger in size is furnished, install and maintain suitable tell-tales throughout the length of the pipe at intervals not exceeding 14 feet. Hang the tell-tales from the crown of the pipe and use as a progressive check on the pipe deflection during backfilling and filling.

Remove tell-tales after the entire fill over the pipe has been completed.

00445.46 Concrete Blocks - When called for by the plans or directed, construct concrete blocks, with commercial grade concrete according to Section 00440.

00445.47 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe or aluminum coated steel pipe will be touching portland cement concrete, give the contact surfaces of the pipe a coating of asphalt mastic applied at a rate which will give a minimum dry film thickness of 50 mils.

Do not place concrete on contact surfaces until the mastic coating has dried to practical hardness. The coating is considered to have reached practical hardness when firm pressure between the thumb and fingers shows a slight tacky condition, but the film is not ruptured, and none of the coating adheres to the fingers.

00445.48 Tracer Wire - Install tracer wire in all trenches for sanitary and storm sewers. Place the tracer wire directly over the pipe centerline and on top of the pipe zone material. Place a branch tracer wire over each pipe connected to the main sewer.

Make tracer wire splices using a solderless connection kit that effectively moisture seals two or more conductors for direct burial and securely join the wires both mechanically and electrically. Insulate splices to be moisture and waterproof. Splices wrapped with tape will not be accepted as waterproof. Have all splice kits approved prior to installation.

Test all tracer wire with locating equipment prior to acceptance.

Finishing, Clean Up and Testing

00445.70 General:

(a) Storm Sewer and Culvert Installations - Inspect storm sewer systems and culverts to assure that the lines are free of obstructions and leakage. Perform video and deflection testing.

(b) Siphon, Irrigation and Sanitary Sewer Installations - After laying and joining pipe for siphons, irrigation and sanitary sewers, and backfilling trenches, test the installations for watertightness, including inlet and outlet connections, to the Engineer's satisfaction. Perform video, deflection, hydrostatic, and low-pressure air testing.

00445.71 Requirements Prior to Tests:

(a) General - All sanitary gravity systems, siphon systems 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 30 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.

(b) Plugging Tees, Wyes, Stubs and Service Connections (Sanitary Only) - 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 - Prior to the testing and inspection of the system, flush and clean all parts of the system and remove all debris.

00445.72 Pipe Testing:

(a) General - After completing installation of the system, including all service connections, backfilling and compaction, and prior to wearing surface paving, conduct a low-pressure air test or a hydrostatic test. Provide all equipment and personnel for the test. Conduct tests during normal working hours. The Engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of the system and allow connections.

The method, equipment and personnel used in testing shall be subject to approval of the Engineer. The Engineer may, at any time, require a calibration check of the instrumentation used.

(1) Safety Precautions - Only qualified personnel will be allowed 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 will affect the results of the test. Determine the average height of groundwater over the lines immediately before starting the test, using an approved method.

(b) Hydrostatic Testing - Pipe and joints shall sustain losses not exceeding 0.04 gallons per hour per inch diameter per 100 feet of pipe when field tested by exfiltration methods, except 0.3 gallons per hour may be used in arid climate zones if approved by the engineer.

The hydrostatic head for test purposes shall exceed the maximum estimated ground water level in the section being tested by at least 72 inches of water column and in no case shall be less than 72 inches of water column above the inside top of the highest section of pipe in the test section, including service connections. The engineer shall make the final decisions regarding test height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 28 feet of water column.

The pipe test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the pipe walls to take place.

All service connection footage shall be taken into account in computing allowable leakage.

(c) Air Testing - 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.

(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 psi 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:

$$T = K/C$$

Where:

- K = the sum of the computations ($0.011\ d^2L$) 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

(d) Individual Joint Testing:

(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.

(2) Method - All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

a. Determine the average height of the groundwater over the line. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

b. Add air slowly to the section being tested until the internal air pressure is raised to 4 psi greater then the average backpressure due to ground water.

(3) Acceptance - The joint shall be considered acceptable if the pressure drops less than 1 psi within five seconds.

00445.73 Deflection Testing for Flexible Pipe - Conduct deflection tests of sanitary and storm sewers constructed of flexible pipe prior to wearing surface paving. Conduct the testing by pulling an approved mandrel through the completed pipeline. Use a mandrel having at least 6 vanes and a diameter 95% of the pipe's initial inside diameter.

Conduct testing on a manhole-to-manhole basis after the line has been completely flushed out with water. Conduct the tests not less than 30 days after the trench backfill and compaction have been completed. Tests may be conducted sooner if approved by the Engineer. The tests may be conducted concurrently with video inspection. If conducted concurrently, pull the mandrel in front of the camera so that the deflection testing is clearly recorded on the video tape unless approved by the Engineer. Provide a water depth gauge, located on the video camera side of the mandrel with the following characteristics:

- Graduated with marks at 0.50 inch increments clearly visible during video inspection.
- Capable of measuring water depth in 0.50 inch increments from 0.50 inch to 2.50 inches.
- Designed so that it will remain plumb regardless of the rotation of the mandrel or video camera.

00445.74 Video Inspection of Sanitary and Storm Sewers - After laying and joining sanitary and storm sewer pipe installations from 6 inches to 72 inches in diameter, including backfill and compaction of trenches, but before any finish surfacing or final paving, conduct a video inspection and make a written report of all sanitary sewer pipes and storm sewer pipes.

The video inspection shall be conducted by a technical service that is equipped to make audio-visual recordings.

The audio-visual recordings shall:

- Be in color format.
- Be clear and usable.
- Include a visual footage reading on the recording.
- Include a voice recording of suspected deficiencies.
- Identify groundwater infiltration sources associated with construction or materials defects.

Submit the audio-visual recordings and written report to the Engineer for review. Correct all deficiencies that are revealed in the recording and written report. Make an additional video inspection of repaired pipes at no additional cost to the Agency.

All recordings and written reports shall become the property of the Agency.

00445.75 Repairs - Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified tests and inspections on those sections at no additional cost to the Agency.

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 additional cost to the Agency.

Measurement

00445.80 Measurement - Pipes and related work performed under this Section will be measured according to the following:

(a) Pipes - The quantities of pipe of the various kinds, types, and sizes, will be measured on the length basis, and will be determined by the length and depth of installation as follows:

- **Length** - The length will be measured, with no deduction for structures or fittings, along the pipe flow line from center to center of manholes, inlets, special sections, or the ends of pipe, whichever is applicable.

- **Depth** - The depth will be used to determine the maximum depth range and pay item for each pipe. The maximum depth range, to the flow line, for each pipe will be "5 feet", "10 feet", "20 feet", and "over 20 feet" as applicable.

  The depth in excavation areas will be the maximum measured vertical distance between the pipe flow line and the surface of the original ground or subgrade, whichever is less, or the slopes of other areas outside the subgrade limits.

  The depth in embankment areas will be the maximum measured vertical distance between the pipe flow line and the surface of the constructed embankment as determined in 00330.42(c-6).

(b) Tee and Wye Fittings - The quantities of tee and wye fittings will be measured on the unit basis. No deduction will be made from measurement of pipe for the length of the fitting.

(c) Slip Joints - The quantities of slip joints will be measured on the unit basis.

(d) Sloped and Skewed Ends - The quantities of sloped ends, skewed ends, or sloped and skewed ends will be measured on the unit basis.

(e) Safety End Sections - The quantities of safety end sections will be measured on the unit basis.

(f) Concrete Pipe Anchors - The quantities of concrete pipe anchors will be measured on the unit basis.

(g) Concrete Closure Collars - The quantities of concrete closure collars will be measured on the unit basis.

(h) Concrete in Blocks - The quantities of concrete used in blocks will be measured on the volume basis, in place.

(i) Reinforcement - The quantities of reinforcement used in blocks will be measured on the lump sum basis or on the weight basis according to 00530.80.

(j) Video Inspection - The quantities of video inspection will be measured on the length basis, to the nearest foot, The length will be measured, with no deduction for structures or fittings, along the pipe flow line from center to center of manholes, inlets, special sections, or the ends of pipe, whichever is applicable. Pipes with sloped ends will be measured from the top of the sloped end section.

(k) Installation Under Railroad - No measurement will be made for additional work necessary to install pipe under railroads. Pipe installed under railroads will be separately measured according to 00445.80(a).

Excavation and backfill for pipes greater that 72 inches in diameter will be measured according to Section 00510.

Trench resurfacing will be measured according to 00495.80.

Payment

00445.90 General - The Contract unit price for each pay item reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if shown).

00445.91 Payment - The accepted quantities of pipe and related work items performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	____ inch _____ Pipe, _____ Depth	Foot
(b)	____ inch _____ Pipe	Foot
(c)	Pipe Tees, _____ inch	Each
(d)	Pipe Wyes, _____ inch	Each
(e)	Slip Joints, _____ inch	Each
(f)	Sloped End Sections, _____ inch	Each
(g)	Safety End Sections, _____ inch	Each
(h)	Concrete Pipe Anchors	Each
(i)	Concrete Closure Collars	Each
(j)	Concrete in Blocks	Cubic Yard
(k)	Reinforcement in Blocks	Lump Sum or Pound
(l)	Video Inspection	Foot
(m)	Installing _____ inch Pipe Under Railroad	Lump Sum

In item (a), the nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank. The appropriate flow line depth range will be inserted in the third blank.

Item (a) includes pipe 72 inches and smaller in diameter.

In item (b), the nominal pipe diameter will be inserted in the first blank. For arch type pipe, the nominal diameter of circular metal pipe from which the pipe arch is formed, or reformed, will be inserted in the first blank. The type of pipe will be inserted in the second blank.

Item (b) includes pipe larger than 72 inches in diameter.

In items (c) and (d), the nominal pipe size will be inserted in the blank.

In item (e), the outer sleeve slip joint size will be inserted in the blank. The inner sleeve will be included in payment made for the smaller pipe.

Item (g) includes safety bars when required.

Item (j) includes reinforcement if there is no item listed for reinforcement in blocks in the Contract Schedule of Items.

In item (m), the nominal pipe diameter will be inserted in the blank.

Item (m) includes all additional work involved in placing pipe under existing railroad tracks as specified within the limits shown.

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

Excavation and backfill for pipes greater that 72 inches in diameter will be paid for according to Section 00510.

Trench resurfacing will be paid for according to 00495.90.

No separate or additional payment will be made for:

- trench excavation, bedding, pipe zone material, and trench backfill for pipes 72 inches and less in diameter
- pipe plugs, stoppers, and other required fittings
- metal pipe anchors
- tracer wire
- hydrostatic, air, joint, and deflection testing

When the Contract Schedule of Items does not indicate payment for pipes or other work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00450 - Structural Plate Shaped Structures

Description

00450.00 Scope - This work consists of constructing structural plate pipe, pipe arches, plate arches, horizontal ellipses, vehicular underpasses and special shaped structures.

00450.01 Definitions:

Structural Plate Pipe - Built-up pipe with a circular cross section of the type, thickness and diameter specified. It is fabricated with the vertical diameter about 5% greater than the nominal diameter shown on the plans.

Structural Plate Pipe Arch - Built-up pipe with a cross section made up of a multi-centered shape of four circular arcs, tangent to each other at their junctions, symmetrical about the vertical axis, and of the type, thickness and span specified. The size is designated by span and rise, measured from the inside crests of corrugations.

Structural Plate Arch - Single or multiple radius structures comprised of a number of curved metal plates that form an arch shape when assembled. The structure is designed to be supported along its lower edges on separately constructed reinforced concrete foundations, and of the design, type, thickness and span as shown. This size is designated by span and rise measured from the inside crests of corrugations.

Structural Plate Horizontal Ellipse - Built-up pipe in an elliptical shape with the horizontal diameter approximately 20% greater than the nominal diameter. The size is designated by span and rise, measured from the inside crests of corrugations.

Structural Plate Vehicular Underpass - Built-up pipe in a high arch shape with large radius sides and invert, and small radius corners between sides and invert. The size is designated by span and rise, measured from the inside crests of corrugations.

Materials

00450.10 Materials - Furnish materials meeting the following requirements:

Aluminum Alloy Structural Plates	02430.20
Bolts, Nuts, and Washers	02430.90
Commercial Grade Concrete	00440
Galvanized Structural Plates	02430.10
Reinforcement	00530

Construction

00450.40 Trench Work - Excavate trench, prepare bedding, backfill and dispose of excavated material according to Section 00510 and the following:

(a) Trenches In Unstable Areas - Excavate unstable materials under the pipe or pipe arch and to a width of at least one-half the diameter or span width on each side of the structure, to depths below the established elevation for the bases or foundation of the structure, as directed. Unless otherwise directed, backfill with granular structure backfill. Bring the backfill material to the moisture content required for compaction and place in 6 inch layers. Compact each layer according to 00330.43. Bring the backfill material to the elevation established.

(b) Trenches in Unyielding Material - When rock, hardpan or other unyielding material is encountered, remove it below the designated grade, as ordered, to a depth under the pipe or pipe arch equal to at least 1/2 inch per foot of fill height over the top of the pipe, but not less than 8 inches, nor more than three-fourths the vertical dimension of the structure. Unless otherwise directed, backfill with granular structure backfill.

00450.41 Installation in Paved Areas - If structures are installed within paved areas to be preserved, resurface according to Section 00495.

00450.42 Erection:

(a) General - Assemble corrugated metal plates at the site of installation to the lines and grades shown or directed. Connect the plates at longitudinal and circumferential seams with bolts. Stagger joints so that no more than three plates come together at any one point. Each plate shall be curved to one or more circular arcs as required, and according to 02430.10, to provide an assembled structure of specified dimensions and design.

Retain any camber specified for the invert when assembling and erecting the structures. Do not create an adverse grade in the structure.

(b) Plate Thickness - The thickness of the respective top, corner and bottom plates in any one structure shall be as shown.

(c) Bolts - Use at least 4 bolts per foot of longitudinal seam. Space bolts at circumferential seams not more than 12 inches apart. Use additional bolts for special conditions of installation if called for in the Special Provisions or by the plans. Unless otherwise allowed, place all bolts with nuts on the inside of the structure.

(d) Assembly - Assemble structural plate structures according to the manufacturer's assembly instructions and the following:

- Hold the unsupported edges of all plates in position by temporary props.
- Extend each row of side plates far enough to support the plate above until the first complete ring has been assembled.
- Progressively install enough bolts to hold the plates in position. Do not tighten bolts until tightening will not interfere with adjusting and matching of additional plates and sections.
- Do not damage the galvanizing or other protective coating when using drift pins or pry bars. Repair any damage at no additional cost to the Agency.
- After all plates are in place, progressively and uniformly tighten the bolts from one end of the structure to the other end of the structure.
- Tighten bolts to at least 100 foot pounds of torque for plates 0.188 inch thick or less, and 150 foot pounds of torque for plates more than 0.188 inch thick.
- Recheck and retighten as necessary before backfilling.
- Do not torque bolts above 300 foot pounds during tightening.

(e) Damaged Coating - Repair damaged galvanizing according to 02420.10(d).

00450.44 Arch Substructures and Headwalls - Rest each side of each arch in a groove formed in the concrete, or rest on a galvanized angle or channel securely anchored to or embedded in the substructure. If the span of the arch is greater than 15 feet or the skew angle is more than 20 degrees, provide a metal bearing surface having a width at least equal to the depth of the corrugation.

Metal bearings may be either rolled, structural, or cold-formed galvanized angles or channels, and shall be at least 3/16 inch thick. Anchor the horizontal leg securely to the substructure on 24 inches centers or less. When the metal bearing is not embedded in a groove in the substructure, punch one vertical leg and bolt to the bottom row of plates.

00450.45 Strutting - If strutting is required, place and remove according to 00445.44.

00450.46 Backfilling - Backfill and compact the trench according to 00510.48(d) and the following:

(a) General - Perform backfilling so that a vertical elongation between 4% and 6% greater than the indicated normal diameter is maintained. Place backfill material evenly on both sides of the structure at least up to the three-quarter point of the structure. Fill above the top of the pipe with minimum cover as indicated on the fill height table included with the plans.

(b) Exposed Pipe - Place and compact embankment materials at exposed pipes according to Section 00445.

(c) Tell-Tales - Install and remove tell-tales according to Section 00445.

(d) Arches And Horizontal Ellipses - In addition to the other provisions of this subsection, exercise care as follows:

(1) Before Headwalls Are Placed - If backfilling pipes before headwalls are built, place the first backfill material midway between the ends, forming as narrow a ramp as possible until the top of the pipe is reached. Build the ramp evenly from both sides, and compact the backfill material as it is placed. After the ramps have been built to the top on each side of the pipe, deposit the remainder of the backfill evenly on both sides from the top of the pipe both ways from the center to the ends.

(2) After Headwalls Are Placed - If headwalls are built before the pipe is backfilled, place the first backfill material adjacent to one headwall until the top of the pipe is reached. Then deposit backfill material evenly on both sides from the top of the pipe toward the other headwall.

In multiple installations, follow the above procedures. Use care to place and bring the backfill up evenly on each side of each pipe to avoid unequal pressure.

Compact the backfill material thoroughly, but not excessively. Using water to hydraulically consolidate the backfill by ponding or jetting the backfill material is not allowed.

00450.47 Footings and Headwalls - Construct footings and headwalls for arches according to the design shown and the requirements of Sections 00440 and 00530.

00450.48 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe will be in contact with portland cement concrete, give the contact surfaces of the aluminum pipe a coating of asphalt mastic according to 00445.47.

00450.49 Work Quality - The following defects constitute poor work and the presence of any in an individual culvert plate or in a shipment will be cause for rejection:

- Dents or bends in the metal itself
- Illegible brand
- Loose or unevenly lined or spaced bolts
- Ragged edges
- Unrepaired, bruised, scaled or broken spelter coating

- Uneven laps
- Variation from the specified alignment
- Wrong plate location

Measurement

00450.80 Measurement - The quantities of structural plate pipes, pipe arches, arches, horizontal ellipses, and vehicular underpasses will be measured on the length basis, excluding overlaps and the lip of plates at structure ends. Pipe arches and arches will be measured along the bottom centerline of the structures. The length of structural plate pipes, horizontal ellipses, and vehicular underpasses will be the average of the top and bottom centerline measurements.

Concrete for footings and headwalls will be measured on the volume basis, and will be the volume within the neat lines of the structure as shown.

Excavation and backfill for pipes greater that 72 inches in diameter will be measured according to Section 00510.

Trench resurfacing will be measured according to 00495.80.

Reinforcement for footings and headwalls will be measured on the weight basis according to 00530.80.

Payment

00450.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	_____ inch Structural Plate Pipe	Foot
(b)	____ inch x ____ inch Structural Plate Pipe Arch	Foot
(c)	____ inch x ____ inch Structural Plate Arch	Foot
(d)	____ inch x ____ inch Structural Plate Ellipse	Foot
(e)	____ inch x ____ inch Structural Plate Vehicular Underpass	Foot
(f)	Structural Plate Concrete Footings and Headwalls	Cubic Yard

In item (a), the nominal size diameter of the pipe will be inserted in the blank.

In items (b), (c), (d) and (e), the size of the span and rise of the structures will be inserted in the applicable blanks.

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

Excavation and backfill for pipes greater that 72 inches in diameter will be paid for according to Section 00510.

Trench resurfacing will be paid for according to 00495.90.

Reinforcement for footings and headwalls will be paid for according to 00530.90.

No separate or additional payment will be made for trench excavation, bedding, pipe zone material, and trench backfill for pipes 72 inches and less in diameter.

Section 00460 - Paved Culvert End Slopes

Description

00460.00 Scope - This work consists of constructing portland cement concrete paved culvert end slopes at locations indicated on the plans or where designated.

Materials

00460.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete 00440
Curing Compound.....02050
Welded Wire Fabric 02510.40

Construction

00460.40 General - Construct paved culvert end slopes according to Section 00440 and the following:

- Shape the base on which the concrete is to be placed to the lines and grades established. Water and compact the areas before placing concrete.
- Finish the surface of the paved culvert end slopes to a smooth, uniform texture by troweling and floating and then brush the surface with a broom or burlap, as directed.

Measurement

00460.80 Measurement - The quantities of paved culvert end slopes will be measured on the area basis. Measurement will be based on the paved end slope area table identified on the plans. No actual field measurement will be made, except to check the work, unless changes are ordered. No allowance will be made for paved culvert end slopes which are constructed on a skew.

If changes are ordered and made in the work, those paved culvert end slopes that are changed will be measured in the field. Measurements will be based on the actual surface area of the paved culvert end slope (not including the culvert opening) plus the face area of the cut-off wall.

Payment

00460.90 Payment - The accepted quantities of paved culvert end slopes will be paid for at the Contract unit price, per square foot, for the item "Paved Culvert End Slopes".

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

Section 00470 - Manholes, Catch Basins, and Inlets

Description

00470.00 Scope - This work consists of constructing manholes, catch basins, inlets, siphon boxes, slope protectors, and other similar structures. Construct the structures of commercial grade concrete, corrugated metal, or other material, with necessary frames, covers, gratings, and other fittings and hardware.

References to manholes, inlets, siphon boxes, and slope protectors 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 shall be cast-in-place or precast, as shown or specified. Concrete inlets and siphon boxes may be either cast-in-place or precast.

Materials

00470.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete	00440
Concrete Drain Tile	02410.40
Corrugated Metal Pipe	02420.10, 02420.40
Joint Material	02440.40, 02440.50, 02440.60
Metal Frames, Grates, Covers, and Ladders	02450.30
Nonreinforced Concrete Pipe	02410.10
Polyethylene Pipe	02410.60
Polyvinyl Chloride (PVC) Pipe, Schedule 40	02410.70
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.

Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material to be supplied to the Project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 497.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

42 inch	54 inch	72 inch	96 inch	132 inch
48 inch	60 inch	84 inch	120 inch	144 inch

Heights of sections shall be multiples of 6 inches, except heights of manhole sections 72 inches through 96 inches in diameter shall be as required to fit site conditions.

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.

00470.13 Inside Drop Manhole Connectors - Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

00470.14 Pipe and Fittings - Furnish pipe and fittings as specified and conforming to the applicable portions of Section 00445. Use tees, ells and other fittings for drop manholes made from the same material as the pipe connecting to the manhole.

00470.15 Pipe Stubouts for Future Sanitary Sewer Connections - 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 Sanitary Sewer Manhole Carry-Through - All sanitary sewer carry-through pipes and fittings through storm sewer manholes shall be ductile iron conforming to Section 02420.

00470.17 Base Drain Backfill - Furnish aggregate base or selected granular backfill material that is free from silts or other fines.

Construction

00470.40 General:

(a) Excavation, Backfill and Foundation Stabilization - Excavate and backfill according to Section 00405. When specified, or as directed, remove unstable material that will not support the manhole or other structure, excavate below grade and backfill with trench foundation stabilization material according to Section 00405.

(b) Pipe Connections - Place connecting pipe at the required alignment and grade. 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. Connect all pipe to manholes according to the manufacturer's recommendations.

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.

Connect flexible pipe to sanitary manholes using an approved adapter specifically manufactured for the intended service. Use only flexible pipe adapters from the QPL. 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.

00470.41 Precast Concrete Manholes - Precast manhole components may be used to construct standard, drop and carry-through manholes.

(a) Bases - If bases are cast in place, consolidate the concrete by mechanical vibration. Screed off the concrete so that the first manhole section to be placed has a level, uniform bearing for the full circumference.

If bases are precast, 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 the initial set has been achieved.

(b) Precast Manhole Sections - Thoroughly wet all lift holes, completely fill with nonshrink grout, and smooth and point both inside and out to ensure watertightness.

(1) Sanitary Manholes - Use preformed plastic or rubber gaskets on all joints between manhole sections.

(2) Storm Manholes - Non-shrink grout is allowed on joints, and on extension rings above the cone. In roadways and other areas intended for traffic, a minimum of one diameter precast riser is required between the cone and manhole cover frame.

When grout is used do the following:

- Clean and wet the surfaces to be joined with water.
- Apply non-shrink grout to the lower portion of the bell or groove of the section already laid and to the upper portion of the spigot or tongue of the section being laid.
- Clean the joint recesses, fill completely with non-shrink grout and wipe to a smooth finish both inside and out.
- Do not allow free water to come in contact with grout joints within 24 hours after the mortared joints are finished.
- Protect the completed joints against rapid drying.

(c) Grates, Frames, Covers and Fittings - Set metal frames for manholes on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. 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.

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 manholes, inlets, siphon boxes and concrete slope protectors 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.

(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).

00470.45 Steps and Ladders - Fasten steps and ladders to the manhole walls according to the manufacturer's recommendations and as shown.

00470.46 Corrugated Pipe Slope Protectors - Construct corrugated metal slope protectors according to the plans and the applicable requirements of Section 00445.

00470.47 Concrete Inlet Base Drains - Provide concrete inlets with base drains leading from abutting aggregate base or selected granular backfill material.

Use nonreinforced concrete pipe, concrete drain tile, polyethylene pipe 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 keep clean until final acceptance of the work.

00470.71 Sanitary 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. 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. 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:

Minimum Test Times For Various Manhole Diameters

	Diameter (inches)								
	30 or less	**33**	**36**	**42**	**48**	**54**	**60**	**66**	**72**
Depth * (feet)	**Time ** (s)**								
8 or less	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	35	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

* Depth is measured from the top of the manhole to the lowest invert.
** Test times for manhole depths between those shown in this table may be calculated by interpolation.

Measurement

00470.80 Measurement - The quantities of manholes, inlets, catch basins, siphon boxes, slope protectors, and other structures will be measured on the unit basis.

Payment

00470.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Concrete Sanitary Sewer Manholes	Each
(b)	Concrete Storm Sewer Manholes	Each
(c)	Concrete Manholes, _____	Each
(d)	Concrete Inlets, Type _____	Each
(e)	Concrete Siphon Boxes	Each
(f)	Concrete Diversion Boxes	Each
(g)	Concrete Irrigation Boxes	Each
(h)	Concrete Junction Boxes	Each
(i)	Concrete Monument Boxes	Each
(j)	Manhole Slope Protectors	Each
(k)	Catch Basins, _____	Each

In items (c), (d) and (k) the type of structure will be inserted in the blank.

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

00470.90

No separate or additional payment will be made for:

- earthwork not covered as trench or ditch excavation
- pipe connections
- rock backfill
- aggregate base backfill
- drain tile
- acceptance testing

Section 00475 - Drain Wells

Description

00475.00 Scope - This work consists of drilling 8 inch diameter drain wells, including furnishing and installing steel well casings, at the locations and to the depths shown, for the purpose of intersecting large voids in underlying rock.

Materials

00475.10 Well Casing - Furnish NPS 8 inch, Schedule 40 black steel well casing pipe meeting the requirements of ASTM A 53.

Construction

00475.40 General - Drill the drain wells at the locations and to the depths directed, before constructing manholes and inlets.

Test each drain well by running water into it to determine if the well has sufficient capacity. The well shall have a capacity of at least 400 gallons per minute for eight continuous minutes.

Measurement

00475.80 Measurement - The quantities of drain wells will be measured on the unit basis.

The quantities of drain wells deeper than 100 feet will be measured on the length basis, for the amount greater than 100 feet.

The quantities of steel well casings will be measured on the length basis.

Payment

00475.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	8 Inch Drain Wells	Each
(b)	Extra for 8 Inch Drain Wells Deeper Than 100 Feet	Foot
(c)	NPS 8 Inch Steel Well Casing	Foot

Item (a) includes all costs involved in drilling 8 inch drain wells up to 100 feet in depth.

Item (b) includes all extra costs involved in drilling in excess 100 feet in depth. The Contractor will not be entitled to extra or additional payment if it is not necessary to drill deeper than 100 feet.

Item (c) includes all costs involved in furnishing and installing steel well casings.

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

No separate or additional payment will be made for testing drain wells or for the water or other materials used in the work.

Section 00480 - Drainage Curbs

Description

00480.00 Scope - This work consists of constructing mechanically extruded curbs using either commercial grade concrete (CGC) or asphalt concrete material.

Construct the curbs at the locations and to the lines, grades and dimensions shown on the plans or as directed.

Materials

00480.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete 00440
Emulsified Asphalt 02710
Epoxy Bonding Agent 02070.10
Preformed Expansion Joint Filler 02440.10

00480.11 Asphalt Concrete - Furnish a dense graded, Level 2, 1/2 inch asphalt concrete mixture meeting the requirements of Section 00744. The mixture may be varied when conditions require it, if approved by the Engineer. The mixture will be accepted visually 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 QPL 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 QPL, 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 allowed.

(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 Measurement - The quantities of drainage curbs will be measured on the length basis, for each continuous run measured along the line and grade of the curb.

Payment

00480.90 Payment - 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, and for furnishing all equipment, 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 work, repairing or abandoning of sewer lines and structures, and adjusting existing manholes, inlets, boxes and other similar structures. Remove and dispose of pipe, manholes and catch basins that are scheduled for removal according to Section 00310.

00490.01 Descriptive Terms:

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 or similar structure designed to permit entry and working space, usually at intersections of sewer pipes.

Manhole Neck - The upper portion of a manhole, having vertical walls and a uniform diameter or dimension just sufficient to receive and support the metal frame.

Materials

00490.10 Materials - Furnish materials of either existing materials in a condition suitable for reuse and meeting current design, or new materials meeting the following requirements:

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 - Furnish high early strength concrete meeting the requirements of commercial grade concrete, except it shall contain a minimum of 705 pounds per cubic yard of Type III or Type IIIA cement or an approved Type C or Type E admixture with a minimum of 592 pounds per cubic yard of Type I or Type II cement.

Construction

00490.40 General - 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 poured around frames, paint the portion of the frame that will contact 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.

New construction shall conform to Section 00470.

Repair, replace or restore to existing condition any manhole or similar structure backfill, inlet base drain, aggregate base or pavement disturbed or fouled by the adjustment work as directed.

Bypass pump sanitary sewer and stormwater flows around the pipe section or manhole being repaired or replaced by plugging an existing upstream manhole and pumping the flow around the work to a downstream manhole. Submit a bypass pumping plan to the Engineer at least 48 hours before beginning bypass pumping. Use a pump with adequate capacity to handle existing flows and additional flow due to rain. Pumps shall not exceed a noise level of 86 dB at a distance of 50 feet. Do not operate bypass pumps at night except in an emergency. Do not discharge raw sewage onto private property or city streets, or into storm drain systems.

00490.41 Manholes over Existing Sewers:

(a) General - Construct manholes according to Section 00470. Test all sanitary sewer manholes according to Section 00470.

Prevent material or debris from entering the line.

When required, provide all diversion facilities and perform all work necessary to maintain flow in existing lines. Obtain the Engineer's approval prior to diverting flows.

(b) Manholes over Existing Rigid Pipe Sewers - Construct manholes over existing rigid sewers after first cleaning and applying an approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole.

If the top of the existing rigid pipe is to be cut out, cut it to the springline for the full width of the manhole. Smooth and point the exposed edge of pipe with mortar.

Make rigid sewer pipe connections using an acceptable pipe connection according to Section 00470.

(c) Manholes over Existing Flexible Pipe Sewers - Construct manholes over existing flexible sewers systems with approved water stops, watertight fittings or boots at connections with the existing flexible sewer.

If approved, manholes may be constructed over existing PVC sewers and sealed at the manhole wall using the following method:

- Apply a coating of PVC solvent to the pipe that will be in contact with the manhole.
- Apply a dense coating of clean mortar sand over the PVC solvent cement.
- After the cement has cured, apply a commercial concrete bonding agent to the sand prior to placement of concrete.

(d) Manhole Connections - Core or sawcut 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.

00490.42 Service Line Connections to Existing Sanitary Sewers - 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 with stainless steel bands.

Where tees or wyes for connection are absent or unusable, connect service lines with approved commercial taps. Do not backfill any tap until it is inspected and approved by the Engineer.

Install taps by coring without protrusion into, or damage to, the existing sewer. Support the sewer and replace bedding material, as necessary, to prevent settlement of the sewer grade.

00490.43 Abandoning Pipe in Place - Drain abandoned pipes and plug watertight. Plug abandoned pipes with gasketed mechanical plugs or grout seals, as directed. Where abandoned pipes connect to sewer manholes, install the plugs or seals from the inside of the manhole and reshape the channel to conform to the Standard Drawings.

Fill abandoned pipes greater than 12 inches diameter with sand, controlled low-strength material meeting the requirements of 00442, or other approved material.

00490.44 Filling Abandoned Pipes, Manholes and Catch Basins - Cap or plug all connecting pipes to manholes and catch basins that are scheduled to be abandoned. Remove the manhole cone or flat top and manhole sections, or the catch basin frame, to a minimum depth of 3 feet below finish grade and fill the remaining manhole barrel or catch basin with granular material meeting the requirements of Section 02630. Compact the granular material to 90% of maximum density according to AASHTO T 99. 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 1 foot of backfill.

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 Agency, 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.

00490.46 Adjusting Manholes:

(a) 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.

(b) 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.

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.

(c) Raising Tops of Manholes - The top of the manhole may be raised by the use of riser rings or by reconstructing the neck. Fabricated metal rings and plates may be furnished and used in the adjustment work, provided that:

- The metal and its fabrication provide at least the strength and support required for covers or grates.
- Uniform bearing of bearing surfaces is assured.
- Positive safeguards are made against displacement when in service.

Do not exceed 24 inches total distance from the top of the metal frame at its new adjusted grade to the top of the cone. Riser rings and repairs shall conform with the requirements of Section 00470. Extend manhole barrels of brick, block or concrete in kind.

(1) Concrete Manholes - Reconstruct the neck of the manhole as follows:

- Remove existing frames, covers and grates.
- Chip away the exposed top surface on which new mortar or concrete is to be placed, to a depth of 1 1/2 inches or until firm concrete is exposed.
- Clean the new surface by brushing, and moisten with water at the time of placing new concrete.
- Place new concrete to the required grade and cure at least three days when using commercial grade concrete, and as directed when using high early strength concrete.
- Seat the frame in fresh mortar and bring to the proper grade.

(2) Masonry Manholes - Reconstruct masonry manholes of bricks or concrete blocks as follows:

- Raise with new bricks, blocks, precast components, mortar or combinations thereof, or with concrete, as conditions warrant.
- Do not place mortar for building up existing masonry to a depth of more than 3 inches.
- Do not place concrete to a depth of less than 3 inches.
- To conform to these requirements, cut down as necessary the existing shells or walls of structures to be adjusted to provide space for the new construction.

(d) Lowering Tops of Manholes (Minor Adjustment) - When the adjustment does not require removal of the cone or flat top, proceed as follows:

- Expose the top of the structure to the required depth.
- Cut off or remove elements of the structure to an elevation below that established for the bottom of the metal frame or cover.
- Build up with mortar, concrete, brick or concrete blocks to the required elevation.
- Join new material to old as specified in above under (a) through (c).

(e) Metal Manholes - Adjust metal manholes to grade by resetting the entire structure on a firm foundation, by adding extensions of like design and material, or by severing the barrel in an acceptable manner. Salvaged structures not reused on the Project become the property of the Contractor.

00490.47 Adjusting Catch Basins and Inlets:

(a) Cast-in-Place Concrete Catch Basins and Inlets:

- After existing frames and grates or covers have been removed, chip away the exposed top surface to expose firm concrete. Provide at least 1 inch clearance below the frame to be placed.
- Clean the new surface by brushing and moistening with water at the time of placing new concrete.
- Provide the necessary forms to maintain existing structure dimensions in the new work.
- Place new concrete according to Section 00440 to the required grades. The frame may either be preset in the form or placed in the fresh concrete to the required grades.
- Finish the concrete top surfaces as required to match the grades required.
- Grout existing and new inside surfaces as required to attain a uniform surface transition.

(b) Precast Concrete Catch Basins and Inlets - The entire precast structure may be reset to a new grade when the nature of the structure and conditions permit.

Precast concrete sections may be added or removed as required to obtain proper grade.

Precast structures may be raised by using precast sections provided that:

- The material conforms to the general requirements of the existing structure.
- Sections are set and joined to each other and to existing sections.
- Uniform bearing of bearing surfaces is assured.
- Positive safeguards are made against displacement when in service.

(c) Catch Basin Connections - Adjust as follows:

- Place connecting pipe at the required line and grade.
- Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.
- Connect to the structure with a watertight joint.

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 1/4 inch from the finish grade and cross section at any point along the straightedge.

Measurement

00490.80 Measurement - The quantities of adjusted and reconstructed manholes inlets, boxes, and other similar structures will be measured on the unit basis.

The quantities of manholes over existing sewers, connections to existing structures, and filling abandoned structures will be measured on the unit basis.

Payment

00490.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Minor Adjustment Of Manholes	Each
(b)	Major Adjustment Of Manholes	Each
(c)	Adjusting Inlets	Each
(d)	Adjusting Boxes	Each
(e)	Adjusting Catch Basins	Each
(f)	Manholes Over Existing Sewers	Each
(g)	Connection To Existing Structures	Each
(h)	Filling Abandoned Structures	Each

Item (a) applies to manholes adjusted by adding or removing precast or metal grade rings.

Item (b) applies to manholes adjusted by:

- removing and reconstructing part or all of the cone or flat top
- removing and replacing the entire cone or flat top
- adding precast risers below the cone of precast manholes

Item (f) applies to manholes that are installed over existing sewers.

Item (h) applies to filling abandoned pipes, manholes, inlets, boxes and other similar structures.

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

No separate or additional payment will be made for:

- earthwork
- backfill
- protective coatings
- replacement of manhole or similar structure backfill
- base drains
- aggregate bases
- pavements
- connections
- structure abandonment
- removing and disposing of existing structures and pipe
- bypass pumping

Section 00495 - Trench Resurfacing

Description

00495.00 Scope - This work consists of resurfacing pipe trenches, including replacement of pavement, curbs, sidewalks, rock surfacing, topsoil, landscaping and other features removed or damaged during pipe trenching operations.

Materials

00495.10 Materials - Furnish trench resurfacing materials that either match existing material removed from pipe trenches, or new materials meeting the following requirements:

Aggregate	00641
Concrete Paving	00756
Concrete Sidewalks, Curbs, and Driveway	00759
Emulsified Asphalt Concrete (EAC)	00735
Emulsified Asphalt Prime Coat	00705
Emulsified Asphalt Surfacing	00710
Emulsified Asphalt Tack Coat	00730
Hot Mixed Asphalt Concrete (HMAC)	00745
Rock Surfacing	00641
Topsoil, Planting, and Seeding	01040

Furnish sand used for edge sealing that is clean sand with no visible sign of silts or organic materials.

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 00745.

(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 mix may be used if approved.

(c) Emulsified Asphalt Prime Coat - Construct emulsified asphalt prime coat according to Section 00705.

(d) Emulsified Asphalt Surfacing - Construct emulsified asphalt surfacing treatment according to Section 00710.

(e) Edge Sealing Tack Coat Application - Seal all adjoining asphalt concrete pavement surfaces with an edge sealing tack coat. Place sufficient tack coat to seal the adjoining surfaces. After the tack coat has been placed, place clean sand over the tack coat. Reapply additional tack coat and sand cover to any edges that are not completely sealed in the first application.

(f) Aggregate Base - Place aggregate base according to Section 00641.

(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 00641.

(j) Topsoil - Place topsoil according to Sections 00405 and 01040.

(k) Landscaping - Place landscaping according to the requirements of Section 01040.

Measurement

00495.80 Measurement - The quantities of trench resurfacing will be measured on the area basis. The length will be measured horizontally along the centerline of the installed pipe from edge to edge of the surface replaced. The width will be measured from edge to edge of the top of the trench.

When the pipe is installed under pavement by tunneling, boring, or jacking methods, the work will be measured according to 00406.80.

Payment

00495.90 Payment - The accepted quantities of trench resurfacing will be paid at the Contract unit price, per square yard, for the item "Trench Resurfacing".

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

No separate or additional payment will be made for replacement of disturbed landscape items.

When the pipe is installed under pavement by tunneling, jacking, or boring methods, the work will be paid for according to 00406.90.

When the Contract Schedule of Items does not indicate payment for trench resurfacing or other work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

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PART 00500 - BRIDGES

Section 00501 - Bridge Removal

Description

00501.00 Scope - This work consists of removing and disposing of existing bridges or portions of existing bridges as shown or specified.

Construction

00501.40 Removal and Disposal - Perform removal and disposal work according to Section 00290 and Section 00310.

Measurement

00501.80 Measurement - No measurement of quantities will be made for bridge removal work performed under this Section.

Payment

00501.90 Payment - The accepted quantities of bridge removal work will be paid for at the Contract lump sum amount for the item "Bridge Removal Work".

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

Section 00503 - Bridge Deck Cold Plane Pavement Removal

Description

00503.00 Scope - This work consists of removing existing pavement from bridge deck surfaces.

Equipment

00503.20 Equipment for Grinding on Bridge Decks - To remove pavement from bridge decks, use power-operated diamond grinders, micro-milling equipment, or hydroblast machines capable of uniformly removing the existing surface to the depths required.

(a) Diamond Grinders - Diamond grinders shall be power-driven self-propelled units with cutting heads made up of diamond cutting blades.

(b) Micro-milling - Micro-milling equipment shall consist of the following:

(1) Cold Plane or Rotomill Grinders - Cold plane or rotomill grinding machines using carbide cutting tools in a rotary drum. Provide equipment with a tooth spacing of not more than 1/4 inch, capable of leaving a smooth, uniform pattern of striations. Limit machines to a gross operational weight of no more than 35 tons and a forward speed to 2.5 feet per minute. Operate at a drum speed of at least 120 RPM.

(2) Shot-Blasters - Mono-directional or bi-directional electric-powered shot blast machines with single or multiple blast wheels.

Machines shall cover at least 2.5 feet per pass, and shall conform to EPA air pollution requirements by containing dust and steel abrasive media. If the equipment is not equipped for simultaneous bi-directional blasting, make separate passes in opposite directions to ensure equal cleaning on all sides of the exposed aggregate. Limit forward speed to 2.5 feet per minute.

(c) Hydroblasting - Hydroblasting equipment shall be capable of removing concrete at a rate and volume acceptable to the Engineer without leaving a striated surface. Remove the entire original deck surface to a minimum depth of 0.125 inch. Demonstrate the removal rate and accuracy of the equipment to the Engineer prior to commencing work.

Construction

00503.40 Pavement Removal on Bridges - Remove pavement from bridges according to the following:

(a) General:

- Before removing the wearing surfaces, do the following:
  - Determine the actual depth of pavement to be removed.
  - Block all deck drains and all catch basins. Do not allow any grinding, chipping, sweeping, flushing, or shot blasting material to enter them.
- Remove material that is within 12 inches of all joints in a manner acceptable to the Engineer. Do not damage any joints.
- Remove AC, laitance, and residual film by approved hand methods in areas that cannot be reached by grinding machines.
- Hydroblast all deck surfaces before placing high performance concrete.

- Repair all damage to abutting concrete surfaces or other surfaces that are damaged by the Contractor's operations at no additional cost to the Agency.

(b) AC Surfacing - Do not grind into the existing concrete bridge deck.

(c) PCC Surfacing - If diamond, cold plane, or rotomill grinders are used, clean the entire surface with a shot blaster after completion of the diamond grinding operation. Provide a final surface that is free of cement paste and sand and has a minimum 0.125 inch depth of exposed large aggregate.

(d) Scheduling - Schedule the work so the full width and length of travel lane pavement can be removed during the same shift. Remove the shoulder area within 24 hours after removing the travel lane pavement.

If the depth of the existing pavement to be removed is over 2 inches, then within the same day construct a wedge of asphalt concrete, at a slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at joints, deck drains, catch basins, and other structures. Maintain wedges as long as the area remains under traffic or until pavement is replaced. Remove and dispose of wedges before placing new surfacings.

00503.41 Surface Tolerance - Test with a 12 foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.

00503.42 Disposal of Materials - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of the material according to 00290.20 unless special sites are specified in the Special Provisions.

00503.43 Maintenance Under Traffic - If the cold planed pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the roadway.

Measurement

00503.80 Measurement - The quantities of bridge deck cold plane pavement removal will be measured on the area basis. The area will be determined by measuring the width and length of the bridge deck surface, measured to the nearest 0.1 foot, and calculated to the nearest square yard.

When the depth of pavement to be removed is variable, the depth is an estimate and will be considered approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00503.90 Payment - The accepted quantities of bridge deck cold plane pavement removal will be paid for at the Contract unit price, per square yard, for the item "Bridge Deck Cold Plane Pavement Removal, _____ Deep".

The depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

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

No separate or additional payment will be made for removing asphalt concrete surfacing from bridge decks for the preparation of waterproofing membrane or for constructing, maintaining, and removing temporary wedges.

Section 00510 - Structure Excavation and Backfill

Description

00510.00 Scope - This work consists of excavating, backfilling and disposing of materials in connection with the construction of bridges, grade separation structures, rigid frame structures, and other major structures. Other major structures under this Section are retaining walls, reinforced concrete box culverts, headwalls, structural plate structures, and pipe culverts, sewers, siphons and irrigation pipes greater than 72 inches in diameter.

This work does not include any earthwork covered under any sections of Parts 00300 or 00400, or any earthwork that may be specifically included and provided for as incidental work for particular items or parts of the work. The construction, measurement, and payment of embankment at bridge ends and engineered fills will be according to Section 00330.

00510.01 Lines, Grades, and Cross Sections - Perform the work to the lines, grades and cross sections shown or as established.

00510.03 Cofferdam Plans, Calculations, and Construction Inspection - Submit stamped cofferdam plans and design calculations according to 00150.35 except as modified by this subsection.

Design cofferdams according to the ODOT Bridge Design and Drafting Manual.

Submit a Cofferdam Design Summary and complete a Cofferdam Design Checklist prepared by the cofferdam design engineer, to accompany the plans and calculations. Include the following in the summary:

- A list of cofferdam members with their capacities and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit 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 except as modified by this subsection.

Design shoring according to the ODOT Bridge Design and Drafting Manual.

Submit a Shoring Design Summary and complete a Shoring Design Checklist prepared by the shoring design engineer, to accompany the plans and calculations. Include the following in the summary:

- A list of shoring members with their capacities and design stresses
- Design loading assumptions for each member
- Design references

Complete the checklist included in the Special Provisions.

Submit 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 - Furnish soil selected from roadbed, ditch, trench, or structure excavations meeting the requirements of 00330.13.

00510.11 Selected Granular Backfill - Furnish granular material selected from roadbed, ditch, trench or structure excavations meeting the requirements of 00330.14.

00510.12 Granular Wall Backfill - Furnish granular wall backfill meeting the requirements of 02630.11.

00510.13 Granular Structure Backfill - Furnish granular structure backfill meeting the requirements of 02630.10.

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
- CDT

Construction

00510.40 Clearing, Grubbing, and Removal Work - In the absence of pay items under Section 00310 and Section 00320, the provisions of those sections apply when applicable. Perform such work as incidental work for which no separate payment will be made.

Clearing, grubbing, and removal limits shall be at least 10 feet outside of the entire structure, including the ends of the structure but within the right-of-way.

00510.41 Structure Excavation - Structure excavation includes:

- Removal of all material necessary for the construction of foundations and substructures as shown or specified.
- Placement of all backfill except granular wall backfill and granular structure backfill.
- Disposal of excavated material not required or suitable for backfill according to 00330.41(a-5).
- Correction, according to recognized practice, of conditions detrimental to the work, including removal of excess water.

Shore, brace, or use cofferdams to protect excavations unless open excavation would not be detrimental to adjacent structures, roadways, or waterways.

If the plans show concrete in footings placed against undisturbed material, make excavation for footings as nearly as possible to neat lines of the footings. Where such material will not stand vertically after excavation and the excavation does not exceed 1 foot outside the footing dimensions, fill all space between the footing and remaining undisturbed material to the top of the footing with footing concrete or granular structure backfill material, as directed. Compact the granular structure backfill to 97% of maximum density, according to 00330.43.

Concrete placed against steel sheet piles in cofferdams or cribs will be considered placed against undisturbed material, whether or not the steel sheets are later removed.

Where practical, excavate rock materials using pavement breakers, rippers, backhoes, other excavation equipment or non-explosive means that preclude breakage of rock materials below and outside of the structure excavation limits. If blasting is required, perform such work in a manner that avoids disturbing rock outside the structure excavation limits. Use controlled blasting techniques for all structure excavation requiring blasting according to Section 00335. Backfill and repair as directed, at no additional cost to the Agency, 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 subexcavated area to the plan elevation according to 00510.46(a).

00510.43 Preservation of Channel - Do not excavate outside of caissons, cribs, cofferdams, sheet piling or sheeting, or disturb the natural streambed unless specified or allowed. Where such excavation is allowed, comply with Section 00405. Do not sidecast any excavated material into the stream.

When allowed, the necessary excavation for placement of riprap outside the perimeter of the footing may be made without the use of cofferdams or cribs, and disposed of according to 00330.41(a-4).

00510.44 Cofferdams and Cribs - Design and construct cofferdams and cribs when shown, specified or determined by the Contractor to be necessary for performing the work in the dry inside them as follows:

- Prepare and submit plans, calculations, summary and checklist for cofferdams or crib designs according to 00510.03.
- Provide interior dimensions for cofferdams and cribs to give sufficient clearance for the inspection of forms.
- When weighted cribs are used to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, provide an appropriate special anchor system such as dowels or keys to transfer the entire weight of the crib into the foundation seal.
- Do not leave cofferdam or crib timber or bracing extending into the substructure concrete.
- Place and cure seal concrete according to 00540.48(e).
- Vent or port, at low water level, any cofferdam that is to remain in place.
- Unless otherwise directed, remove cofferdams or cribs, including all sheeting and bracing, after the completion of the substructure. Do not disturb or damage the finished concrete.

00510.45 Pumping - No pumping of water from the interior of any foundation enclosure will be allowed during the placing of concrete or for a period of at least 24 hours thereafter unless an effective means of eliminating moving water through fresh concrete is employed. Water may then be pumped, if approved.

Do not pump to dewater a sealed cofferdam until the seal concrete meets the requirements of 00540.48(e).

00510.46 Preparation of Foundations - Do not place concrete on prepared foundations without prior approval. Construct foundations as follows:

(a) Backfilled Foundations - Construct the top surface of the foundation fill at least 3 feet beyond the area to serve as a foundation unless otherwise shown or directed. Use selected granular backfill or granular structure backfill as directed. Place in 6 inch layers and compact to not less than 95% of maximum density according to 00330.43.

(b) Undisturbed Soil Foundations - Do not disturb the sides or bottoms of foundation excavations. Place concrete against undisturbed soil when shown. Concrete may be used as backfill, subject to 00540.45(a). If soil is disturbed, compact all disturbed material to 95% of maximum density according to 00330.43.

(c) Formed Foundations on Soil - Do not disturb the bottoms of foundation excavations. If soil is disturbed, compact all disturbed material to 95% of maximum density according to 00330.43.

(d) Rock Foundations - Before placing concrete:

- Clean all rock surfaces and remove loose material
- Clean seams and fractures according to 00510.41, and seal with grout
- Level, step or roughen the rock surface as shown or as directed

Construct formwork, if allowed or required, and place concrete as soon as practical following the removal of material, to the specified elevation.

00510.47 Embankment Construction at Bridge Ends - Construct embankments at bridge ends according to 00330.42(c-7) and, when shown, engineered fills according to 00330.42(c-8).

00510.48 Backfill:

(a) General - Prepare for, place and compact backfill according to 00330.42 and 00330.43, if it becomes a part of a roadway embankment or is to support a roadway, bridge approach end panel, rock slope protection or slope paving, and is not covered by 00510.41, 00510.42, 00510.46, or 00510.47.

Do not place backfill that will cause unbalanced loading on the concrete until the concrete has been in place seven calendar days and test cylinders show the concrete strength to be 100% of design strength according to 00540.17(c).

Do not place backfill against any other concrete until the concrete has been in place three calendar days, and test cylinders show the concrete strength to be 40% of design strength according to 00540.17(c).

Place backfill and riprap in a manner that will not damage the concrete footings, drain pipes, and other permanent work. Do not jet or puddle the backfill unless approved in writing. Prevent large lateral or wedging compaction forces from occurring directly against the concrete.

Dispose of excess materials according to 00330.41(a-4).

(b) Bridge Abutments and Retaining Walls - Backfill at abutments and retaining walls with granular wall backfill to the upper pay limits shown or as directed, and as follows:

- Do not place backfill until superstructure elements are set, pinned and tensioned.
- Place backfill required at the front face of retaining walls before backfilling behind the wall.
- For single span bridges with abutments, keep the backfill heights within 2 feet of each other.
- Place granular wall backfill at all weep holes.

(c) Pier and Column Footings - Backfill piers and columns as follows:

- Use either selected general backfill, selected granular backfill, riprap or other materials as shown or directed.
- Deposit backfill around piers and columns on all sides to approximately the same elevation at the same time.
- Place backfill up to the original ground surface, the upper limits of pay excavation, or as shown or directed.

(d) Reinforced Concrete Box Culverts, Structural Plate Structures and Pipe Culverts Over 72 Inches in Diameter - Provide bedding, if required, according to 00405.12. Use backfill materials conforming to 00510.12 or 00510.13 unless otherwise specified. Place and compact as shown and according to 00405.46. Place backfill up to the surrounding ground surface, to the top of trench, or the upper backfill pay limits shown or as directed.

Measurement

00510.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Shoring, Cribbing and Cofferdams - No measurement of quantities will be made for shoring, cribbing, and cofferdams.

(b) Structure Excavation - Structure excavation will be measured according to the following:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of structure excavation will be listed in the Special Provisions.

(2) Volume - Under this method, structure excavation will be measured on the volume basis in original position (position before excavating).

Quantities will be limited to the neat lines shown, or if not shown, will be limited to the following:

a. Lower Limit - The lower limit will be the elevations shown for the bottoms of structure footings or bases, including bedding, if any.

b. Upper Limits - The upper limit will be determined as follows:

1. Within Embankments - The planes of the new embankment at the elevation specified or established.

2. Within Roadbed or Channel Change Excavations - The planes of the bottoms and side slopes of the excavations.

3. All Other Cases - The ground surface immediately before starting the excavation.

c. Horizontal Limits - The horizontal limits will be the vertical planes parallel to and 1 foot outside the neat lines of the footings or bases of all structures, except for structural plate structures and pipe culverts over 72 inches in diameter, which will be as shown.

When the Engineer approves or directs, structure excavations less than the specified horizontal limits, the measured limits will be the actual excavation made.

(c) Structure Excavation Below Elevations Shown - Structure excavation below elevations shown will be measured according to the following:

(1) Lump Sum - When structure excavation is lump sum basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made as follows:

- **0 to 3 Feet Below Elevations** - For excavation 0 to 3 feet below elevations shown, measurement will be determined according to 00190.10(f) and based on a theoretical unit price of the lump sum structure excavation item.

- **More than 3 Feet Below Elevations** - For excavation more than 3 feet below elevations shown, measurement will be determined according to Section 00196.

(2) Volume - When structure excavation is volume basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made on the volume basis.

Quantity limits will be from the bottom limit described in 00510.80(b-2-a) to the new lower limits of the excavation for the footing or base of the structure, including bedding, if any, established by the Engineer. The horizontal limits will be vertical extensions of the quantity limits established according to 00510.80(b-2-c).

(d) Granular Wall/Structure Backfill - Granular wall backfill and granular structure backfill will be measured on the volume basis, of material used in backfilling as determined by cross section measurement of the materials in place. The quantities will be limited to the quantities placed according to the plans and specifications or as directed. When backfilling excavated areas, the quantities will be limited to the pay limits of the excavation for the part of excavated areas backfilled with the specified granular backfill material.

Payment

00510.90 Payment - The accepted quantities of work performed under this Section will be paid for as follows:

(a) Shoring, Cribbing and Cofferdams - Shoring, cribbing, and cofferdams will be paid for at the Contract lump sum amount for the item "Shoring, Cribbing and Cofferdams".

No separate or additional payment will be made for maintaining and removing all materials.

No separate or additional payment will be made for clearing and grubbing, preparing foundations, pumping, and cleaning up.

If the Engineer orders excavations that extend below the elevation shown, the Contractor will be compensated to extend shoring, cribbing, and cofferdams as follows:

Footing Elevation Changes	Compensation
0 to 3 feet below	No extra payment
More than 3 feet below	Section 00196

When the Contract Schedule of Items does not indicate payment for shoring, cribbing and cofferdams, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

(b) Structure Excavation - Structure excavation will be paid for at the Contract lump sum amount or the Contract unit price, per cubic yard, for the item "Structure Excavation".

Except for granular wall backfill, no separate or additional payment will be made for backfilling and compacting to the elevation specified.

(c) Structure Excavation Below Elevations Shown - Structure excavation below elevations shown will be paid for as follows:

(1) Lump Sum - For excavation 0 to 3 feet below elevations shown, payment will be determined and made according to 00190.10(f). For excavation more than 3 feet below elevations shown, payment will be determined and made according to Section 00196.

(2) Volume - For excavation 0 to 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation".

For excavation more than 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation Below Elevations Shown". If the Contract Schedule of Items does not indicate payment for this work, payment will be determined according to Section 00196.

(d) Granular Wall/Structure Backfill - Granular wall backfill and granular structure backfill will be paid for at the Contract unit price, per cubic yard, for the item "Granular Wall Backfill" or "Granular Structure Backfill", as applicable.

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

No separate or additional payment will be made for:

- removing material forced up between foundation piles during driving or of material used in backfilling around piles, should subsidence occur during driving
- bedding
- excavations made below the elevations established for the bottoms of the footings or bases, including bedding, if any, or for any other unauthorized excavations. Backfill, seal, or otherwise repair these unauthorized excavations with concrete or other material acceptable to the Engineer according to 00510.46 at no additional cost to the Agency.
- water removed from excavations and water used in compaction or other items of work

Section 00512 - Drilled Shafts

Description

00512.00 Scope - This work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts, according to these Specifications and the plans.

00512.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ soil, rock, or a casing.

Permanent Casing - Casing designed as part of the drilled shaft and intended to remain in place after concrete placement is completed.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00512.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

The Foundation Data shown in the plans is a compilation of pertinent information including, but not limited to, the Soils and Geological Exploration Logs.

Materials

00512.10 General - Furnish materials meeting the following requirements:

(a) Reinforcement - Use reinforcement complying with Sections 00530 and 02510.

(b) Concrete - Use Class 4000 structural concrete according to Section 02001, except as modified in this Section.

00512.12 Concrete Mix Design - Design the drilled shaft concrete mix for minimum segregation. Use a pre-approved mix design that meets the slump requirements of Section 02001.

Mix a trial batch and take test cylinders for one 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 1.0 gallon per cubic yard. Retarding or water-reducing agents may be used to maintain specified slump ranges and to facilitate temporary casing extraction. To allow for adequate concrete workability throughout the duration of concrete placement and prior to temporary casing extraction, provide a concrete mix having a slump loss characteristic such that a minimum slump of 4 inches is maintained for the entire duration of the pour. Admixtures may be used if tested and certified in the mix design and if approved.

00512.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A 252 or ASTM A 36. Furnish permanent casing meeting the requirements of ASTM A 36 with the application of supplemental requirement S5. Test each heat of steel at 40 °F with a minimum absorbed energy requirement of 15 foot pounds. Do not use previously used casing for permanent casing. Use casing of sufficient strength to resist handling, transportation and installation stresses and the external stresses of

the subsurface materials. Ensure that the casing is clean and watertight prior to placement in the drilled shaft excavation. Use casing with an outside diameter not less than the specified drilled shaft diameter.

00512.14 Drilling Slurry - Furnish drilling slurry meeting one of the following requirements:

(a) Mineral Slurry - Use mineral slurry conforming to the following requirements:

Property	Test	Requirement
Density	Mud Density API * 13B-1, Section 1	64 - 75 lb./cu. ft.
Viscosity	Marsh Funnel and Cup API * 13B-1, Section 2.2	26 - 50 sec./qt.
pH	Glass Electrode, pH Meter, or pH Paper	8 - 11
Sand Content	Sand API * 13B-1, Section 5	4.0 % max.

Maintain slurry temperature at 40 °F or more during testing.

* American Petroleum Institute

(b) Synthetic Slurries - Select synthetic slurries from the QPL. Use synthetic slurries according to the manufacturer's recommendations and the Contractor's quality control plan. The sand content of synthetic slurry shall be less than 2.0 percent (API 13B-1, Section 5) prior to final cleaning and immediately prior to concrete placement.

(c) Water Slurry - Water may be used as slurry when casing is used for the entire length of the drilled shaft. Use of water slurry without full-length casing will only be allowed with the Engineer's approval. Use water slurry conforming to the following requirements:

Property	Test	Requirement (Maximum)
Density	Mud Weight (Density) API 13B-1, Section 1	70 lb./cu. ft.
Sand Content	Sand API 13B-1, Section 5	2.0 %

Do not use blended slurries.

00512.15 Crosshole Sonic Log (CSL) Access Tubes - Furnish steel crosshole sonic log (CSL) access tubes meeting the following requirements:

- Steel access tubes shall be at least 1 1/2 inch inside diameter Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S.
- Use access tubes having a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of the source and receiver probes used for the testing. Ensure that access tubes are watertight, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Fit the access tubes with watertight caps on the top and bottom.
- Access tube acceptance will be based on manufacturer's certification that the furnished material meets the requirements of this Specification.

00512.18 Grout - Furnish portland cement grout meeting the requirements of Section 02080.

00512.19 Quality Control - Maintain and be responsible for quality control of the drilled shaft work throughout the construction operation. The Engineer will inspect all drilling operations and verify the suitability of all drilled shaft construction procedures. Provide lights, mirrors, weighted tape, weighted probe, personnel, and all assistance required for the Engineer to perform inspection during drilled shaft construction.

Labor

00512.30 Personnel Qualifications - Perform the drilled shaft construction work using a company and personnel experienced in drilled shaft construction work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the companies experience relevant to the Project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth and any special construction techniques required. Also provide the experience qualifications of the company performing the CSL testing. Before the preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction and CSL testing:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last five years, with drilled shafts of diameters and depths equal to or larger than those shown in the plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- On-site supervisors shall have at least two years experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and scope to those shown in the plans and in similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.
- Drill operators shall have at least one year experience in the construction of drilled shaft foundations.
- Perform CSL testing using an independent testing organization retained by the Contractor and approved by the Agency. Furnish personnel experienced in operating the CSL testing equipment. Submit the CSL testing firm qualifications according to 00512.40(a). The CSL testing firm shall have successfully performed CSL testing on a minimum of five projects during the last three years. CSL testing personnel shall be trained in the operation of the CSL equipment and have at least one year of experience in operating CSL testing equipment on a minimum of 10 shafts.

The Engineer will respond within 21 calendar days after receipt of the submittal. Do not begin work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors, drill operators, or CSL testing personnel to the Engineer, who will have seven calendar days to respond to each request. Additional costs resulting from the suspension of work due to the changing of personnel is the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of work will be allowed.

Construction

00512.40 Submittals - Provide the following submittals to the Agency for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 calendar days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.

- A review of equipment suitability based on the Contractor's understanding of the site subsurface conditions. Include a project history of the drilling equipment that demonstrates the successful use of the equipment for drilled shafts of equal or greater size in similar subsurface conditions.
- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include details of the methods and materials used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the casing and surrounding soil, if permanent casing is specified. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft (if applicable).
- Details of the proposed method(s) for ensuring drilled shaft stability during excavation and concrete placement.
- Details for the use of drilling slurry including mix design, slurry head requirements, mixing methods, maintaining, and disposing of the slurry (if applicable). Include a discussion of the suitability of the proposed drilling slurry in relation to the anticipated subsurface conditions.
- A plan for quality control of all drilling slurries, if their use is proposed. In the quality control plan, include property requirements, required tests and test methods to ensure the slurry performs as intended. Submit to the Engineer the name and current phone number of synthetic slurry manufacturer's representatives who will provide technical assistance during construction. Provide the name(s) of the Contractor's personnel assigned to the Project and trained by the synthetic slurry manufacturer in the proper use of synthetics slurries.
- Unstamped reinforcing steel shop drawings and details of reinforcement placement, including bracing, splicing, centering, and lifting methods and the method for supporting the reinforcement on the bottom of the shaft excavation according to 00150.35. Include details on the type, number, and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction. Include details for attaching the CSL test access tubes to the reinforcing cage (if applicable).
- Evidence that the proposed materials and concrete mix design conform to all applicable Specifications.
- Details of concrete placement, including proposed operational procedures for pumping and tremie methods. Include details for grout placement in the crosshole sonic logging test access tubes after testing is completed (if applicable).
- Detailed procedures for permanent casing installation and temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and equipment for casing installation and removal.
- CSL testing company performing the CSL testing work, including documentation demonstrating that the company, and company personnel, meets the required qualifications.
- Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.
- Methods for protecting existing structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 calendar days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 calendar days for approval of modifications. Do not begin drilled shaft construction work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the Agency. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or material of the drilled shafts shown on the plans that are proposed in the repair plan will require stamped calculations and working drawings according to 00150.35.

(c) Drilled Shaft Inspection Reports - Provide the Engineer with a completed Drilled Shaft Inspection Report for each drilled shaft, detailing the actual location, alignment, elevations, dimensions, and quantities of the shafts.

Submit the report within 21 calendar days after the completion and acceptance of each shaft. A "Drilled Shaft Inspection Report" form is available from the Engineer.

(d) Concrete Placement Logs and Volume Curves - Measure and record all concrete placed into drilled shafts using standard ODOT forms designated for this purpose or other forms approved by the Engineer. Provide the Engineer with a completed Drilled Shaft Concrete Placement Log and Concrete Volume Curve Form for each drilled shaft within 24 hours after completion of shaft concrete placement.

00512.41 Drill Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least seven calendar days before beginning any shaft construction work at the site to discuss construction procedures, schedules, staging, personnel, equipment to be used, and other elements of the approved shaft installation plan as specified in 00512.40. If synthetic slurry is used to construct the shafts, the frequency of scheduled site visits to the project site by the synthetic slurry manufacturer's representative will be discussed. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the casing, mixing and installing slurry (as applicable), placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the synthetic slurry shall also attend.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, hold an additional meeting before any additional shaft construction operations are performed.

00512.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown and within the specified tolerances listed below. Determine the drilled shaft dimensions and alignment with approved methods. The following construction tolerances apply to drilled shafts unless otherwise stated:

- **Horizontal Position (At the Plan Elevation of the Top of Shaft):**

  - **Shaft Diameter Less Than or Equal to 6 Feet** - 3 inch horizontal tolerance from the location shown.

  - **Shaft Diameter Greater Than 6 Feet** - 6 inch horizontal tolerance from the location shown.

- **Top Elevation of Shaft Concrete:**

  - **Top Elevation Above Water** - Minus 3 inches to plus 1 inch from the plan top of shaft elevation.

  - **Top Elevation Under Water** - Minus 3 inches to plus 6 inches from the plan top of shaft elevation.

- **Vertical Alignment in Soil** - May not vary from the plan alignment by more than 1.5% of the shaft length.

- **Vertical Alignment in Rock** - May not vary from the plan alignment by more than 2% of the shaft length.

- **Top of Steel Reinforcement** - Plus or minus 6 inches from the plan top of steel reinforcement elevation.

Frequently check the plumbness, alignment, and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary to complete corrections for out-of-tolerance drilled shafts will be at the Contractor's expense, and no extension of the Project completion date will be granted. Materials and work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for as Extra Work.

00512.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls and bottoms for the full depth of the excavation, using approved materials, equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer's satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation:

- Is stabilized at the bottom, sides and surface to prevent soil caving or swelling or a reduction of soil strength, and
- Is covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.

(b) Protection of Existing Structures - Control shaft construction operations to prevent damage to existing structures and utilities. Preventive measures include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation and monitoring and controlling the vibrations from construction activities such as the driving and vibrating of casing or sheeting, drilling of the shaft, or from blasting, if blasting is allowed. Repair all damage caused to existing structures, utilities or other facilities, resulting from drilled shaft construction activities, at no additional cost to the Agency.

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

Where the acceleration coefficient used for seismic design of the structure is less than or equal to 0.10, temporary telescoping casing may be used for the drilled shafts, subject to the following conditions:

- Submit the request to use temporary telescoping casing to the Engineer for approval. Specify the diameters and lengths of the temporary telescoping casing and the shafts where use is requested.
- The minimum diameter of the shaft shall be as shown on the plans.
- Backfill all voids between the temporary telescoping casing and the plan shaft dimensions with a material that approximates the geotechnical properties of the subsurface soils, or with concrete as approved.
- Use temporary telescoping casing material conforming to 00512.13.

(d) Unexpected Drilled Shaft Obstructions - Remove any natural or manmade object encountered that was not revealed by the Agency's site investigation, and that would cause a significant decrease in the rate of advancement if removed using the techniques and equipment used successfully to excavate the shaft. The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and the classification of any unexpected obstructions. Removal of unexpected obstructions from the shaft excavation will be paid as Extra Work.

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid as Extra Work.

(f) Drilling Slurry Installation - If synthetic drilling slurry is selected, provide a manufacturer's representative to provide technical assistance at the site prior to use of the slurry, who shall remain at the site during construction and completion of a minimum of one drilled shaft to adjust the slurry mix for the specific site subsurface conditions. After the manufacturer's representative is no longer at the site, provide the approved personnel trained in the use of the synthetic slurry for the remainder of the shaft slurry operations to supervise the proper slurry mix design and quality control procedures.

All in-hole drilling slurry shall meet the required slurry specifications during excavation and prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

Unless otherwise approved, maintain the level of slurry in the excavation at not less than 5 feet above the groundwater level for mineral slurries or 10 feet above the groundwater level for synthetic or water slurries. Maintain the slurry level a sufficient distance above all unstable zones to prevent bottom heave, caving or sloughing.

Maintain the required slurry properties and levels at all times during shaft construction, including work stoppages, unless other approved stabilization methods are applied.

Feed slurry continuously into the shaft excavation as drilling progresses so that a stable excavation is maintained. Use a self-priming pump to reclaim the slurry. Keep a standby pump available during the drilling operation.

(g) 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.

(h) Clean Out - Use appropriate means, such as a cleanout bucket, pump or air lift, to clean the bottom of the drilled shaft excavations. No more than 2 inches of loose or disturbed material will be allowed at the bottom of the excavation for end-bearing drilled shafts. No more than 6 inches of loose or disturbed material will be allowed at the bottom of the excavation for side friction drilled shafts. Assume end-bearing shafts unless otherwise shown or specified. Shaft cleanliness will be determined by the Engineer.

Notify the Engineer of completion of each drilled shaft excavation to permit inspection before proceeding with construction. Measure final shaft depths with a suitable weighted tape or other approved method after final cleaning to determine that the shaft bottom meets the requirements in the Contract. Do not proceed with shaft construction until the bottom cleanliness requirements have been met and the bottom (shaft tip) elevation is approved.

00512.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel extending from 6 inches above the bottom of the shaft excavation to the elevation shown. The reinforcing cage may be supported on the bottom of the shaft excavation if approved. Support the reinforcing cage to prevent distortion or settlement during concrete placement. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement unless otherwise approved.

(c) Splicing - Splice all drilled shaft reinforcement using approved mechanical splicer's unless otherwise shown or approved.

(d) Concrete Cover - Maintain the required concrete cover shown on the plans by placing concentric spacer bars or other approved devices around the reinforcing cage. Provide details of the proposed centering method on the shop drawings submitted according to 00512.40.

00512.46 Crosshole Sonic Log Test Access Tubes - Furnish and install access tubes for CSL testing as shown. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible in each drilled shaft and in the pattern shown. Extend the access tubes from the bottom of the reinforcement cage to at least 24 inches above the top of the shaft. Joints required to achieve full-length access tubes shall be watertight. Do not damage the access tubes during reinforcement cage installation and concrete placement. Fill the tubes with potable water, according to 02020.10(b), as soon as possible, but no more than one hour after concrete placement and reinstall the top watertight caps. Check water level and top off as needed.

Replace all access tubes that the test probe cannot pass through to the full depth of the shaft at no additional cost to the Agency. Replace all damaged access tubes with 1.5 inch to 2.0 inch diameter holes cored through the concrete for the entire length of the shaft. Unless otherwise directed, locate replacement core holes approximately 6 inches inside the reinforcement. Do not damage the shaft reinforcement during coring operations.

Fill the access tubes with grout only after all CSL testing has been completed and the shaft has been accepted.

00512.47 Concrete - Furnish and place concrete according to the following:

(a) Concrete Placement - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Prior to concrete placement, ensure the shaft clean-out requirements are met according to 00512.43(h) and the properties of the slurry (if used) conform to specifications. Shaft concrete may be placed without mechanical vibration in those areas of the drilled shaft that are not formed or are below the ground line or the water surface.

Place concrete continuously until concrete at the top of the shaft is free of water, soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation. Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement occurs because of a delay in concrete delivery or other factors, reduce the placement rate to maintain a flow of fresh concrete into the shaft excavation.

Unless otherwise approved by mix design, allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter of at least 8 inches. For placement by concrete pump, use hose with inside diameter of at least 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) Dry Shaft Concrete Placement - Concrete may be placed by free-fall if all of the following conditions are met:

- no more than 3 inches of water is present in the bottom of the excavation at the beginning of the pour
- groundwater seepage into the excavation is at a rate of no more than 12 inches per hour
- shaft diameter is greater than or equal to 3 feet

Under free-fall placement, deposit concrete through the center of the reinforcement cage by a method which prevents segregation of aggregates and splashing of concrete on the reinforcement cage. Place concrete so that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars or steel cage bracing.

(c) Wet Shaft Concrete Placement - If the drilled shaft excavation does not meet the requirements for dry concrete placement, stabilize water inflow and place the concrete under water or slurry with a tremie pipe or pump hose according to 00540.48(e). Place concrete continuously from the bottom of the shaft to the top-of-shaft elevation shown. Use a plug in the tremie pipe or pump hose to force water or slurry ahead of the advancing flow of fresh concrete. Dispose of all displaced water, slurry, or waste concrete according to 00290.20. When groundwater, the drilling water or slurry in the shaft excavation is to be removed by pumping during concrete placement, have a standby pump available.

Place concrete in a continuous operation so that the concrete always flows upward within the shaft. Withdraw the delivery hose or pipe slowly as the elevation of the fresh concrete rises in the shaft. Keep the discharge end of the pipe or hose at least 5 feet below the surface of the concrete after the concrete has reached a depth of 5 feet. Maintain sufficient concrete inside the hose or pipe to prevent drilling fluid from entering. During concrete placement, provide and maintain markings on the tremie pipe or pump hose, or a sounding device or other appropriate method to determine the relative elevations of the fresh concrete surface and the bottom end of the pipe or hose. Raise the bottom end of the pipe or hose only when the pipe or hose has a sufficient head of fresh concrete to prevent the formation of a void at the bottom.

(d) Concrete Curing and Cleaning - Allow the exposed top of concrete to cure a minimum of seven calendar days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel, and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the plans. Remove all loose material and poor quality concrete at the top of the shaft down to sound concrete prior to performing any required CSL testing.

(e) Casing Removal - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of at least 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00512.42. Casing that cannot be extracted during, or immediately after, the concrete placement operation may be cause for rejection of the shaft.

Remove the tops of permanent casing to the top of the drilled shaft or the finished groundline, whichever is lower, unless otherwise shown or directed. Remove the tops of permanent casing for shafts constructed in a permanent body of water to the low water elevation, unless otherwise shown or directed.

00512.48 Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the results of CSL, or other, integrity testing (if conducted), field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts. For shafts that are integrity tested, the Engineer will determine final acceptance of each tested shaft, based on the integrity test results and inspection reports and will provide a response to the Contractor within five calendar days after receiving the CSL test report.

(a) Crosshole Sonic Log Testing - Provide crosshole sonic log testing equipment and perform crosshole sonic log testing and analysis on the first drilled shaft completed at each structure and subsequent shafts as specified or designated for testing by the Engineer. Provide CSL testing equipment conforming to the requirements of ASTM D 6760 and approved by the Engineer. Provide all necessary access and other support to the CSL testing firm necessary to do the CSL testing work.

Unless otherwise directed, perform one CSL test on each shaft designated for testing. A single CSL test consists of all ultrasonic profile combinations in a given shaft. Test completed drilled shaft foundations using Ultrasonic Crosshole Testing methods (Crosshole Sonic Log (CSL) Testing) according to ASTM D 6760. Inform the Engineer of scheduled CSL testing at least three calendar days prior to the testing. Perform all CSL testing using the Contractor's CSL technician in the presence of the Engineer.

Allow at least three calendar days of curing time before testing unless otherwise approved. Additional curing time beyond three calendar days may be required if the shaft concrete contains admixtures such as set retarding admixture or water reducing admixture. Additional CSL testing required due to the CSL testing being conducted on concrete that has not cured sufficiently is at no additional cost to the Agency. Additional curing time required due to concrete admixtures will not be grounds for additional compensation or time extensions.

(b) Contractor's CSL Test Reports - Provide a brief summary report of the data, with interpretation of the test results, to the Engineer at the completion of each test. Provide copies (either hardcopies or electronic files) of the raw test data as requested. Mark the test data files to identify, as a minimum, the structure, bent and shaft number, the date of CSL testing, depths of testing and any other pertinent information.

Submit three copies of a final CSL Test Report for each shaft tested according to ASTM D 6760. Provide electronic file copies of the raw CSL data measurements (compatible with the Cross Hole Ultrasonic Monitor (CHUM) program), if requested. The report shall summarize the CSL testing performed, data analysis, and interpretation of CSL data with special attention made to the identification and location of any anomalies or possible defects. Provide interpretation of the CSL test data in terms of overall shaft integrity and acceptance. Submit all reports to the Engineer within five calendar days of the performance of the tests.

(c) Additional Testing and Investigation - Conduct additional testing or investigation necessary to identify the location, extent and condition of possible shaft defects if requested by the Engineer. Additional testing and investigation may include, but is not limited to, additional CSL testing, excavation work or core drilling.

If requested by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. The number, location and depths of the core holes will be determined by the Engineer. Submit the method and equipment used to drill and remove cores from the shaft to the Engineer for review and approval prior to drilling. Use a coring method that provides complete core recovery and

minimizes abrasion and erosion of the core. If a defect is confirmed, as determined by the Engineer, all investigation costs associated with identifying the defect will be at no additional cost to the Agency and no extension of the Project completion date will be granted, regardless of whether the identified defect is repaired or not.

If no defect is identified in the investigation work, and the CSL tubes were satisfactorily installed according to ASTM D 6760 and accepted, the Agency will pay for all coring and excavation costs associated with the additional investigation and grant an appropriate time extension, if required, according to Section 00190 and Section 00195. If it is determined by the Engineer that the CSL tubes were not installed properly thus invalidating the CSL test results, all coring, excavation, and other investigation and evaluation costs will be at no additional cost to the Agency and no extension of the Project completion date will be granted.

Fill all core holes with grout only after the evaluation process is completed and the shaft is accepted and approved.

(d) Drilled Shaft Repair - Repair all defects and rejected shafts according to 00512.40(b). Perform additional CSL testing, or other investigation required, as directed by the Engineer, to confirm the quality of the completed shaft repair work at no additional cost to the Agency with no time extension granted.

For temporary casing not extracted from the shaft excavation, submit a repair plan or a structural evaluation to the Engineer for approval according to 00512.40. If caving occurs during concrete placement submit a repair plan to the Engineer for approval.

00512.49 Scheduling and Restrictions - Unless otherwise approved, do not proceed with construction of subsequent shafts until the CSL testing has been completed on the first drilled shaft and the results have been approved and accepted, in writing by the Engineer. Approval to proceed with the construction of subsequent shafts, before receiving approval of the first shaft will be based on the Engineer's observations of the Contractor's workmanship during construction of the first shaft and the Engineer's review and assessment of the following:

- The Contractor's conformance with the approved shaft installation plan.
- The Contractor's daily reports and inspector's daily logs of excavation, rebar, and concrete placement.
- The concrete placement logs and volume curves.

Written notification will be provided to the Contractor on whether or not to proceed with subsequent shaft construction within 24 hours after completion of the first shaft. If the Engineer determines the first shaft to be of questionable quality, discontinue all shaft construction until the CSL test results of the first shaft are received and reviewed and the shaft accepted, in writing, by the Engineer.

Denial of permission to proceed with subsequent shaft construction will not be cause for contract time extension.

Do not proceed with the third drilled shaft until the final CSL test results from the first drilled shaft has been received and reviewed and the shaft accepted, in writing, by the Engineer.

After the first drilled shaft on the Project has been accepted, make no significant changes in construction methods, equipment, or materials used to construct subsequent shafts, unless otherwise approved.

Measurement

00512.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Furnish Drilling Equipment - No measurement of quantities will be made for furnishing drilling equipment.

(b) Permanent Casing - Permanent shaft casing will be measured on the length basis.

(c) Drilled Shaft Excavation - Drilled shaft excavation will be measured on the length basis by the vertical excavated length from the bottom of the shaft to the ground surface or to the mudline if under water. If the top of the shaft is located below the original ground surface, measurement will be made to the top of the shaft as shown or directed. If directed to excavate drilled shafts below the elevations shown, the drilled shaft excavation will be measured from the revised bottom of shaft.

(d) Drilled Shaft Concrete - No measurement of quantities will be made for drilled shaft concrete. Estimated quantities of concrete will be listed in the Special Provisions.

(e) Drilled Shaft Reinforcement - No measurement of quantities will be made for drilled shaft reinforcement. Estimated quantities of reinforcement will be listed in the Special Provisions.

(f) Crosshole Sonic Log Equipment Mobilization - CSL testing equipment and operating personnel mobilization will be measured on the unit basis for each time the Contractor mobilizes equipment and personnel to the Project for CSL testing as required by the Engineer.

(g) Crosshole Sonic Log Test Access Tubes - CSL access tubes will be measured on the length basis of the number of tubes installed in the shafts.

Grout used to fill the access tubes after the completion of CSL testing will not be measured.

(h) Crosshole Sonic Log Tests - CSL tests will be measured on the unit basis for each CSL test completed, reported, and accepted. No separate measurement will be made for CSL tests performed at the Contractor's option.

Payment

00512.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Furnish Drilling Equipment	Lump Sum
(b)	Permanent Shaft Casings	Foot
(c)	Drilled Shaft Excavation, ____ Diameter	Foot
(d)	Drilled Shaft Concrete	Lump Sum
(e)	Drilled Shaft Reinforcement	Lump Sum
(f)	CSL Equipment Mobilization	Each
(g)	CSL Test Access Tubes	Foot
(h)	CSL Tests	Each

Item (a) includes furnishing and moving the drilling equipment to the Project, setting up the equipment at the various locations on the Project and removing the equipment from the Project.

Partial payments for item (a) will be made as follows:

- When drilling equipment is on the job, assembled and ready to excavate the shafts 60%
- When all shafts have been excavated and shaft concrete has been placed and accepted ...40%

In item (c), the diameter of the shaft will be inserted in the blank. Item (c) includes excavating the shafts and disposing of the excavated material and for furnishing, placing, splicing, and removing temporary shaft casing and forms.

Item (e) includes all reinforcement within the drilled shaft plus the reinforcement shown which is to be embedded in the shaft and extends above the top of the drilled shaft including the continuous vertical and spiral reinforcement extending from the bottom of the shaft to the elevation shown. No separate or additional payment will be made for bracing, mechanical splices, centering devices, and support for the bottom of the reinforcement cage.

Item (f) includes each time the Contractor mobilizes all testing equipment and personnel onto the Project as required for CSL testing. Once CSL equipment and personnel are mobilized onto the Project, no separate or additional payment will be made for equipment mobilization required to access test shafts at different locations within the Project limits.

Item (g) includes filling the tubes with grout after completion of CSL testing.

Item (h) includes all testing, interpretation, analysis, electronic data, and final report for each tested and accepted shaft.

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

If the Contractor chooses to use a larger shaft diameter casing than the shaft diameter shown, no additional payment will be made for the larger casing, or for the additional excavation, concrete, and reinforcement.

Section 00520 - Driven Piles

Description

00520.00 Scope - This work consists of furnishing and driving piles of the type and dimensions shown or specified, including cutting off or building up piles when required.

Materials

00520.10 General - Furnish materials meeting the following requirements:

Preservative Treatment of Timber	02190
Prestressed Concrete Piles	02520.20
Reinforced Pile Tip	02520.10
Steel Piles	02520.10
Steel Reinforcement for Concrete	00530
Timber Piles	02120.20
Timber Pile Straps	02120.30

00520.11 Engineer's Estimated Length List - Furnish steel piles of sufficient length to attain the penetration and bearing resistance specified, and to extend into the cap or footing as shown. The Contractor may, at no additional cost to the Agency, drive test piles, make borings, and perform other investigations the Contractor considers necessary. The "Engineer's Estimated Length" of steel piles will be listed in the Special Provisions.

00520.12 Pile Order List - Furnish prestressed concrete and timber piles according to the pile order list in the Special Provisions, which will list the type, number, and length of piles. The pile order length includes an allowance for variation. The Contractor may increase the order lengths as necessary to suit pile driving operations at no additional cost to the Agency.

00520.13 Test Piles - Furnish test piles according to the test pile length list in the Special Provisions. When test piles are required, the production pile lengths shown or specified in the Special Provisions are estimated lengths only. The actual lengths to be furnished for production piles will be determined by the Engineer after the test piles have been driven. This applies for all pile types.

00520.14 Unused Piles - Acceptable full length piles furnished according to the estimated length list, order list, or revised pile order list, but not incorporated in the work, will be handled according to one of the following:

- Mark and identify piles for the Contractor's own use.
- Return piles to the supplier with the Agency paying transportation and restocking charges.
- The Agency 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.

(5) Hydraulic Hammers - Provide either single or double acting hydraulic hammers equipped with monitoring systems to measure impact velocity and determine equivalent energy and stroke. Locate monitoring systems for easy access by the Engineer.

(b) Vibratory Hammers - Control installation of production piles with vibratory hammers according to the power consumption, rate of penetration, specified tip elevation, or other acceptable means which assure the pile resistance equals or exceeds the required nominal pile bearing resistance. After driving piles with a vibratory hammer, verify pile resistance (see 00520.42) by driving them with an impact hammer of suitable energy. Do not use vibratory hammers to drive test piles or when preboring or jetting.

(c) Driving Components:

(1) Pile Cushion - Protect the heads of prestressed concrete piles with a pile cushion made of wood or other approved material.

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 Agency's "Pile and Driving Equipment Data" form at least 14 calendar days before pile driving begins. This form is available from the Engineer. Within 14 calendar days of receiving the form, the Engineer will notify the Contractor of approval or rejection of the pile-driving equipment.

During pile-driving operations, no changes to the approved equipment will be allowed without the Engineer's written permission. Submit a request for change on a "Pile and Driving Equipment Data" form. The Engineer will give notification of approval or rejection within 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 nominal pile bearing resistance shown.

Table 00520-1 Pile Hammer Requirements [1]

Nominal Pile Bearing Resistance (kips)	Minimum Field Energy (foot-pounds)
≤ 180	6,500
> 180 and ≤ 280	11,000
> 280 and ≤ 420	20,000
> 420 and ≤ 600	35,000
over 600	Wave Equation required

[1] Using FHWA Gates equation (see 00520.42(b)), except all driving criteria for double acting and differential hammers both air, steam and diesel will be by the wave equation analysis.

If during the pile-driving operation, the Engineer determines the hammer is not operating properly and is unable to drive the piles to the required resistance, do not use the hammer until repaired to the Engineer's satisfaction.

The required number of hammer blows indicated by the FHWA Gates equation at the nominal pile bearing resistance shall be at a rate between 3 and 15 blows per inch.

(3) Wave Equation Method - Select a suitable hammer for driving piles and perform wave equation analyses. Use the 1987 or newer version of the Wave Equation Analysis Program (WEAP). Conduct the wave equation analyses using personnel qualified by training and experience to perform this type of work.

Submit the WEAP analysis concurrent with the Pile and Driving Equipment Data Form. The Engineer will approve or reject the pile driving equipment submittal after a review of the wave equation analysis conducted by the Contractor.

Provide pile hammers meeting the following requirements based on wave equation analysis:

- The energy of the submitted hammer shall produce a wave equation predicted blow count between 3 and 15 blows per inch for the nominal resistances, pile lengths and other conditions specified.
- The pile stresses indicated by the wave equation at the nominal resistance shall not be greater than the stress at the point of impending damage to the pile as follows:
    - **Steel Piles** - Tensile and compressive stresses in the pile of 90% of the pile material's yield strength for the grade of steel specified at any time during the pile installation.
    - **Prestressed Concrete Piles:**
        - A tensile stress of (.095 $\sqrt{f'_c}$) + effective prestress
        - A compressive stress of (0.85 f'_c) - effective prestress

        Where: f'_c = concrete compressive strength (ksi)
    - **Timber Piles** - A compressive driving stress of three times the allowable static design stress.

Hammers not meeting these requirements will be rejected. Replace rejected hammers with suitable hammers.

Use input values for the wave equation analyses provided in the Special Provisions and according to the following:

Use the following settings and default values as input to the wave equation analysis program:

- Output option (IOUT) zero (normal option).
- R_N is the nominal pile bearing resistance.
- Smith damping.
- Do not use residual stress option.

- Default hammer efficiency values. Do not adjustment the hammer's efficiency outside of the wave equation program recommended (default) values without prior concurrence of both the pile hammer manufacturer and the Engineer.
- % skin is the percent skin friction.

A Pile Driving Analyzer (PDA) test may be required prior to approval of non-default wave equation input values.

At a minimum, provide the following information and documentation:

- A written summary of how the proposed hammer and associated equipment meets the specifications regarding blow count criteria and allowable pile stresses.
- Electronic and paper copies of the wave equation input and output files. Output files shall be in the standard WEAP output format.
- WEAP analysis demonstrating that for the required nominal bearing resistances and conditions provided, the hammer will produce pile stresses less than those described above for the range of hammer strokes expected in the field.
- The "Pile and Driving Equipment Data" form.
- WEAP hammer input files for hammers not in the wave equation default hammer files.

For Agency reviewing and approving of the wave equation analysis submittals, the following will be taken into consideration:

- The pile length for use in the WEAP analysis will be the total pile length at the end of driving, including all pile length above the ground surface. This length may be longer than the Engineers Estimated length depending on the site conditions, equipment used, pile hammer access limitations and other factors.
- The properties and thicknesses of the hammer and pile cushion materials.
- Various hammer types such as direct-drive diesel, standard diesel, air/steam or hydraulic hammers have major effects on predicted stresses and blow counts.
- Changes in pile type or size will affect the blow count rate and pile stresses.
- Battered piles may effect hammer energy transfer and blow counts.

Failure to address these issues may be cause for rejection of the proposed pile hammer.

The size of the pile hammer selected according to the above specification may have significant impacts on the size and capacity of associated equipment including the leads and crane. This equipment, in turn, may have significant impacts on the size and capacity of work bridges, shoring required for existing structures or other aspects and elements of construction.

Failure of a previously approved hammer to operate properly during construction will be cause for rejection.

Construction

00520.40 Preparation for Driving:

(a) Excavation - Unless otherwise provided or authorized, do not drive piles until after excavation is complete. Remove to the correct elevation any material forced up by pile driving before concrete for the foundation is placed, at no additional cost to the Agency.

(b) Embankments - Unless otherwise provided or authorized, do not drive piles until the roadway embankment at bridge ends is in place according to 00330.42. Drive piles completely through roadway embankments to the required penetration and bearing in the underlying material.

00520.41 Driving:

(a) General - Drive piles as specified with approved pile driving equipment to the required penetration depth and to the required nominal pile bearing resistance as shown or specified.

(b) Installation Sequence - Unless otherwise shown or specified, install individual piles in pile groups starting from the center of the group and proceeding outward in either direction, or as approved.

(c) Minimum Penetration - Unless otherwise specified or approved, drive piles at least 12 feet below the footing or pile cap, 12 feet below the groundline at trestle pile locations, and completely through embankments at bridge ends. When shown or specified drive piles to a greater minimum penetration. If the required penetration cannot be attained with a hammer complying with 00520.20(d), provide a larger hammer, prebore or jet holes, or use other approved methods as necessary to attain the required penetration.

(d) Preboring - Use augering, wet-rotary drilling or other methods of preboring only when specified or with written approval. When allowed, prebore holes at pile locations and to the depths shown or directed. Make prebored holes smaller than the diameter or diagonal of the pile cross section, but sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as cobbles, boulders or rock layers are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. The use of a reinforced section (spud) to loosen the subsurface material at pile locations will not be allowed unless otherwise approved.

Perform preboring in a manner that will not impair the bearing or lateral capacity of the piles already in place or the safety of existing adjacent structures. When it is determined that preboring has disturbed the load bearing resistances of previously installed piles, restore those piles that have been disturbed to conditions meeting the requirements of this Specification by redriving or by other acceptable methods. The Contractor shall be responsible for the costs of any necessary remedial measures unless the preboring method was specifically included in the Contract Documents and properly executed by the Contractor.

(1) End-Bearing Piles - For end-bearing pile as classified by the Engineer, preboring may be carried to the surface of the end-bearing foundation material. Following that, drive pile with an approved impact pile hammer to the specified blow count.

(2) Other Piles - For other piles, extend preboring to the minimum pile penetration depth and then drive pile with an approved impact pile hammer to the specified blow count.

After completion of driving, fill any void space remaining around the pile with sand or other approved material.

(e) Jetting - Jetting may only be used when allowed in the Contract Documents or if approved in writing. When jetting is not required in the Contract Documents, but approved at the Contractor's request, determine and submit for review the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The Contractor shall be responsible for all damage caused by unapproved or improper jetting operations, unless the jetting method was specifically included in the Contract Documents and properly executed by the Contractor. Control, treat if necessary, and dispose of all jet water in a satisfactory manner. Drive all jetted pile with an approved impact hammer.

(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 will be at no additional cost to the Agency.

Install piles so the axial alignment of the top 10 feet of the pile is within 5 inches of the specified alignment. For piles that cannot be inspected after installation, make an alignment check before installing the last 5 feet of pile. The Engineer may require that driving be stopped to check the pile alignment. Pulling laterally on piles to correct misalignment or splicing a properly aligned section onto a misaligned section will not be allowed.

If the specified location or alignment tolerances are exceeded, the effect of the pile misalignment on the substructure design will be investigated. If the Engineer determines corrective measures are necessary, implement suitable measures and pay all costs and delays associated with the corrective action.

(g) Heaved Piles - Make elevation readings on piles during pile driving operations to check on pile heave. Take elevation readings after each pile has been driven and again after piles within a radius of 15 feet have been driven. Redrive to the required penetration and resistance all piles that have risen more than 1/2 inch, at no additional cost to the Agency. Continue readings until the Engineer determines that such checking is no longer required. If pipe piles which have been filled with concrete subsequently heave, redrive them to original position, after the concrete has attained specified strength, with an approved hammer-pile cushion system.

(h) Test Piles - When specified, furnish and drive test piles at the locations and to the lengths directed. All test piles shall be of the kind and size specified for the permanent foundation piles unless otherwise directed. Drive all test piles with approved pile driving equipment. The specified length of test piles will be greater than the estimated length of production piles to provide for variation in soil conditions. Drive test piles using driving equipment identical to that which the Contractor proposes to use on the production piling. Excavate to the elevation of the bottom of the footing before driving test piles. (see Section 00510)

Drive test piles to or below the required minimum tip elevation and to a hammer blow count established by the Engineer. Allow test piles which do not attain the hammer blow count specified at the minimum tip elevation shown to "set up" for 24 hours, or less if directed, before being redriven. (see 00520.42(d)) If the tops of test piles reach plan grade without attaining the required pile bearing resistance, splice them and drive until the required bearing resistance is attained.

Remove test piles that are not to be incorporated in the completed structure to at least 2 feet below the surface of the ground and backfill the remaining hole with acceptable material.

Do not order piling to be used in the permanent structure until test pile data has been reviewed and the production pile order lengths are determined. The Engineer will provide the Engineer's estimated length list or pile order list within seven calendar days after completion of all test pile driving specified in the Contract.

00520.42 Nominal Pile Bearing Resistance:

(a) General - Drive piles with approved pile driving equipment to the lengths necessary to attain the required penetration and nominal pile bearing resistance. Adequate pile penetration will be considered reached when the piles are driven to or below the minimum penetration depth and the specified equation resistance value is achieved. If piles do not achieve the specified resistance when driven to order length or estimated length, splice and drive them to penetrations established by the Engineer. The pile blow count shall be at a rate of between 3 and 15 blows per inch at the required

nominal pile bearing resistance. The required number of hammer blows per inch at final penetration shall be maintained for 3 consecutive inches unless "refusal" driving is first obtained. "Refusal" driving is defined as 20 blows per 1 inch or as determined by the Engineer.

If water jets are used with the driving, the bearing value shall be determined by the specified equation from the results of driving after the jetting has been completed according to 00520.42(e).

(b) FHWA Gates Equation - Unless otherwise specified, the Engineer will determine nominal pile bearing resistance of the driven pile by the FHWA Gates equation:

$$R_n = 1.75 \left(\sqrt{E}\right) \log_{10}(10N) - 100$$

where:

R_n = Nominal Pile Bearing Resistance (kips)
E = W x H (Hammer energy (foot-pounds) at the ram stroke observed in the field)
W = Weight (pounds) of striking parts of hammer
H = Height of fall (feet) of the ram measured during pile driving in the field
$Log_{10}(10N)$ = Logarithm to the base 10 of the quantity 10 multiplied by N
N = Number of hammer blows per inch at final penetration to be sustained for 3 consecutive inches

$$N = 10^{\left[\frac{R_n + 100}{1.75\sqrt{E}} - 1\right]}$$

or N = 10 to the power in brackets

The FHWA Gates equation is applicable only if:

- The hammer is in good condition and operating in a satisfactory manner
- The hammer has a free fall
- A follower is not used
- The head of the pile is not broomed or crushed

If the Engineer determines that the hammer being used may not be attaining the specified bearing resistance when the above equation is applied, the Engineer may order the Contractor, at no additional cost to the Agency, to verify the bearing resistance values obtained by the use of a different hammer.

(c) Wave Equation Analysis - If specified, the Engineer will determine nominal pile bearing resistance based on wave equation analysis.

(d) Set Period and Redriving - If piles do not attain the required nominal bearing resistance when driven to the specified length, and if allowed or required, allow the piles to stand for a "set period" without driving. The "set period" shall be a minimum of 24 hours unless otherwise approved by the Engineer. After the set period, perform check driving on either 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 redriving. Warm up the hammer before redriving begins by applying at least 20 blows to another pile. Redriving shall consist of driving the pile to the required bearing resistance with a maximum of 15 blows. If the specified hammer blow count is not attained on redriving, the Engineer may direct the Contractor to drive all of the remaining pile length and repeat the set period and redriving procedure. Splice those piles driven to plan grade that do not

attain the hammer blow count required, and drive until the required bearing resistance is attained. If the required bearing resistance is attained for each pile that is redriven, then the remaining piles in that bent will be considered satisfactory when driven to at least the same penetration and resistance as the redriven piles.

(e) Jetted Piles - The nominal pile bearing resistance of jetted piles will be based on impact driving blow count after jetting has been completed. Jet pipes may be removed when the pile tip is at the required minimum pile tip elevation and before the pile is driven to the required bearing resistance. For piles that are jetted at the Contractor's request and do not attain the required nominal bearing resistance at the ordered length, splice, as required, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved according to appropriate criteria in 00520.42. Regardless of Agency approval, the Contractor shall pay all costs of splicing and driving piles beyond the order length if jetting is requested by the Contractor.

(f) Followers - The required nominal pile bearing resistance of piles driven with followers will only be considered acceptable when the follower-driven piles attain the same tip elevation as piles driven without followers. (see 00520.20(c-4))

(g) Vibratory Hammers - The nominal bearing resistance of piles driven with vibratory hammers will be based on impact driving blow count after the vibratory equipment has been removed. When vibratory installation of the piles is approved by the Engineer and the vibrated piles do not attain the required nominal bearing resistance at the specified length, splice them as required, at no additional cost to the Agency, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved, according to 00520.42.

(h) Load Tests:

(1) Static Load Test - Perform static load tests on foundation or test piles when specified or required. Conduct static load tests according to ASTM D 1143 using the quick load test method to plunging failure or the capacity of the loading system. Use testing equipment and measuring systems capable of applying 150% of the nominal pile bearing resistance or 1,000 tons, whichever is less.

(2) Dynamic Load Tests - Take dynamic load test measurements during the driving of piles designated as dynamic load test piles as specified. Perform dynamic testing according to ASTM D 4945.

Drive the pile to such depth that the dynamic load test equipment indicates that the nominal pile bearing resistance shown has been achieved, unless otherwise directed. Monitor the stresses in the piles during driving with the dynamic test equipment to ensure the values do not exceed the values in 00520.20(d-3). If necessary, reduce the driving energy by using additional cushions or reduce the energy output of the hammer to stay below the values in 00520.20(d-3). If non-axial driving is indicated by dynamic test equipment measurements, immediately realign the driving system.

00520.43 Steel Piles:

(a) General - Unless otherwise specified, furnish standard steel piles in the longest practical lengths.

(b) Storage and Handling - Store and handle steel piles in ways that protect them from damage. Bent or kinked piles will be rejected.

(c) End Treatment - Cut pile ends square.

(d) Reinforced Pile Tips - Install pile points, shoes, or other tip reinforcement according to the manufacturer's recommendations and Section 02520.

(e) Driving - During driving, protect the pile head with a fitted metal helmet.

(f) Splices - Where splices are unavoidable, submit for approval their number, location and details.

(1) Welded Splices - Make welded splices using a full penetration butt weld, as shown. Comply with the welding procedures of AWS D1.1.

(2) Mechanical Splices - Mechanical splices may be used if the splice transfers the full pile strength in compression, tension, and bending, according to unstamped working drawings submitted according to 00150.35 and approved by the Engineer.

(g) Welding - Weld pile splices, pile tips, pile anchors, and other welded attachments to steel piles according to AWS D1.1.

(1) Splices - Splice joints for round piles shall conform to Joint B-U4a or C-U4a-GF (Single-Bevel Groove Weld) in D1.1 Figure 3.4. Weld back-up rings with a full penetration groove weld.

Splice joints for H-piles shall conform to Joint B-U3b or B-U3-GF (Double V-Groove Weld) in D1.1 Figure 3.4 for both the web and flange sections. Joint B-U4a or C-U4a-GF may be substituted on the flange weld. Provide access holes at the ends of the web according to D1.1 Section 5.17.

(2) Submittals - Prior to welding, submit the following for approval:

- A Welding Procedure Specification (WPS) for all pile welds, conforming to the limitations of D1.1 Table 4.5. Both ASTM A 36 and ASTM A 252 Grade 1 and 2 may be treated as prequalified base metals under Group 1. ASTM A 252 Grade 3 will not be considered a prequalified base metal unless the steel has a Carbon Equivalent (CE) of 0.30% or less. Develop a Procedure Qualification Record (PQR) for all welding using Grade 3 steel or present proof that the chemistry of the steel meets the CE requirements.
- Qualification documents for each welder. Use welders qualified according to D1.1 Section 4 for the position, process and pile diameter used on the job.

Do not begin welding without approval.

Following completion of all welding, submit the following:

- An inspection report stating that the welding under the Contract was performed according to D1.1. The report shall include a review of the WPS, a review of welder qualifications and a report on visual inspection of the welds on the job site. The inspection shall be signed by a Certified Welding Inspector (CWI) holding QC1 certification as defined in D1.1 Section 6.
- If the plans or Specifications call for additional inspection other than visual, include reports in the submittal.

(3) Additional Testing - The Engineer may request additional nondestructive testing (NDT), such as radiography or ultrasonic testing of any or all welds. If the additional testing identifies defects warranting rejection, perform repair and additional inspection at no additional cost to the Agency. If the additional NDT does not identify defects warranting rejection, the Agency will pay the cost of the additional testing. Radiographic and ultrasonic defect indications will be evaluated according to the statically loaded criteria of D1.1.

(h) Cutoff Lengths - Cut off the tops of all permanent piles square and smooth at the elevation shown or as directed. All cut-off pile becomes the property of the Contractor. Dispose of according to 00290.20. With approval, undamaged cutoffs may be used as pile extensions or welded together to form full length piles. Steel pile cutoffs welded together, whether pile extensions or full length piles, shall not vary from a straight line more than 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 Agency projects if requested by the Contractor.

(i) Capping - If required by the plans, cap steel piles with a steel plate of the size and shape shown. Connect this cap to the pile according to the details shown.

00520.44 Prestressed Concrete Piles:

(a) General - Furnish full-length prestressed concrete piles according to the Special Provisions and Section 00550.

(b) Lifting, Storing, and Transporting - Lift, store and transport prestressed concrete piles according to 00550.49.

(c) Strength Before Driving - Do not drive precast, prestressed concrete piles until the conditions of 00550.12(d) are met, and the Engineer gives consent to proceed.

(d) Extensions or "Build-ups" - If additional driving is required beyond the order length, splice on pile extensions or build-ups as specified and directed. Prestressed concrete pile cutoffs may be used as extensions if additional driving is not required. Do not use pile cutoffs as extensions exceeding 5 feet in length unless approved.

(1) Epoxy-Dowel Method - Make splices of prestressed concrete piles to prestressed concrete piles and poured-in-place extensions or build-ups with the epoxy-dowel method, as shown or approved.

(2) Mechanical Splices - Mechanical splices may be used subject to limitations of 00520.43(f).

(e) Cutoffs - Cut off permanent prestressed concrete piles at the elevations shown or directed. All cut-off lengths become the property of the Contractor. Dispose of according to 00290.20. Take care to prevent spalling of the concrete below the footing or pile cap. Repair damage to the piles at no additional cost to the Agency.

(f) Finishing - Finish all exposed prestressed concrete pile surfaces to 1 foot below ground surface according to 00550.47.

00520.45 Timber Piles:

(a) General - Furnish full length treated timber piles according to the Special Provisions and 02120.20. Cut the heads of piles back square to untreated wood before driving. Provide a length of pile above the elevation of cutoff sufficient to permit the complete removal of all pile damaged by driving. Splicing of timber piles will not be allowed.

(b) Storage and Handling - Store and handle piles to avoid damage. Avoid breaking the surface of treated piles. Do not use cant hooks, dogs or pike poles on portions of the piles remaining in the completed work. Give cuts or breaks in the surface of treated piles three brush coats of

pentachlorophenol, hot creosote oil or other preservative from the QPL. Pour pentachlorophenol, hot creosote oil or preservative from the QPL into all bolt holes. If the treatment is damaged so the integrity of the pile is in jeopardy, the pile will be rejected. Furnish a replacement pile at no additional cost to the Agency.

(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 00290.20.

(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 gauge minimum diameter) held in place by large headed commercial corrosion resistant nails or staples. Hot-dipped galvanized or stainless steel straps and clips conforming to 02120.30 may be used instead of commercial corrosion resistant wire. Neatly trim the edges of the fabric projecting below the binding.

00520.46 Damaged or Defective Piles - In addition to other specified requirements:

- Approval of a pile hammer shall not relieve the Contractor of responsibility for piles damaged from misalignment of the leads, failure of capblock or cushion materials, failure of splices, malfunctioning of the pile hammer or other improper construction methods.
- Piles damaged during installation will be considered unsatisfactory unless the nominal bearing resistance is proved by load tests performed by the Contractor. If such tests indicate inadequate resistance, take corrective measures, such as the use of damaged piles at reduced resistance, installation of additional piles, strengthening of damaged piles, or replacement of damaged piles.
- A concrete pile will be considered defective if a visible crack appears around the entire periphery of the pile, or any other crack or defect is observed which is determined to affect the strength or performance of the pile.
- Do not place footing concrete until all piles within a footing are inspected by the Engineer.

Measurement

00520.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Furnish Equipment for Driving Piles - No measurement of quantities will be made for furnishing equipment for driving piles.

(b) Furnish Piles - The quantities of furnishing steel, prestressed concrete, timber, and test piles will be measured on the length basis, to the nearest foot, as follows:

(1) Steel Piles - Steel piles will be the length of each pile remaining in the completed work, from the pile tip to the cutoff plane.

(2) Prestressed Concrete and Timber Piles - Prestressed concrete and timber piles will be the sum of the lengths of piles of the types and lengths ordered, furnished according to these Specifications, and stockpiled in good condition at the work site.

(3) Test Piles - Test piles, including test piles remaining in the completed work, will be measured according to (b-1) and (b-2) above as applicable.

No allowance will be made for that length of pieces furnished by the Contractor to replace piles previously accepted by the Engineer, but that are subsequently damaged before completion of the Project

(c) Drive Piles - The quantities of driving steel, prestressed concrete, timber, and test piles will be measured on the unit basis. Driving test piles includes test piles remaining in the completed work.

Preboring will be measured on the length basis, to the nearest foot.

Jetting will be measured on the unit basis, for each pile driven with the aid of jetting.

(d) Load Tests - Load tests to be will be measured on the unit basis, for the number of specified load tests completed and accepted. Load tests made at the option of the Contractor will not be measured.

(e) Reinforced Pile Tips - The quantities of reinforced pile tips will be measured on the unit basis.

(f) Pile Splices - Pile splices will be determined as follows:

(1) Steel Piles - Splices incorporated in the finished structure that were made to increase the length of the pile 5 feet or more for estimated pile lengths of 60 feet or less and 10 feet or more for estimated pile lengths of over 60 feet beyond the estimated pile length will be measured on the unit basis. Only one splice will be measured per pile.

No measurement will be made for splices to steel piles within the estimated lengths listed in 00520.11 of the Special Provisions.

(2) Prestressed Concrete Piles - No measurement of quantities will be made for prestress concrete pile splices shown or specified Additional splices required to complete the work will be done as Extra Work according to Section 00196.

Payment

00520.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Furnish Pile Driving Equipment	Lump Sum
(b)	Furnish _____ Piles	Foot
(c)	Furnish _____ Test Piles	Foot
(d)	Drive _____ Piles	Each
(e)	Drive Test Piles	Each
(f)	Preboring Piles	Foot
(g)	Jetting Piles	Each
(h)	Pile Load Test (static)	Each
(i)	Pile Load Test (dynamic)	Each
(j)	Reinforced Pile Tips	Each
(k)	_____ Steel Pile Splices	Each

Partial payments for Item (a) will be made as follows:

- When equipment for driving piles is furnished and is satisfactorily driving piles 75%
- When driving piles is complete and equipment has been removed from site.....25%

Item (a) includes:

- furnishing all materials, equipment, and labor necessary for transporting, erecting, maintaining, replacing any ordered equipment, dismantling and removing the entire pile driving equipment
- resubmittal of wave equation analysis data if original data is rejected
- replacing previously approved hammers if hammer operates improperly
- all considerations when selecting the pile hammer size

The cost of all materials and labor, including the manipulation of the pile driving equipment in connection with driving piles will be included in the unit price each for driven piles. Furnishing equipment for driving sheet piling is not included in this work.

In items (b),(c), (d) and (k) the type and size of pile will be inserted in the blank.

Item (d) includes cutting off piles, treating and capping pile heads, attaching anchor brackets, lugs or other attachments, and finishing concrete piles.

Items (d) and (e) include all expenses involved in driving piles which have not attained the required bearing resistance and are required to stand for a "set period".

Item (j) includes attaching the tips to the piles.

Item (k) includes steel pile splices required to increase pile length beyond the estimated length listed in 00520.11 of the Special Provisions. No payment will be made for splices to steel piles that are within the estimated lengths listed in 00520.11 of the Special Provisions.

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

No separate or additional payment will be made for work needed to drive piles to minimum tip elevation as shown or specified.

No separate or additional payment will be made for welding inspection performed according to 00520.43(g-2).

No separate or additional payment will be made for preboring and jetting of piles if not included in the Contract Schedule of Items but requested by the Contractor.

Preboring and jetting, if not included in the Contract Schedule of Items, larger hammers, and construction of concrete pile extensions, build-ups, and splices ordered by the Engineer, as a result of differing site conditions (see 00140.40) will be made on an Extra Work basis according to Section 00196.

Section 00530 - Steel Reinforcement for Concrete

Description

00530.00 Scope - This work consists of furnishing and placing steel reinforcement of the grade, type and size shown or specified.

Materials

00530.10 General - Furnish materials meeting the following requirements:

Deformed Bar Reinforcement	02510.10
Epoxy Coated Reinforcement	02510.11
Galvanized Coating	02510.30
Mechanical Splices	02510.20
Welded Wire Fabric	02510.40
Wire Reinforcement	02510.60

00530.11 Order Lists and Bending Diagrams - Before ordering material, submit all order lists according to 00150.37 and unstamped bending diagrams according to 00150.35 for approval. Do not order material until such lists and bending diagrams have been approved. The review of order lists and bending diagrams by the Engineer will in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Revise lists and diagrams as required to make them comply with the design drawings at no additional cost to the Agency.

Order lists and bending diagrams for reinforcement affected by stressing system in prestressing beams or post-tensioning systems such as anchorage design and duct placement will not be reviewed before the stressing system is reviewed.

00530.12 Fabrication - Cold bend reinforcement bars to the shapes shown. Make bends, tag, mark and ship reinforcement bars according to the current edition of the CRSI "Manual of Standard Practice".

00530.13 Miscellaneous Metal - Minor metal parts such as drains, bolts, concrete anchors, spacer blocks, expansion and bearing devices, access hole covers and frames, anchor bolts, inserts and similar miscellaneous metal, unless otherwise provided, will be classified as reinforcement.

Pipe attached to or used in conjunction with bridge deck drains or catch basins will be classified as reinforcement.

00530.14 Concrete Inserts - Furnish hot-dip galvanized expanded coil concrete inserts with closed-back ferrule threaded to receive UNC threaded bolts or rods of the size shown. Provide concrete inserts with the following minimum lengths and capacities:

Bolt or Rod Diameter (Inches)	Minimum insert Length (Inches)	Minimum Safe Working Load in Shear or Tension (Pounds)
3/4	4 1/2	4,000
1	5 1/2	6,000
1 1/4	7 1/2	10,000
1 1/2	9 1/2	16,000

Labor

00530.30 Mechanical Splice Installers - Provide qualified mechanical splice installers to construct mechanical splices. To qualify an installer, provide the Engineer with three completed mechanical

splice samples of each type and size to be installed on the Project for each mechanical splice installer, at no additional cost to the Agency. Prepare the splice samples as follows:

- Make splice samples in the presence of the Engineer using the same materials, equipment, and procedures that will be used on the Project.
- Construct each splice sample according to the manufacturer's recommendations.
- Construct each splice sample with 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 with the heat treatment lot number.

Provide splice samples that meet the requirements of 02510.20. Do not begin mechanical splice installation until the Engineer confirms, in writing, the qualification of each mechanical splice installer. The Engineer may suspend mechanical splice installation if the Contractor substitutes unapproved personnel during construction.

Construction

00530.40 Protection of Material - Store reinforcement above the surface of the ground on dunnage. Protect reinforcement from damage at all times. Ensure reinforcement is free of dirt, detrimental rust or scale, paint, oil and other foreign substances when placed in the work.

In addition to the requirements above, store epoxy coated bars with supports close enough to prevent sagging in the bundles. Provide protective padding when bundles are stacked or when supported on metal. Store bars as close as practical to where they will be placed in the structure. Cover bars with an opaque material during storage to protect them from exposure to sunlight and saline mist. Move bars to or from storage according to 02510.11(c) to minimize damage to the coating. Do not allow the total exposure time from bar delivery to concrete placement, while in storage or in place, to exceed two months.

00530.41 Placing and Fastening - Place all reinforcement within the tolerances recommended in the CRSI "Manual of Standard Practice" unless otherwise specified. Hold reinforcement firmly during the placing and setting of concrete.

(a) Fabric - If fabric reinforcement is shipped in rolls, straighten it into flat sheets before placing.

(b) Ties and Supports - Keep reinforcement properly positioned during placement of concrete according to the following:

- Tie bars in top mats of footings and deck slabs at all intersections. Where bar spacing is less than 6 inches, tie alternate intersections.
- Tie all other bars at all intersections except where spacing is less than 1 foot in each direction; in that case tie alternate intersections.
- When precast concrete blocks are used, provide blocks that have cast-in wire ties. Provide tie wires meeting the requirements of 02510.60.
- For bridge decks, support the top mat of reinforcing steel from the bottom mat with reinforcing bar supports according to Chapter 3 of the CRSI "Manual of Standard Practice" (SBU, BBU or CHCU) at 24 inch maximum centers.
- Where at least one of the bars to be tied or supported is epoxy coated, provide tie wires that are either plastic coated or epoxy coated. Where precast concrete blocks with cast-in wire ties are used to support bridge deck reinforcement, the wire ties need not be coated.

(c) Clearances:

- Provide the same surface clearance for ties and splices that is shown or specified for the reinforcement.
- Maintain distance from the forms with stays, precast concrete blocks, ties, hangers, or other approved supports.
- Separate layers of bars with precast concrete blocks or by other suitable devices.
- Use precast concrete blocks with approved shape and dimensions and with the same or greater compressive strength as the concrete to be placed.
- Do not use pebbles, pieces of broken stone or brick, metal pipe or wooden blocks as bar supports or to separate layers of bars.
- Use stainless steel metal chairs conforming to the requirements of ASTM A 493, Type 430 or plastic chairs from the QPL when the legs of the chair will be on an exposed surface.
- Turn up the legs of metal chairs a minimum of 1/8 inch.
- Remove all precast member lifting devices prior to placing concrete deck reinforcement.
- Ensure bridge deck clearances meet the requirements of 00540.48(g).

(d) Approval - After placing reinforcement in any member have it inspected and approved before placing concrete. Concrete placed in violation of this provision may be rejected and removal required.

00530.42 Splicing:

(a) General - Furnish full length reinforcing bars the specific length shown or the calculated length for those designated "full length".

If specific locations are designated for splices, make splices only at those locations, or use full-length bars.

In the absence of other directions, including bars designated "continuous," furnish reinforcing bars to provide the minimum practical number of bars.

Where splicing is allowed, unless shown otherwise:

- Splice No. 11 bars and smaller by lapping, or with an approved mechanical splice.
- Splice No. 14 bars and larger with an approved mechanical butt splice.

(b) Lapped Splices - In lapped splices, place the bars in contact and fasten together according to 00530.41 with at least three ties per splice.

Where coated reinforcement is spliced to uncoated reinforcement, provide the required splice lap for the coated reinforcement unless shown otherwise.

(c) Mechanical Splices:

(1) General - Construct mechanical splices according to 02510.20 and the manufacturer's recommended procedures. Use devices that join bars end-to-end if a butt splice is specified; otherwise bars may be lapped or joined end-to-end. All requirements for mechanical splices apply to mechanical butt splices.

Ensure mechanical butt-spliced reinforcing bars do not deviate from the layout line by more than 1/4 inch over a 3 foot length of bar.

When approved, dowels may be replaced by reinforcing bars with threaded sleeve mechanical splice couplers embedded in the portion of concrete placed first and threaded reinforcing bars inserted in the couplers after forms are removed. Construct assemblies that develop 135% of the specified minimum yield strength of the dowels shown or specified. Construct reinforcing bars that have effective splice or development lengths equal to the replaced dowels.

(2) Sampling and Testing:

a. General - Furnish labor, material and equipment for fabricating sample mechanical splices at no additional cost to the Agency. All sample splices will be tested by the Agency at no cost to the Contractor.

b. Samples - Provide all samples meeting the requirements of 02510.20 and this subsection.

c. Testing - Construct test splices in the presence of the Engineer. Construct test splices with two equal lengths of straight reinforcing bar so that the total length of the assembled sample is not less than 148 inches. Mark each splice sleeve with the heat treatment lot number.

d. Jobsite Quality Control - During the installation of mechanical splices:

- Submit one quality control sample for each 100 splices performed up to 500 splices then submit one sample for each 500 splices. This sequence of testing will be required for each heat treatment lot used.
- Make non-threaded mechanical splice quality control samples at the jobsite in a manner similar to that used for the production splices.
- Fabricate threaded sleeve mechanical splice quality control samples on a random basis during the cutting of threads on the reinforcing bars and deliver to the Engineer at the jobsite with the material they represent.
- Complete the splice according to the manufacturer's recommendations.
- Quality control samples will be tested according to this Section. If any sample fails to meet the test criteria, the lot which it represents will be rejected until the cause of failure has been determined. Materials from a rejected lot may be accepted if they are shown to be free of the condition which caused the failure.

(3) Installation - Install splices in the presence of the Engineer. Splices made without the Engineer present will be rejected.

Do not place stirrups and other reinforcing bars between a mechanical splice sleeve and the surface of the concrete where it would impair the specified clearance. Instead, place additional reinforcement as necessary at no additional cost to the Agency.

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 aerial miles of the Pacific Ocean, coat exposed areas of bare steel with heat shrink tubing from section 2510.11 of the QPL. On all other projects, coat exposed areas of bare steel with heat shrink tubing or epoxy patching material from section 2510.11 of the QPL. Apply coating according to AASHTO M 284.

(d) Welded Splices - Perform welded splices of steel reinforcing according to AWS D1.4. Submit welder certification, Welding Procedure Specifications and Procedure Qualification Records to the Engineer for approval.

00530.43 Splicing Welded Wire Fabric - Overlap sheets of welded wire fabric as shown or provide edge and end laps not less than one mesh in width. Securely fasten sheets at the ends and edges according to 00530.41.

00530.44 Substitutions - Substitute different size bars only if approved.

00530.45 Inspection and Repair of Epoxy Coated Rebar - Inspect coated bars before placement for damage to coating. Patch all visual defects in the coating with a prequalified patching material according to AASHTO M 284 before installation. Clean areas to be patched to remove all surface contaminants and damaged coating. Promptly treat cleaned areas according to the resin manufacturer's recommendations and before detrimental oxidation occurs. Where rust is present, remove it by blast cleaning or power tool cleaning methods immediately before applying the patching material. Clean and roughen the metal before applying patching material. Feather the patching material 2 inches to 3 inches, or as recommended by the manufacturer, into undamaged coated areas. Apply patching material to a thickness greater than 8 mils.

Clean visual damage found after placement as specified above. Coating damage exceeding 2 percent of the surface area in any lineal foot section of a bar may be cause for rejection of that bar.

00530.46 Marine Environment - On projects within 3 aerial miles of the Pacific Ocean, clean bars with a high pressure washer (1,500 pounds per square inch minimum pressure, with a fan pattern, 4.5 gallons per minute capacity) just prior to placing concrete.

Measurement

00530.80 Measurement - The quantities of reinforcement will be measured by one of the following methods:

(a) Lump Sum - Under this method, no measurement will be made. Estimated quantities of reinforcement will be listed in the Special Provisions. The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed estimated quantities.

(b) Weight - Under this method, reinforcement will be measured on the weight basis, of reinforcement incorporated into the concrete based on the total computed weight for the sizes and lengths of bars as shown or authorized.

The following assumed densities will be used as a basis for computing the theoretical weight of miscellaneous metal:

Steel	-	490 pounds/cubic foot
Copper	-	555 pounds/cubic foot
Cast Iron	-	450 pounds/cubic foot

The weight of mesh will be computed from the theoretical weight of plain wire. If the weight per square foot is shown, that weight will be used.

For the purpose of computing weight of reinforcement, weights published in the CRSI "Manual of Standard Practice" will be used.

The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed quantities.

If bars are substituted at the Contractor's request, and as a result, more steel is used than specified, only the amount specified will be included in the pay quantities. When laps are made for splices for the convenience of the Contractor, the extra reinforcement will not be included in the pay quantities.

Payment

00530.90 Payment - The accepted quantities of reinforcement will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Reinforcement	Lump Sum or Pound
(b)	Coated Reinforcement	Lump Sum or Pound

Item (a) includes fabricating and placing uncoated reinforcement as specified.

Item (b) includes placing epoxy coated reinforcement as specified.

Payment for reinforcement will be made when the reinforcement is incorporated into the concrete.

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

No separate or additional payment will be made for clips, wire, separators, wire chairs, and other material used in fastening the reinforcement in place.

Section 00535 - Resin Bonded Anchor Systems

Description

00535.00 Scope - This work consists of drilling and preparing holes in hardened concrete and providing and installing anchor bolts and/or reinforcement using a resin bonded anchor system as shown.

Materials

00535.10 Materials - Furnish anchor bolts meeting the requirements of 02560.30 and reinforcing steel meeting the requirements of Section 02510 as shown. High-strength anchor bolts meeting the requirements of ASTM A 193, Grade B7 may be substituted in place of these specified in 02560.30(b).

Furnish a polyester, vinyl ester, or epoxy resin bonding system from the QPL that will sustain not less than the pullout forces shown. See Table 00535-1 when pullout forces are not shown. Provide the resin in proper proportions to be mixed easily.

TABLE 00535-1

Minimum Pullout Force					
	Anchor Bolts			Rebar	
	Grade 36	Grade 55	Grade 105	Grade 60	
Dia. (inch)	Force (Pounds)			Size	Force (Pounds)
1/2	7,400	9,700	15,300	3	7,900
5/8	11,700	16,900	24,300	4	14,400
3/4	17,300	22,500	36,000	5	22,300
7/8	24,000	31,200	49,900	6	31,700
1	31,700	40,900	65,400	7	43,800
				8	56,700

Unless shown otherwise, do not install anchors larger than 1 inch in diameter using a resin-bonded anchor system.

Unless shown otherwise, select a resin from the QPL as follows:

- For Grade 36 and Grade 55 anchors, use either low strength or high strength resin.
- For Grade 105 anchors and Grade 60 rebar, use high strength resin only.

Provide the Engineer with:

- Certification, according to 00165.35, that the anchor system meets all requirements for the Project.
- Mill test certificates verifying the strengths of material used in the manufacture of the anchors.
- Proposed embedment depths for approval, if not shown.

Unless shown otherwise, galvanize all anchors which have any portion of the anchor exposed. Galvanize according to AASHTO M 232 (ASTM A 153) or AASHTO M 298 (ASTM B 695), Class 50. When within 25 aerial miles of the Pacific Ocean, galvanize according to AASHTO M 232 (ASTM A 153) only. Unless otherwise shown, anchors that become completely encased in concrete will not require galvanizing.

Provide thread lengths as shown. If thread lengths are not shown and the anchor is not rebar, provide threads on the resin-bonded end of the anchor for at least 80% of the embedment depth shown.

Construction

00535.40 Construction - Install the anchor system according to the manufacturer's recommendations and to the embedment depths shown. Use epoxy resins only when the ambient air temperature is within the temperature range recommended by the manufacturer. Unless stated otherwise in the manufacturer's instructions, use a drill bit diameter 1/8 inch larger than the nominal anchor diameter for AASHTO M 314 anchors and 5/64 inch larger than the out-to-out diameter for rebar. Unless shown otherwise, drill holes for anchor bolts as follows:

- When the center of the hole is more than 6 inches from a concrete edge, use either a 9 pound air hammer weight, or a carbide bit rotary hammer with 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 be free of concrete dust, foreign matter, and standing water.

When nuts are applied to anchor bolts, tighten to one quarter turn past snug-tight unless shown otherwise.

Measurement

00535.80 Measurement - No measurement of quantities will be made for resin bonded anchor systems.

Payment

00535.90 Payment - No separate or additional payment will be made for resin bonded anchor systems. This work is included in payment made for the applicable items in which the anchor system fastens.

Section 00540 - Structural Concrete

Description

00540.00 Scope - This work consists of furnishing, placing, and finishing portland cement concrete, throughout this Specification referred to as structural concrete or concrete, for bridges and other structures according to these Specifications and in close conformity to the lines, grades and dimensions shown or established.

00540.01 Abbreviations and Definitions:

ASTV - Actual Strength Test Value - See 02001.02 for definition.

Falsework - Structural system to support the vertical and horizontal loads from forms, reinforcing steel, plastic concrete, structural steel, loads from placement operations and other related loads.

Forms - Structural system to contain the horizontal pressures exerted by plastic concrete.

HPC - High Performance Concrete - See 02001.02 for definition.

Post-Tensioned - Tensioning of prestressing steel after concrete has reached specified strength.

Surrounding Temperature - The air temperature measured in the shade. When placement and curing of concrete is enclosed, it is the lowest temperature within the enclosure.

Tolerance:

- The permitted variation from a given dimension or quantity, or
- The range of variation permitted in maintaining a specified dimension, or
- A permitted variation from location or alignment.

00540.02 Deck Pre-Placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel who are to be involved in the concrete work at a mutually agreed time approximately three weeks in advance of placing concrete for bridge decks. Ensure the Engineer, concrete supplier, and any other subcontractor is represented. Present and discuss all phases of the concrete deck placement work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer and the entire concrete placement crew at the job site one-half hour before the first placement begins to discuss placement duties and procedures.

Materials

00540.10 General - Furnish materials meeting the following requirements:

Concrete	02001
Concrete Coating	02210.30
Curing Materials	02050
Epoxy and Non-Epoxy Bonding Agents	02070
Epoxy and Non-Epoxy Grouts	02080
Epoxy Cement	02060
Poured Joint Fillers	02440.30
Preformed Expansion Joint Filler	02440.10

00540.11 Classes of Concrete - Furnish concrete meeting the requirements of Section 02001 and the requirements of Table 02001-1 for the classes of concrete to be used in various structures and concrete paving mixtures. The plans or Special Provisions will show the class of concrete required for the component parts of the structure. Use the specified class of concrete, or a higher class. Where the class is not specified, use Class 3300.

00540.14 Concrete Mix Tolerances and Limits - Furnish a workable concrete mixture, uniform in composition and consistency and meeting the properties and limits requirements of 02001.20.

00540.15 Form Materials - Furnish wood, plywood, metal, or other suitable form material. For round concrete columns, provide either metal or other approved form material that produces a smooth and true surface free from fins, joints and other irregularities. Where plywood is used, provide a minimum nominal thickness of 5/8 inch.

00540.16 Quality Control - Provide quality control according to Section 00165 and the following:

- Sample and test according to the MFTP.
- For all structural concrete, provide personnel according to 00540.30 to sample and test the mix for temperature, air content, slump, water-cementitious ratio, density and yield, from the first load of each placement, whenever there is a visible change in the slump of the concrete, and when a set of cylinders is obtained.
- If the results of any test are outside of the specification limits, stop placement of the load. Correct the load or, if the load cannot be corrected, do not incorporate it into the work. Test subsequent loads before any further concrete placement. Correct subsequent loads if any of the tests are still outside the specification limits. Return to the specified test frequency when the test results from two consecutive loads are shown to meet the specification limits.

00540.17 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance will be based on the Contractor's quality control testing, if verified, according to Section 00165. Blend aggregates only as allowed in 02001.20.

(1) Aggregate Gradation - A stockpile contains specification aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level indicated in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled aggregates that contain non-specification aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the Contractor's QCT, according to the tolerances and limits of 02001.20.

(c) Hardened Concrete - Cast and cure test specimens according to AASHTO T 23 in 6 inch x 12 inch or 14 inch x 8 inch, single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test cylinders at an Agency 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) Acceptance - Hardened concrete with an ASTV meeting or exceeding the specified design strength, f'c will be accepted for strength. If the ASTV is less than f'c but at least 85% of f'c, the Engineer may review the results to determine if the concrete represented by the cylinders is suitable for the intended purpose. Remove concrete that has an ASTV less than 85% of f'c unless otherwise authorized, in writing, by the Engineer. If the concrete is removed, the cost of removal, replacement and all related work is the Contractor's responsibility. If the Engineer determines that the concrete is suitable for the intended purpose, the concrete may be allowed to remain in place, subject to a price adjustment according to 00150.25.

If an ASTV falls below f'c, the Contractor may submit a written plan within three days of the test for review by the Engineer. Provide a plan outlining a proposed alternate method of evaluating compressive strength. Provide evidence that a reasonable f'cr (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. If the Engineer determines that the compressive strength test results are suspect from definable external factors, the Engineer may allow an alternate method of acceptance.

Equipment

00540.22 Concrete Conveying Equipment - Use clean, non-aluminum conveying equipment capable of supplying concrete to the point of placement without segregation.

(a) Concrete Pumping Equipment - Provide a discharge line for the pump made of steel or rubber pipe and having the following minimum size:

Nominal Maximum Size of Concrete Aggregate	Minimum Pipe Size, Inside Diameter
1 inch	4 inches
1 1/2 inches	5 inches

(b) Chutes - Use steel or steel-lined chutes. Where steep slopes are required, equip the chutes with baffles or provide short lengths that reverse the direction of movement.

(c) Pipes or Trunks - Other than tremie seal pipe, provide rubber or steel pipes, and plastic trunks.

(d) Tremie Seal Pipe - Provide a tremie seal pipe that:

- Is rigid pipe with minimum diameter of 10 inches and sufficient length to reach from the bottom of the excavation to above the waterline, with an attached receptacle or hopper for receiving concrete.
- If jointed, is the flange-and-gasket type and waterproof.
- Has means to close the discharge end.
- Is supported to permit free movement of the discharge end throughout the seal.
- Is equipped with a device to permit rapid lowering when necessary to retard or stop the flow of concrete.

00540.23 Vibrators - Provide vibrators that:

- Are an internal type unless other methods are approved by the Engineer.
- Are capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.
- Are in working condition to meet manufacturer's rating.
- Are fitted with a manufactured rubber head to minimize damage to epoxy coated reinforcement.

00540.24 Deck Finishing Machine - Provide a deck finishing machine that is:

- Capable of finishing the entire roadway surface or the specified stage construction width.
- Self-propelled with positive control in both forward and reverse directions.
- Capable of raising rolls or screed to clear the screeded surface with positive control to the specified grade.
- Equipped with augers.
- Equipped with rollers or vibrating screeds.

(a) Deck Finishing Machine Support System - Furnish calculations and detailed drawings of the proposed deck finishing machine support system according to 00540.41.

(b) Other Deck Finishing Equipment - In narrow bridge widenings where a deck finishing machine is not practical, a mechanical vibrating screed may be used.

00540.25 Straightedge - Furnish a 12 foot metal straightedge for checking bridge deck roadway and sidewalk surface tolerances.

00540.26 Concrete Saws - Provide power-driven concrete saws for sawing joints and as required for surface texture.

00540.28 Power Washers - Provide power washers that produce a minimum 2,500 psi pressure at the nozzle, with a fan pattern, and a minimum 4.5 gallons per minute capacity. For bridge decks, provide at least one power washer for each side of the deck section to be placed. When using power washers to produce a fog spray for curing, match the flow rates and pressures of the power washers with the fogging nozzles to produce an average droplet size of 3 mils, according to the nozzle manufacturer's recommendation.

00540.29 Work Bridges - Provide at least two transverse work bridges when placing concrete on a bridge deck. Use the transverse work bridges to facilitate placement of the cure.

Labor

00540.30 Quality Control Personnel - In addition to the certified technicians required in 02001.50 provide and designate an individual to be present at the placement site at all times during concrete placements for projects with more than 100 cubic yards of structural concrete and for all high performance concrete, and who is authorized and responsible for acceptance and rejection of materials.

Construction

00540.40 Tolerances - The following tolerances apply to cast-in-place structures:

(a) Foundation Footings:

(1) Lateral Alignment:

- Actual (as cast) location of the center of gravity: 0.02 times width of footing in the direction of misplacement, but not more than 2 inches
- Supporting masonry: 1/2 inch

(2) Level or Vertical Alignment:

- Top of footing supporting masonry: 1/2 inch
- Top of other footings: minus 2 inches to plus 1/2 inch

(3) Cross-Sectional Dimensions:

a. Horizontal dimension of formed members: minus 1/2 inch to plus 2 inches

b. Horizontal dimension of unformed members cast against soil:

- Less than and equal to 2 feet: minus 1/2 inch to plus 3 inches
- Over 2 foot and less than and equal to 6 feet: minus 1 1/2 inch to plus 6 inches
- Over 6 feet: minus 1/2 inch to plus 12 inches

c. Vertical dimension (thickness): 0 to plus 6 inches

(4) Relative Alignment - Footing side and top surfaces may slope with respect to the specified plane at a rate not to exceed 1 inch in 10 feet.

(b) All Other Structural Members:

(1) Vertical Alignment:

- Exposed surfaces: ± 3/4 inch
- Concealed surfaces: ± 1 1/2 inches
- Construction joints: 0 to minus 3 inches

(2) Lateral Alignment - Centerline alignment: 1 inch

(3) Level Alignment:

a. Profile grade: ± 1 inch

b. Top of other concrete surfaces and horizontal grooves:

- Exposed: ± 3/4 inch
- Concealed: ± 1 1/2 inches

c. On ramps, sidewalks and intersections, in any direction, the gap below a 12 foot unleveled straightedge resting on high spots shall not exceed 1/4 inch.

d. On bridge decks, in any direction the gap below a 12 foot unleveled straightedge does not vary from the testing edge by more than 1/8 inch.

(4) Cross-Sectional Dimensions:

- Bridge slabs and decks vertical dimension (thickness): minus 1/8 inch to plus 1/4 inch
- Members such as columns, beams, piers, walls and others (slab thickness only): minus 1/4 inch to plus 1/2 inch
- Openings through members: 1/2 inch

(5) Relative Alignment:

a. Location of openings through members: 1/2 inch

b. Formed surfaces may slope with respect to the specified plane at a rate not to exceed the following amounts in 10 feet:

- Watertight joints: 1/8 inch
- Other exposed surfaces: 1/2 inch
- Concealed surfaces: 1 inch

c. Unformed exposed surfaces, other than pavements and sidewalks, may slope with respect to the specified plane at a rate not to exceed the following amounts:

- In 10 feet: 1/4 inch
- In 20 feet: 3/8 inch

00540.41 Design of Falsework for Vertical Pressures:

(a) Submittal of Working Drawings and Calculations - Submit stamped falsework plans and design calculations according to 00150.35, except as modified below.

Ensure the falsework designer prepares a Falsework Design Summary and completes a Falsework Design Checklist to accompany the plans and calculations. Include in the summary a list of each falsework member with its:

- Assumed dead and live loads
- Allowable and design stresses
- Allowable and calculated deflections
- Design references and derivations for design formulas
- Documentation for computer generated calculations

The Falsework Design Checklist is included in the Special Provisions.

Submit 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.

Ensure design loads used are the maximum loadings. Ensure deflections used on manufactured devices and assemblies do not exceed the manufacturer's recommendations. Furnish catalog data that lists the manufacturer's recommendations.

(c) Falsework Foundation:

(1) On Soils - Consider anticipated construction and soil conditions in determining the soil's support capacity, including draining water away from the supports. For falsework supported on soils, show the following in the calculations:

- Assumptions and methods used to determine the soil's capacity to support the footing loads.
- Anticipated falsework footing settlement based on the allowable soil bearing values.

(2) On Piles - For falsework supported on piles, show on the working drawings the pile type, size and spacing. Accompany these drawings with calculations which show the assumptions and methods used to design the piles and the bearing values to which the piles need to be driven to support the calculated loads.

(d) Requirements at Highway and Railroad Traffic Openings - For falsework adjacent to or spanning a highway or railroad traffic opening, do the following:

- Design the posts using a minimum elastic section modulus, about each axis, of:
  - 12.2 cubic inches for structural steel
  - 244 cubic inches for timber
- Increase the vertical post load 150%. If the load on the falsework will be increased by load transfer due to prestressing, increase the vertical post load by the additional load due to prestressing or by 150%, whichever is greater.
- Provide mechanical connections for posts to supporting footing with capacity to resist a minimum lateral force of 2,000 pounds applied in any direction at the base of the post.
- Provide mechanical connections between top of posts and the cap or stringer capable of resisting a lateral force of 1,000 pounds from any direction.
- Tie down all beams or stringers spanning traffic so that each will resist a 500 pound force from any direction.
- Use 5/8 inch diameter or larger bolts at connections for timber bracing.
- Show temporary erection/removal bracing on the falsework plans.

(e) Additional Requirements at Railroad Traffic Openings - For falsework bents within 20 feet of the track centerline:

- Design bracing so that the bent will resist the required horizontal load or 500 pounds, whichever is greater.
- Provide solid sheathing of 5/8 inch thick plywood between 3 feet and 16 feet above the top of the rail, properly blocked at the edges.
- On falsework plans, show:
  - Collision posts if they are required
  - Soffit and deck overhang forming details

00540.42 Falsework Construction - Construct falsework according to the current edition of "AASHTO Construction Handbook for Bridge Temporary Works", except where in conflict with these Specifications. Assure that falsework is constructed according to the falsework design and on soils equal to or exceeding design assumptions. Within two days of notice of the falsework design engineer's pending inspection, the Engineer will provide a list of construction concerns. Do not place concrete until the falsework design engineer of record, accompanied by the Engineer, field inspects that portion of the falsework proposed for use. Do not place concrete until all construction concerns have been addressed, the falsework design engineer furnishes the Engineer a written statement that the falsework conforms to the design and will serve the intended use, and the Engineer agrees in writing that the falsework will serve the intended use.

Set falsework to give the finished structure the camber shown or specified.

Install telltales on falsework at locations as directed and use jacks, hardwood wedges or other methods approved, to take up settlement in the formwork.

When used, provide sand jacks consisting of a metal piston and metal frame filled with compacted, clean, dry sand. Ensure the annular space between the top bearing plate or piston and the frame does not exceed 1/4 inch.

Use temporary concrete barriers according to 00225.12(c) to protect falsework from damage from adjacent traffic. Make provisions to prevent damage by debris in streams.

Upon completion of the structure, remove all falsework to at least 24 inches below ground line or streambed.

Limit the height of timber blocking and wedging to 24 inches, or to less than one and one-half times the least horizontal dimension of the blocking or wedges, whichever is smaller. Limit post, shim pack and wedging assemblies supporting beams to six faying (interface or contact) surfaces. Ensure adjacent beam support assemblies do not have a difference of more than two faying surfaces. Ensure timber blocks loaded perpendicular to the grain are free of splits.

For post-tensioned structures, do not remove falsework until post-tensioning is complete.

00540.43 Joints - Construct joints in concrete bridges according to details shown or directed.

(a) Construction Joints - Make construction joints between concrete placements only where shown or specified unless otherwise approved.

Do not form construction joints in concrete exposed to salt water between levels of extreme low and high water. Where concrete may be exposed to the action of alkaline water or soil, place concrete continuous until completion of the section, or until the concrete is at least 18 inches above the ground or high water level.

Unless otherwise shown, provide construction joints with a roughened surface. Do not smooth or trowel aggregate into the cement paste. Provide a minimum deviation from a plane surface or 1/4 inch and a maximum deviation from a plane surface equal to the maximum size of aggregate in the specified class of concrete.

Within 24 hours after placing concrete, clean the joint surface by removing loosened particles of aggregate, damaged concrete, unconsolidated concrete and surface laitance with a high pressure washer conforming to 00540.28 to the extent that clean aggregate (free of cement film) on 50% of the surface is exposed. Clean the joint surface again immediately prior to the concrete placement to remove any subsequent deposits of dirt, debris or other foreign materials. Saturate the joint surface with potable water immediately before resuming concrete placement. Remove standing water in depressions or hollows of the joint surface.

(b) Open Joints - Locate open joints as shown. Construct the form so the form support system may be released as soon as the concrete takes its initial set. Do not chip or break the corners of the concrete when removing forms. Do not extend reinforcing bars across an open joint unless shown.

(c) Joints with Fillers - Construct joints with preformed expansion joint fillers or poured fillers as shown and according to the manufacturer's recommendations for the filler used.

(d) Bridge Deck Expansion Joints - Construct expansion joints for bridge decks as shown and according to Section 00585.

00540.44 Foundations - Place concrete foundations for structures on suitable soil or rock bearing surfaces, concrete seals or piles as shown. Excavate and backfill according to Section 00510.

00540.45 Construction of Forms - Construct forms that:

- Are mortar-tight and sufficiently rigid to conform to and maintain the specified dimensions and tolerances.
- Provide a 3/4 inch chamfer on all exposed concrete edges unless otherwise noted.
- Provide a smooth concrete surface unless otherwise specified.
- Are constructed so portions may be removed without disturbing forms that are to remain.
- Are treated with a release agent that is not detrimental to the concrete.
- Are cleaned of dirt, sawdust, excess water and other foreign material before placing concrete in the forms.
- Are saturated with water immediately before placing concrete and kept damp during placement.
- Are retightened before depositing new concrete on or against concrete which has hardened.

On structures 25 aerial miles from the Pacific Ocean, construct metal ties or anchorages within the forms so they can be removed to a depth of 2 inches from accessible surfaces. On all other structures, construct metal ties or anchorages within the forms so they can be removed to a depth of at least 1 inch from accessible surfaces.

Install embedded conduit 2 inches clear of the nearest face of concrete.

Secure in place expanded polystyrene forms and spacers between adjacent concrete placements to prevent floating or displacement during concrete placement. Carefully cut joints in expanded polystyrene and fill with a suitable filler or mastic to prevent intrusion of concrete mortar. After the concrete has hardened, completely remove expanded polystyrene unless otherwise stated.

Permanent stay-in-place bridge deck forms are not allowed unless shown otherwise.

(a) Footings - When footings are not founded in firm rock, concrete may be placed without forms if the excavation does not exceed the tolerances of 00540.40(a-3-b).

Do not form portions of footings founded in firm rock. Place concrete against undisturbed rock, filling the overbreak to the top of rock or top of footing.

(b) Accessible Box Girder Cells - Falsework and deck forms for accessible box girder cells may be supported by girder stems or bottom slab provided the bottom slab is fully supported and designed to take additional loading from deck forms and falsework, deck concrete, and concrete placement forces.

(c) Inaccessible Box Girder Cells - Falsework and deck forms for inaccessible box girder cells may be left in place provided:

- Falsework and deck forms left in place are not supported off the bottom slab. Falsework and deck forms supported by girder stems are allowed.
- 1/2 inch preformed expansion joint filler are placed between the end of deck forms and transverse beams and at 25 foot spacing in the deck forms.
- Box girder cells are cleared of materials and forms except as necessary to support the deck slab before the deck forming is complete.

(d) Form Maintenance - Set forms and maintain them true to designated line and grade until the concrete hardens. When forms appear to be unsatisfactory, either before or during the placing of concrete, the Engineer may order the work stopped until the defects have been corrected. Leave forms in place for periods specified in 00540.52.

00540.47 Delivering Concrete - Schedule delivery of concrete to ensure continuous delivery during placement. For all placements except seal and deck placements, ensure the interval between the end of one load and the start of the next load does not exceed 20 minutes. See 00540.48 for seal and deck placements.

If the requirements of the previous paragraph are not met, the Engineer will determine whether the concrete has taken its initial set and may order a bulkhead installed or removal of concrete in the affected placement.

00540.48 Handling and Placing Concrete:

(a) General - Do not place concrete under water or in flowing water unless specifically authorized. Place concrete:

- In the sequence shown or as approved.
- In its final position in the forms within 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 QPL and furnish at no additional cost to the Agency.
- As close as possible to its final position and consolidated to:
  - Avoid segregation of the materials and displacement of the reinforcement
  - Produce a dense, homogeneous concrete, free of voids and rock pockets
- Through pumps, chutes or trunks conforming to 00540.22, when placement requires dropping concrete more than 5 feet. Place the bottom of pump hose, chutes, pipes or trunks as close to final placement position as practical.
- In layers not more than 18 inches thick, except for seal concrete placement, and unless shown otherwise. Place and consolidate each layer before the preceding layer has taken initial set to avoid surfaces of separation between the layers.

Do not place concrete prior to complete approval of:

- The excavation and the bearing material in a foundation
- Installed piling
- The falsework and forms
- Placed reinforcing steel

After initial set of the concrete, do not disturb the forms or place loads on the ends of reinforcing bars projecting from the concrete placement until allowed by 00540.52.

(b) Pumping Concrete - Pump concrete with pumping equipment conforming to 00540.22. Pump a cement-water slurry through the lines before starting the mix through the pump. Operate the pump in a manner that produces a continuous stream of concrete without air pockets or segregation. When a placement nears completion, if concrete remaining in the pipeline is to be used, remove it in a manner that will not cause contamination of the concrete already in place.

There will be no extra payment for additional cement or additives required to ensure a mix is pumpable.

(c) Vibrating Concrete - Except for seal concrete, thoroughly consolidate fresh concrete according to the following:

- Vibrate concrete internally using mechanical vibrating equipment.
- Provide an extra vibrator for emergency use.
- Re-vibration of concrete may be required as directed.

Apply vibration at the point of freshly deposited concrete. Apply vertically at points uniformly spaced not farther apart than 1 1/2 the radius over which the vibration is visibly effective. Penetrate into previously placed plastic layers.

Do not use vibrators to make concrete flow or to move concrete from one point to another in the forms. Do not apply directly on or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration.

Supplement vibration by spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners or other locations impossible to reach with vibrators.

Continue vibration until the concrete is thoroughly consolidated. Discontinue vibration if segregation occurs or localized areas of grout form.

(d) Concrete Exposed to Salt Water, Alkaline Water, or Soil - For concrete exposed to salt water, see 00540.43(a) for location of construction joints, and 00540.53 for surface finish requirements.

Do not allow alkaline water or soil to contact the concrete during placement or for a period of at least 72 hours after placement. See 00540.43(a) for location of construction joints.

(e) Seal Concrete - Deposit seal concrete in still water near its final position, by means of a tremie seal pipe meeting the requirements of 00540.22(d) or a concrete pump with a rigidly held discharge line to prevent unwanted vertical movement. Place seal concrete continuously from start to finish, at a rate of at least 50 cubic yards per hour, keeping the surface of the concrete nearly horizontal at all times. Place each increase in height before the preceding concrete has taken its initial set.

Do not use vibrators.

At the start of the work and on any withdrawal of the pipe, close the discharge end to prevent water entering the pipe. During the progress of the work, keep the pipe full of concrete to the bottom of the hopper. When concrete is dumped into the hopper, start the flow of concrete by slightly raising the discharge end, always keeping it in the deposited concrete. Control the elevation of water inside the cofferdam to prevent any flow through the seal.

Dewatering may proceed when the concrete seal has achieved a compressive strength of 2,200 psi. Remove high spots, laitance and other unsatisfactory material from the exposed surface.

(f) Walls, Abutments, Bents, Piers, Columns, Beams, Girders, and Slabs - Place concrete following the sequences shown and the delay period specified in 00540.52.

Delay placement for the superstructure until the column forms have been stripped sufficiently to determine the character of the column concrete. Ensure superstructure loads are not carried by the bents or piers until the concrete has been in place and has attained the strength specified in 00540.52.

Stop placement for the bottom slab of box girder structures at the bottom of beam stems or bottom of stem fillets. Before placing concrete in the stems, wait for a period not less than that specified in 00540.52.

Stop placement for T-beams and box girder stems at the bottom of the deck fillet. Before placing deck concrete, wait for a period not less than that specified in 00540.52.

(g) Bridge Decks - Use deck finishing machines conforming to 00540.24 and set to run parallel to the skew of the bent lines. Place screed rails outside the finishing area. Extend screed rails beyond both ends of the scheduled placement length for a distance that allows the finishing machine to reach all of the concrete.

For bridges with continuous spans, ensure reinforcing steel is in place and tied in any adjacent span in the continuous bridge segment before placing concrete.

Before placing concrete, operate the finishing machine the length of the proposed placement, and check the deck thickness and clearance from the screed to the reinforcing steel in the presence of the Engineer, by an approved method. The permissible variation from the clearance indicated will be plus or minus 1/4 inch. Make necessary corrections before beginning the placement.

Furnish transverse work bridges according to 00540.29. Extend the screed rails beyond the start end to allow placement of all transverse work bridges on the screed rails before placement of concrete begins.

Do not place bridge deck concrete until the Engineer is satisfied that the Contractor:

- Meets the requirements of 00540.41, 00540.45 through 00540.49, and 00540.52.
- Has the finishing machine and transverse work bridges placed and ready on the screed rails.
- Is able to deliver concrete for decks so deck placement progresses at a rate of not less than 20 feet per hour.
- Proceeds up grade from the lowest deck elevation, unless otherwise shown.
- Is able to produce and place concrete at a rate sufficient to complete proposed placement and finishing operations within the specified time.
- Illuminates the work area during hours of darkness.
- Has experienced concrete finishers and necessary finishing tools and equipment at the work site.
- Provides wind breaks, fog spray, or other approved methods when the concrete surface is exposed to conditions which may cause premature drying during placement operations.

If delays occur lasting longer than 30 minutes, the Engineer may order construction of a bulkhead. If a bulkhead is constructed, do not begin further placement in that span or the adjacent falsework span, if any, for at least 24 hours. Construct bulkheads only where shown or when directed by the Engineer.

00540.49 Weather Conditions for Concreting:

(a) All Concrete Placement:

(1) Hot Weather - Maintain the concrete temperature during hot weather as specified. When concrete temperatures approach 80 °F, take appropriate action to lower concrete temperature.

Do not place concrete on or in forms if surface temperature of forms or reinforcing steel is 90 °F or above.

(2) Cold Weather:

a. General - Do not place concrete if the air temperature is, or is forecast to be, below 40 °F the day of placement or is forecast to be below 40 °F on any of the next 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.

Ensure the temperature of the concrete is not less than 60 °F when placed in the forms. If air temperature is below 40 °F, heat mixing water to a temperature of at least 70 °F, but not more than 150 °F, or heat the aggregates with either steam or dry heat. Ensure the temperature of concrete produced with heated aggregate, heated water, or both does not exceed 80 °F before placing.

b. Enclosures - If enclosures are used, do the following:

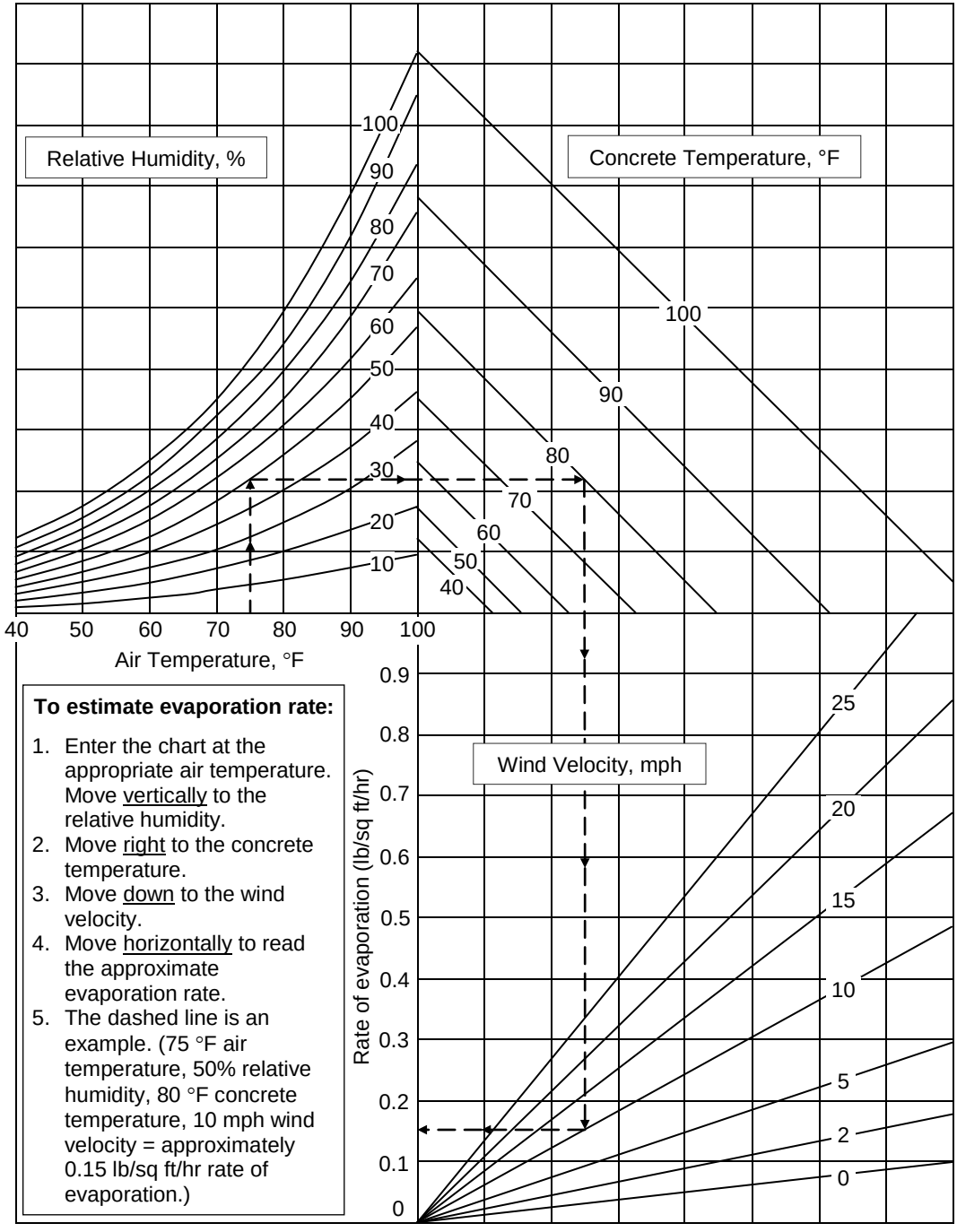
- Furnish and use a 24-hour high-low or continuous temperature recording thermometer to record air temperature within the enclosure.
- Supply heat and curing moisture.
- Maintain the air temperature in the enclosure between 60 °F and 80 °F for a period of seven days after placing concrete.

c. Insulated Forms - When approved by the Engineer, insulated forms, capable of maintaining the surface of the concrete at not less than 50 °F for a period of seven days, may be used instead of enclosures and heating. If forms are insulated, protect exposed horizontal surfaces with a similar layer of insulating material securely fastened in place. If the insulated forms do not maintain the proper temperature at the concrete surface, use auxiliary protection, and provide additional heat and thermometer, as described in (b) above.

(b) Bridge Deck Placement - Place concrete for bridge decks:

- Only if not raining and the combination of air temperature, relative humidity, concrete temperature and wind velocity produces an evaporation rate of less than 0.10 pounds per square foot of surface area per hour, according to Figure 00540-1, or
- Within an enclosure, according to 00540.49(a-2-b).

FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE [1]



[1] Based on ACI 305 R, "Hot Weathering Concreting"

00540.50 Bridge Deck Roadway and Sidewalk Finish:

(a) General - After the bridge deck roadway and sidewalk concrete is placed and consolidated, strike it off to lines, grades and cross sections shown.

(b) Deck Roadway Finish - After the deck roadway concrete has been screeded with a finishing machine conforming to 00540.24, float, if necessary, to produce a uniform surface, according to 00540.55. If the work does not conform to the prescribed limits, stop the operation until revised methods, changes in equipment, or correction of procedures are approved for trial. Also stop the revised operation if it does not produce a specified surface.

(c) Deck Roadway Texturing - After correcting any non-specification surface tolerance according to 00540.55, texture the deck roadway surface with a saw that cuts grooves into the bridge deck as follows:

- Cut grooves 1/8 inch wide and 1/8 inch to 3/16 inches deep.
- Unequally space grooves from 3/4 inch to 1 1/2 inches apart with a minimum of 12 grooves for every foot of deck surface. Measure groove spacing parallel to the roadway centerline.
- Orient the grooves perpendicular to the roadway centerline and full width of the roadway except leave smooth strips 16 inches wide along each curb face. Do not overlap grooves.
- Continuously remove saw slurry and laitance from the sawing operation while cutting grooves.
- Cut grooves after the bridge deck has been checked for non-specification surface tolerances as required by 00540.55 and after the water cure is complete.
- Cut grooves no sooner than 14 days after the deck is cast. Cut grooves before opening the roadway to traffic. For structures constructed in stages, the roadway may be opened to traffic before cutting grooves provided the time period from opening to actual construction of grooves is between June 1 and October 1.

(d) Deck Sidewalk Finish - After the deck sidewalk surface has been struck off with a strike board, float it with a wooden or cork float. Use an edging tool on edges and at expansion joints. Remove edging tool marks prior to final finishing. Apply a light broom texture to the surface.

00540.51 Curing Concrete:

(a) General Requirements - Cure cast-in-place concrete with water. Begin curing as soon after placement as possible without damaging the freshly placed concrete. Continue curing for 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 wet burlap or an approved wet or dry material.

Do not interrupt curing for more than one hour during the curing period.

If temperature falls below 35 °F during the 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:

- Provide wind breaks or other approved methods when exposed to conditions which may cause premature drying during placement operations. Premature drying is defined as an evaporation

rate equal to or greater than 0.20 pounds per square foot per hour, as determined from Figure 00540-1, or as the loss of surface sheen when the evaporation rate at the surface exceeds the bleed rate.

- Provide high pressure washers, according to 00540.28, fitted with fog nozzles during all deck placements to prevent and control premature drying. Apply fog spray upwind of the concrete placement during finishing. The purpose of fogging is to maintain a layer of high humidity above the concrete surface in order to minimize water loss in the mix after placement and before application of cure. Do not allow larger water droplets that drip from nozzles to fall onto the freshly finished plastic concrete.
- Cover the concrete with a single layer of clean initial covering immediately after finishing. Apply initial covering no later than 20 minutes after final pass of the finishing machine and no greater than 20 feet from the back of the finishing machine. Provide an initial covering with a minimum length sufficient to cover the bridge deck from side to side of the concrete placement. Use one of the following:
  - Saturated wet burlap having a minimum dry weight of 10 ounces per yard for material 40 inches wide. Presoak the burlap by immersing it completely in water for 72 hours prior to the deck placement and presoak new burlap with a wetting agent. Overlap the edges at least 6 inches.
  - Non-woven, needle punched polypropylene fabric curing blanket from the QPL. Thoroughly wet fabric within 15 minutes of fabric placement. Overlap the edges at least 12 inches.
- Provide soaker hoses for additional soaking of the initial covering. Place over the full width of the concrete placement, at a maximum of 10 foot intervals. Do not allow initial wetting of burlap or fabric to dry before soaker hoses are in place and operational. Operate soaker hoses continuously to keep the initial covering saturated.
- Place a layer of 4 mil polyethylene film over the initial covering and soaker hoses. Provide clear or white polyethylene film if the air temperature is forecasted to be above 65 °F within 24 hours of the concrete placement, and black at other times, as determined by the Engineer. Overlap the edges of polyethylene film by 12 inches. Keep the film in place by taping and weighting the edges where they overlap or are vulnerable to movement by wind. Once a particular type of film has been placed, do not change it during the curing period.
- Maintain a continuous water cure of the concrete surface for 14 days.

(c) Additional Cure Time - If, during the cure time, the surrounding temperature falls below 45 °F, extend the cure for the number of hours the temperature is below 45 °F.

00540.52 Removal of Forms and Falsework, and Subsequent Loading - Do not remove forms and falsework or place subsequent loads without approval.

In determining when to remove forms and falsework, and when to place subsequent loads, the Engineer will consider the Contractor's proposed schedule, the location and character of the structure, the weather, and other conditions influencing the setting of the concrete. If appropriate, these operations will be controlled by compressive strength tests of cylinders cast by the Contractor and witnessed by the Engineer. Test the cylinders at a recognized testing laboratory at no additional cost to the Agency. Cure cylinders under conditions which are equivalent to the most unfavorable field conditions for the portions of the concrete which the cylinders represent.

Forms and falsework may be removed and subsequent loads may be placed when both conditions of Table 00540-1 are met.

Table 00540-1

Part 1:

Form and Falsework Removal for:	Percent of Specified Strength	Counting Days [1]
Side form for footings, walls, abutments, caps, traffic and pedestrian barriers, and any other side forms not supporting the concrete weight	–	1
Columns	–	3
Cantilevered bridge deck sidewalks	–	7
Bridge decks supported on steel beams or precast, prestressed concrete members; top slabs of concrete box culverts	80	7
Crossbeams, caps, box girders, T-beam girders, and flat slab superstructures [2]	80	7
Arches [2]	80	7

Part 2:

Subsequent Loading [3] of:	Percent of Specified Strength	Counting Days [1]
Footings for signal, luminaire and sign supports	100	7
Footings [4]	–	3
Walls, wall-type abutments, columns, vertical girder stems, and box culvert stems over 4 feet in height [4]	–	3
Bottom slabs of box girders	66	5
Members and falsework designed integrally to carry the additional loads	100	7
Pile caps, bents, and other members designed as moment-carrying members	100	7
All other members	100	7

[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 requirement of 00540.51.

Remove forms and falsework:

- With methods not likely to deface, damage, or cause overstressing of the concrete.
- In a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.
- From the interior of structural steel box girders.
- From accessible concrete box girder cells before any loading, post-tensioning or removal of the supporting falsework.
- From all decks after subsequent loading is authorized, except those necessary to support the deck slab in inaccessible cells.

Dispose of forms and falsework according to 00290.20(c).

00540.53 Surface Finish Other Than Bridge Decks - Provide concrete surfaces with a general surface finish unless otherwise shown or specified. See 00540.50 for bridge deck and sidewalk surface finishing. Leave concrete surfaces unfinished as they come from the forms when exposed to salt water between the levels of extreme low and high water, except for needed repairs.

If a Class 1 or Class 2 surface finish is required, it will not include the interior sides of girders and the underside of decks between girders. Finish Class 1 and Class 2 surfaces to a point 1 foot below finished ground line.

(a) General Surface Finish - Give all concrete surfaces a general surface finish prior to the higher class finish specified for a particular item of work. A general surface finish consists of the following:

(1) On All Surfaces:

- Remove form bolts and metal to a depth of 1 inch, 2 inches on structures within 25 aerial miles of the Pacific Ocean.
- Remove rock pockets and unsound concrete.
- Fill holes and depressions at least 1/2 inch in depth or diameter with an approved patching material.

(2) On All Exposed Surfaces:

- Correct bulges, fins, depressions, stains, discolorations and other imperfections.
- Slope formed surfaces with respect to the specified plane at a rate not to exceed the following amounts in 10 feet, if required:
  - Watertight joints: 1/8 inch
  - Other exposed surfaces: 1 1/2 inch
  - Concealed surfaces: 1 inch
- Slope unformed, exposed surfaces, other than pavements and sidewalks, with respect to the specified plane at a rate not to exceed the following, if required:
  - In 10 feet: 1/4 inch
  - In 20 feet: 3/8 inch

The Engineer will determine the extent of the required repairs.

(b) Class 1 Surface Finish (Ground and Coated) - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Apply coating according to (d) below.

(c) Class 2 Surface Finish (Ground, Floated and Coated or Uncoated) - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Float the surface with a rubber or sponge float, using a paste of fine mortar sand, cement, water, and bonding agent to fill air holes or voids and to bring the surface to a uniform texture. Keep the retextured surface damp a minimum of 12 hours or until the paste has set, whichever is longer. If dusting occurs after the retextured surface sets and is rubbed, refinish the surface.

After the paste has set for a minimum of 24 hours, apply coating according to (d) below.

(d) Concrete Coating - Apply either a concrete paint or a concrete stain or sealer as shown or specified. Where a Class 1 or Class 2 surface finish is shown, apply a concrete paint unless specified or shown otherwise.

(1) Concrete Paint - Thoroughly saturate the surface with water and coat it, while damp, with a coating material conforming to 02210.30(c). Apply a minimum of two coats of coating material. Apply coating according to the manufacturer's instructions. The second coat may be applied any time after the previous coat, when touched lightly, does not adhere to the finger. Additional coats may be required to provide uniformity in coverage and color. Mortar sand may be added to the coating material to help achieve a uniform surface.

(2) Penetrating Concrete Stain or Sealer - Select a penetrating concrete stain or sealer from the QPL. Apply stain or sealer to a dry concrete surface and according to the manufacturer's instructions. Ensure the concrete has cured sufficiently. Apply a minimum of two coats of stain or sealer. Additional coats may be required to provide uniformity in coverage and color.

00540.54 Crack Inspection and Deck Sealing - Immediately after the cure period, the Engineer will inspect the deck surface for cracks.

After correcting non-specification surface tolerance according to 00540.55 and after texturing the deck surface according to 00540.50(c), seal all visible cracks with a methacrylate sealer or epoxy sealer as directed by the Engineer. In areas where the cracks are numerous, the entire area may be flooded with a methacrylate or an epoxy sealer. Cover the sealer with a dry, washed sand, prior to the sealer setting. Use only QPL listed methacrylate or epoxy products approved for deck sealing applications.

Perform deck sealing work at no additional cost to the Agency. Complete all deck sealing work before opening to traffic, unless otherwise directed by the Engineer. If the bridge is opened to traffic at the Contractor's request prior to completion of deck sealing, perform all additional traffic control to complete deck sealing at no additional cost to the Agency.

00540.55 Final Acceptance of Bridge Deck Surface - Ensure the finished bridge deck roadway surface meets the tolerance specified in 00540.40(b-3-d) at every point. Furnish a 12 foot straightedge and use it under the Engineer's direction.

Correct non-specification surface tolerances by complete removal and replacement or with a diamond grinder. If the surface is ground, take care not to unnecessarily sacrifice concrete cover over the reinforcing bars. Restore transverse texture to specification tolerance. Perform correction work, including required traffic control, at no additional cost to the Agency.

Measurement

00540.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Concrete - Concrete will be measured by one of the following methods:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of concrete will be listed in the Special Provisions.

Concrete quantities listed for cast-in-place deck is based on the nominal deck thickness shown.

Concrete quantities for prestressed, precast members, piling, bridge rail, slope paving, tremie seals and other similar items will not be included in the listed quantities.

(2) Volume - Under this method, concrete will be measured on the volume basis within the neat lines of the structure as shown.

No deductions will be made for the volume of pile heads, metal reinforcement, scoring, chamfer strips or structural steel embedded in the concrete.

(b) Saw Cut Texturing - The quantities of surface texturing will be measured on the area basis. The area will be determined by surface measurement of the width of bridge deck or end panel from curb face to curb face minus 16 inches on each side, and the full length of the bridge deck or end panel. The area will be calculated to the nearest square yard, for each bridge.

Payment

00540.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Foundation Concrete, Class _____	Lump Sum or Cubic Yard
(b)	Deck Concrete, Class _____	Lump Sum or Cubic Yard
(c)	General Structural Concrete, Class _____	Lump Sum or Cubic Yard
(d)	Saw Cut Texturing	Square Yard

In items (a), (b), and (c), the class of concrete will be inserted in the blank.

Item (a) includes footings, pile caps, and all other elements so designated.

Item (b) includes bridge decks and all other elements so designated.

Item (c) includes columns, crossbeams, diaphragms, wingwalls, backwalls, abutments, and all elements that are not designated as either (a) or (b) above.

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

Reinforcing steel, metal expansion joints, or other metal incorporated in the work will be paid for according to the appropriate Section in which the work is performed.

No separate or additional payment will be made for:

- surface finish, fogging, curing, joint filler, admixtures and other similar items, and for all other items required to complete the concrete work
- portland cement and fly ash used in excess of the minimum specified
- extra concrete required to fill footings cast directly against rock or soil or where forms are omitted
- additional concrete placed in deck buildups on top of beams to achieve the desired deck elevations

Section 00545 - Reinforced Concrete Bridge End Panels

Description

00545.00 Scope - This work consists of constructing reinforced portland cement concrete bridge end panels at the locations shown or as directed, and in close conformity to the lines, grades and dimensions shown or established.

Materials

00545.10 Materials - Furnish materials meeting the requirements of Section 00530 and Section 02001, modified as follows:

- Furnish Class HPC4000 concrete for end panels, unless shown otherwise.
- When pipe under end panels are shown, provide one of following types:
  - Class V reinforced concrete pipe meeting the requirements of 02410.20
  - Schedule 80 polyvinyl chloride (PVC) pipe meeting the requirements of ASTM D 1785
  - Type PSM polyvinyl chloride (PVC) sewer pipe meeting the requirements of ASTM D 3034 SDR 26
  - Grade A or B galvanized steel pipe, STD weight class minimum, meeting the requirements of ASTM A 53, hot-dip galvanized according to AASHTO M 111 (ASTM A 123)
- For pipe under end panels, provide pipe bedding, pipe zone material, and backfill meeting the requirements of 00405.12, 00405.13, and 00405.14.
- Provide granular structure backfill meeting the requirements of 00510.13.

00545.15 Quality Control - Provide quality control according to Section 00165.

Labor

00545.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CDT
- CSTT

Construction

00545.40 General - Perform work according to Section 00530 and Section 00540 except as modified by this Section.

00545.41 Earthwork - Remove pavement and subgrade according to Section 00310 and Section 00330.

00545.42 Surface Finish - For end panels with an asphalt concrete wearing surface, a finishing machine and roadway texturing are not required. For end panels without an asphalt concrete wearing surface, texture the end panel roadway surface by saw cutting according to 00540.50(c). Perform saw cutting on end panels no sooner than 14 days after the end panels are cast.

00545.43 Curing - Cure concrete according to 00540.51(a).

00545.44 Expansion Joints - Construct expansion joints as shown, according to Section 00585, and as follows:

- Install armored corners for strip seal joints in preformed blockouts a minimum of 14 days after the bridge deck and end panels are cast. Set the joint opening as shown. Support the armored corners securely in position before placing concrete in the joint blockout.
- Place compression joint seals or poured sealant joint seals a minimum of 14 days after the bridge deck and end panels are cast.
- Place asphaltic plug joints a minimum of 14 days after the end panels are cast and after final paving is complete.

Saw cut the AC wearing course at the roadway end of end panels when detailed on the plans, as soon as practical but within 48 hours after paving. Use a 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 QPL.

00545.45 Pipes under End Panels - Install pipes under end panels for future utilities as shown and according to Section 00445.

00545.46 AC Paving - Compact AC abutting end panels according to 00745.62(b).

00545.47 Bridge Rails - Construct bridge rails on end panels as shown and according to Section 00587.

Measurement

00545.80 Measurement - The quantities of reinforced concrete bridge end panels will be measured on the area basis. The area will be determined by surface measurement of the width and length of each separately constructed end panel. The area will be calculated to the nearest square yard, for each bridge.

Surface texturing by saw cutting will be measured according to 00540.80.

Expansion joints at panel ends will be measured according to 00585.80.

Bridge rails on end panels will be measured according to 00587.80.

Payment

00545.90 Payment - The accepted quantities of reinforced concrete bridge end panels will be paid for at the Contract unit price, per square yard, for the item "Reinforced Concrete Bridge End Panels".

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

Surface texturing by saw cutting will be paid for according to 00540.90.

Expansion joints at panel ends will be paid for according to 00585.90

00545.90

Bridge rails on end panels will be paid for according to 00587.90.

No separate or additional payment will be made for:

- saw cutting and filling the joint in the wearing surface at the roadway end
- furnishing and placing pipe under the end panels for future utilities
- extra thickness of panels as shown at the panel ends
- required stage construction, including splices

Section 00550 - Precast Prestressed Concrete Members

Description

00550.00 Scope - This work consists of the manufacture, storage, transportation and installation of precast prestressed concrete girders, box girders, slabs or other concrete members. Precast prestressed concrete members in this Specification will be referred to as members.

00550.02 Design - Essential elements of design and section dimensions for members are as shown. Submit unstamped working drawings, stressing calculations, and detensioning sequence for all members for approval according to 00150.35.

00550.03 Alternate Designs - Agency design specifications will be furnished by the Agency upon request. The Contractor may propose another type of prestressing system or different member dimensions provided the following requirements are met:

- Before manufacturing the members, submit stamped design calculations, working drawings, and specifications for all modified members according to 00150.35.
- With the calculations, show that the member meets all applicable service and strength limit states used for the Agency design.
- Do not increase member dimensions by more than 1 inch, except that bulb width and overall depth may be increased up to 2 inches from the dimensions shown. Where overall depth is increased, verify that the required minimum vertical roadway clearance has been maintained.
- Do not incorporate alternate materials or members into the work until the proposal has been accepted by the Engineer.
- Make any structural changes required to accommodate an approved alternate prestressing system or section at no additional cost to the Agency.

00550.04 Member Tolerances:

(a) General - Fabricate members to the dimensional tolerances in the PCI "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products" and as specified below. Acceptance or rejection of members outside these tolerances will depend on how the structure's strength, rideability and appearance are affected.

(b) Twist - Provide members with a relative twist of member bearing surfaces between member ends of less than or equal to 1/16 inch per foot of bearing width measured at right angles to the centerline of the member.

00550.05 Fabricator Certification and Qualification - Certification under the PCI Plant Certification Program is required for all plants producing precast prestressed concrete bridge members. Certification in Bridge Group B3 or Bridge Group B4 is mandatory for the fabrication of prestressed straight strand bridge members. Certification in Bridge Group B4 is mandatory for the fabrication of prestressed draped strand bridge members.

Materials

00550.11 Materials - Furnish materials meeting the following requirements:

Backer Rod	02440.14
Concrete Coating	02210.30
Concrete	02001
Deformed Bar Reinforcement	02510.10
Epoxy and Non-Epoxy Grouts	02080
Epoxy Coating	02510.11
Keyway Grout	02080.30
Poured Joint Filler	02440.30
Prestressing Reinforcement	02515
Tie Rods	02560.30

00550.12 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance of aggregate will be based on the Contractor's quality control testing, if verified, according to Section 00165.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the QCT, according to Section 02001.

(c) Hardened Concrete:

(1) General - Acceptance of hardened concrete will be based on analysis of compressive strength test results of cylinders cast and cured by the Contractor and tested according to AASHTO T 22 by a CSTT at an ODOT certified laboratory and verified according to Section 00165.

(2) Sampling and Testing - Obtain a sample from a delivery vehicle, selected at random, during placement in each bed. Test the sample for temperature, slump, density and air content and cast at least three cylinders for testing at 28 days. Cure the cylinders in a manner similar to the members they represent. Alternately, the cylinders may be cured in a curing chamber correlated in temperature with the concrete in the beds. Leave the cylinders in the bed with the member or in the curing chamber until the member is stripped. After the member is stripped, place the acceptance cylinders in storage in a moist condition according to AASHTO T 23.

(3) Acceptance - Concrete members with an ASTV meeting or exceeding the specified design strength, f'_c, will be acceptable for strength. If the compressive strength of a single test specimen varies by more than 10% from the average of the other specimens, that compressive strength value will be discarded. The average compressive strength test of the remaining specimens will be the ASTV.

If the ASTV is less than f'_c but at least 85% of f'c, the Engineer may review the results to determine if the member is suitable for the intended purpose. If suitable, the concrete represented by an ASTV less than f'_c may be accepted subject to a price adjustment according to 00150.25.

Concrete that has an ASTV less than 85% of f'_c will not be accepted. All costs of removal, replacement, and all related work is the Contractor's responsibility.

Equipment

00550.20 Prestressing Equipment - Provide hydraulic jacks equipped with calibrated pressure gauges. Calibrate the jack and gauge combination and furnish a graph or table showing the calibration to the Engineer.

If other types of jacks are used, furnish calibrated proving rings or other devices that accurately indicate the jacking forces.

Recalibrate the jack and gauge combination annually or at any time the results are in question.

00550.25 Vibrators - Provide either internal or external vibrators in working condition meeting the manufacturer's rating.

When epoxy coated reinforcement is used, use internal vibrators fitted with a manufactured rubber head to minimize damage to the epoxy coating.

Construction

00550.40 Forming - Provide forms that are mortar-tight and sufficiently rigid to conform to the specified dimensions without appreciable distortion, warping or opening of joints.

Before placing concrete in the forms, remove all dirt, sawdust, excess water and other foreign material.

Tighten forms before depositing new concrete on or against hardened concrete.

00550.41 Placing Reinforcement - Place reinforcement according to the plans, Section 00530, and these Specifications.

00550.42 Pretensioning:

- Do not proceed with stressing prior to receiving the Engineer's approval of stressing calculations submitted according to 00550.02.
- Provide a person, skilled in the use of the system of prestressing to be used, to supervise the work and assist the Engineer.
- Hold the prestressing strands accurately in position and stress by jacks meeting the requirements of 00550.20.
- Determine the force induced in the strands by measurement of elongation and, independently, by direct measurement of force using a pressure gauge dynamometer and load cell. If the difference in force determination for the two methods exceeds 5%, determine the cause and correct it.
- Measure strand elongation on the first and last strands stressed, and on at least 10% of the other strands in the bed.
- Record the jacking forces and the elongations produced.
- In single straight strand tensioning, and in a completely open bed with no headers or other possible sources of friction, loads indicated by the gauging system may be used.

00550.43 Placing Concrete:

(a) General - Place concrete so that the finished members are uniform and monolithic, free from cold joints.

Do not deposit concrete in the forms until the Engineer has inspected and approved the placement of reinforcement, conduit, anchorages and prestressing steel.

In preparation for placing concrete, prepare forms according to 00550.40. Remove struts, stays and braces serving temporarily to hold the forms in correct shape and alignment before the placing of concrete when the concrete placing has reached an elevation rendering them unnecessary. Remove these temporary members entirely from the forms and do not bury them in the concrete.

Place concrete close to its final position, without segregation of materials or displacement of the reinforcement.

(b) Consolidation - Consolidate concrete, during and immediately after placing, by mechanical vibration as follows:

- Operate vibrators at frequencies that produce consolidated placements.
- Do not use vibration for shifting concrete to the extent of causing segregation.
- Vibrate at points uniformly spaced and not further than twice the radius over which vibration is visibly effective.
- Continue vibration until the concrete is thoroughly consolidated, but not until segregation occurs or localized areas of grout form.

00550.44 Hot or Cold Weather - Produce and place concrete within the temperature range specified in 02001.20(d). When the air temperature is, or is expected to be, below 40 °F or above 100 °F, observe the following precautions:

- Do not place concrete on forms, reinforcing steel or appurtenances when the temperature of these facilities is below 40 °F. Provide heat to maintain their temperature at 40 °F minimum.
- Do not place concrete when the form temperature is 100 °F or more.

00550.45 Curing - Cure members with low-pressure steam or radiant heat inside a suitable enclosure to contain the steam or heat, and minimize moisture and heat loss.

(a) Curing Temperature - Measure cure temperature by one of the two following methods:

(1) Measuring Enclosure Temperature:

- Equip the enclosure with 24-hour recording thermometers at each end of each casting bed. Record the temperature for each thermometer on a single chart for each 24-hour period.
- Do not allow the curing temperature within the enclosure to exceed 160 °F. During the initial application of live steam or radiant heat, do not allow the temperature within the enclosure to increase at a rate exceeding 40 °F per hour.

(2) Measuring Concrete Temperature:

- Embed a thermocouple 6 inches to 8 inches from the top or bottom of the member on its centerline and near its midpoint.
- Record the concrete temperature with a calibrated recorder that provides a continuous record of time and temperature throughout the curing cycle.
- Do not allow the concrete temperature to exceed 190 °F. During the initial application of steam or radiant heat, do not allow the concrete temperature to increase at a rate exceeding 80 °F per hour.

(b) Curing with Low-Pressure Steam:

- Make the initial application of steam after initial set of concrete as determined by AASHTO T 197 (ASTM C 403).
- Provide a steam supply line to the enclosure equipped with a motor-operated modulating steam control valve operated by a temperature-sensing element located in the enclosure.
- Provide steam at 100% relative humidity.
- Do not apply steam directly on the concrete, form surfaces or test cylinders.
- Distribute the steam within the enclosure through suitable ports located on each side of the units within the enclosure at not more than 30 foot centers to keep the units being cured completely and uniformly surrounded with steam.

(c) Curing with Radiant Heat - Radiant heat may be applied to beds by means of pipes circulating steam, hot oil or hot water, by electric blankets or heating elements adjacent to forms, or by circulating warm air under and around forms. Do not allow pipes, blankets or heating elements to be in contact with concrete, form surfaces, or test cylinders.

00550.46 Release of Prestress - Transfer bond stress to the concrete, or release end anchors, only when the concrete has attained the minimum compressive strength shown or specified for such transfer of load. Cut or release the elements according to the sequence shown on the reviewed working drawings so lateral eccentricity of prestress will be a minimum.

Determine the compressive strength of the concrete to establish time for detensioning by testing standard cylinders cast and cured identically with the member. Cast and test cylinders used to determine release time according to AASHTO T 22 and AASHTO T 23.

00550.47 Surface Finish - Apply the specified finish to each surface as shown or specified.

Where no finish is shown or specified, provide a Class 1 surface finish to all exposed concrete surfaces, except on the tops of members, unless shown otherwise. For concrete surfaces that are not exposed, provide a general surface finish except on the tops of members. For surfaces receiving a Class 1 surface finish (ground and coated), finish the surfaces when the member is in its final position and finish to a point 1 foot below the finished ground line.

Provide a roadway finish on the tops of members. After the concrete has been struck to grade and cross section, float it to produce a uniform surface. After the concrete has hardened sufficiently, texture it with a 1/8 inch wide steel-tined tool that will mark the finished concrete to a depth of 1/8 inch to 3/16 inch. Space the markings 3/4 inch on centers. Do not overlap the texturing. Produce the texture transverse to the roadway centerline and full member width.

(a) General Surface Finish - Apply a general surface finish as a final finish or preparatory to a higher class finish.

Remove strands in members, except members with ends to be embedded in concrete, to a depth of 1 inch from the face of the concrete and point up the resulting holes flush with the end of the member with an epoxy grout from the QPL.

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 QPL. On exposed surfaces, correct all bulges, fins, depressions, repairs, stains or discolorations to produce a smooth surface with uniform texture, lines, and appearance.

The Engineer will determine the extent of required repairs.

(b) Class 1 Surface Finish (Ground and Coated) - After completion of the general surface finish:

- Grind the surface with a power grinder or other equal method to remove all laitance and surface film.
- Thoroughly saturate the surface with water and coat while damp with a coating material conforming to 02210.30(c).
- Apply a minimum of two coats of coating material. The second coat may be applied at any time after the previous coat does not adhere to the finger. Apply additional coats as required to provide uniformity in coverage and color.
- Mortar sand may be added to the coating material to achieve a uniform surface.

00550.48 Exposed Reinforcement - After a member is removed from the casting bed, clean any projecting reinforcement of dirt, oil, grease, rust and corrosives and protect it from damage until concrete is cast around it.

00550.49 Lifting, Storing, Transporting, Erecting, and Bracing - Be responsible for the safety of precast members during all stages of construction. Include lifting and storage details on the working drawings for all precast members. Lifting, storage, transporting, erecting, and bracing details will not be reviewed by the Engineer. Lifting, storage, transporting, erecting and bracing of members is the sole responsibility of the Contractor subject to the following requirements:

(a) Lifting:

- Lift members so as to prevent damage.
- Lift members at the support points specified by the manufacturer.
- Lift members in a manner that does not cause damaging bending or torsional forces.
- Members will be rejected if not handled correctly as specified.

(b) Storing - Store members with support points that are level transversely.

(c) Transporting - Transport members from the casting yard not less than 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.

- Temporary prestress strands may be added to precast concrete members for the purpose of controlling concrete stresses during transportation. Detension these strands after the members are set in the field and prior to establishing grades for the bottom of deck forms.
- Temporary strands may be either post-tensioned or pretensioned in the fabrication yard. Debond post-tensioned strands completely from end to end. Debond pretensioned strands completely from end to end except for a length at the end of the beam equal to the development length of the strand, but not more than 10 feet. Pretensioned strands may be used for simple span girders only.
- The stress from temporary strands may be transferred to the concrete member only after the stress from the permanent strands has been transferred to the concrete member. This requirement may be waived for pretensioned strands if calculations are submitted, and approved by the Engineer, that show acceptable stress levels in the member.
- For pretensioned temporary strands, form a hole in the girder at mid span or at each end of the debonded length, so the strand can be cut for detensioning. Ensure these holes are free draining and patched after detensioning. The detensioned strands may be left in place.

- Post-tensioned temporary strands may be placed in a conduit or debonded full length with direct contact sheathing. In either case, patch the holes formed by the conduit or sheathing to a depth of 1 1/2 inch, after the removal of the conduit or sheathing to this same depth. The detensioned strands may be left in place.
- Submit stamped calculations that predict the effect of temporary strands on initial and long term girder camber according to 00150.35.

Damaged members will be rejected. Replace damaged members, or if allowed by the Engineer, repair damaged members to the Engineer's satisfaction at no additional cost to the Agency.

(d) Erecting and Bracing - After a member has been erected and until it is secured to the structure, provide temporary bracing as necessary to resist wind or other loads. Provide the Engineer with an erection plan and bracing details at least 2 days prior to erecting girders. Bracing details are not necessary for side-by-side slab and box beam construction.

00550.50 Tie Rods - Furnish tie rods according to the Plans and Section 02560. Install as follows:

- Clean and lubricate tie rods and nuts before installation.
- Lubricate galvanized tie rods and nuts with a lubricant from the QPL containing dye that visibly contrasts with the color of galvanizing or coating.
- Install compressible washer type direct tension indicators under the non-turned nuts and tighten the nuts at the other end of the tie rods as recommended by the manufacturer until the gaps in the indicators are nil or as shown. A nil gap is defined as a gap when the number of spaces between the protrusions of a direct tension indicator in which the 0.005 inch feeler gauge is refused at each tie rod equals or exceeds 2, 3, 3, 4, or 4, when the number of spaces between protrusions in the direct tension indicator are 4, 5, 6, 7, or 8, respectively, and a visible gap exists in at least one space.

00550.51 Keyway Grouting for Slabs, Box Beams, and Integral Deck Members - After forms have been removed from slabs, box beams and integral deck bulb tees, sandblast all keyways to remove residual form oil and any other foreign material. After the members are in place and the tie rods are tensioned (for slabs and box beams) or welded connections are made (integral deck bulb tee girders), clean the keyways of all foreign material and keep moist for 24 hours before grouting. For slabs and box beams, after the tie rods are tensioned, seal the space remaining at the bottom of the keyways with a backer rod as shown before grouting.

Do not pour keyway grout unless the air temperature is above 45 °F and at or below the maximum air temperature recommended by the manufacturer. Water cure grout for the period of time indicated by the manufacturer.

00550.52 Poured Joint Filler for Integral Deck Members with AC Wearing Surface - After grout is poured to the level of the keyway shown for slabs and box beams, remove loose grout, and other foreign material from exposed keyway walls. After keyway grout is fully cured, dry surfaces to be sealed immediately before installing poured joint filler.

Install poured joint filler according to the manufacturer's directions. Cure the filler sufficiently to resist the pressures and temperatures of the paving operation before the wearing surface is placed.

00550.53 Differential Camber Correction for Integral Deck Members with No AC Wearing Surface - Correct differential camber between adjacent slabs, box beams or integral deck bulb tees in a span (measured in place at the site) if the variance between adjacent members or stages is 1/2 inch or more at any place along the top edge corners.

Equalize the camber differences by either patching with an epoxy or nonepoxy grout deck patching material from the QPL, or other approved method, at no additional cost to the Agency. Before patching, clean the area by sandblasting. Water cure the patch for the period of time indicated by the manufacturer. If patching is used, slope it away from the joint on a 1V:6H slope or flatter.

Measurement

00550.80 Measurement - The quantities of work performed under this Section will be measured on the length basis, and will be the sum of the horizontal lengths shown for each type and size of member. Field measurement of each member length will not be made. The quantities will be determined by calculating the theoretical horizontal length shown, added together for a total for each type and size, then rounded to the nearest foot.

Payment

00550.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	_____ Precast Prestressed Girders	Foot
(b)	_____ Precast Prestressed Slabs	Foot
(c)	_____ Precast Prestressed Box Beams	Foot

In item (a), the girder type and depth will be inserted in the blank.

In item (b), the slab depth will be inserted in the blank.

In item (c), the box beam depth will be inserted in the blank.

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

No separate or additional payment will be made for:

- reinforcement, prestressing steel, enclosures for post-tensioning steel, anchorages, plates, nuts, and all other material contained within the member
- furnishing, transporting, and placing members
- furnishing and tensioning rods and pretensioning strands
- grouting keyways and installing poured joint filler
- furnishing and installing metal diaphragms for integral deck bulb tees
- furnishing and placing anchor bolts, dowels and diaphragm threaded rods where applicable
- furnishing and installing elastomeric bearing pads

00550.91 Fabrication Inspection Expense - If fabrication of members outside of the State of Oregon creates additional shop and plant inspection expenses for the Agency, the Contractor's payment for members will be reduced according to 00165.91.

Section 00555 - Post-Tensioning

Description

00555.00 Scope - This work consists of post-tensioning cast-in-place and precast concrete by furnishing, placing and tensioning stressing steel according to details shown and specified. This work also includes furnishing and installing any items necessary for the stressing system used including, but not limited to, anchorage assemblies, ducts and grout for pressure grouting. Concrete that is to be stressed by the post-tensioning method will be referred to as a member.

00555.03 Anchorage Devices - Secure all post-tensioned stressing steel at the ends by means of approved permanent type anchorage devices. Design anchorage devices according to the current AASHTO LRFD Bridge Design Specifications. Identify post-tensioning anchorage systems as either "Normal Anchorage Devices" or "Special Anchorage Devices" as defined in the AASHTO LRFD Bridge Design Specifications. Provide anchorage devices that meet all testing and construction requirements of the AASHTO LRFD Bridge Design Specifications and the AASHTO LRFD Bridge Construction Specifications.

For bearing plates, provide 7 inch minimum edge distance from the top of deck and 2 inch minimum edge distance from expansion joint blockouts and any other concrete edge.

Materials

00555.10 General - Furnish materials meeting the following requirements:

Anchorage Devices	02530 and 02540
Couplings	02515.60
Tendon Duct	02515.50

00555.11 Stressing Steel - Furnish stressing steel according to one of the following as the Contractor may elect, unless otherwise shown or specified:

Seven-Wire Strand	02515.10
High Strength Steel Bars	02515.30
Seven-wire strand epoxy coated reinforcement	02515.40

00555.12 Tendon Grout - For grouting post-tensioning ducts, furnish a commercial, pre-packaged, thixotropic tendon grout meeting the requirements of 02080.50. Label each grout bag with application, mixing and pumping instructions, lot number, date of manufacture and shelf life. A grout expiration date may be used in lieu of the date of manufacture and shelf life. Tendon grout will be rejected if the shelf life or expiration date has been exceeded.

Use water meeting the requirements of Section 02020.

At least 48 hours prior to the trial batch, submit a detailed written mix design showing the exact brand and batch quantities of 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 on the project at least 48 hours before the scheduled grouting. Grouting may proceed anytime after approval of the grout trial batch.

Perform the following tests:

(a) Flow Cone - Determine the efflux time at 0 quiescent time according to ASTM C 939 modified as follows:

- Fill the flow cone to the top of the cone.
- When thoroughly mixed, the efflux time of grout will be the time to fill a one quart container that is placed directly under the flow cone. Ensure the efflux time of the grout immediately after mixing is between 5 and 30 seconds.
- Let the grout stand for 30 minutes without agitation then retest as follows:
  - Remix for 30 seconds.
  - Ensure the efflux time of the grout immediately after remixing is 30 seconds or less.

(b) Bleeding - Determine wick induced bleeding according to ASTM C 940 as modified by the PTI "Guide Specification for Grouting of Post-Tensioned Structures" except limit the maximum allowable bleed to 0.0% at 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 2 sets of 3 cubes, for informational purposes only, to the Engineer for 7 and 28-day testing.

If the proposed grout mix design does not produce acceptable trial batch results, revise the mix design and perform another trial batch. Results from previous projects will not be considered acceptable documentation. Seven and 28-day test results will be used for documentation purposes only.

Equipment

00555.20 Certified Calibrated Jacking Equipment - Equip each jack used to stress tendons with either:

- A pressure gauge with an accurate reading dial at least 6 inches in diameter and of such capacity that the final pressure reading is in the upper half of its range. Calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force, and provide a certified calibration chart; or
- A certified, calibrated load cell with an indicator by which the stressing force in the tendon may be determined, and with a range such that the lower 10% of the manufacturer's rated capacity will not be used in determining the jacking stress.

Adjustment or repair of jacks, gauges, or load cell after certification will be cause for rejection.

The certified calibration charts for the hydraulic jacks, pressure gauges or load cells used for tensioning stressing steel may be checked before and during tensioning operations by Agency personnel with Agency-furnished load cells. Perform certified calibration of stressing system not more than 180 days before use.

00555.21 Grouting Equipment - Provide grouting equipment with:

- Separate motors or engines for the grout mixer and the grout pump, and a system for controlling each independent of the other.
- A high speed, high shear, colloidal mechanical grout mixer that will produce uniform and thoroughly mixed tendon grout.
- Equipment which will accurately measure solids and liquids to be batched.
- An easily accessible filter screen before the grout pump with clear openings of 1/8 inch maximum size.
- A grout pump capable of producing a minimum pressure of 75 psi, with a pressure gauge reading from 0 to 300 psi, and with a relief valve that will limit grouting pressures to less than 200 psi.
- Watertight grout hoses, valves and pipe fittings.

Provide standby water flushing equipment which:

- Is in addition to and separate from the grouting equipment
- Has a different power source than the grouting equipment
- Is capable of developing a pumping pressure of 250 psi and has sufficient capacity to flush out any partially grouted ducts or vents if necessary

Labor

00555.30 Personnel - Provide the following:

- **Post-Tensioning Supervisor** - A person, skilled in the use of the system of stressing to be used, to supervise the work.

- **Grouting Technician** - An American Segmental Bridge Institute (ASBI) certified grouting technician to supervise, inspect, and document the entire grouting operation.

Construction

00555.40 Required Submittals:

(a) Test Report - Submit a certified test report to the Engineer for review and acceptance for each size and type of anchorage device showing that the device meets the requirements of the AASHTO LRFD Bridge Design Specifications and the AASHTO LRFD Bridge Construction Specifications. With the certification, include a statement that the design, materials and manufacture of the anchorage devices have not changed since testing. Ensure the concrete strength, edge clearance dimensions and amount of reinforcing for the test block is not greater than that proposed for the Project.

(b) Working Drawings and Calculations - Submit stamped working drawings and calculations for post-tensioning systems to the Engineer for review according to 00150.35.

(c) Review of Methods - Submit for review complete details of the materials, equipment, method and sequence proposed for the stressing operations, including but not limited to:

- Additions or rearrangement of reinforcing steel or changes in member dimensions from that shown.

- For normal anchorage devices, bearing stress and resistance calculations satisfying Section 5.10.9.7.2 in the LRFD Bridge Design Specifications.
- Complete specifications and details of the ducts, stressing steel including arrangement and alignment, and the anchoring devices.
- Pressure grouting materials and equipment.

Furnish reinforcement working drawings that are compatible with the approved Post-Tensioning System working drawings.

Do not cast any member to be stressed before the working drawings have been reviewed according to 00150.35.

00555.41 Ducts - Provide ducts for post-tensioning tendons according to the following:

(a) General - Make ducts mortar-tight and place them accurately at the locations shown or as directed. Provide positive, metallic, mortar-tight connection joints between sections of rigid duct which do not permit angle changes at the joints. Use waterproof tape at connections.

(b) Vents - Provide vents in all ducts within plus or minus 3 feet of high and low points, and other locations shown. Make vents of 3/4-inch nominal diameter standard PVC, galvanized steel or copper pipe. Make connections to ducts with compatible structural fasteners. Make the vents mortar-tight, tape as necessary, and provide means for injecting grout through the vents and for sealing the vents. Securely fasten ducts and vents in place to prevent movement. After grouting, remove the ends of vents to provide 2 inches of cover to the nearest concrete surface.

(c) Repair - Before placing concrete, repair all holes or openings in the ducts. Holes less than 1/4 inch may be repaired by several wraps of waterproof tape. Repair holes larger than 1/4 inch with a split metal sleeve which overlaps itself by 3 inches, extends at least 3 inches on either side of the hole, is sealed with waterproof tape, and is secured to the duct. Cut out indentations which cannot be repaired and repair as above for holes larger than 1/4 inch.

(d) Maintenance - After installing ducts, keep the ends covered at all times in a manner that prevents entry of moisture or debris. If the surrounding temperature is below 32 °F, keep the ducts free of water to avoid damage due to freezing.

Before placing forms for the decks of box girder cells, demonstrate to the satisfaction of the Engineer that all ducts are unobstructed.

Clean all ducts and remove accumulated water at the time of placing stressing steel.

00555.42 Stressing:

(a) General - Do not make welds, or grounds for welding equipment, on the forms or on the steel in the member after any stressing steel has been installed.

Protect stressing steel against physical damage and rust or other corrosion at all times until grouted. A corrosion inhibitor may be used. Stressing steel that has sustained physical damage, detrimental rust, pitting or other results of corrosion at any time will be rejected. Stressing steel with only light rust is acceptable if rust spots can be removed by rubbing or scraping with the fingernail and only light streaks of rust remain.

Tension stressing steel by means of hydraulic jacks so that the force in the stressing steel is not less than the value shown.

(b) Duct Alignment - Provide a duct alignment according to the approved working drawings to the follow tolerances:

- **Horizontal Alignment** - ± 1/2 inch unless shown otherwise
- **Vertical Alignment** - ± 3/8 inch

(c) Timing - Do not stress members until at least 14 days, excluding days when the surrounding temperature is below 40 °F for a total of 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 will in no way relieve the Contractor of full responsibility for successfully constructing the member.

(d) Procedures - Tension stressing steel by jacking at each end of the tendon unless otherwise noted.

(1) Continuous Span Members - Jacking of both ends need not be done simultaneously.

(2) Simple Span Members - When jacking from one end only is allowed, tension half of the stressing steel in each member from one end of the span and the other half from the opposite end, unless otherwise allowed in writing.

(3) Bent Cap Members - Subject to prior written approval, bent cap stressing steel may be tensioned by jacking from one end only.

(e) Measuring Prestressing Force - Conduct tensioning so the tension being applied and the elongation of the stressing steel may be measured at any time. Keep a record of gauge pressures, load cell reading and elongations. Furnish a copy of the record to the Engineer when requested.

Determine prestressing force by both of the following methods:

(1) Measurement of Strand Elongation - Determine required elongation from average load-elongation curves for prestressing strand used.

(2) Observation of Jacking Force - Observe jacking force on a calibrated gauge or load cell or by use of a calibrated dynamometer.

Ascertain the cause of any difference in force determination between (1) and (2) that exceeds 5% and correct the condition causing the discrepancy.

00555.43 Bonding and Grouting - Bond stressing steel to the concrete by filling the void space between the duct and the tendon with tendon grout consistent with the approved trial batch. Complete grouting each tendon within 14 calendar days after placing it. If projects are within 25 aerial miles of the Pacific Ocean, complete grouting each tendon within 7 calendar days after placing it. Test grout according to ASTM C 939, as modified in 00555.13(a) at least once daily at the start of grout production, and as requested by the Engineer, to verify that flow characteristics of the grout remain within the tolerances specified in 00555.13(a). Perform Mud Balance tests for each batch according

to 00555.13(c). Compare and document the wet density value with the value obtained during the trial batch. If the values differ by more than 3%, rerun ASTM C 939 as modified in 00555.13(a) for continued compliance.

(a) Pre-Grouting Procedure - Cut stressing steel 1 inch beyond wedges or anchor nuts after stressing operations. Coat stressing strand ends and bearing plates with an epoxy bonding agent from the QPL after post tensioning stressing operations and before post tensioning duct grouting. Do not coat wedges. Prepare post tensioning blockouts according to 00540.43(a) or as approved. Encase each anchorage with concrete after completion of all post tensioning operations.

(b) Grouting Operation - Provide a standby flushing system and demonstrate that it is readily accessible and operable should it become necessary to flush out a partially grouted tendon.

Do not retemper grout. Continuously agitate grout until it is pumped.

(c) Grouting Procedure - Make all ducts clean and free of deleterious materials. Blow out each duct thoroughly with oil-free air immediately before grouting. Ducts may be flushed with water immediately before grouting if approved.

Fit grout injection pipes with positive mechanical shutoff valves. Fit vent and ejection pipes with grout-tight caps, valves or other mechanical closing devices.

Grout from the low end of the structure.

Keep the temperature of the concrete surrounding the duct at 35 °F or higher at the time of grouting and until job-cured grout cubes reach 800 psi compressive strength.

Maintain grout temperatures between 50 °F and 90 °F during mixing and pumping. If necessary, cool the mixing water.

Open all vents when grouting starts. Allow grout to flow from the first vent until residual flushing water or entrapped air is removed, then close the vent. Close remaining vents in sequence in the same manner.

Whenever the grout pumping pressure exceeds 100 psi:

- Inject grout at any other vent which has been, or is ready to be, closed as long as a one-way flow of grout is maintained. If this procedure is used, fit the vent used for injection with a mechanical shutoff valve.
- If the one-way flow of grout cannot be maintained, immediately flush the grout out of the duct with water.

Pump grout through the duct and continuously waste it at the outlet vent until:

- No visible slugs of water or air are ejected.
- The afflux time of the grout at the mixer during the grouting process is not more than 5 seconds different from the efflux time at the mixer during the initial measurements of the flow cone test during the trial batch, and is between 5 and 30 seconds.
- The efflux time of the ejected grout is not more than 5 seconds different from the efflux time at the mixer.

Do not over-mix the grout.

Close the outlet vent and maintain the pumping pressure or 60 psi, whichever is greater, for at least 30 seconds; then close the valve at the injection pipe while maintaining this pressure. Do not open valves or vents until the grout sets.

Following grouting, fill all grouting and anchorage recesses with concrete and finish flush immediately after applying an epoxy bonding agent from the QPL.

Measurement

00555.80 Measurement - No measurement of quantities will be made for work performed under this Section. Estimated quantities of materials will be listed in the Special Provisions.

Payment

00555.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Post-Tensioning".

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

No separate or additional payment will be made for anchorage devices, ducts, tendons, prestressing steel, grout, and admixtures, or for preparation and testing of grout.

Section 00560 - Structural Steel Bridges

Description

00560.00 Scope - This work consists of furnishing, fabricating, and erecting steel structures as shown or specified. It also includes miscellaneous metal work on bridges and structures, such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices, and structural steel shapes.

00560.02 Prefabrication Conference - Meet with the Steel Fabricator, the Engineer and the Agency's steel inspector for a conference at a time mutually agreed upon in advance of ordering steel materials for fabrication. At this conference, present and discuss all phases of the steel fabrication schedule and work. A prefabrication conference is not required for miscellaneous metal work, unless required by Special Provision.

00560.03 Working Drawings - Submit stamped copies of detailed working drawings according to 00150.35. Any work done before review of these drawings shall be at the Contractor's risk. When material is ordered in advance, obtain approval before placing the order.

Provide steel identification on the working drawings according to 00560.22(a).

(a) Reviews - The Engineer's review of the working drawings submitted will only cover "strength and detail" requirements. The Engineer assumes no responsibility for errors in dimensions.

(b) Revisions - Submit copies of any revisions to the detailed working drawings for review. Work done before review of these revisions shall be at the Contractor's risk.

Materials

00560.10 Materials - Furnish structural plates, shapes, bars, and miscellaneous metals meeting the requirements of Section 02530 and Section 02560.

Shop Fabrication

00560.20 Notice of Work - Give the Engineer at least 14 calendar days notice of the beginning of work at the mill, when directed, or at the shop, so inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. Do not fabricate material, or perform work at the mill or shop, before the Engineer has been notified.

00560.21 Fabrication Inspection Expense - If fabrication of structural steel outside of the State of Oregon creates additional mill, shop, and plant inspection expenses for the Agency, the Contractor's payment for structural steel structures will be reduced according to 00165.91.

00560.22 Test Results Certificate and Steel Identification:

(a) Test Results Certificate and Initial Identification - Furnish test results certificates, showing chemical analysis and physical tests for each heat or plate of steel, for all members according to 00165.35 and Section 02530. Identify each piece of steel to be fabricated.

Identify on working drawings each piece to be made of steel other than AASHTO M 270 (ASTM A 709), Grade 36 steel. Give pieces made of different grades of steel different assembling or erecting marks, even though they are of identical dimensions and detail.

Provide a system of marking individual pieces made of steel, other than AASHTO M 270 (ASTM A 709), Grade 36, and issue cutting instructions to the shop (generally by cross-referencing

the assembly marks on the working drawings with the corresponding item on the mill purchase order) that maintain identity of the heat number.

Material that can be identified by heat number and mill test report may be furnished from stock.

Mark any unmarked excess material placed in stock for later use with the heat number and with its AASHTO M 160 (ASTM A 6) specification identification color code.

(b) Steel Identification during Fabrication - During fabrication, and until member assembly, each piece of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, shall show clearly and legibly its specification identification color code shown in AASHTO M 160 (ASTM A 6).

Individually marked pieces of steel used in furnished size, or reduced from furnished size, may be used only if end or edge trim does not disturb the heat number or color code. Any usable piece may be used without further color coding providing the heat number or color code remains legible.

Mark individual pieces, other than AASHTO M 270 (ASTM A 709), Grade 36, with the AASHTO M 160 (ASTM A 6) specification identification color code before cutting to a smaller size.

Mark individual pieces of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, which are furnished in tagged lifts or bundles with the AASHTO M 160 (ASTM A 6) specification identification color code immediately on being removed from the bundle or lift.

Pieces of steel, other than AASHTO M 270 (ASTM A 709), Grade 36 steel, which before assembling into members, will be subject to fabricating operations such as heating, blast cleaning, galvanizing or other coating that might obliterate paint color code marking, shall be marked for grade by steel die stamping or by a substantial tag firmly attached. Use only rounded characters when primary stress components are identified by steel die stamping. Impressions shall have a maximum allowable depth of 0.010 inch and shall be placed a minimum distance of 2 inches from edges of tension-stressed plate members. Characters shall be 1/4 inch to 3/8 inch high and shall have a minimum face radius of 0.015 inch.

(c) Check Samples - To verify the accuracy of test reports, obtain check samples from material furnished for fabrication. The plates, shapes or bars from which check samples are required will be as designated on the Plans, and shall be ordered from the mill with the extra size required for samples. The Engineer may take additional samples from drop-offs or scrap material as deemed necessary. No more than two samples will be required from any one plate according to AASHTO M 270 (ASTM A 709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or from any one shape or bar. Remove material for check samples in the presence of the Engineer. The Engineer will select the locations where samples are to be taken. Check samples may be ordered cut from either end of the designated steel plate, according to AASHTO M 270 (ASTM A 709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or shape or bar. To verify accuracy of test reports for HPS 50W and HPS 70W with thermo-mechanical control process, check samples of both ends of each plate is required.

Check samples in plates shall be rectangular, not less than 24 inches long in the required direction, depending on plate width, for the longitudinal axis of tensile specimens, and 5 inches wide. Bend specimens, where required, shall be not less than 24 inches long in the direction of rolling of the plate. Check samples in bars or shapes shall be the full section and at least 24 inches long. In removing the sample, take care not to damage it by overheating. The Agency will be responsible for the necessary machining of check test specimens and their testing. To expedite obtaining test results, the Contractor may, if approved, perform machining and testing of specimens, in the presence of the Engineer.

The normal basis of acceptance of material will be the mill report or other test report, and fabrication need not be held up pending results of check tests. If the check tests indicate material with properties failing to meet the minimum requirements of the material specification, the material may be rejected and the Contractor required to order new material at no additional cost to the Agency.

For purposes of determining compliance with these Specifications, if the results on an original tensile specimen are within 2,000 psi of the required tensile strength, within 1,000 psi of the required yield point, or within 2% of the required elongation, a retest will be allowed on 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 shall be oriented with the final direction of rolling in the same manner as the original specimen, and may come from any location within the plate. The extra material from plates, shapes or bars that is not used for check testing shall become the property of the Contractor.

(d) Certification of Identification - Upon request, furnish an affidavit certifying that throughout the fabrication operation the identification of steel has been maintained according to this Specification.

00560.23 Shop Inspection and Testing:

(a) Facilities - Furnish facilities for the inspection of material and work in the mill and shop. Allow the Engineer free access to the material and work for inspection.

(b) Testing - Furnish samples for testing as specified according to Section 00165.

(c) Rejections - The Inspector's inspection at the mill or shop of any material, work or finished members will not prevent their subsequent rejection, if later found damaged or defective, nor relieve the Contractor of the responsibility to correct or replace the work at no additional cost to the Agency.

(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 allowed.
- Bent so no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are:

	Plate Thickness				
	Up to 1/2"	**Over 1/2" to 1"**	**Over 1" to 1 1/2"**	**Over 1 1/2" to 2 1/2"**	**Over 2 1/2" to 4"**
All grades of structural steel in this Specification	2 t	2.5 t	3 t	3.5 t	4 t

Where t = Plate thickness in inches

Low alloy steel in thicknesses over 1/2 inch may require hot bending for small radii

00560.26 Welding:

(a) Bridge Welding - Welding, welder qualifications, prequalification of weld details, and inspection of welds for bridge structures shall all conform to AWS D1.5.

(b) Non-Bridge Structures - Welding, welder qualifications, prequalification of weld details and inspection of welds for non-bridge structures shall all conform to AWS D1.1. Non-bridge structures include bridge railing posts, railing splices, deck expansion joints, earthquake restraints and similar structures. Submit all welding procedure specifications to the Engineer for approval.

Test earthquake restraint welds radiographically or ultrasonically. Testing will be witnessed by the Engineer. Additional inspection for earthquake restraint welds shall include:

- Ultrasonic inspection of 100% of the complete penetration welds using a straight beam transducer. A weld will be acceptable if it has no indications of cracks and no indications of lack of fusion between adjacent layers of weld metal and between weld metal and base metal.
- Magnetic particle inspection of 10% of the fillet welds.

00560.27 Bolt Holes:

(a) Punched Holes - Use a die with a diameter not exceeding the diameter of the punch by more than 1/16 inch. Ream any holes that are required to be enlarged to admit the bolts. Make clean cut holes without torn or ragged edges. Poor matching of holes will be cause for rejection.

(b) Drilled or Reamed Holes - Assemble and securely hold connecting parts requiring drilled or reamed holes. Match-mark connecting parts before disassembling.

Where practical, direct reamers by mechanical means.

Perform drilling and reaming with twist drills. Make drilled or reamed holes cylindrical, perpendicular to the member, and complying with the size requirements of these Specifications. Remove burrs on the outside surfaces. If required, take apart assembled parts for removal of burrs caused by drilling.

Poor matching of holes will be cause for rejection.

(c) Accuracy of Punched and Drilled Holes - Locate all holes punched full size, subpunched, or subdrilled so accurately that after assembling (before any reaming is done) a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75% of the connecting holes in the same plane. Non-conforming pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller than the nominal size of the hole, the non-conforming pieces will be rejected.

(d) Accuracy of Drilled and Reamed Holes - When holes are drilled or reamed, 85% of the holes in any connecting group shall, after drilling or reaming, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

Provide steel templates with hardened steel bushings in holes and accurately dimensioned from centerlines of the connections inscribed on the template. Use the centerlines in accurately locating the template from the milled or scribed ends of the members. When steel templates 1 inch or greater in thickness are used 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 subpunching 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), subpunch or sub drill all holes 3/16 inch smaller and, after assembling, ream 1/16 inch larger or drill full size to 1/16 inch larger than the nominal diameter of the bolts. Sub drill if thickness limitation governs.

Holes not more than 1/32 inch larger than the nominal diameter resulting from a drill or reamer of the nominal diameter are considered acceptable. The slightly conical hole from punching operations is considered acceptable.

(g) Holes for Ribbed Bolts, Turned Bolts, and Others - Make holes with a driving fit as specified for ribbed bolts, turned bolts, or other approved bearing-type bolts by one of these methods:

- Subpunch 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) Subpunching and Reaming Field Connections - Unless otherwise specified, subpunch (or sub drill if subdrilling is required according to 00560.27(f) or 00560.27(g)) and subsequently ream holes in all field connections and field splices of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames while assembled on a steel template, as required by 00560.43. Holes for field splices of rolled beam stringers continuous over floor beams or crossframes may be drilled full size unassembled to a steel template.

Subpunch and ream all holes for floor beam and stringer field end connections to a steel template or ream while assembled. Drill or ream full size field connection holes through a steel template after the template has been carefully located as to position and angle and firmly bolted in place. Make templates used for reaming matching members, or the opposite faces of a single member, exact duplicates. Locate templates used for connections on like parts or members so accurately that the parts or members are duplicates and require no match-marking.

For any field connection, instead of subpunching and reaming or subdrilling and reaming, the Contractor may drill holes full size with all thicknesses of material assembled in proper position.

Use templates as described above, or do not interchange splice plates.

(2) Numerically Controlled Punched or Drilled Field Connections - Alternately, for any connection or splice designated in 00560.27(f), instead of subpunching and reaming field connections according to 00560.27(h), the Contractor may punch or drill bolt holes full-size in unassembled pieces and connections, including templates, for use with matching subsized and reamed holes by means of suitable numerically controlled punching or drilling equipment subject to this Section. Punch or drill full-size holes according to 00560.27(c).

Submit for review a detailed outline of the procedures proposed for accomplishing the work from initial punching or drilling through check assembly, if required. Include the specific members of the structure that may be numerically controlled punched or drilled, the sizes of the holes, the location of common index and other reference points, composition of check assemblies, and all other pertinent information. Do not begin until written approval is received.

Punch or drill holes by numerically controlled equipment to appropriate size through individual pieces, or drill through any combination of pieces held tightly together. Use each splice plate only once as a template and do not interchange after assembly drilling is complete.

If numerically controlled punching or drilling equipment is used, the Engineer may require the Contractor, by means of check assemblies, to demonstrate that this punching or drilling procedure consistently produces holes and connections conforming to 00560.27(g) and 00560.43.

00560.28 Carbon Steel Bolt Connections - Unless otherwise shown or specified, make connections with unfinished carbon steel bolts nuts and washers conforming to Section 02560. Use holes conforming to 00560.27.

(a) Turned Bolts - Provide and install turned bolts as follows:

- The body surface shall have a surface roughness of 125 microinches, or less, according to ANSI B46.1.
- The unthreaded body shall equal total thickness of connected parts.
- The outer thread diameter shall equal the nominal diameter of the bolt specified.
- Heads and nuts shall be hexagonal with standard dimensions for bolts of the nominal size specified or the next larger nominal size.
- Install bolts in carefully reamed holes with a tight driving fit.

(b) Ribbed Bolts - Provide and install ribbed bolts as follows:

- The body shall have an approved form with continuous longitudinal ribs.
- The diameter of the body, measured on a circle through the points of the ribs, shall be 5/64 inch greater than the nominal bolt diameter specified.
- Round heads shall conform to ANSI B 18.5.2.1M unless otherwise specified.
- Ribbed bolts shall make a driving fit with the holes.
- The hardness of the ribs shall be such that the ribs do not permit the bolts to turn in the holes during tightening.
- If for any reason the bolt twists before drawing tight, ream the hole and use an oversized bolt as a replacement.
- Nuts shall be hexagonal, with standard dimensions for bolts of nominal size specified or the next larger nominal size.

(c) Washers - Use hardened washers of suitable thickness under the turning element (nut or 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 AASHTO M 164 (ASTM A 325) or equivalent fastener using bolts, nuts, and washers conforming to Section 02560 and in holes conforming to 00560.27.

Fit-up bolted connections as follows:

- Provide all steel material within the grip of high-strength bolts (no compressible material such as gaskets or insulation).
- Remove burrs that would prevent solid seating.
- So that parts fit solidly together after bolts are tightened.

- Make slope of surfaces in contact with the bolt head or nut less than 1:20 with respect to a plane normal to the bolt axis.
- Install all bolts, unless otherwise shown, to expose the heads on the exterior surface of the structure.

(b) Surface Conditions - Make all joint surfaces including surfaces adjacent to the bolt head and nut free of scale, oil, grease, dirt, foreign material, and unless otherwise shown or specified, free of paint, lacquer, rust inhibitor, galvanizing or other coating.

(1) Coated Members - Prepare and coat steel-to-steel contact surfaces within slip-critical bolted joints for coated steel according to Section 00594. Prior to assembly, prepare the contact surfaces with approved methods not harmful to the primer.

Coat fasteners visible to the public, as determined by the Engineer, according to Section 00594 (except the primer coat) after installation. All direct tension indicators shall be mechanically galvanized according to 02560.40(b).

a. Non-Coastal Projects - On projects more than 25 aerial miles, of the Pacific Ocean, all high-strength fasteners shall be either black or galvanized as the Contractor elects. The fasteners shall meet the following requirements:

1. Black Fasteners - Clean black fasteners, including hardened washers, and the surrounding areas stained by the black fasteners, after installation, using an approved method. Coat according to Section 00594.

2. Galvanized Fasteners - Clean and prepare fasteners as approved, in areas visible to the public, as determined by the Engineer, and coat according to Section 00594 after installation.

b. Coastal Projects - On projects within 25 aerial miles of the Pacific Ocean, all high-strength fasteners, including hardened flat washers, shall be galvanized according to 02560.40 prior to installation. In areas visible to the public, as determined by the Engineer, clean and prepare fasteners as approved, and coat according to Section 00594.

(2) Non-Coated Weathering Steel Members - Blast clean steel-to-steel contact surfaces within slip-critical bolted joints for non-coated weathering steel according to SSPC-SP 10 "Near-White Blast Cleaning". The appearance of the blast-cleaned surface shall closely approximate Pictorial Standard Sa 2-1/2 of SSPC-Vis 1.

All fasteners shall be black. Do not use direct tension indicators for non-coated weathering steel connections.

(3) Galvanized Members - After galvanizing, roughen surfaces of galvanized slip critical connections by means of hand wire brushing. Power wire brushing is not allowed.

(c) Installation and Tightening:

(1) General - Fasteners shall be assigned lot numbers (including rotational capacity lot numbers) prior to shipping, and components shall be assembled when installed. Protect fasteners from dirt and moisture at the Project Site. Take from protected storage only as many fasteners as anticipated to be installed and tightened during a work shift. Return fasteners not used to protected storage at the end of the shift. Do not remove lubricant present in as-delivered condition. Clean and lubricate fasteners, if necessary, and retest before installation. Use lubricant according to 02560.70. Do not relubricate tension control fasteners designed to automatically provide the tension without consulting with the manufacturer.

Provide a tension measuring device at the Project Site if high-strength bolts are being installed and tightened. The device shall have capacity for the bolt being installed. Confirm the accuracy of the tension-measuring device through calibration by an approved testing agency at the start of work and at least annually. Use the tension-measuring device to calibrate wrenches if applicable, to assist the bolting crew in understanding and proper use of the method to be used, and to confirm the ability of the complete fastener assembly to be used in the work, including lubrication, if required, to satisfy the requirements of Table 00560-1.

Install fasteners with washers of specified size and quality, located as described below, in properly aligned holes, and tighten according to 00560.29(c-3) unless otherwise specified. Tighten to at least the tension specified in Table 00560-1 when all the fasteners are tight. Tightening may be done by turning the bolt while the nut is prevented from rotating when it is impractical to turn the nut. Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air to tighten each bolt in 10 seconds.

Non-galvanized fasteners may be reused, if approved, but not more than once. Retightening previously tightened fasteners loosened by the tightening of adjacent fasteners will not be considered a reuse. Do not reuse galvanized fasteners.

Use bolt, nut and washer combinations from the same rotational-capacity lot.

Verify correct lengths of all AASHTO M 164 (ASTM A 325) bolts. In the tightened connection, the unthreaded portion of the bolt shall not jam against the internal threads of the nut. The bolt shall have full nut engagement with a positive stick-through. The space between the nut and the bolt head (the grip) shall include a threaded length of bolt at least 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 00560-1

Required Fastener Tension in Bolts

Nominal Bolt Size (inch)	Minimum Tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1 1/8	56
1 1/4	71
1 3/8	85
1 1/2	103

(2) Washer Requirements:

- Where the outer surface of the bolted parts has a slope greater than 1:20 with respect to a plane normal to the bolt axis, use a hardened, beveled washer to compensate for the lack of parallelism.
- Use a hardened washer under the element of the fastener (nut or bolt head) turned in tightening.
- Where AASHTO M 164 (ASTM A 325) bolts of any diameter are to be installed in an oversize or short slotted hole in an outer ply, use a hardened washer conforming to ASTM F 436.

- Where AASHTO M 164 (ASTM A 325) bolts of any diameter are to be installed in a long slotted hole in an outer ply, use plate washers or continuous bars of at least 5/16 inch thickness with standard holes. These washers or bars shall have sufficient size to completely cover the slot after installation. Make the plate washer from structural grade steel.
- Oversize and slotted holes shall be as defined by Manual of Steel Construction Load and Resistance Factor Design (AISC).

(3) Direct Tension Indicators (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 according to 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 runout. If the nut cannot be run down for this thread length, the DTI lot shall be rejected unless the load recorded is less than 95 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 shall be able to be run down by hand for the complete thread length of the bolt excluding the thread runout. Reject the DTI lot if the nut cannot be run down for this thread length.

c. Installation - Install fastener assemblies using 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 00560-2

Direct Tension Indicators

Bolt Diameter (inch)	Verification Tension (Kips)	Maximum Verification Refusals	DTI Spaces	Minimum Installation Refusals
1/2	13	1	4	2
5/8	20	1	4	2
3/4	29	2	5	3
7/8	41	2	5	3
1	54	2	6	3
1 1/8	59	2	6	3
1 1/4	75	3	7	4
1 3/8	89	3	7	4
1 1/2	108	3	8	4

Table 00560-2 Notes:

Maximum Verification Refusals are for galvanized DTI's under a stationary element. The maximum number if 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 [1]

	Disposition of Outer Faces of Bolted Parts		
Bolt Length (underside of head to end of bolt)	**Both faces normal to bolt axis**	**One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)**	**Both faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)**
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters [2]	2/3 turn	5/6 turn	1 turn

[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°.

[2] No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to 00560.29(c-5).

(6) Lock-Pin and Collar Fastener Tightening - Install lock-pin and collar fasteners by methods and procedures as recommended by the manufacturer and approved.

When using lock-pin and collar fasteners, install lock-pins in all holes of the connection and initially snug-tighten sufficiently to bring all plies of the joint into firm contact, progressing systematically from the most rigid part of the connection to the free edges in a manner that minimizes relaxation of previously tightened fasteners. After all fasteners in the connection are snug-tight, fully tighten the fasteners, progressing systematically from the center most rigid part of the connection to its free edges. Ping the fasteners with a hammer for soundness. Remove and replace loose or relaxed fasteners with new fasteners to the satisfaction of the Engineer.

(d) Inspection - Before installing fasteners in the work, the Engineer will check the marking, surface condition and storage of bolts, nuts, and washers, and 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 00560.29(c-5), as applicable, and will monitor the installation of fasteners in the work to confirm that the procedure is properly used and that, when so used with the fastener assemblies supplied, the tensions specified in Table 00560-1 are provided.

The Engineer will monitor the installation of fasteners in the work to assure that the selected installation method, as demonstrated in the initial testing to develop the specified tension, is routinely followed.

Either the Engineer or the Contractor, in the presence of the Engineer and with the Engineer's approval, shall inspect the tensioned bolts using an inspection torque wrench, unless alternate fasteners or direct tension indicators are used, allowing verification by other methods. Conduct inspection tests in a timely manner prior to prevent possible loss of lubrication, and before corrosion influences torque.

Place three fastener assembly lots, in the same conditions as those under inspection, individually in a device calibrated to measure bolt tension. Perform this calibration operation at least once each inspection day. There shall be a washer under the turned element in tensioning each bolt if washers are used on the structure. If washers are not used on the structure, the material used in the tension-measuring device that abuts the part turned shall be of the same specification as that used on the structure. In the calibrated device, each bolt shall be tensioned by any convenient means to the specified tension. Apply the inspecting wrench to the tensioned bolt to determine the torque required to turn the nut or head 5 degrees (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. Retension and reinspect any bolt whose head or nut turns at this stage. The Contractor may, however, retension all the bolts in the connection and resubmit it for inspection, provided DTIs are not over-tensioned or fasteners assemblies are not damaged.

Labor

00560.30 Fabricators - Structural steel bridge fabricators shall have an American Institute of Steel Construction (AISC) Major Steel Bridges (Cbr) certification. For fracture critical structures, the fabricator shall also have an AISC Fracture Critical Endorsement (F). All fabricators of earthquake restraints shall have either a current AISC Cbr certification or a Simple Steel Bridge Structures (Sbr) certification.

Construction

00560.40 Members Work:

(a) General - Fabricate members true to line and free from twists, bends and open joints.

(b) End Connection Angles - Fabricate floor beams, stringers and girders having end connection angles to exact length shown, as measured between the heels of the connection angles, with a permissible tolerance of plus 0 to -1/16 inch. Where continuity is required, face end connections. Provide connection angles with a thickness of not less than 3/8 inch, nor less than shown after facing.

(c) Stiffeners - Fabricate end stiffeners of girders and stiffeners intended as supports for concentrated loads to have full bearing (either milled, ground, or on weldable steel in compression areas of flanges, welded as specified) on the flanges to which they transmit load or from which they receive load. Fabricate stiffeners not intended to support concentrated loads, according to paragraph 3.5.1.10 of AWS D1.5, unless specified otherwise.

(d) Abutting Members - Mill, 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:

Member	Maximum Surface Roughness
Steel slabs	2,000 microinch
Heavy plates in contact with shoes to be welded	1,000 microinch
Milled ends of compression members, milled or ground ends of stiffeners and fillers	500 microinch
Bridge rollers and rockers	250 microinch
Pins and pin holes	125 microinch
Sliding bearings	125 microinch

(g) Pins and Rollers - Turn pins and rollers to the dimensions shown. Make them straight, smooth and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed carbon-steel shafting. Pins and rollers 9 inches or less in diameter may be cold-finished or forged and annealed carbon-steel shafting.

In pins larger than 9 inches in diameter, bore a hole not less than 2 inches in diameter full length along the axis after the forging has cooled to a temperature below the critical range, under conditions that prevent injury by too rapid cooling, and before annealing.

Provide threads for all bolts and pins for structural steel construction according to ASME B1.1, Unified Inch Screw Threads, Class 2A for external threads and Class 2B for internal threads, except for pin ends having a diameter of 1 3/8 inch, or more, use a thread pitch of 6 threads per inch.

(h) Pin Holes - Bore pin holes true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise specified. Produce the final surface by a finishing cut.

The diameter of the pin hole shall not exceed that of the pin by more than 0.02 inch for pins 5 inches or less in diameter, or by 0.03 inch for larger pins.

The distance outside-to-outside of end holes in tension members and inside-to-inside of end holes in compression members shall not vary from that specified more than 1/32 inch. Bore holes in built-up members after the fabrication is completed.

(i) Shear Connectors - Fabricate shear connector studs with material, welding and inspection according to Section 7 of AWS D1.5.

00560.41 Repair of Defects - Do not begin the repair of defects in the fabricated material until the proposed corrective procedure has been approved.

00560.42 Cambering - Provide a smooth, unbroken curve or camber over the full length of the member when shown.

Camber roll beams in the fabricating shop by use of heat or hydraulic jacks. The temperature of the heated area shall not exceed 1,200 °F as controlled by pyrometric stick (temperature crayon) or thermometers. Do not quench to accelerate cooling.

Trim web plates of cambered plate girders before assembly.

Camber truss spans according to 00560.46.

00560.43 Shop Assembling:

(a) General - Assemble in the shop the field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders and rigid frames with milled ends of compression members in full bearing, and then ream their subsize holes to specified size while the connections are assembled. Use full truss or girder assembly, unless progressive truss or girder assembly, full chord assembly, progressive chord assembly, or complete structure assembly is specified.

Make check assemblies with numerically controlled punched or drilled field connections and template drilled field connections of rolled beam stringers continuous over floor beams or cross frames according to 00560.43(g).

Obtain approval for each assembly, including camber, alignment, accuracy of holes and fit of milled joints before reaming is commenced or before a numerically controlled drilled check assembly is dismantled.

Furnish a camber diagram, prepared by the fabricator, showing the camber at each panel point in the cases of trusses or arch ribs, and at the location of field splices and fractions of span length (quarter

points minimum, tenth points maximum) in the cases of continuous beam and girders or rigid frames. When the shop assembly is Full Truss or Girder Assembly or Complete Structure Assembly, show the camber measured in assembly. When any of the other methods of shop assembly is used, show calculated camber.

(b) Full Truss or Girder Assembly - Assemble all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder or rigid frame at one time.

(c) Progressive Truss or Girder Assembly - Assemble, initially for each truss, bent, tower face or rigid frame, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths.

Assemble, initially for each arch rib, continuous beam line or plate girder, at least three connecting shop sections.

Make successive assemblies with at least one panel or section of the previous assembly (repositioned if necessary and adequately pinned to assure accurate alignment) plus two or more panels or sections added at the advancing end.

In the case of structures longer than 150 feet, make each assembly not less than 150 feet long regardless of the length of individual continuous panels or sections.

The sequence of assembly may start from any location in the structure and proceed in one or both directions, so long as the preceding requirements are satisfied.

Obtain approval for assemblies consisting of less than three panels or shop sections.

(d) Full Chord Assembly - Assemble, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower, then ream their field connection holes while the members are assembled, and ream the web member connections to steel templates set at geometric (not cambered) angular relation to the chord lines. Mill at least one end of each web member or scribe normal to the longitudinal axis of the member and accurately locate the templates at both ends of the member from one of the milled ends or scribed lines.

(e) Progressive Chord Assembly - Assemble connecting chord members in the manner specified for Full Chord Assembly and in the number and length specified for Progressive Truss or Girder Assembly.

(f) Complete Structure Assembly - Assemble the entire structure, including the floor system.

(g) Check Assemblies with Numerically Controlled Punched and Drilled Field Connections - A check assembly consists of at least three connecting shop sections, or in a truss, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths; that is, the length between field splices. Check assemblies shall be based on the proposed order of erection, joints in bearings, special complex points such as the portals of skewed trusses, and similar considerations, as directed. Check assemblies shall be the first such sections of each major structural type to be fabricated.

Use geometric angles (giving theoretically zero secondary stresses under dead-load conditions after erection) or cambered angles (giving theoretically zero secondary stresses under no-load conditions) as shown or specified.

No match-marking and no shop assemblies other than the check assemblies are required.

If the check assembly fails to demonstrate that the required accuracy is being obtained, further check assemblies may be required at no additional cost to the Agency. Acceptance of the check assembly does not relieve the Contractor of the responsibility for assuring accurate fit-up during erection.

(h) Match-Marking - Match-mark connecting parts assembled in the shop for the purpose of reaming holes in field connections, and furnish a diagram showing such marks to the Engineer.

00560.44 Coatings:

(a) Galvanizing - Galvanize as shown or specified according to 02530.70.

(b) Other Coatings - Unless otherwise shown or specified, prepare and coat all steel surfaces according to Section 00594.

00560.45 Marking and Transporting to Site - Handle members and transport to the Project Site according to 00560.24 and the following:

- Mark each member with an erection mark for identification and furnish an erection diagram showing the erection marks.
- Mark the weight of members weighing more than 6,000 pounds on the member.
- Load structural members on trucks or cars so they may be transported and unloaded without being excessively stressed, deformed or otherwise damaged.
- Ship fasteners (bolts, nuts, and washers) according to 02560.60(a-3).
- Do not allow welding to be done on the steel members for the purpose of transporting anchorage.
- List and describe the contained material plainly on the outside of each shipping container.
- Furnish as many copies of material orders, shipping statements and erection diagrams as directed and show the weights of the individual members on the statements.
- Brace the girders properly and adequately, so as to eliminate cyclic out-of-plane bending stresses in the web gap between the end of stiffener on the web and the girder flange due to cyclic swaying motion in transit. Take care to minimize dynamic loads transmitted to girder support points during transit.
- Furnish the Engineer stamped detail plans of loading, unloading, supporting and bracing of the steel plate girders on trucks or cars for shipment to the Project Site, according to 00150.35. The review will not relieve the Contractor of responsibility for safe transportation of steel members.

00560.46 Erecting:

(a) General - Erect the metalwork, remove temporary construction and do all work required to complete the structure(s), including the removal of the old structure(s) according to Section 00501, if specified.

(b) Methods and Equipment - Before starting the erection work, the erection method proposed and the amount and character of equipment to be used will be reviewed. This review will not relieve the Contractor of the responsibility for the safety of the method or equipment, or from carrying out the work in full according to the plans and specifications. Do not perform work until approval has been obtained.

(c) Falsework - Design, construct, maintain and remove falsework according to 00540.41, 00540.42, and 00540.52. Review of the Contractor's plans will not relieve the Contractor of any responsibility.

(d) Field Inspecting and Testing - All erecting work is subject to the Engineer's inspection. Provide all facilities required for a thorough inspection of the work. Material not previously inspected, as well as previously inspected material, will be inspected after delivery to the construction Site.

(e) Handling and Storing Materials - Handle and store materials at the erection site according to 00560.24 and 00560.45.

(f) Bearings and Anchorages - Test, furnish and place structure bearings according to Section 00582. Construct rockers, hangers and other anchorages made entirely of structural steel according to the following:

- Drill holes for anchor bolts and set them in portland cement grout, or preset them as specified.
- Locate anchors and set rockers or rollers considering variation from mean temperature at the time of setting, and anticipated lengthening of bottom chord or bottom flange due to dead load after setting. As nearly as practical, at mean temperature and under dead load, the rockers and rollers shall stand vertically and anchor bolts at expansion bearings shall center their slots.
- Provide full and free movement of the superstructure at moveable bearings. Make sure it is not restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

(g) Assembling Steel - Handle the material carefully so no parts will be bent, broken or otherwise damaged.

Do not perform hammering which will injure or distort the members.

Prepare bearing surfaces and surfaces to be in permanent contact before the members are assembled.

Assemble the parts accurately as shown, following any match-marks.

Unless erecting by the cantilever method, erect truss spans on blocking that gives the trusses proper camber. Leave the blocking in place until the tension chord splices are completed and all other truss connections are pinned and bolted.

Use fitting-up bolts of the same nominal diameter as the high-strength bolts, and cylindrical erection pins 1/32 inch larger.

Fill 50% of the holes in splices and field connections with equal numbers of fitting-up bolts and cylindrical erection pins before bolting with high-strength bolts. Fill 75% of the holes in splices and connections carrying added construction loads during erection with equal numbers of fitting up bolts and erection pins.

Tighten permanent bolts in butt-jointed splices of compression members and in railings after the span, if movable, has been swung.

Perform all field welding according to AWS D1.5 and all interim specifications.

(h) Pin Connection - Use pilot and driving nuts when driving pins. Drive pins so the members take full bearing on them. Screw pin nuts up tight and burr the threads at the face of the nut with a pointed tool.

(i) Misfits - The correction of minor misfits involving small amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, immediately report to the Engineer any error in the shop fabrication or deformation resulting from handling, storage and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, or by a

moderate amount of reaming and slight chipping or cutting. Have the correction method approved. Make the correction in the Engineer's presence. The Contractor shall be responsible for all misfits, errors and injuries. Make the necessary corrections and replacements as approved by the Engineer.

Finishing and Cleaning Up

00560.70 Finish (Non-Coated Weathering Steel Only) - Sandblast all exposed surfaces of AASHTO M 270 (ASTM A 709), Grade 50W non-coated weathering steel, according to SSPC-SP6, Commercial Blast Cleaning, SSPC's Steel Structures Painting Manual. The appearance of the blast-cleaned surface shall approximate Pictorial Standard Sa 2 of SSPC-VIS 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces, except no mill scale particles will be allowed; only rust or mill scale stains down in the profile will be allowed. The use of acids to remove scale and stains in the field is not allowed.

Promptly clean exposed surfaces of steel contaminated with stains, oil or foreign material after the above sand blasting cleaning process, as directed, to preserve conditions for uniform weathering of steel.

Measurement

00560.80 Measurement - No measurement of quantities will be made for work performed under this Section. Estimated quantities of structural steel will be listed in the Special Provisions.

00560.81 Miscellaneous Metal - Minor metal parts such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices and other structural steel shapes, unless otherwise provided, will be classified as structural steel.

The weight of miscellaneous metal will be included in the estimated quantity of structural steel specified.

Payment

00560.90 Payment - The accepted quantities of structural steel will be paid for at the Contract lump sum amount for the item "Structural Steel".

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

No separate or additional payment will be made for:

- bolts, studs or bearing devices made entirely of structural steel (such as rockers and hinges)
- fabricating, transporting and erecting the structure(s)
- furnishing, erecting, and removing falsework
- preparing and coating

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Section 00570 - Timber Structures

Description

00570.00 Scope - This work consists of furnishing and installing timber and glue-laminated timber in bridges and other timber structures as shown or directed. Timber and lumber will be identified as timber in this Section.

The terms "hardware" and "fastenings" include nails, spikes, bolts, washers and nuts, dowels, lag screws, timber connectors, truss rods and shoes, and all other metal used in timber construction.

Materials

00570.10 Materials - Furnish materials meeting the following requirements:

Coatings for Steel	00594
Coatings for Timber	02210
Connectors and Fasteners	02150
Driven Piles	00520
Galvanizing	02530.70
Glued Laminated Timber	02140
Preservative Treatment	02190
Timber	02130

When preservative treatment of timber is required, the plans or Special Provisions will indicate the type and kind of treatment.

00570.11 Metal Parts - Hot-dip galvanize all hardware and all other metal parts after fabrication according to 02530.70 or coat all hardware and all other metal parts after fabrication according to Section 00594.

00570.12 Timber Fabrication:

- Use either split ring or shear plate timber connectors as specified. Install in precut grooves of dimensions as recommended by the manufacturer.
- Fabricate all members including holes, grooves, and special cuts, requiring timber connectors before treatment.
- When prefabricating from templates or shop details, bore bolt holes not more than 1/16 inch from specified location and perpendicular to the face of the timber. Bore bolt holes according to 00570.41.
- Submit unstamped working drawings for review, according to 00150.35, for prefabricated material before fabrication.

00570.13 Timber Storage - Store timber on the site in orderly piles or stacks. Provide protection from the weather or direct sun by a suitable covering.

Open-stack untreated timber on supports at least 12 inches above the ground surface and sticker to permit air circulation between the tiers and courses. Provide 1/2 inch thick by 1 1/2 inch wide stickers. Place stickers with the wide face bearing against the timber and at a spacing that provides adequate support for the members for their full length. Align stickers vertically to prevent uneven support and warp during storage.

Store timber after fabrication in a manner that prevents alignment changes of the members before assembly.

Store, protect, and handle glue-laminated timber according to the American Institute of Timber Construction AITC 111 "Recommended Practice for Protection of Structural Glued Laminated Timber during Transit, Storage, and Erection".

Construction

00570.40 Treated Timber - Handle treated timber that prevents dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. Use nylon slings to handle treated timber. Do not use cant hooks, peaveys, pikes or hooks.

When treated timbers are to be placed in a marine or brackish environments, field treated and untreated cuts, borings and other joint framings will not be allowed below high-water elevation.

Do not cut, frame, or bore treated timber after treatment unless necessary. If untreated wood is exposed by cutting, planing, sanding, or any other means, trim all cuts and abrasions in timber, and cover with two applications of a field preservative according to 02190.30.

Pour field preservative into all holes bored after treatment, or treat the holes with field preservative with an approved pressure hole treater. Treat all unfilled holes with field preservative and plug with treated plugs. Field treat according to 02190.30 and the recommendations of the manufacturer.

When forms or temporary braces are attached to treated timber with nails or spikes, fill the resulting holes by driving larger size galvanized nails or spikes flush with the surface, or plug holes as required for unfilled bolt holes.

00570.41 Fasteners:

- Bore holes for drift pins, drift bolts, and dowels either 1/32 inch smaller than or the same size of the actual pin diameter.
- Bore holes for bolts 1/32 inch to 1/16 inch larger than the bolt diameter. Accurately align holes in main members and side plates. Do not force drive bolts.
- Bore holes for truss rods with a bit 1/16 inch larger than the rod.
- Drive nails and spikes with sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces are evidence of poor work and sufficient cause for removal of damaged material.
- Bore holes for lag screws in two parts as follows:
  - Bore the lead hole for the shank the same diameter as the shank and the same depth as the length of the unthreaded shank.
  - Bore the lead hole for the threaded portion a diameter equal to approximately two-thirds of the shank diameter.
- Use a malleable iron washer of the size and type designated under all bolt heads and nuts in contact with wood except under button-head bolt heads.
- Lock all nuts after final tightening with a second nut or use self-locking nuts.
- Countersink where smooth faces are required. Coat recesses formed for countersinking with field preservative according to 02190.30 and the manufacturer's directions. After the bolt or screw is in place, fill horizontal recesses with asphalt roofing cement.
- Install all fasteners and connections according to the manufacturer’s recommendations.

00570.42 Framing - Cut and frame all timber to a close fit so that the joints have even bearing over the entire contact surfaces. Shimming will not be allowed.

(a) Pile Bents - Drive piles according to Section 00520. No shimming on tops of piles will be allowed.

Select the piles for any one bent as to size, to avoid undue bending or distortion of the sway bracing.

Distribute the piles of varying sizes to secure uniform strength and rigidity in the bents of any given structure.

(b) Framed Bents - Provide true and even bearing of sills on pedestals or piles. Finish concrete pedestals so the sills or posts support framed bents with even bearing.

Fasten posts to sills as shown. Remove all earth from contact with all timber so there will be free air circulation around them.

(c) Caps - Place timber caps to obtain an even and uniform bearing over the tops of the supporting posts or piles.

(d) Bracing - Bolt or lag screw intermediate intersections of bracing.

00570.43 Stringers - Place stringers according to the following:

- Knots near edges will be in the top portions of the stringers.
- Outside stringers may have butt joints, but lap interior stringers to take bearing over the full width of the floor beam or cap at each end. Do not extend the stringer end more than 6 inches beyond the floor beam or cap.
- Separate the lapped ends of untreated stringers at least 1/2 inch and securely fasten where shown or specified.
- Stagger joints when stringers are two spans in length.
- Frame cross-bridging between stringers as shown, with full bearing at each end against the sides of stringers, and securely toe-nail with at least two nails in each end.

00570.44 Decking - Unless otherwise shown or specified, construct decking with 4 inch x 12 inch planking and covering materials.

(a) Planking - Provide planking that is surfaced on four sides (S4S).

Place planking heart side down with 1/4 inch opening between planks for seasoned material and with tight joints for unseasoned material. Spike planks securely to each stringer with a minimum of one 3/8 inch x 8 inch spike placed 3 inches in from each edge.

(b) Covering Materials - Cover the planking with one of the following:

- 2 inch x 2 inch timber strips, placed transverse to the planking and nailed with 16d galvanized common nails at 12 inch centers. Cover deck with a warranted waterproofing membrane according to Section 00591 and a Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00745; or

- 1 inch thick tongue and groove structural CD exterior grade plywood. Nail the plywood with face grain parallel to stringers using 10d galvanized or zinc coated ring shank nails. Place nails at 6 inch centers along all edges and 12 inch maximum centers intermediate. Fasten expanded metal grillage with a minimum opening of 1/4 inch and a minimum thickness of 1/8 inch to the top of the plywood for the entire roadway area. Minimum fastening shall be at 12 inch centers each direction using 8d galvanized common nails. Cover deck with a warranted waterproofing membrane according to Section 00591 and a Level 2, 1/2 inch Dense HMAC wearing surface according to Section 00745.

00570.45 Wheel Guards and Railings - Frame wheel guards and railing as shown, and erect true to line and grade.

Unless otherwise specified, provide wheel guards, rails, and rail posts that are surfaced on four sides (S4S).

Lay wheel guards in sections not less then 12 feet long unless otherwise shown.

For trusses, build railings after the removal of the falsework and the adjustment of the trusses to correct alignment and camber.

00570.46 Trusses - Finished trusses shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and show a smooth curve through panel points conforming to the correct camber. Fit all bearing surfaces accurately. Uneven or rough cuts at the points of bearing will be cause for rejection of the piece containing the defect.

00570.47 Coating - When specified, coat timber bridges according to the manufacturer's recommendations.

Measurement

00570.80 Measurement - The quantities of all timber, except piling and glue-laminated timber, incorporated into the permanent, finished structure, will be measured on the volume basis, based on the nominal dimensions of the members and the actual dimensioned length. No allowance will be made for waste.

The quantities of glue-laminated timber members will be measured on the volume basis, based on the net dimensions of the members.

Driven piles will be measured according to 00520.80.

Warranted waterproofing membrane will be measured according to 00591.80.

Asphalt concrete wearing surface will be measured according to 00745.80.

Payment

00570.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Timber and Lumber	MFBM
(b)	Glued Laminated Timber	MFBM

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

Driven piles will be paid for according to 00520.90.

Warranted waterproofing membrane will be pair for according to 00591.90.

Asphalt concrete wearing surface will be paid for according to 00745.90.

No separate or additional payment will be made for hardware, fastenings, preservative treatment, and coatings.

Section 00581 - Bridge Drainage Systems

Description

00581.00 Scope - This work consists of furnishing and installing metal deck drains, drain pipe and appurtenances for bridges as shown, specified or directed.

Materials

00581.10 Materials - Furnish steel pipe of standard weight meeting the requirements of ASTM A 53 and galvanized after fabrication according to AASHTO M 111 (ASTM A 123).

Furnish deck drains, hangers, clamps, and other incidentals meeting the requirements of Section 02530 and Section 02560.

Construction

00581.40 General - To prevent movement during concrete placement, support the pipe and deck drains by ties and other approved devices according to 00530.41.

00581.42 Appurtenances - Provide a watertight connection to the deck drains in the bridge deck as shown or directed.

00581.50 Test Bridge Drainage Systems - Test bridge deck drains and pipe connections to the storm drain system according to Section 00445 to ensure that the drains and drain pipe are water tight and free of obstructions.

Measurement

00581.80 Measurement - The quantities of bridge deck drains will be measured on the unit basis of each deck drain installed.

Payment

00581.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per each, for the item "Bridge Drains".

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

No separate or additional payment will be made for drain pipe connected to bridge drains or for water used in testing the drain systems.

Section 00582 - Bridge Bearings

Description

00582.00 Scope - This work consists of the following:

(a) Composite Bearings - Design, fabricate, test and install composite bearings according to the latest AASHTO LRFD Design Specifications and Section 02570. The bearing fixity (fixed bearing, guided bearing, nonguided bearing) and restrictions about type of bearing (disc, fabric pad, pot, spherical) will be shown or specified.

(b) Elastomeric Bearings - Furnish, test, and install elastomeric bearings according to the AASHTO LRFD Construction Specifications and Section 02571.

(c) Rockers and Hangers - Furnish and install bearings, such as rockers and hangers, which consist entirely of structural steel, according to Section 00560.

00582.02 Definitions:

Composite Bearing - Bearing having a rotational element between an upper and a lower unit. This includes disc bearings, fabric pad bearings, pot bearings and spherical bearings.

Disc Bearing - Composite bearing whose rotational element is comprised of a polyether urethane disc with an upper and lower unit.

Elastomeric Bearing - Bearing consisting of a single layer of elastomer (plain) or of several layers of elastomer alternated with steel plates (reinforced).

Fabric Pad Bearing - Composite bearing whose rotational element is a preformed fabric pad.

Fixed - Restrained against all horizontal structural movement.

Guide Bars - The elements that restrain the lateral movement of a sliding bearing.

Guided - Able to accommodate structural movement in a specified horizontal direction.

Nonguided - Able to accommodate structural movement in all horizontal directions.

Pot Bearing - Composite bearing whose rotational element is a piston supported on an elastomeric disc, totally confined within a base pot cylinder.

Spherical Bearing - Composite bearing whose rotational element consists of an upper plate with a spherical concave bottom surface and a lower plate with a spherical convex top surface.

Materials

00582.10 Materials - Furnish materials from the QPL and meeting the requirements of Section 02570 and Section 02571, as applicable.

00582.20 Composite Bearings - Unless otherwise shown, use only one type of composite bearing per bridge, subject to the following requirements:

- Make composite bearings, including all plates except distribution plates and masonry plates, removable and replaceable.

- Provide rotational elements between upper and lower units to meet the following:

  - **Upper Unit** - The upper unit shall consist of a distribution plate that is permanently attached to the superstructure and a sole plate attached to the distribution plate with cap screws. For a guided or nonguided bearing, a stainless steel sheet shall be welded to the bottom surface of the sole plate.

  - **Lower Unit** - The lower unit shall consist of a masonry plate permanently anchored to the structural support and a base plate attached to the masonry plate with cap screws. A separate masonry plate and base plate are not necessary for fabric pad bearings fabricated as outlined in 00582.27, third paragraph.

  - **Bearing-to-Base Connection:**

    - The base pot of a pot bearing, the lower bearing plate of a disc bearing, or the convex plate of a spherical bearing shall be welded to the base plate.
    - For guided or nonguided bearings, a polytetrafluoroethylene (PTFE) sheet shall be recessed into and bonded to the top surface of the piston of a pot bearing, the upper bearing plate of a disc bearing, the top surface of the concave plate of a spherical bearing, or a steel backing plate bonded to the top surface of a fabric pad forming a sliding surface with the stainless steel surface of the sole plate.
    - For fixed bearings, the piston of a pot bearing, the upper bearing plate of a disc bearing, or the concave plate of a spherical bearing shall be welded to the sole plate.

  Provide bearings that accommodate the loads, movements, and rotations as shown.

  Use schematic drawings, 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:

- The shear restriction mechanism shall allow free rotation but prevent any shear being applied to the rotational element.
- Each guided bearing shall resist the total horizontal load at the bent or hinge where it is located.

00582.25 Composite Bearings with Polytetrafluoroethylene (PTFE) Sliding Surface:

(a) PTFE Sliding Surfaces - Recess PTFE 1/16 inch into the material it is bonded to for all composite bearings.

Bond PTFE to the steel substrate sufficiently to develop a horizontal force as shown and not less than 10% of the vertical design capacity shown, in addition to the shear force developed as a result of the natural bearing friction shear force.

(b) PTFE Rotational Surface for Spherical Bearings - Use only woven PTFE having a minimum thickness of 1/8 inch. The PTFE shall be recessed 1/16 inch into the spherical element.

PTFE fabric minimum thickness shall be 1/16 inch when measured according to ASTM D 1777.

(c) Stainless Steel Sliding Surfaces - Provide a flat stainless steel sliding surface which completely covers the PTFE surface in all operating positions, plus at least 2 inches more in every direction of possible movement.

Provide a spherical stainless steel rotational surface attached to the convex surface of the spherical convex plate of each spherical bearing so that it completely covers the convex surface of the plate.

00582.26 Guide Bars for Composite Bearings - Provide a sliding surface between the guide bars and the guide element made of polished stainless steel against virgin PTFE. The virgin PTFE shall be bonded and mechanically fastened to the guide bars. Provide guide bars that:

- Resist the horizontal design forces on the bearing, but not less than 10% of the vertical design load of the bearing.
- Resist the total horizontal load at the bent or hinge where it is located. Do not include the resistance due to bearing friction as part of the horizontal load capacity of guided bearings and fixed bearings.
- Are Integral and machined from a solid plate, or attached by welding or with cap screws, or fabricated from a single steel plate.
- Have a space equal to 3/16 inch plus or minus 1/16 inch to the guided member.
- Allow the guided member to be always within the guides at all points of translation and rotation of the bearing. Avoid guiding the member off the fixed base or any extension of it where transverse rotation is anticipated.

00582.27 Sole, Base, Distribution, and Masonry Plates for Composite Bearings - Make the bottom surface of sole plates flat and level. Make the top surface flat, and sloped as required to mate with the bottom surface of the distribution plate.

Use 3/4 inch minimum plates, except sole plates may taper to 5/8 inch at the thinnest edge.

For fabric pad bearings, keeper bars at least 1/4 inch thick shall be fastened to the top surface of the base plate, around the perimeter of the fabric pad, with high-strength cap screws. Provide a gap at all bar ends to allow drainage.

Provide studded anchors or threaded bolts, as shown or specified, to anchor the masonry plates to the supported and supporting members. Locate anchoring devices to avoid conflict with metal reinforcement and prestressing systems.

00582.30 Fabrication - Fabricate bearings according to the reviewed working drawings and these Specifications.

(a) Working Drawings - Submit unstamped working drawings according to 00150.35 for both composite bearings and elastomeric bearings.

(1) Composite Bearings - For composite bearings, include:

- Complete details of the anchor layout
- Plan and elevation of the bearing showing dimensions and tolerances
- Complete details of all components with sections showing all materials incorporated into the bearing
- All ASTM or other material designations
- Vertical and horizontal force capacity
- Compressive stresses on all sliding surfaces, and on elastomeric polyether urethane and cotton duck surfaces, at maximum and minimum design loads
- Rotational capacity

- Translation capacity for guided and nonguided bearings
- Instructions for installation of the bearing

(2) Elastomeric Bearings - For elastomeric bearings, include:

- The overall dimensions of the bearings
- The durometer hardness of the elastomer and the ASTM designation of reinforcing materials, if any
- The thicknesses of the components of reinforced bearings and the cover over edges of reinforcements

(b) Minimum Requirements for Composite Bearings:

(1) Edges - Grind edges of all parts of the bearing so that sharp edges are eliminated.

(2) Welding - Perform all welding and inspection of welding for structural steel according to 00560.26.

(c) Special Requirements for Horizontal Capacity of Composite Bearings - Submit stamped calculations supporting the design for horizontal force capacity, according to 00150.35. Calculations are not required when the design horizontal capacity is less than, or equal to, 10% of the design vertical capacity. A horizontal proof load test report may be submitted instead of engineer's calculations. See 002570.20(b) for test requirements.

00582.31 Disc Bearings - Fabricate upper and lower bearing plates as follows:

- Connect the lower bearing plate to base plate by means of a fillet weld around entire perimeter of the lower bearing plate.
- For a fixed bearing, connect upper bearing plate to the sole plate by means of a fillet weld around the entire perimeter of upper bearing plate.

00582.32 Fabric Pad Bearings - Fabricate fabric pad bearings according to the following:

(a) Steel Backing Plate - Minimum thickness of the steel backing plate shall be 3/8 inch.

Bond the backing plate to the top surface of the fabric pad under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the fabric pad manufacturer.

Finish the surface of steel recess to a surface roughness of 250 microinches or better, and to Class A flatness:

(b) Fabric Pad - Maximum allowable bearing pad thickness is 4 inches. For pads over 2 inches thick, place an 11 gauge steel shim at mid-depth.

00582.33 Pot Bearings - Fabricate pot bearings according to the following:

(a) Pot - Fabricate the pot from one solid plate by machining.

Finish the top and bottom surfaces of the pot cylinder to Class A flatness.

Connect the pot cylinder to the base plate by means of a fillet weld around the entire perimeter of the pot cylinder.

(b) Piston - Fabricate the piston from one solid plate by machining.

Finish the top surface to Class A flatness.

Finish the bottom surface to Class C flatness.

For a fixed bearing connect the piston to the sole plate by means of a fillet weld around the entire perimeter of the piston.

(c) Elastomeric Disc - Make the disc in one piece.

Recess the upper edge of the elastomeric disc to accommodate the flat brass sealing rings.

Lubricate the disc with a material compatible with the elastomer.

00582.34 Spherical Bearings - Fabricate spherical bearings according to the following:

(a) Spherical Concave Plate:

Finish top surface to a roughness of 125 microinches or better, and Class A flatness.

Fabricate the concave radius of the bottom surface to have a positive tolerance not to exceed 0.010 inch according to ANSI Y14.5.

For a fixed bearing, connect to the sole plate by means of a fillet weld around the entire perimeter of top surface of spherical concave plate.

(b) Spherical Convex Plate - Fabricate the top convex stainless surface from one of the following:

- Solid stainless steel ASTM A 240, Type 304 or 304L
- Stainless steel weld overlay a minimum of 3/32 inch thick

Fabricate convex radius of the top surface to have a negative tolerance not to exceed 0.010 inch according to ANSI Y14.5.

Finish the top surface to a roughness of 20 microinches or better, and other surfaces to a roughness of 250 microinches or better.

Finish the bottom surface to Class B flatness.

Connect to base plate by means of a fillet weld around entire perimeter of bottom surface of spherical convex plate.

00582.35 Composite Bearings with Polytetrafluoroethylene (PTFE) Sliding Surfaces:

(a) PTFE Sliding Surfaces - Bond PTFE to steel substrate under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the PTFE manufacturer.

After completion of the bonding operation, the PTFE surface shall be smooth and free of bubbles.

(b) Stainless Steel Sliding Surfaces - Attach stainless steel to steel substrate by a seal weld around entire perimeter of stainless steel sheet. Clamp stainless steel sheet down to have full contact with the steel substrate during welding. Fabricate so welds do not protrude beyond the sliding surface of the stainless steel.

00582.36 Guide Bars for Composite Bearings - Construct guide bars parallel to the surface on which they bear and to other guide bars to within a tolerance of plus or minus 1/32 inch for the full length of the bar.

The tolerance for section dimensions is plus or minus 1/16 inch.

If guide bars are welded to the sole plate, weld before attaching the stainless steel surface.

00582.38 Coatings for Steel Bearings - Coat all exposed steel surfaces, except stainless steel, according to Section 00594.

00582.39 Elastomeric Bearings - Fabricate elastomeric bearings according to the following:

(a) Pads - Pads 1/2 inch and less in thickness shall be made entirely of elastomer. Pads over 1/2 inch in thickness shall consist of alternate laminations of elastomer and metal.

(b) Pad Sizing - Mold pads individually to the sizes required. No shearing to size or drilling of holes will be allowed except pads 1/2 inch and less in thickness may be sheared.

(c) Tolerances and Finishes - Tolerances and finishes shall be according to 002571.20(d).

00582.40 Shipping and Handling - Protect all bearings from damage during shipment, and keep them dust-free. Protect composite bearings as follows:

- Fully assemble each bearing at the manufacturing plant and deliver to the construction site as a complete unit ready for installation.
- Mark centerlines on the sole plate and base plate for checking alignment in the field.
- Hold bearings together with removable restraints so the sliding surfaces are not damaged.
- Ship and store bearings in lightproof, moisture-proof and dustproof packages.

Construction

00582.50 Installation - Use only one type of bearing on any one bridge unless shown, specified or directed otherwise.

(a) Composite Bearings - Install composite bearings as follows:

- Obtain approval of the bearing assembly proposed for use before constructing the upper portions of the supporting structure so bearing elevations may be properly determined.
- Before constructing bridge bearing seats, inform the Engineer in writing, of the total bearing thickness.
- Do not place bridge bearings on concrete bearing areas that are irregular or improperly prepared.
- Install bearings level and according to the manufacturer's recommendations, subject to these Specifications.
- Install bearings in exact positions, and with full and even bearing.
- Protect the sliding surfaces of PTFE bearings from contact with concrete or other foreign matter.
- To prevent gouging and contamination, install bearing with the stainless steel surface on top of the PTFE interface.

(b) Elastomeric Bearings - Construct bearing seats for elastomeric bearings parallel to the bottom surfaces of the members which will bear on them. Install as follows:

- Set elastomeric bearing pads directly on the concrete pad surface.
- Provide for a uniform bearing over the entire area of the bearing seat and over the entire area of the superstructure member in contact with the bearing pad.
- Keep pads in correct position during erection of superstructure members.

(c) Cleanup - Remove all forms and debris that interfere with the free action of the bearing assemblies.

Measurement

00582.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Composite Bearings - Composite bearings will be measured on the unit basis, of bearing devices in place which includes all components from the bearing seat attachment through the superstructure attachment.

(b) Elastomeric Bearing Pads - Elastomeric bearing pads will not be measured.

Payment

00582.90 Payment - The accepted quantities of bridge bearings will be paid for according to the following:

(a) Composite Bearings - Composite bearings will be paid for at the Contract unit price, per each, for the item "Bearing Devices, Bent ___".

The bent number will be inserted in the blank.

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

No separate or additional payment will be made for designing, fabricating, and testing composite bearings.

(b) Elastomeric Bearing Pads - No separate payment will be made for elastomeric bearing pads. This item is included in one or more of the listed items.

Section 00583 - Electrical Conduit In Structures

Description

00583.00 Scope - This work consists of furnishing and installing electrical conduit in structures as shown or as directed.

Materials

00583.10 Materials - Furnish galvanized rigid metal or intermediate metal conduit meeting the requirements of 02920.10, and nonmetallic schedule 40 conduit meeting the requirements of 02920.11. Furnish other materials meeting the requirements of Section 00960 and Section 02920.

Construction

00583.40 General - Install conduit as shown and specified, according to the applicable portions of 00530.41 and Section 00960.

Install galvanized steel conduit on all runs externally attached to structures, and all runs stubbing out of the structure or entering conduit expansion devices. Where nonmetallic conduit is installed elsewhere in the run, the conduit segment stubbing out or entering the expansion device shall have a minimum length of 5 feet of galvanized rigid metal embedded within the concrete.

Install embedded conduit in concrete members with 2 inch clearance from the nearest face of concrete.

Measurement

00583.80 Measurement - The quantities of electrical conduit in structures will be measured on the length basis, including the stub-outs if shown.

Payment

00583.90 Payment - The accepted quantities of electrical conduit in structures will be paid for at the Contract unit price, per foot, for the item " ____ inch Electrical Conduit".

The size of the conduit will be inserted in the blank.

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

No separate or additional payment will be made for junction boxes, cabinets, expansion joints, fittings, or fasteners.

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 as shown and specified.

Materials

00584.10 Materials - Furnish elastomeric concrete nosing using materials from the QPL and the following:

Provide materials delivered in their original, undamaged containers bearing the manufacturer's label with the following information:

- Product name
- Component part
- Name and address of manufacturer
- Date of manufacture
- Use-by date
- Batch number
- Mixing ratio

Provide sufficient materials in storage at the site prior to beginning construction to complete the entire elastomeric concrete nosing as detailed on the plans or as directed. Store the materials to prevent damage by the elements and to ensure the materials maintain their original quality.

Store the materials so that the storage space is dry and maintains a temperature as recommended by the manufacturer. Use only stored materials that meet these requirements at the time of use.

If used, the promoter/initiator for the methacrylate resin may consist of a metal drier and peroxide. Do not mix the metal drier directly with the peroxide. Store the containers so that no leakage from one material contacts the containers of the other materials.

Equipment

00584.20 Equipment - Use equipment recommended by the product manufacturer and approved by the Engineer.

Labor

00584.30 Manufacturer's Representative - Provide a manufacturer’s representative on-site during the installation of the elastomeric concrete nosing. The manufacturer’s representative shall be either someone independent of the Contractor’s work force or a member of the Contractor's work force that possesses certification from the manufacture that the Contractor's representative has the knowledge, skills, and training to install the elastomeric concrete nosing. Discuss the work to be done with the manufacturer's representative to review the methods of installation and the equipment needed before beginning the work.

The representative shall advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of the elastomeric concrete nosing.

Mix, place, and cure the elastomeric concrete nosing according to the recommendations of the manufacturer's representative.

Construction

00584.40 General - Construct elastomeric concrete nosing according to the following:

(a) Training - Use installers trained in application methods and in the health and safety requirements specific to the materials used.

(b) Safety - Make available to workers any manufacturer's safety precautions for hazardous chemicals. Ensure that all workers wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) Weather Conditions at Time of Installation - Do not proceed with installation until the weather conditions meet the requirements of the manufacturer's representative.

00584.41 Surface Preparation - Ensure that all surfaces to receive elastomeric concrete nosing material are sound, dry, clean, frost free, and sand blasted at the time of nosing installation. Sandblast steel contact surfaces to SSPC-10, "Near-White Blast Cleaning", immediately before constructing the nosing. Prepare the deck surface according to these Specifications and the material manufacturer's recommendations.

00584.43 Elastomeric Concrete Placement - When an asphaltic concrete overlay is to be used as the wearing surface, place a bond breaker on the area where the concrete nosings are to be constructed before placing the asphaltic concrete overlay over the bridge deck joints. After the overlay is placed, sawcut the overlay to the width shown on the plans, remove the overlay material in the joint area and construct the elastomeric concrete nosing.

Prepare the elastomeric concrete nosing material by mixing the aggregate at the recommended temperature with the mixed binder. Clean and dry the bonding surfaces and prepare joint surfaces according to the manufacturer's recommendations. Place the properly mixed elastomeric concrete into the prepared area on each side of the expansion joint. Compact and trowel the elastomeric concrete to the required shape.

Form and cast the elastomeric concrete nosing to smoothly match the surface of the finished roadway. Finish the surface to a moderately rough texture such as that produced by a wood float.

Protect the elastomeric concrete nosing material from damage, and allow the nosing to cure properly prior to opening the work area to traffic. Do not open up to traffic without the approval of the manufacturer's representative.

00584.75 Warranty - Provide a manufacturer's warranty that the elastomeric concrete will not delaminate, debond, rut, or otherwise fail to perform for two years. Acts of god, or failures adjacent to the installation would not be included. The manufacturer will replace or repair the installation using specification materials.

The Warranty period will start on the date the Engineer accepts the work and authorizes final payment.

The Warranty shall recite that the manufacturer is required to repair or replace, at the discretion of the Engineer, all elastomeric joint nosings that fail during the warranty period at no additional cost to the Agency. The repairs shall be made within six months of the Agency's written request to do so.

Perform Warranty repair work when weather permits. At the discretion of the Engineer, temporary repairs may be required at the manufacturer's expense to protect traffic until permanent repairs can be made.

Measurement

00584.80 Measurement - The quantities of elastomeric concrete nosing will be measured on the length basis, from face of curb to face of curb taken along the centerline of the joint, between the outer limits of the installed material. Only one measurement will be taken along each installed joint, regardless of the number of recesses, openings, or voids filled with the elastomeric concrete nosing material.

The estimated quantities of elastomeric concrete nosing is based on a nominal depth of 2 inches.

The quantities of elastomeric concrete nosing deeper than 2 inches will be measured on the volume basis to the nearest 0.05 cubic yard.

Joint seal material will be measured according to 00585.80.

Payment

00584.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Elastomeric Concrete Nosing	Foot
(b)	Elastomeric Concrete Nosing Material	Cubic Yard

Item (a) includes elastomeric concrete nosing installed to a nominal depth of 2 inches.

Item (b) includes materials only for concrete nosing depths greater than 2 inches.

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

Payment for the elastomeric concrete nosing will be limited to 75% of the amount due until the Agency has received the signed warranty.

Joint seal material will be paid for according to 00585.90.

No separate or additional payment will be made for providing the manufacturer's representative or for furnishing the warranty.

Section 00585 - Expansion Joints

Description

00585.00 Scope - This work consists of the fabrication, joint preparation, and installation of expansion joints as shown or specified.

00585.01 Definitions:

Armored Corner - Steel armoring to protect the vertical edges of a joint opening. The armor may be steel angles or steel shapes.

Asphaltic Plug Joint - A closed expansion and contraction joint system composed of aggregate and flexible binder material placed over a steel bridging plate.

Closed Expansion Joint - A joint in which a seal material is placed to prevent water or debris from entering the joint. This includes poured joint seals, preformed compression joint seals, asphaltic plug joints, performed strip seal systems, and modular expansion joint systems.

Filled Joint - A joint using a preformed filler, poured joint filler, traffic loop sealant, or a combination of these materials.

Modular Expansion Joint System - A closed expansion and contraction joint using a series of continuous preformed polychloroprene strip seals inserted into steel shapes to seal the joint.

Poured Joint Seals - A closed expansion and contraction joint sealed with a rapid-cure poured joint sealant.

Preformed Compression Joint Seal - A closed expansion and contraction joint sealed with a continuous preformed polychloroprene elastomeric compression gland.

Preformed Strip Seal System - A closed expansion and contraction joint using a continuous preformed polychloroprene elastomeric gland (strip seal) inserted into an extruded or formed steel retainer bar with steel anchors.

Materials

00585.10 Materials - Furnish expansion joints using materials from the QPL and meeting the following requirements:

Asphaltic Plug Joint Binder	as specified or as recommended by the manufacturer
Asphaltic Plug Joints	02440.19
Backer Rod	02440.14
Elastomer	02570.10
Hot Poured Joint Filler	02440.30
Lubricant/Adhesive	02440.15
Polytetrafluoroethylene (TFE)	02570.10
Poured Joint Sealant	02440.11
Preformed Joint Filler for Concrete	02440.10
Preformed Joint Seals	02440.20
Stainless Steel Sliding Surfaces	02570.10
Structural Steel	02530
Traffic Loop Sealant	00990

00585.11 Approval of Materials - Submit QPL listed products to the Engineer for Project specific approval.

Equipment

00585.20 Equipment - Use approved equipment as recommended by the product manufacturer.

Labor

00585.30 Closed Expansion Joint Installers - Use installers trained by the manufacturer in application methods of materials and health and safety to install closed expansion joints as detailed.

00585.31 Closed Expansion Joint Manufacturer's Representative - Provide a manufacturer's representative on-site during the installation of closed expansion joints. The manufacturer's representative shall be either someone independent of the Contractor's work force or a member of the Contractor's work force that possesses certification from the manufacturer that the Contractor's representative has the knowledge, skills, and training to install the expansion joints.

The representative shall advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of expansion joints.

Construction

00585.40 Filled Joints - Unless otherwise specified, form filled joints with preformed joint filler by placing concrete directly against the preformed joint filler material. Provide formwork behind the preformed joint filler material firm enough to prevent deflection of the joint material when placing the concrete, or place preformed joint filler against formed concrete. If shown or specified, place traffic loop sealant or pour joint filler at the top of the joint.

00585.41 Closed Expansion Joints - The following requirements apply to all closed expansion joints:

(a) Submittals - Submit stamped working drawings according to 00150.35 for each expansion joint at least 21 calendar days before beginning work.

(1) Design - Joints shall be designed to:

- Prevent the entrance of water and incompressible materials into the joint.
- Produce no appreciable elevation changes in the deck surface plane with the expansion and contraction movements of the structure.
- Accommodate the required structure movements shown on the plans.
- Support a wheel load (plus impact) corresponding to the design load shown on the plans.

(2) Shop Drawings - Submit shop drawings including, but not limited to:

- Plan, elevation and section of the joint system with dimensions and tolerances.
- Complete details of all joint materials with all ASTM, AASHTO or other material designations.
- Method of installation including sequence and installation details at traffic barriers, roadway surfaces, curbs and sidewalks.

(3) Additional Submittals for Modular Joints - See 00585.47(b) for submittals for modular joints.

(4) Notification - Notify the Engineer in writing at least seven calendar days prior to installation of the joint. Include the Contract number, bridge number, joint seal material, product name and the approximate date of installation.

(5) Certificate of Compliance - Provide the Engineer with a certificate of compliance 21 calendar days before beginning work, including the manufacturer's name, prior to joint installation, verifying that the materials as furnished will meet the requirements of these Specifications.

(b) Safety - 21 calendar days before beginning work, provide safety precautions from the manufacturer for hazardous chemicals. Wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) Joint Preparation - Prepare the joint surfaces as directed in this Section and the material manufacturer's recommendations. Ensure that all joint surfaces to receive a seal are sound, dry, clean and frost-free at the time of joint installation. Remove expansion joint material from existing joints and construct the required joints as detailed. Repair existing joints of spalled, cracked or deteriorated concrete as shown or as directed to provide a uniform and smooth surface along the joint.

(d) Weather Conditions at Time of Installation - Install joint seals when the joint is dry and meets the manufacturer's technical representative's approval.

(e) Leakage Check - Check joints for leakage after rainfall has occurred or by flooding the joint with water. If leakage is observed, repair the joints at no additional cost to the Agency and according to the manufacturer's recommendations.

00585.42 Armored Corners - Provide joint corner armoring and anchors as shown or specified, and according to the following:

(a) Tolerance - Install armored corners that are straight and do not deviate from a true line by more than 1/4 inch horizontal and 1/8 inch vertical over the length of the joint, nor more than 1/16 inch in either direction from a 12 foot straight edge.

Maintain a minimum cross sectional thickness of 3/8 inch when measuring the vertical backwall and the flanges of the steel retainers that act as the locking edge rails for strip seal joints. The steel retainer rails may be manufactured from rolled shapes and plates or may be hot-rolled steel with the gland groove milled after rolling.

(b) Installation - Furnish armored corners in the longest practical length as controlled by transportation and installation.

Fabricate steel according to Section 00560. Sandblast steel shapes just prior to installation. Use welding procedures conforming to AWS D1.1.

For new construction, install armored corners in preformed blockouts a minimum of 14 days after the deck is cast with the joint opening as shown. Support the armored corners securely in position before placing concrete or elastomeric concrete in the joint blockout. Install the preformed seal a minimum of seven days after the concrete blockouts have been cast and after the deck concrete reaches 3,000 psi. For elastomeric concrete installations, install the preformed seal a minimum of 24 hours after placing the strip rails in the elastomeric concrete.

00585.43 Asphaltic Plug Joints - Furnish and install asphaltic plug joints according to the following:

(a) General - Provide a plane surface on which to place the steel bridging plate. Use elastomeric concrete as needed to repair the deck surface of new or existing concrete.

(b) Installation Procedures - Install asphaltic plug joints according to the binder manufacturer's recommendations.

Place poured joint sealant in curbs and sidewalks.

00585.44 Poured Joint Seals - Install poured joint seals according to the manufacturer's recommendations.

00585.45 Preformed Compression Joint Seals - Install preformed compression joint seals according to the manufacturer's recommendations and the following:

- In one continuous strip that extends across the full roadway width and into the curbs without splices.
- So they remain in compression throughout the design movement range. Provide for maximum and minimum compressive pressures according to AASHTO M 297 (ASTM D 3542).

Base the compression joint seal nominal size on the design movement of the joint and the seal's anticipated compression set.

00585.46 Preformed Strip Seal Systems - Install preformed strip seal systems according to the manufacturer's recommendations and the following:

(a) General - Use steel retainers acting as the locking edge rails that have a minimum cross sectional thickness of 3/8 inch for the vertical backwall and flanges. The steel retainers may be manufactured from extruded or hot-rolled steel.

Furnish steel extrusions in the longest practical length as controlled by transportation and installation. Make steel extrusion splices with an approved weld according to AWS D1.1.

Field weld rail segments that are too long to ship in one piece according to AWS D1.1.

Base the joint opening between retainer bars on structure temperature at the time of joint placement and the designed temperature movement rating.

(b) Installation Procedure - Install seals in one continuous strip, extending across the full roadway width and into the curbs without splices.

Remove all lubricant/adhesive from the top of the installed seal before the adhesive sets.

00585.47 Modular Expansion Joint Systems - Design, fabricate, install, inspect, and water test modular expansion joint systems according to the manufacturer's recommendations and the following:

(a) General - Furnish factory-fabricated modular expansion joints of multi-cell assemblies preset by the manufacturer before shipment, according to the approved working drawings.

Use expansion joint seals of one continuous strip extending across the full roadway width and into the curbs as shown.

Field weld rail segments that are too long to ship in one piece.

(b) Submittals - In addition to the requirements of 00585.41(a), submit the following to the Engineer for review or approval at least 21 calendar days before beginning work:

(1) Manufacturer's Experience - Written certification that the joint manufacturer has at least three years experience in designing and manufacturing modular expansion joints. Include the following:

- Bridge locations
- Names of owning agencies or other entities
- Names, addresses and telephone numbers of the owners' representatives

(2) Shop Drawings and Calculations - In addition to the requirements of 00585.41(a-1) and 00585.41(a-2), stamped drawings and calculations according to 00150.35, 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 - The following certifications:

- A manufacturer's certificate of compliance with the AISC Quality Certification Program, Simple Steel Bridges.
- A manufacturer's certificate of compliance verifying that the materials as furnished will meet the requirements of these Specifications.
- Manufacturer's certification that all polytetrafluoroethylene (PTFE) sheeting, PTFE fabric and elastomer meet the requirements of Section 18 of the AASHTO LRFD Bridge Construction Specifications. Do not use reprocessed material.
- Certification that welding inspection personnel are qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors.
- Certification that personnel performing nondestructive testing (NDT) are qualified and certified as NDT Level II under the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1a.
- Mill test reports for all steel and stainless steel in the joint assemblies with shop drawings and calculations.

(4) Quality Assurance Inspection Program - Arrange for an independent inspection agency to provide quality assurance inspection. Submit the forms to be used by the independent inspection agency and the proposed Quality Assurance Inspection Program to the Engineer for approval prior

to the start of fabrication. Quality assurance inspection is not required to be full-time inspection, but shall cover each phase of the manufacturing process. Include the frequency of inspection in the Quality Assurance Inspection Program.

(c) Shipping and Handling - Deliver the expansion joint units to the job site and store according to the manufacturer's written recommendations and as approved by the Engineer.

Do not weld lifting mechanisms, temperature setting devices and construction adjustment devices to the centerbeams or edgebeams.

Damage to the joint unit during shipping and handling will be cause for rejection of the joint.

(d) Design Requirements:

(1) General - Design and fabricate modular expansion joints from steel components so:

- Individual components conform to the applicable portions of 00585.46.
- Metal to metal contact surfaces meet the requirements of Section 00560 and welded according to AWS D 1.5.
- That joint openings of all individual cells remain equal throughout the full movement range of the joint.
- Sliding surfaces of internal joint components are made of stainless steel and polytetrafluoroethylene (PTFE).
- The expansion joint seals do not protrude above the top of the extrusions. Split extrusions may be used at curb upturns.

Design the elastomeric or urethane springs and bearings so that they are removable and replaceable. Provide for the removal and reinstallation of the strip seal from above the joint by using a 1 1/4 inch minimum joint gap width.

Account for the effects of vertical and horizontal rotations and longitudinal movements of the superstructure.

(2) Limit States Fatigue Wheel Loads - Design the centering beams or transverse seal separation beams, including edge beams, support bars, bearings and other structural elements for the simultaneous application of the vertical and horizontal limit states fatigue wheel load ranges shown below:

Limit States Fatigue Vertical Wheel Load Range (Normal to the roadway surface)	**Limit States Fatigue Horizontal Wheel Load Range (Parallel to the roadway surface)**
26,000 pounds/wheel	8,100 pounds/wheel

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.

Width of Top Flange of Center Beams or Edge Beams	**Percentage**
2 1/2 inches	40
3 inches	50
4 inches	60

(4) Fatigue Limit States Design - Design the expansion joint structural steel members, connections both welded and bolted, and steel components to remain free of cracks after 100 million cycles, which represents the endurance limit. Perform fatigue testing to satisfy the fatigue limit states equation shown below for all expansion joint steel structural members, connections both welded and bolted, and steel components.

$$(0.5)f_{sr\ calc} \leq F_{sr\ test}$$ Fatigue Limits States Equation

where:

$f_{sr\ calc}$ = calculated stress range based on the simultaneous application of two sets of vertical and horizontal limit states fatigue wheel ranges at 6 feet spacing.

$F_{sr\ test}$ = allowable limit states fatigue stress range at the endurance limit of 100 million cycles.

(5) Fatigue Testing - Perform constant amplitude fatigue testing to determine $F_{sr\ test}$, for all structural members, connections both welded and bolted, and components.

Base the allowable limit states fatigue stress range at 100 million cycles with a survival probability of 95%.

Apply the test loadings so that the vertical and horizontal loadings are applied simultaneously. Perform testing so that the horizontal load is 20% of the vertical load.

Use an independent testing laboratory for the fatigue testing. Contact the Engineer for information on facilities capable of performing fatigue testing.

(e) Fabrication - Fabricate the modular joint seals according to the dimensions, shapes, designs and details shown in the approved shop drawings. All modular joint seals for the Project shall be fabricated by the same manufacturer. Weld seal retainer clips continuously on the top and bottom, if welded to the seal separation or edge beams.

(1) PTFE Sliding Surface - Bond the PTFE under controlled conditions and according to written instructions provided by the manufacturer of the PTFE. Complete the bonding operation so that the PTFE surface is smooth and free from bubbles.

(2) Stainless Steel Sliding Surface - Finish the stainless steel sliding surface to a finish of 8 microinches (RMS) or less.

Weld the stainless steel sheet all around to the steel backing plate by a tungsten-arc welding process according to the current AWS specifications. Clamp the stainless steel sheet so that it has full contact with the steel backing plate during welding. Stop the welds so that they do not protrude beyond the sliding surface of the stainless steel.

(f) Installation - Install the joint assembly according to the shop drawings submitted under 00585.47(b-2), and as follows:

- Install so that the joint matches the roadway profile and grade.
- Fill the blockout opening with the same class of concrete that is used in the deck. Place concrete after the modular expansion joint has been set to final line and grade.
- Construct the bottom inside edge of the outside extrusions so that the concrete-steel interface below the joint is at the same elevation and distance from the centerline of the joint, full length of the joint.
- Place modular expansion joint seal units only in preformed blockouts. Coordinate the shop drawings with Agency-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-4).

No kinks or bends are allowed in the expansion joint units, except those necessary to match the roadway grades. Remove any expansion joint unit exhibiting bends or kinks, other than those shown on the approved shop drawings from the Project Site.

Replace polychloroprene strip seals not fully bonded to the steel extrusions with fully bonded seals at no additional cost to the Agency.

Perform fatigue testing of all structural members, splices, connections and components according to 00585.47(d-5). Retest any revised details of material substitutions developed after the initial fatigue testing.

(3) Field Inspection - The manufacturer's representative shall provide full-time quality control inspection to ensure that workmanship meets these specifications.

(4) Acceptance - Expansion joint units shall satisfy each of the three levels of inspection described above prior to acceptance. Replace or repair expansion joint units that fail any one of the three levels of inspection at no additional cost to the Agency.

Submit any proposed corrective procedures to the Engineer for approval before undertaking corrective work.

00585.48 Hot-Dip Galvanizing - Hot-dip galvanize steel expansion joint surfaces, except stainless steel, according to AASHTO M 111 (ASTM A 123).

The contact surfaces at all galvanized slip critical structural bolted connections shall meet Class C (slip coefficient 0.33) surface preparation requirements.

00585.75 Manufacturer's Warranty - Furnish a Manufacturer's Warranty according to 00170.85(c-1), for a Warranty period of two years.

For purposes of the Warranty, expansion joints will be deemed to have failed when:

- Leakage is detected
- Delamination is detected
- Debonding is detected
- Rutting that is greater than the surrounding pavement surfaces is detected

The Warranty shall recite that, upon written notification by the Agency, that the expansion joint, or portions of the expansion joint, used according to the manufacturer's recommendations, have failed, the manufacturer will replace expansion joint or portions of the expansion joint, within 6 months of the Agency's written notification.

The Warranty shall also recite that if the manufacturer fails to replace the expansion joint of portions of expansion joints within the given 6 month period after written notification, the Agency at it's discretion, will replace the expansion joints or portions of the expansion joint, or have the expansion joints or portions of the expansion joint replaced by an independent contractor, with the total cost of replacement, including all materials, equipment, labor, associated mobilization, and traffic control costs will be paid for by the manufacturer.

Provide materials and use procedures to replace failed expansion joints that meet the specifications in effect at the time of original installation, or if no longer available, use current expansion specifications.

Measurement

00585.80 Measurement - No measurement of quantities will be made for closed expansion joints. Estimated quantities of closed expansion joints will be listed in the Special Provisions.

The estimated quantities of asphaltic plug joints is based on a nominal depth of 2 1/4 inches.

The quantities of asphaltic plug joint material for joints deeper than 2 1/4 inches will be measured on the volume basis.

No measurement will be made for elastomeric concrete used to provide a plane surface on which to place the steel bridging plate.

Payment

00585.90 Payment - The accepted quantities for work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Asphaltic Plug Joint Seals	Lump Sum
(b)	Asphaltic Plug Joint Seal Material	Cubic Yard
(c)	Poured Joint Seals	Lump Sum
(d)	Type _____ Preformed Polychloroprene Compression Joint Seals	Lump Sum
(e)	Performed Elastomeric Strip Seals	Lump Sum
(f)	Type _____ Modular Expansion Joint Seals	Lump Sum

Item (a) includes sawcutting, steel bridging plate, and installation of the asphaltic plug joint to a nominal depth of 2 1/4 inches.

Item (b) includes materials only for asphaltic plug joint depths greater than 2 1/4 inches.

In items (d) and (f), the type of joint seal will be inserted in the blank.

Payment will not be made before joints have passed the leakage test of 00585.41(e). No payment will be made for any material installed as replacement material for that removed, unless the Engineer determines that the reason for the removal was beyond the Contractor's control, or that the plans specifically required the removal.

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

Payment for work under this Section will be limited to 75% of the amount due until the Agency has received the signed warranty.

No separate or additional payment will be made for:

- preformed expansion joint filler, poured joint filler, traffic loop sealant, or sawcutting
- providing the manufacturer's representative or for furnishing the warranty

Section 00587 - Bridge Rails

Description

00587.00 Scope - This work consists of constructing bridge rails of the material or combination of materials shown or specified.

Bridge rails will be classified as concrete or steel according to the predominant material used in the rail.

Materials

00587.10 Materials - Furnish materials meeting the following requirements:

Cast Steel Posts	02810.40
Concrete	02001
Concrete Coating	02210.30
Galvanizing	02530.70
Grout	02080.30
Reinforcement	00530
Structural Steel	02530
Structural Steel Tubing	02810.20
Thrie Beam Rail	02810.50
Tube	02810.30

Construction

00587.40 General - Construct bridge rails:

- True to line, grade and dimensions shown or established, with a smooth, even top rail without following any unevenness in the superstructure.
- Vertical, rather than normal to the deck, whether the deck is superelevated or not, unless shown otherwise.
- After falsework has been removed, so that the span is self-supporting.

00587.42 Concrete Rails:

(a) General - Construct concrete rails according to Section 00540 and the following:

- Cast-in-place rails may be slipformed as the Contractor elects subject to paragraph (c) of this subsection.
- Construct expansion joints which permit freedom of movement. After all other work is completed, use a sharp chisel to remove all loose or thin shells of concrete likely to spall under movement at expansion joints.

(b) Fixed Forms - Forms shall be smooth and tight fitting, rigidly held in line and grade, and removed without damage to the concrete. Make form joints in vertical planes. Construct all moldings, panel work, and bevel strips as shown. Make corners in the finished work true, sharp and free from cracks, spalls or other defects.

(c) Slipformed - Concrete rails may be slipformed if the plans contain details for slipforming. Before slipforming any permanent rail, the Contractor shall meet one or both of the following requirements (1) and (2) as directed:

(1) Cast a test section at least 20 feet long as follows:

- Place the test section off the structure.
- Use the same section and reinforcement as detailed for use on the structure.
- Include one typical contraction or open joint.
- Remove at no additional cost to the Agency.

(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 $\pm$ 1/2 inch.
- Keep the top and faces of the finished rail free from sags, humps, and other irregularities.
- Maintain contraction joints, open joints, and expansion joints to the dimensions shown until the concrete sets.
- Use slipforming only for sections of rail with constant dimensions. Use fixed forms where dimensions vary, as at luminaire or signal supports and at rail end transitions.
- Brush-finish exposed rail surfaces with vertical strokes. Do not grind brush-finished surfaces that are to receive a Class 1 finish.
- Remove and replace any unsatisfactory work at no additional cost to the Agency.

(d) Surface Finish - Give all exposed concrete surfaces a general surface finish followed by a Class 1 surface finish (ground and coated) according to 00540.53 except as provided in 00587.42(c).

(e) Latex Paint Cure for PCC - As an option to curing cast-in-place or slipformed bridge rails, according to the Specifications, the following procedure may be used:

- Allow free moisture to flash off, but only until the concrete surface does not glisten, and never for more than one hour.
- Apply the first coat of a latex paint approved for bridge use and meeting the requirements of 02210.30(c) at an application rate of 150 square feet per gallon.
- Allow the first coat to air-dry for one hour.
- Apply the second coat of latex paint at the same rate as above, with application direction transverse to the direction of the first coat.

00587.43 Metal Rails:

(a) Construction - Provide structural steel tubing, tube or metal thrie beam rail as shown or specified. Fabricate and erect metal rails according to Section 00560. Adjust metal rails before fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout their length.

(b) Coating - Unless otherwise specified, galvanize steel portions of the railing. Galvanize after fabrication of the rail according to 02530.70. If galvanized portions of the rail are to be coated, coat according to Section 00594.

Measurement

00587.80 Measurement - No measurement of quantities will be made for work performed under this Section. Estimated quantities of bridge rails will be listed in the Special Provisions.

Payment

00587.90 Payment - The accepted quantities of bridge rails will be paid for at the Contract lump sum amount for the appropriate bridge rail items listed in the Contract Schedule of Items.

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

No separate or additional payment will be made for anchor bolts and anchorage devices, except those cast in precast concrete members.

Payment for anchor bolt and anchorage devices in cast-in-place concrete members and for reinforcement extending from a precast unit, cast-in-place deck, wall or bridge end panel into the rail will be included in payment made for the precast unit, cast-in-place deck, wall or end panel, as appropriate.

Payment for guardrail terminal connectors, connection plates, spacer blocks and other connection hardware will be included in the payment for the guardrail transition item according to 00810.90.

Section 00591 - Waterproofing Membrane

Description

00591.00 Scope - This work consists of furnishing and placing bridge deck waterproofing membrane on the decks of bridges as shown.

Materials

00591.10 Materials - Furnish a warranted waterproofing membrane system from the QPL that complies with the maximum profile grades and superelevations shown. Profile grade and superelevation limitations for products are listed in the QPL and are available from the manufacturer.

(a) Concrete Patching Material - If concrete repairs are required, furnish a PCC patching material from the QPL that is compatible with the membrane.

(b) Tack Coat - Furnish hot asphalt tack coat meeting the requirements of 00745.11(a), or a primer coat as recommended by the membrane manufacturer. An emulsified tack will not be allowed.

Labor

00591.30 Manufacturer's Representative - Provide the services of a manufacturer's representative authorized to sign a warranty on behalf of the manufacturer to observe the installation of each membrane system, including the wearing course. The manufacturer's representative may be an employee of the Contractor if written documentation from the manufacturer is provided stating that the Contractor is certified to install warranted materials and the identified employee is certified to serve as the manufacturer's representative. Follow the recommendations of the manufacturer's representative in all matters pertaining to proper installation of the membrane system. Instruct the manufacturer's representative to immediately alert the Contractor and the Engineer of anything that could affect the performance of the waterproofing membrane or the warranty.

Construction

00591.40 General - Do not begin membrane installation until all materials and equipment necessary to perform the installation and any required repairs are at the job site.

(a) Weather and Other Restrictions - Place tack coats, surface patching, and waterproofing membrane when the deck is dry, the air temperature is between 40 °F and 90 °F, and the surface temperature of the deck is below 120 °F.

(b) Handling Materials - Load and unload waterproofing membrane and primer without damage to the materials. Store membrane indoors at a temperature between 60 °F and 120 °F until it is placed on the bridge deck. Do not allow the membrane to sit in direct sunlight longer than necessary.

(c) Pre-Placement Meeting - Hold a pre-placement meeting with the Engineer at least 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, detailing membrane placement at the curbs or rail. Do not proceed with the work until the proposed procedure, and shop drawing if applicable, have been approved by the Engineer.

(d) Area of Application - On bridges without curbs, apply the waterproofing membrane from outside edge to outside edge of the deck, or within the limits of the AC wearing course.

Protect adjacent surfaces not to be covered with the membrane from spatter or coating.

00591.42 Preparing Existing Bridge Decks:

(a) Surface Removal - Unless otherwise specified, remove the existing asphalt concrete wearing surface from the deck, according to Section 00503, before placing the waterproofing membrane. Ensure that the deck is smooth and free of obstructions. Small areas of asphalt and asphalt stain need not be removed if smooth and tightly bonded to the deck, as determined by the Engineer. The nominal thickness of the wearing surface on the bridge(s) will be identified in the plans.

Completely remove any existing paint and pavement markers.

Remove any spalled or loose surface concrete to sound concrete. Prepare the deck surface so that it is smooth and free of voids, sharp projections, form release agents, concrete curing agents and other contaminants.

Prior to placing the membrane, verify that the deck is free from loose rocks, or other debris. Clean the deck with compressed air immediately prior to placing the membrane.

Dispose of all removed materials according to 00290.20.

(b) Surface Patching - Leave the final surface smooth enough to allow placing the waterproofing membrane directly on the deck, yet rough enough to provide good adhesion.

Use hand-placed grout or other approved material to smooth or fill all gaps, breaks, or edges that are more than 1/4 inch deep, including the offset in adjacent slabs with different camber, vertical edges adjacent to different milling passes or striations left by milling machine teeth. If a water-based grout is used, allow for proper cure time as recommended by the membrane manufacturer, prior to applying the membrane.

00591.43 Tack Coat - Place a hot tack coat, or primer as applicable, on a dry deck only.

00591.45 Installation - Construct waterproofing membrane according to the manufacturer's recommendations and as approved.

Release bubbles or pockets of trapped air or vapor and repair in a manner satisfactory to the Engineer.

00591.46 Protection During Construction:

(a) General - Do not use the waterproofing membrane as a temporary wearing surface or haul road. Until the membrane is protected by pavement, keep Contractor traffic on the membrane to a minimum. Allow Contractor traffic only with the approval of the Engineer and the membrane manufacturer.

Immediately repair and damage to the membrane caused by the paving operation. Make repairs before resuming paving.

(b) Protective Course and Tack Coat - If the wearing course will be 3/4 inch open-graded HMAC, place a protective course of 3/8 inch dense-graded HMAC conforming to Section 00744, at least 3/4 inch thick, over the membrane. Treat the top surface of the membrane with a hot asphalt

tack coat according to the membrane manufacturer's recommendations prior to placing the protective course, or prior to placing a 3/4 inch or 1/2 inch dense-graded HMAC wearing course, if applicable. The mix may be Level 3 or Level 4 as directed.

00591.47 Leakage Test - As soon as the deck is ready for traffic, flood the deck with water to test the membrane for leakage. No water leakage will be allowed. Make appropriate repairs and re-test, at no additional cost to the Agency, 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 Agency makes written request to the manufacturer for repair or replacement, the Warranty period will stop until the requested repair(s) or replacement(s) are made and accepted.

(b) Failure - For purposes of the warranty, failure is defined as:

- Leakage of the membrane, or
- Delamination of the membrane from the underlying or overlying pavement.

(c) Remedy - Upon notification by the Engineer of a failure as defined above, provide the following remedy:

- Repair failures within 60 days at no additional cost to the Agency.
- Use materials and procedures meeting these Specifications.
- Match repairs to finished grade.
- Coordinate timing of repair work with the Engineer.

(d) Traffic Control; Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure of the membrane causes a traffic hazard, the failure may be temporarily corrected by Agency or other forces at the manufacturer's expense. Replace temporary repairs with permanent repairs at the manufacturer's expense and according to these Specifications.

Measurement

00591.80 Measurement - The quantities of waterproofing membrane will be measured on the area basis, and will be the sealed surface area, excluding curb and rail faces, and will be limited to the neat lines and dimensions shown.

Payment

00591.90 Payment - The accepted quantities of waterproofing membrane will be paid for at the Contract unit price, per square foot, for the item "Warranted Waterproofing Membrane".

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

Payment for work done under this Section will be limited to 75% of the amount due until the Agency has received the signed warranty.

00591.90

No separate or additional payment will be made for:

- overlaps
- removing the existing asphalt concrete wearing surface and pavement markings, preparing the surface, surface patching, asphalt used as a protective course, and for providing tack coat, and primer
- providing the manufacturer's representative, furnishing the warranty

Section 00593 - Powder Coating Metal Structures

Description

00593.00 Scope - This work consists of preparing and powder coating new and existing metal structures and features, including all steel, galvanized, aluminum, and other specified surfaces.

00593.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

AAMA - American Architectural Manufacturers Association

(b) Definitions:

Apparent Magnetic Surface - The magnetic surface that a magnetic gauge senses, somewhere between the peaks and valleys of the profile, after the steel is roughened by abrasive cleaning.

Cleaning - Removing detrimental material in preparation for coating.

Coat - Apply powder to a substrate to form a single uniform layer. A coat is comprised of as many applications as necessary to achieve the specified coat thickness.

Coating - Protective material after it is applied to a structure.

Coating System - All specified coats applied separately in a predetermined order.

Hold Point - A time at which the Contractor is required to stop a particular activity until a phase of work is inspected or tested. If the Engineer finds this phase conforms to the Specifications, the subsequent phase of work may proceed.

Manufacturer's Recommendation - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

Phase - An activity or step of the preparation and coating procedures to be inspected or tested. The transition from one phase to another represents a hold point.

Preparation - Measures taken to provide a suitable surface ready to coat.

Substrate - A surface to which a coating is to be applied. This may be the prepared surface of the metal structure or a previous coating.

Surface Profile - Roughness of a cleaned steel surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

00593.03 Precoating Conference - Before beginning work, the Contractor's supervisory personnel, together with any subcontractors and their supervisory personnel who are to be involved in the preparation and coating work, and a representative from the coating manufacturer shall meet with the Engineer for a precoating conference at a time mutually agreed upon. Submit the following 14 calendar days before the precoating conference:

- The name, location, and contact information (mail address, phone, and e-mail) for the firm performing the powder coating operation.

- Quality assurance and quality control (QA/QC) programs established and followed by the firm performing the powder coating operation.
- A product data sheet and material safety data sheet of each type of coating material to be used, including the products to be used for field repair of damaged areas.
- Project specific powder coating plan, including a specific cleaning, surface preparation, pre-heating, application, curing, shop and field coating repair, handling, and storage processes to be taken for the assemblies being coated for the Project.
- Letter from galvanizer that neither water quenching nor a chromate conversion coating will be used on the surfaces that are to be powder coated.

00593.04 Notice - Notify the Engineer, in writing, at least seven calendar days in advance of the date that preparation and coating operations are to begin.

Materials

00593.10 Materials - Furnish material meeting the requirements of this Section and the Special Provisions.

(a) Coating Systems:

(1) Steel Substrates - Provide a two coat system for steel substrates consisting of a zinc-rich epoxy primer and a polyester topcoat.

(2) Galvanized and Other Non-Steel Metallic Substrates - Provide a two coat system for galvanized and non-steel metallic substrates consisting of an epoxy primer and polyester topcoat.

(b) Specifications - Furnish an epoxy powder primer meeting the following requirements:

Test	Zinc-rich Epoxy	Epoxy
Adhesion (ASTM D 3359, Method B)	B5 (no failure)	B5 (no failure)
Flexibility (ASTM D 522, Method B)	Pass 1/4" Mandrel Bend	Pass 1/8" Mandrel Bend
Pencil Hardness (ASTM D 3363)	H Plus	H Plus
Specific Gravity (ASTM D 792)	2.30 minimum	1.25 minimum
Zinc in Dry Film (calculated weight)	50% minimum	–

Furnish a polyester topcoat meeting the requirements of the American Architectural Manufacturers Association (AAMA) Specification 2605.

Before notice required by 00593.04, submit a manufacturer's certification stating that each coating material in the coating system:

- Meet the requirements of this Section.
- Meet the specifications of the manufacturer's data sheets.
- Are compatible, including coating repair materials.

The color of the topcoat will be specified in the Special Provisions. Obtain approval of the Engineer before applying any coating.

00593.12 Caulking - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. The caulking color shall be clear or match the color of the top coating.

Furnish industrial grade polystyrene or polyurethane backing material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer's approval of the caulking and backing material before using.

Construction

00593.40 General - Structures to be prepared and powder coated include new and existing steel, galvanized, and non-steel metallic substrates.

00593.41 Special Fabrication, Preparation, and Coating:

(a) Inaccessible Surfaces - Coating inside of rolled sections, such as poles and rail tubes, is not required unless otherwise specified.

(b) Fabrication Areas - Schedule fabrication, preparation, and coating so that the coating system is not damaged by the welding or fabricating process.

Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00593.42.

Do not apply coatings within 4 inches of the weld before finishing the welding operation.

00593.42 Preparation of Surfaces:

(a) Steel Substrates - Clean new and existing steel surfaces to be coated according to SSPC-SP 10, "Near-White Blast Cleaning". The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1 and have a 1.0 to 2.5 mil profile finish.

Apply a phosphate conversion coating as a surface treatment immediately after blasting. Use heat to dry the phosphate coating immediately after it is applied.

(b) Galvanized Substrates - Clean and prepare galvanized surfaces to be coated according to ASTM D 6386, the approved project specific powder coating plan, and the following:

- **Newly Galvanized Steel** - Smooth and clean surfaces according to ASTM D 6386, Section 5 and prepare surfaces according to ASTM D 6386, Section 5.4.1.
- **Partially Weathered Galvanized Steel** - Check and prepared according to ASTM D 6386, Section 6, then smooth and clean surfaces according to ASTM D 6386, Section 5, then prepare surfaces according to ASTM D 6386, Section 5.4.1.
- **Weathered Galvanized Steel** - Prepare according to ASTM D 6386, Section 7.

(c) Other Non-Steel Metallic Substrates - Solvent clean non-steel metallic substrate surfaces according to SSPC-SP 1 then either light brush blast, according to SSPC-SP 7, with a non-ferrous blasting media or hand sand. The prepared surface shall have a 1.0 to 2.5 mil profile finish.

(d) All Substrates - Remove fins, tears, slivers, and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing, or similar operations.

00593.43 Coating Metal Structures:

(a) Description - When not in conflict with this Section and the Special Provisions, perform powder coating application according to the following:

- The recommendations of the coating manufacturer.
- The best practices of the trade.

(b) Application of Coating - Apply the powder coating system according to the following requirements:

(1) Surface Condition - Ensure that the surface to be coated is free of moisture, dust, grease, rust, or other substance which would prevent the bond of succeeding applications. Prepare contaminated surfaces to the Engineer's satisfaction before applying the coating.

(2) Application Methods - After surface preparation, apply the two coat system according to the powder coating manufacturer's recommendations, the approved Project specific powder coating plan and the following:

- Pre-heat surface.
- Apply the epoxy primer coat, followed by a partial cure.
- Apply the polyester finish coat, followed by the finish cure.

Apply each coat in a uniform layer, completely covering the preceding coat. Finish each individual coat by the manufacturer in a sufficiently different shade so that skips and holidays can be easily detected. Correct skips or other deficiencies before application of succeeding coats.

(c) Coating Requirements:

(1) Minimum Dry Film Thickness - Apply all coats to the following minimum thicknesses:

- **Primer:** 2.5 mils
- **Topcoat:** 2.5 mils

(2) Coating Thickness and Coverage Requirements - Each coat shall consist of as many applications as necessary to cover the work and achieve the minimum thickness specified. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the steel substrate.

The dry film thickness will be measured for acceptance using a Type 2 gauge according to SSPC-PA 2. If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D 4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness the total coating system will be rejected even if the thickness of the total system equals or exceeds the total specified thickness.

(3) Additional Top Coat Requirements - Even if the total thickness of prime coat exceeds the prime coat specified thickness, apply the top coat to at least the minimum required topcoat thickness, as well as provide uniform and complete coverage and appearance.

(d) Time of Application - Apply the prime coat within 4 hours of the final cleaning and before any visible indication of rust forms.

(e) Caulking - Apply the caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch. Apply caulk over the backing material to form a watertight seal.

00593.44 Inspecting and Testing - The powder coating firm shall conduct or make arrangements for powder coating tests required in the approved Project specific powder coating plan. Tests include the following:

Test	Test Method
Cleanness of Abrasive Material	ODOT TM 616
Cleanness of Compressed Air	ASTM D 4285
Pictorial Surface Preparation Standards	SSPC-VIS 1
Surface Profile by Replica Tape	ASTM D 4417
Hardness	AAMA 2605 and ASTM D 3363
Dry Film Thickness by Magnetic Gauge	SSPC-PA 2
Dry Film Thickness by Tooke Gauge	ASTM D 4138
Pull-off Strength of Coating [min. 400 psi] (Test Method B)	ASTM D 4541

Provide access to the Engineer, at the powder coating facility, to visually inspect the assemblies for the presence of coating holidays and other unacceptable surface imperfections, and to witness the coating thickness testing, the hardness testing, and the adhesion testing.

Provide documentation of the QA/QC testing to the Engineer.

Assemblies failing these tests will be rejected. Repair and recoat the rejected assemblies as directed.

Do not ship assemblies to the Project site without Engineer's approval.

00593.45 Protecting Against Damage:

(a) Contaminated Surfaces - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00593.42 and recoat with all specified coats. Clean, reprepare and recoat at no additional cost to the Agency.

(b) Surfaces Not to Be Coated - Protect surfaces that are not to be coated from blast-cleaning, overspray, and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the Agency.

(c) Handling, Shipping, or Surface Damage - After curing and acceptance, individually wrap the coated assemblies with multiple layers of bubble wrap, or other protective wrapping materials specified in the approved Project specific powder coating plan.

During storage and shipping, separate each wrapped assembly with expanded polystyrene spacers and other spacing materials specified in the approved plan.

After erection, repair marred and damaged coated surfaces due to the Contractor's shipping, storage, handling, and erection operations according to 00593.60.

00593.60 Repair of Damaged and Unacceptable Coatings - Repair damaged surfaces as follows:

(a) Surface Preparation - Prepare the surface according to SSPC-SP 1, SSPC-SP 2, and SSPC-SP 3. Use a solvent that is acceptable to the paint manufacturer or approved by the Engineer. Extend the prepared area at least 2 inches into adjacent, tightly adhering, intact coating.

(b) Feathering of Repair Areas - Feather the existing coating system surrounding each repair location. Feather the repair area for a distance of 1 inch to 2 inches to provide a smooth, tapered transition into the existing intact coating.

(c) Coating Application in Repair Areas - When steel substrate is exposed in the repair area, apply a coat of zinc rich primer before applying the topcoat.

When the damage does not extend to the bare substrate, apply only the affected coats.

Measurement

00593.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00593.90 Payment:

(a) New Metal Structures - No separate payment will be made for preparing and powder coating new metal work. Payment for this work, including correction of damages, will be included in payment made for furnishing and placing the new metal structures.

(b) Existing Metal Structures - The accepted quantities for preparing and powder coating existing metal structures will be paid for at the Contract lump sum amount for the item "Prepare and Powder Coat Existing Structures".

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

No separate or additional payment will be made for correction of damages described in 00593.44.

Section 00594 - Preparing and Coating Metal Structures

Description

00594.00 Scope - This work consists of preparing and coating new metal structures and features in the shop and in the field, and preparing and coating existing metal structures. This includes all:

- Interior and exterior steel surfaces
- Steel railings, bridge bearings, and bridge expansion joint assemblies
- Other miscellaneous steel
- Galvanized and aluminum surfaces

00594.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

AAMA - American Architectural Manufacturers Association
DFT - Dry Film Thickness
FTMS - Federal Test Method Standard

(b) Definitions:

Apparent Magnetic Surface - The magnetic surface that a magnetic gauge senses, somewhere between the peaks and valleys of the profile, after the steel is roughened by abrasive cleaning.

Cleaning - Removing detrimental material in preparation for coating.

Coat - Apply paint or other protective material to a substrate to form a single uniform layer. A coat is comprised of as many applications as necessary to achieve the specified coat thickness.

Coating - Protective material after it is applied to a structure.

Coating Material - Protective material in the liquid state before application.

Coating System - All specified coats applied separately in a predetermined order.

Field Coating - The on-site coating of new or existing metal structures before or after erection.

Hold Point - A time at which the Contractor is required to stop a particular activity until a phase of work is inspected or tested. If the Engineer finds this phase conforms to the Specifications, the subsequent phase of work may proceed.

Maintenance Coating - The coating of existing steel structures that have been previously coated and need recoating.

Manufacturer's Recommendation - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

Paint - A pigmented liquid, applied as a thin layer, which is converted to a solid colored film after curing. This film provides a decorative and protective coating to the substrate. The binder is a resin that may or may not be modified with natural vegetable oils, fish oils, or other ingredients.

Phase - An activity or step of the preparation and coating procedures to be inspected or tested. The transition from one phase to another represents a hold point.

Preparation - Measures taken to provide a suitable surface ready to coat.

Shop Coating - The coating of steel surfaces in the fabrication shop before the metal is transported to the erection site.

Skin - A solid or semi-solid membrane that forms on paint in a container.

Skimming - The process in which a film forms over a liquid coating, either during storage or after application.

Stripe Coat - Separate, independent coating that is applied to complex details and irregular surfaces before the application of the full coat. Complex details and irregular surfaces include but are not limited to edges, seams, corners, gaps, crevices, weld lines, pitted surfaces, holes, nuts, bolts, rivets, and threads. Brushes are used to push the coating around and into complex details and irregular surfaces. Each stripe coat is a different color than the preceding and subsequent full coat, extends a minimum of 1 inch from the irregular surface, and completely hide the substrate.

Solvent - Liquid used to solvate or put materials into solution or to clean equipment and tools.

Substrate - A surface to which a coating is to be applied. This may be the prepared surface of the metal structure or a previous coating.

Surface Profile - Roughness of a cleaned metal surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

Thinner - Volatile liquids used to thin compatible coating materials. Thinners may be a blend of solvents.

(c) References - In this Section, references such as SSPC-SP 1 and SSPC-PA 1 refer to Volume 2, "Systems and Specifications", of SSPC's "Painting Manual".

In these Specifications, references are made to FTMS 141, "Paint, Varnish, Lacquers, and Related Materials: Methods of Inspection, Sampling and Testing", which is distributed by the U.S. General Services Administration.

00594.03 Precoating Conference - Before beginning work, the Contractor's supervisory personnel, together with any subcontractors and their supervisory personnel who are to be involved in the preparation and coating work and a representative from the coating manufacturer, shall meet with the Engineer for a precoating conference at a time mutually agreed upon. 14 calendar days before the precoating conference, submit a plan for accomplishing all phases of the preparation and coating work including but not limited to the following:

- ventilation
- containment
- surface preparation
- painting
- coating materials
- quality control plan
- waste handling and disposal

00594.04 Notice - Notify the Engineer, in writing, at least seven calendar days in advance of the date that preparation and coating operations are to begin.

00594.05 Access and Containment For Field Preparation and Coating - Contain work debris that is generated from dry blast cleaning operations according to the Class 1A requirements of SSPC-Guide 6, with the following parameters:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials may be used where rigid containment materials are not specified. Provide flexible containment materials that are air impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Type H1 instrument verification of air pressure in rigid containment
- Type H2 visual verification of air pressure in flexible containment
- Type I1 minimum specified air movement 50 feet per minute cross draft. Use portable fans as needed to provide air movement in stagnant areas.
- Type J1 exhaust air filtration 99% cleaning efficiency for particulate diameters above 39 microinches and less than 2 grains of particulate per thousand cubic feet of exhaust air (or air recycled to work area).
- Operate dust collection, air flow, and air movement equipment during blowdown to prevent settling of dust on the structure or within the containment.

Contain work debris that is generated from water jet cleaning operations according to the Class 2W requirements of SSPC-Guide 6, with the following parameters:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials may be used where rigid containment materials are not specified. Provide flexible containment materials that are water impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Ceiling not required.
- Wall height shall effectively prevent loss of contaminated water.

Contain work debris that is generated from hand tool cleaning or power tool cleaning operations according to the Class 1P requirements of SSPC-Guide 6. For hand tool cleaning or vacuum shrouded power tool cleaning, ground covers or free-hanging tarpaulins are an acceptable alternate means of containment provided the debris is captured and controlled to the same degree as Class 1P. Provide Type A1 rigid flood decking work access platforms regardless of containment methods.

Emission from various containment systems will be assessed visually. Address any visible emissions immediately.

Maintain all traffic clearances shown. Do not allow the containment and cables, hoses, supplies and equipment to encroach on the indicated traffic clearances at any time.

For containment using forced air ventilation, submit a sketch showing the size (length x width x height) and location of each containment that will be used, and identifying the air moving equipment (manufacturer, model, and capacity in cubic feet per minute) for each containment, to the Engineer for review 21 calendar days prior to precoating conference.

Structural design requirements include:

- Dead load, live load, and wind load when designing loads for containment structures and work platforms. Dead load is the self-weight of the containment and work platforms, live load is all personnel, equipment, and materials, including collected debris, required for normal operations, and wind load is a basic wind speed of 90 mph applied in the most critical direction.
- Design a factor of safety of least 6 for wire ropes and connecting hardware and at least 4 for all other components for containment structure and work platform components. Factor of safety is the ultimate failure load of the component divided by the maximum working load combination applied to the component.
- Verify structural adequacy of bridge with added loading from containment structures and work platforms using either AASHTO Standard Specifications for Highway Bridges, Group II, III, V, and VI load combinations, or AASHTO LRFD Bridge Design Specifications, Strength III loading combination.
- Submit for review at least 21 calendar days before the precoating conference the containment structure plans, specifications, shop drawings, welding procedures, and design calculations assuring that the containment system, work platforms, and the structural members of the bridge can safely resist the combined effects of dead loads, live loads, and wind loads. The plans, specifications, and calculations shall be prepared and stamped by a civil or structural engineer licensed to practice in the State of Oregon, who has designed at least one bridge painting containment structure.

Comply with Section 00290 for spill response, spill containment and cleanup of spills, and contamination.

Comply with all applicable requirements of the Occupational Safety and Health Administration, including but not limited to applicable portions of 29 CFR Ch. XVII, Sections 1926.55 through 1926.57, 1926.62, 1926.65, 1926.450 through 1926.454, and 1926.500 through 1926.503.

00594.06 Waste Handling and Disposal - Dispose of waste material according to 00290.20, and the requirements of SSPC Guide 7 that do not conflict with 00290.20.

Materials

00594.10 Materials - Furnish materials meeting the requirements of this Section, the Special Provisions, and the applicable portions of SSPC-PA 1, "Shop, Field and Maintenance Painting", when not in conflict with either this Section or the Special Provisions.

00594.11 Coating Materials:

(a) Coating System - Furnish coating materials from the QPL and the following:

- Shop coating of steel or iron surfaces, 3 coat system with inorganic zinc primer.
- Shop coating or maintenance coating of steel or iron surfaces, 3 coat system with organic zinc primer.
- Field rehabilitation of coated steel or iron surfaces, 3 coat system with surface tolerant organic zinc primer.
- Shop coating or maintenance coating of non-ferrous surfaces, 2 coat system.

Application of coating materials will not be allowed until certifications required by 00165.35(a) and 00165.35(b) have been provided and the materials are accepted for use by Agency check testing.

(b) Manufacturing - Furnish coating material meeting the following requirements:

- Be prepared at the factory ready for application or mixing of multi-component coatings. Proportion multi-component coating materials by the manufacturer with each component in its correct proportion and furnished in separate containers ready for field mixing. No field mixing will be allowed for moisture-cured urethane coating system components unless approved by the Engineer.
- Be homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Include additives for control of sagging, pigment settling, leveling, drying, dryer absorption, skimming, and other qualities and properties that affect its application and curing.
- Not require a pretreatment chemical or material prior to application of the prime coat except as stipulated in these Specifications.
- Include required tinting and coloring materials at the time of manufacture. Do not use gray for the first prime coat. To provide contrast between coats, when successive coats are specified, use a different color for each coat of the system. Use tinting material that is compatible with the coating material and is not detrimental to performance.
- Unless otherwise specified, conform to the following colors:
  - Federal Standard 595B color #24272 for ODOT Green top coat
  - Federal Standard 595B color #30059 for weathering steel top coat
  - Federal Standard 595B color #26357 for miscellaneous metal on concrete bridges
- Not vary in composition without prior notice by the manufacturer and approval of the Engineer. No reformulation will be allowed.
- Be applied before expiration of manufacturer's recommended shelf life.

(c) Packaging - Furnish each container meeting the following requirements:

- Be the manufacturer's original unopened container.
- Be new steel or plastic of not more than 6 gallon capacity.
- Meet U.S. Department of Transportation's Hazardous Material Shipping Regulations.
- Be lined, if necessary, to prevent attack by the coating material. The lining shall not delaminate from the container wall so as to contaminate the coating.
- Be labeled with a quality compliance certificate according to 00165.35, showing the following:
  - Manufacturer's name
  - Exact title of coating material
  - Manufacturer's batch number
  - Date of manufacturer
  - Identification of all toxic substances
  - Handling and application precautions

(d) Sampling and Testing - Have the coating material manufacturer furnish the following to the Agency's Materials and Research Section:

- One unopened 1 quart container of each coating material, each component of multi-component coating material, and each thinner, from each batch of each coat. The Agency may, at its discretion, place an inspector at the site of manufacture and obtain check samples at the jobsite.

- Test results certification according to 00165.35 for each batch of each coat, and if the coating material is specified for use on steel-to-steel contact surfaces, certification that the coating material meets the requirements of 00594.11(e).
- A product data sheet for each type of coating material and thinner.
- A material safety data sheet with the initial sample of each type of coating material and thinner.

Agency testing will include the following tests necessary to ensure that the coating materials conform to Specifications, manufacturer's product data sheet, and other testing as the Agency deems appropriate.

Test	Test Method
Density of Liquid Coatings, Inks, and Related Products	ASTM D 1475
Determination of Zinc in Dry Films of Paints and Coatings	ODOT TM 614
Coarse Particles in Pigments, Pastes, and Paints	ASTM D 185
Consistency of Paints Using the Stormer Viscometer	ASTM D 562
Fineness of Dispersion of Pigment-Vehicle System	ASTM D 1210
Drying, Curing, or Film Formation of Organic Coatings at Room Temperatures	ASTM D 1640
Volatile Content of Paints	ASTM D 2369
Pigment Content of Solvent-type Paints	ASTM D 2371
Volume Nonvolatile Matter in Clear or Pigmented Coatings	ASTM D 2697
Vehicle Solids (Ordinary Centrifuge)	FTMS 141, Method 4051
Nonvolatile vehicle Content	FTMS 141, Method 4053

Agency testing is not to be construed as determining or predicting the performance or compatibility of the individual coating material or the total coating system.

(e) Specifications - The coatings on steel-to-steel contact surfaces at all slip-critical structural bolted connections using high strength bolts shall meet Class B (slip coefficient of 0.5) coating requirements according to "Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints", as adopted by the Research Council on Structural Connections.

00594.12 Caulking - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. The caulking color shall be clear, approximate the color of the top coating, or be over coated.

Furnish industrial grade polystyrene or polyurethane backing material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer’s approval of the caulking and backing material before using.

Construction

00594.40 General:

(a) New Steel Structures - Prepare and coat new steel structures and features erected at locations shown. Except as provided in these Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site.

(b) Existing Steel Structures - Prepare and coat the existing steel structures described in the Special Provisions.

(c) Rehabilitating Coated Steel Structures - Prepare and coat new steel members and existing steel structures impacted by erection. This includes all existing steel surfaces uncovered by the removal of existing steel, wood, and concrete members, except top flanges. Impacted areas include, but are not limited to areas, where rivets or bolts are removed, and existing steel surfaces damaged during erection or other Contractor operations. Except as provided in these Specifications, perform all required preparation and coating of new steel members at the fabrication shop after completion of fabrication and before transporting to the Project Site. Perform preparation and coating of existing steel structures impacted by erection in the field.

(d) Non-Steel Metallic Substrates - Prepare and coat new non-steel substrates and features erected at locations shown. Except as provided in these Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site. Prepare and coat existing non-steel substrates described in the Special Provisions.

00594.41 Special Fabrication, Preparation and Coating:

(a) Inaccessible Surfaces - Before fabrication, prepare and coat with all coats steel surfaces inaccessible to preparation and coating after fabrication.

Prepare and coat contact surfaces within slip-critical joints, constructed as part of the work under Section 00560, according to 00594.42 and 00594.43(d-1).

(b) Welded Areas - Schedule fabrication, preparation, and coating so that the coating system is not damaged by the welding or fabricating process.

Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00594.42.

Do not apply coatings within 4 inches of the weld before finishing the welding operation.

00594.42 Preparation of Surfaces:

(a) New Steel Structures - Clean new steel structure surfaces to be coated according to SSPC-SP 10, "Near-White Blast Cleaning", except as modified by this Section. The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1.

(b) Existing Steel Structures - Blast-clean existing steel structure surfaces to be coated according to SSPC-SP 10, "Near White Blast Cleaning" with the appearance of the blast-cleaned surface to closely approximate Pictorial Standard SP 10 of SSPC-Vis 1 or clean to SSPC-SP 12, "High and Ultrahigh Pressure Water Jetting", cleaned to visual condition WJ-2.

(c) Rehabilitating Existing Coated Steel Structures - Clean all existing steel surfaces to be coated according to SSPC-SP 15, "Commercial Grade Power Tool Cleaning". The cleaned surface shall have a minimum surface profile of 1 mil.

The areas to be prepared shall include all areas of existing coated surfaces exposed by the removal of the existing components involved in the rehabilitation, all areas in which rivets, bolts, or plates are to be removed, and areas damaged by erection or other Contractor operations. Completely clean all existing lead-based coatings exposed by the removal of any structural or miscellaneous member to SSPC-SP 15 "Commercial Grade Power Tool Cleaning" requirements. Extend all prepared areas at least 2 inches into tightly adhering, intact paint. Overlap the subsequent coating and the still intact coating by a minimum of 2 inches. Lightly sand the overlap area of the intact coating to provide a profile for the subsequent repair coating to adhere to.

(d) Non-Steel Metallic Substrates:

(1) Galvanized Surfaces - Prepare surfaces to be coated according to ASTM D 6386.

(2) Aluminum - Solvent clean surfaces to be coated according to SSPC-SP 1 then follow by a light brush blast according to SSPC-SP 7, with a minimum nozzle pressure of 75 psi, or hand sand the surface to create a minimum 1 mil profile, or clean the surface according to the manufacturer's recommendation.

(e) All Metal Structures - Remove fins, tears, slivers, and sharp edges, plus hardened or damaged edges resulting from flame cutting, shearing, or similar operations.

Clean all surfaces of material detrimental to the application of the coating system as follows:

(1) Cleaning Methods - Blast-clean surfaces using one or more of the following methods to discharge the abrasive:

- A stream of high-pressure air
- A rotating centrifugal paddlewheel
- A stream of high-pressure water

Surfaces shall be dry before cleaning unless a wet blast cleaning method is used. Use methods specified in SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning", SSPC-SP 3, "Power Tool Cleaning", and SSPC-SP 15 "Commercial Grade Power Tool Clean", as necessary to augment blast-cleaning.

(2) Abrasives - Perform blast-cleaning using an abrasive of a size which will continually produce a surface profile of at least 1 mil, but not more than 4 mils, as measured by ASTM D 4417 using replica tape on the prepared surface. The blast-cleaning shall result in a roughened steel surface comparable to a Keane-Tator Surface Profile Comparator for sand or grit using ASTM D 4417.

If a centrifugal wheel with a grit mixer is used for blast-cleaning, inspect each member and for those members not meeting the comparator or profile requirements, perform a final blast-cleaning with high-pressure air with an abrasive to obtain the specified profile.

Provide abrasives that have no corrosion products, water, oil, or any other material detrimental to the application and adherence of the coatings. Provide abrasives that conform to SSPC-AB 1 or SSPC-AB 3. Cleanliness will be tested according to ODOT TM 616 and ASTM D 4940. The conductivity results from ASTM D 4940 shall not exceed 100 microsiemen/cm. Wet abrasives are allowed if wet sandblasting methods are used.

(3) Air - The high-pressure air used for blast-cleaning or blowing down shall be free of water, oil or any other material detrimental to the coating system. Provide adequate separators and traps. Compressed air cleanliness will be tested according to ASTM D 4285 by the Engineer.

(4) Rust Inhibitor - If a rust inhibitor is not used with wet surface preparation methods, brush-blast any rust bloom on the surface before applying the coating. If an effective rust inhibitor is used, it shall be compatible with the coating system and be applied to the freshly cleaned surface or contained in the liquid used in cleaning. Use a rust inhibitor from the QPL, or prepare a test panel at least 14 calendar days before beginning work to show that the rust inhibitor does not cause loss of bond between the prepared steel substrate and the primer. If bond failure occurs, no further use of the rust inhibitor will be allowed.

(5) Cleaning Procedures - Perform blast-cleaning operations without damaging partially or entirely completed portions of the work. Do not blast-clean adjacent to areas being coated.

The blast-cleaned surface will be examined for any traces of corrosion, water, oil, grease, and other material deposited during the cleaning operations. If present, remove any detrimental material by solvent cleaning and reblast the surface.

(6) Final Preparation - Before coating, the prepared surface shall be:

- Blown down using high pressure air, within the fully enclosed containment with the specified ventilation operating and supplemented by brushing if required.
- Free of all residue.
- Repair any damaged galvanizing according to ASTM A 780.
- Acceptable to the Engineer.

00594.43 Coating Metal Structures:

(a) Description - When not in conflict with this Section and the Special Provisions, perform coating application according to the following:

- The applicable portions of SSPC-PA 1.
- The recommendations of the coating manufacturer.
- The best practices of the trade.

(b) Application Site Mixing, Thinning, and Storage of Coating Materials:

(1) Rejection - The container contents will be rejected, and not be used if:

- The material arrives at the application site in other than original, unopened containers.
- The container has a break in the lid seal or a puncture.
- The coating materials have begun to polymerize, solidify, gel or deteriorate in any other manner.
- The recommended shelf life, as stated in the manufacturer's product data sheets, has expired.
- A skin forms on the surface of the material or on the sides of the container and the volume of the skin exceeds 2% of the material. If there is not more than 2% skin, remove and discard only the skin.

(2) Mixing - Thoroughly mix coating materials by mechanical means to ensure a uniform composition. Do not mix coating materials by means of air stream bubbling or boxing. Mix in the original container and continue until all pigment or metallic powder is in suspension. Ensure that all solid coating material that may have settled to the bottom of the container is thoroughly dispersed. After mixing, inspect the coating materials for uniformity and to ensure that no unmixed pigment or lumps are present.

Add separately packaged catalysts, curing agents, hardeners, initiators or dry metallic powders to the base coating material only after the base coating material is thoroughly mixed to achieve a uniform mixture with all particles wetted. Add the proper volume of curing agent to the correct volume of base with constant agitation. Use the mixture within the pot life specified by the manufacturer. Discard unused portions at the end of each workday.

(3) Thinning - Do not add additional thinner at the application site unless approved. The amount and type of thinner, if allowed, shall conform to the manufacturer's specifications.

(4) Straining - Strain all coating materials after mixing to remove undesirable matter, but not pigment or metallic powder.

(5) Agitation - Constantly agitate coating materials as recommended by the manufacturer, and all inorganic zinc primers during application, using paint pots equipped with mechanical agitators.

(6) Storage - Store the coating material and solvents in original containers. Store the containers in a weather-tight space where the temperature is maintained between 40 °F and 100 °F or according to the manufacturer recommendations, whichever is more restrictive.

(c) Application of Coating:

(1) Surface Condition - Ensure that the surface to be coated is free of moisture, dust, grease or other substance which would prevent the bond of succeeding applications. Protect freshly coated surfaces from contamination by abrasives, dust or foreign materials from any source. Prepare contaminated surfaces to the Engineer's satisfaction before applying succeeding coats.

(2) Application Methods - Apply coating materials by air or airless spray, brush, roller, any combination of these methods, or as recommended by the coating material manufacturer unless otherwise specified. Regardless of which application method is used to apply the coating, push the coating into complex details, crevices, gaps, difficult to access areas and areas with brushes where spraying does not adequately cover or penetrate. All application techniques shall conform to Section 7, SSPC-PA 1.

Apply each coat in a uniform layer, completely covering the preceding coat. Each individual coat shall be furnished by the manufacturer in a sufficiently different shade so that skips and holidays can be easily detected. Do not tint the coating material in the field unless approved. Correct runs, sags, skips or other deficiencies before application of succeeding coats. Corrective work may require recleaning, application of additional coating, or other measures as directed, at no additional compensation.

(d) Coating Requirements:

(1) Number of Coats and Film Thickness - Apply all coats to the minimum thickness specified in the manufacturer's product date sheet for the coatings.

Apply the coating system in the number of coats specified in the QPL, with each coat consisting of as many applications as necessary to cover the work and achieve the minimum thickness specified for the coat.

Apply only a coating of zinc primer to all steel-to-steel and steel-to-concrete, except top flanges, contact surfaces, whether in the shop or field. The dry film thickness shall not be less than 3 mils nor more than the manufacturer's class "B" certification allows.

Do not assemble coated joints before the coatings have cured for at least the time used in the qualifying test, or as recommended by the manufacturer.

On steel-to-wood contact surfaces, apply all coatings specified.

(2) Stripe Coats - On maintenance coating projects apply a prime stripe coat before applying the full prime coat and apply an intermediate stripe coat before applying the full intermediate coat.

The stripe coat shall be a different color and be approximately 3 mils thick. Each stripe coat will have its own hold point and shall not be used to correct deficiencies in the preceding or subsequent coats.

The full prime coat may be applied prior to the prime stripe coat to prevent flash rusting of the cleaned steel surfaces if approved. In either case, the first application of prime coat shall be accomplished by the use of brushes as described in the definition of “Stripe Coat” in 00594.01(b).

(3) Coating Thickness and Coverage Requirements - Coating thickness measurements will be made by the Engineer after the application of each coat and before application of the succeeding coat. In addition to coating thickness measurements, a visual inspection for complete coverage will be made by the Engineer after each coat. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the metal substrate.

The dry film thickness will be measured for acceptance using a Type 2 gauge according to SSPC-PA 2. The frequency of measurements will be based on the following:

- A single gauge reading will be taken for each 10 square feet of surface area.
- A spot measurement is only taken at locations where a gauge reading is less than 100% of the Project specified minimum DFT.
- All spot measurements shall meet 100% of the project specified minimum DFT.
- Additional readings may be required to identify the limits of the non-compliant areas.

If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D 4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness, or reveals a missing intermediate coat, the total coating system will be rejected even if the thickness of the total system equals or exceeds total specified thickness.

In areas where dry film thickness measurements are impractical, wet film thickness measurements will be made according to ASTM D 4414.

(4) Additional Top Coat Requirements - Even if the total thickness of prime and intermediate coats exceed the prime and intermediate coats specified thicknesses, apply the top coat to at least the minimum required topcoat thickness, as well as provide uniform and complete coverage and appearance.

(e) Time of Application - Within 3 aerial miles of the Pacific Ocean, prime existing steel structure surfaces on the same day they are cleaned, apply an approved rust inhibitor to the entire surface on the same day as cleaning, and prime within 48 hours after inhibitor application, or reblast all surfaces prior to coating.

Beyond 3 aerial miles of the Pacific Ocean, prime existing steel surfaces as soon as possible within 3 calendar days of cleaning.

All surfaces shall be free of flash rust and dry before priming.

Apply each coat over the preceding coat as soon as possible, allowing for drying time of the preceding coat, weather, temperature, and similar factors, as well as the manufacturer's recommendation.

Each coat shall be dry before recoating, and sufficiently cured so the succeeding or additional coat can be applied without delamination, blistering, wrinkling, or loss of adhesion or cohesion. Recoat times shall conform to the manufacturer's recommendations unless they conflict with this Section or any coating problems develop. Revision of recoat times requires approval of the Engineer before recoating.

(f) Caulking - Apply the caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch.

Apply caulk over the backing material to form a watertight seal.

In areas that collect or channel water, apply caulk even if coating fills the gap.

(g) Adhesion - Minimum adhesion shall be 350 psi within one week of application of each coat to its substrate. The Engineer will perform adhesion tests according to ASTM D 4541, using test method "B".

(h) Environmental Conditions - Apply coating materials only during periods when, according to testing by ASTM E 337, the:

- Air temperature is above 45 °F
- Steel surface temperature is:
  - Greater than 45 °F
  - Less than 115 °F
  - At least 5 °F above the dew point
- Relative humidity is within the manufacturer's recommended range

Application of coating materials will not be allowed if the Engineer determines that conditions are not favorable for proper application and performance of the coating.

If fresh coatings are damaged by the elements, replace or repair at no additional cost to the Agency.

If a coating system allows application in environmental conditions different from those specified, submit a letter from the manufacturer stating the conditions under which the coatings can be applied. Application under conditions other than specified will not be allowed without the Engineer's written approval.

Cover and protect the metal if coating is to be applied in adverse weather conditions. Heat the metal and surrounding air to the temperature specified in this subsection. Continue protecting the newly coated steel until the coating achieves proper cure.

(i) Stenciling - Stencil the month and year of application and the type of coating used in block letters 2 inches high at a location on each end of each span on the structure being coated. The exact location of stenciling will be determined by the Engineer. Use flat black color stenciling unless otherwise directed.

00594.44 Inspecting - The Engineer will inspect each phase of preparation and coating. Do not proceed with succeeding phases until approved. Provide the inspector timely access to areas where work is being performed. Allow adequate time for inspection at each hold point. Hold points are the following:

- Before cleaning operations begin
- After cleaning operations are completed and before application of any coating materials
- After each stripe coat
- After each full coat
- After cleaning in conjunction with coating repairs
- After application of each coat in coating repairs
- After application of last coat, before moving work platforms and containment structures

Repair coating system damages resulting from Agency inspection and testing at no additional cost to the Agency.

Aspects of the preparation and coating process to be inspected and tested include, but are not limited to:

Test	Test Method
Environmental Conditions for Coating	ASTM E 337
Cleanness of Abrasive Material	ODOT TM 616
Ionic Contamination of Abrasive Material	ASTM D 4940
Cleanness of Compressed Air	ASTM D 4285
Pictorial Surface Preparation Standards	SSPC-VIS 1, 3, 4, and 5
Surface Profile by Keane -Tator Comparator	ASTM D 4417
Surface Profile by Replica Tape	ASTM D 4417
Wet Film Thickness	ASTM D 4414
Dry Film Thickness by Magnetic Gauge	SSPC-PA2 (modified)
Dry Film Thickness by Tooke Gauge	ASTM D 4138
Pull-off Strength of Coating	ASTM D 4541 (Method B)

00594.45 Protecting Against Damage:

(a) Contaminated Surfaces - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00594.42 and recoat with all specified coats. Clean, reprepare, and recoat at no additional cost to the Agency.

(b) Surfaces Not to Be Coated - Protect surfaces that are not to be coated from blast-cleaning, overspray and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the Agency.

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 Agency.

Protect navigation lights and conduits. If navigation lights or lenses are damaged by the preparation or coating operations, immediately repair or replace at no additional cost to the Agency. Keep navigation lights operating and visible during the hours of darkness.

(c) Handling, Shipping, or Surface Damage - Exercise care in moving or handling steel in the shop, during shipping and during erection. Do not move or handle coated metal until the coating has cured.

Repair marred or damaged coated surfaces at no additional cost to the Agency, with the same materials and to the same condition as specified. At the completion of all work, the coating shall be complete and the surfaces undamaged and clean.

(d) Other Damage - Prevent, at no additional cost to the Agency, damage resulting from preparation and coating work, including:

- Damage to marine or vehicular traffic or harm to pedestrians in the vicinity of the work.
- Abrasive material or debris falling into an area which would create a traffic hazard.
- Damage to the bridge substructure, superstructure or motorized equipment.
- Damage to other property as a result of the Contractor's operations.

00594.60 Repair of Damaged and Unacceptable Coatings - Repair damaged surfaces and surfaces not in compliance with requirements of 00594.43 as follows:

(a) Surface Preparation - Repair localized damage, corrosion, and unacceptable coatings.

Prepare areas exhibiting coating defects down to the metal substrate, whether exhibiting visible corrosion or not, according to SSPC-SP 10.

If approved, prepare small areas according to SSPC-SP 15 so it does not damage adjacent areas. Extend the prepared area at least 2 inches into adjacent tightly adhering, intact coating.

In areas exhibiting coating defects which do not extend down to the metal substrate remove all loose, delaminating, non-intact, non-sound coating, or otherwise defective coating down to sound, still performing coating. Extend the prepared areas at least 2 inches into adjacent tightly adhering, intact coating.

(b) Feathering of Repair Areas - Feather the existing coating system surrounding each repair location. Feather for a distance of 1 inch to 2 inches to provide a smooth, tapered transition into the existing intact coating.

Verify that the edges of coating around the periphery of the repair areas are tight and intact by probing with a putty knife according to SSPC-SP 3. Roughen the existing coating in the feathered area to ensure proper adhesion of the repair coats overlap the intact, still sound surfaces at least 2 inches.

(c) Coating Application in Repair Areas - When the bare metal substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

When the damage does not extend to the bare metal substrate, apply only the affected coats.

Maintain the thickness of the system in overlap areas within the specified total thickness tolerances and overlap the intact, sound existing coating at least 2 inches.

Measurement

00594.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00594.90 Payment:

(a) New Metal Structures - No separate payment will be made for preparing and coating new metal work. Payment for this work, including correction of damages, will be included in payment made for structural steel according to 00560.90 and metal sign supports according to 00930.90 as appropriate.

(b) Existing Metal Structures - The accepted quantities for preparing and coating existing metal structures will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Containment	Lump Sum
(b)	Moving Bridge Containment System	Lump Sum
(c)	Surface Preparation	Lump Sum
(d)	Coating Application	Lump Sum
(e)	Coating Materials	Lump Sum

Item (a) includes designing, erecting, and securing access platforms and containment structure, and containment worker protection requirements.

Item (b) includes moving and removing the access platforms and containment structure.

Item (c) includes preparing existing metal surfaces.

Item (d) includes coating existing metal surfaces.

Item (e) includes the coating material.

Partial payments of items (c), (d), and (e) will be made only for portions of the structure that have been prepared and coated with all coats specified. The partial payment will represent an estimate of the work completed as a percentage of the total coating system work to be done.

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

No separate or additional payment will be made for correction of damages described in 00594.45.

Section 00595 - Reinforced Concrete Box Culverts

Description

00595.00 Scope - This work consists of constructing cast-in-place reinforced concrete box culverts (RCBC) and precast reinforced concrete boxes to the lines, grades, and dimensions shown or directed.

Materials

00595.10 Cast-in-Place Materials - For cast-in-place RCBC, cast-in-place ends, and cast-in-place wingwalls and aprons, furnish materials meeting the following requirements:

Reinforcement.....00530
Concrete 00540

Unless otherwise shown, provide Class 3300 - 1 1/2" or 3/4" portland cement concrete.

00595.11 Precast Materials - For precast boxes, furnish materials meeting the requirements of AASHTO M 259 or AASHTO M 273. Furnish joint seals meeting the requirements of 02440.40.

Unless otherwise shown, provide Class 5000 - 1 1/2" or 3/4" portland cement concrete.

Construction

00595.40 Cast-in-Place - Construct cast-in-place RCBC, cast-in-place ends, and cast-in-place wingwalls and aprons according to the following:

(a) Reinforcement - Place reinforcing steel according to Section 00530.

(b) Portland Cement Concrete - Place portland cement concrete according to Section 00540 and the following:

(1) Placing Concrete - Allow base slabs or box culvert footings to set at least 12 hours before constructing the remainder of the box culvert.

When constructing box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as a monolith, with sidewalls constructed full height. If this method is used, place construction joints vertical and at right angles to the axis of the culvert.

When constructing box culverts more than 4 feet in height, place concrete in the walls to at least the bottom elevation of the top slab. Allow three days before placing the top slab according to 00595.40(b-2).

Construct each wingwall as a monolith.

(2) Removal of Forms and Falsework and Subsequent Loading - Do not remove forms and falsework or place subsequent loads until the following conditions are met:

Form and Falsework Removal	**Counting Days** [1]
Stems and walls	1
Top Slabs	10

Subsequent Loading [2]	**Counting Days** [1]
Stems and walls over 4 feet in height	3

[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.

(3) Concrete Finish - Finish all exposed concrete surfaces with a general finish according to 00540.53(a).

00595.41 Precast - Construct precast boxes according to AASHTO M 259 except as shown. A production run will be considered continuous if it is not interrupted for more than three calendar days.

Place a continuous flexible watertight seal in the joint, on the sides and top, between each precast reinforced concrete box section.

Measurement

00595.80 Measurement - The quantities of reinforced concrete box culverts will be measured on the length basis, along the centerline of the box culvert, from end to end of the cast-in-place ends.

No measurement of quantities will be made for wingwalls and aprons.

No separate measurement will be made for concrete and reinforcement used in the box culverts. Estimated quantities of concrete and reinforcement will be listed in the Special Provisions.

Payment

00595.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

(a) Reinforced Concrete Box Culverts ..... Foot
(b) Wingwalls and Aprons ..... Lump Sum

Item (a) includes cast-in-place ends regardless of the type of box culvert constructed.

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

Section 00596 - Retaining Walls

Description

00596.00 Scope - This work consists of furnishing and constructing retaining walls as shown or specified, and in close conformity to the lines, grades, and dimensions shown or established.

The Special Provisions will list the types and locations of walls to be constructed.

00596.02 Definitions - Geosynthetic terms not defined in this subsection are identified in ASTM D 123, ASTM D 4439, or 00350.01. If there is a conflict, definitions in this subsection take precedence.

Alternate Fasteners - Spiral binders or high tensile locking spring steel clip or clamp-on ring type fasteners specified as an alternate to tie wire for assembling and joining gabions.

Bin Walls - Concrete or metal gravity retaining structures filled with granular backfill material. Bin walls consist of interlocking, prefabricated modules or bolted lightweight steel members constructed like building blocks.

Company - In the case of a proprietary retaining wall, the firm or other entity that identifies lawful claim to the retaining wall or design of the retaining wall. In the case of non-proprietary retaining wall, the firm or other entity that produces, provides, or designs the retaining wall.

Conventional Segmental Retaining Walls:

- A basic gravity retaining wall type, and
- Retaining walls composed of segmental retaining wall units only (i.e., no soil reinforcements).

Crib Walls - Prefabricated, interlocking reinforced or unreinforced gravity retaining structures backfilled with granular backfill material. Crib walls consist of alternating transverse and longitudinal beams.

Extensible Tensile Reinforcements - Reinforcements in which the deformation at failure is comparable to or greater than the deformability of the reinforced backfill (e.g., geotextile and polymeric materials).

Gabion Retaining Walls:

- A basic gravity retaining wall type, and
- Retaining walls composed of assembled wire baskets, connected together, filled with specified rock, and placed with a riprap geotextile between the back face of the basket and the backfill material.

Geogrid - See 00350.01 for geogrid definition.

Geosynthetic - See 00350.01 for geosynthetic definition.

Geotextile - See 00350.01 for geotextile definition.

Inextensible Tensile Reinforcements - Reinforcements in which the deformation at failure is significantly less than the deformability of the reinforced backfill (for example, metallic materials).

Internal Connecting Wires - Internal wires used to prevent gabions from bulging.

Mechanically Stabilized Earth (MSE) Retaining Walls:

- A basic gravity retaining wall type, and
- Retaining walls composed of granular backfill and either extensible or inextensible tensile reinforcements in the granular backfill mass. Examples of facing include precast concrete panels, cast-in-place facades, and segmental retaining wall units.

Prefabricated Modular Block Retaining Walls - Unreinforced, prefabricated concrete block gravity (non-MSE) retaining walls composed of concrete blocks greater than 3 cubic feet.

Proprietary Retaining Walls:

- Retaining walls in which a private company identifies lawful claim to the product or design of the product,
- Retaining wall products typically associated with a trade name or name brand, or
- Retaining walls designed by someone other than the retaining wall Contract Documents engineer of record.

Retaining Wall or Retaining Structure - A group of interrelated components designed to resist earth pressures.

Rigid Gravity Retaining Walls - A basic gravity retaining wall type that includes cast-in-place concrete gravity retaining walls.

Segmental Retaining Wall Unit - A machine-formed solid or hollow modular concrete block less than 3 cubic feet.

Semi-Gravity Retaining Walls - A basic gravity retaining wall type that includes cast-in-place concrete cantilever or counterfort retaining walls.

Tie Wire - Wire used to assemble and join gabion units.

00596.03 Variables - The amount and type of work required to construct a proprietary retaining wall varies according to the wall selected. The Contractor is responsible for making a careful study of the work required for each wall and for determining the quantities.

Variables could involve shoring, excavation, backfilling, excess material, staging work, corrosion protection, utilities and drainage systems adjustments and other details of the work.

00596.04 Proprietary Retaining Wall Submittals - Submit stamped working drawings and design calculations, and field construction manuals and product brochures prepared by the manufacturer of the proprietary retaining wall selected, as necessary, according to 00150.35. Submit this information at least 30 calendar days before beginning retaining wall fabrication or construction. Obtain the Engineer's written approval before fabricating retaining walls.

(a) Working Drawings - Provide working drawings that include at least the following information:

(1) General:

- **General Notes** - Necessary information on design and construction of the retaining wall.

- **Materials and Quantity Summary List** - Show all items of each wall.

- **Plan View** - Show the construction centerline and related horizontal curve data, the offset from the construction centerline to the face of the wall at all changes in horizontal alignment, and the centerline of any utility or drainage structure or pipe that is behind or passes under or through the wall.

- **Elevation View** - Show the elevation at the top of the wall at all horizontal and vertical break points, and at least every 65 feet along the wall; vertical curve data; the location of the original and final ground line at both the heel and face of the wall; elevations at the base of the wall (for example, top of cast-in-place footings and leveling pads); the distance along the face of the wall to all steps in the wall base; and the applied bearing pressures.

- **Typical Sections** - Show wall construction and limits of backfill.

- **Structural and Geometric Details** - The following minimum structural and geometric details:

  - Loading conditions
  - Footing 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 length, size and number of soil reinforcements; and the distance along the face of the wall to where changes in the length of the soil reinforcement occur.

- **Typical Section** - Show soil reinforcement limits.

- **Facing Components** - Show all dimensions, including thickness; all details necessary to construct the facing components; all reinforcing steel in the component; and the location of tensile soil reinforcement attachment devices embedded in the facing. Show the type of concrete finish.

- **Soil Reinforcements** - Show all dimensions and details necessary to construct the soil reinforcements.

(b) Design Calculations - The design calculations shall include but not be limited to:

(1) General:

- **Design Input** - Show wall geometry; soil parameters; and both permanent and temporary design loads, including applied loads from pedestrian rails, fencing, guard rail, concrete barrier, soundwalls, sign supports, or luminaire supports.

- **External Stability Calculations** - Indicate factors of safety against sliding and overturning.

- **Foundation Bearing Pressure Calculations** - Indicate the factor of safety against foundation bearing failure.

- **Appurtenances** - Show calculations for the design of pedestrian rails, fencing, guard rail, concrete barrier, soundwalls, sign supports or luminaires when not fully detailed on the plans. Design concrete barriers according to AASHTO Standard Specifications for Highway Bridges, and Interim Revisions, to withstand a horizontal force of 10,000 pounds per 5 feet applied at the top of the barrier and conforming to the National Cooperative Highway Research Program (NCHRP) Report 350, unless otherwise indicated.

(2) MSE Retaining Walls:

- **Internal Stability** - Indicate reduction factors and factors of safety against soil reinforcement rupture, pullout, and facing connection strength.

- **Local Stability** - Indicate factors of safety against sliding and bulging of segmental retaining wall facing units.

(c) Field Construction Manual - Provide a field construction manual, prepared by the manufacturer of the proprietary retaining wall selected, including step-by-step directions for constructing the retaining wall.

Materials

00596.10 Materials - Furnish materials meeting the following requirements:

(a) Agency Approval - Use only retaining wall materials, products or systems that have met the requirements of the Agency Retaining Structures Program and have an "Approved" status according to the Agency Retaining Structures Program prior to the Project Bid Opening. Information regarding approval or any other aspect of the Agency Retaining Structures Program may be obtained from the Agency Retaining Structures Coordinator in Salem.

(b) Agency-Furnished Designs - For retaining wall designs shown (i.e., non-proprietary retaining walls), either provide specified materials according to these applicable material Specifications or provide products from the QPL also according to these applicable material Specifications. Obtain like materials for the retaining wall from the same company.

(c) Proprietary Retaining Wall Systems - For proprietary retaining walls, provide products from the selected company according to the company's specifications and these applicable material Specifications. If there is a conflict between the company's specifications and the Agency's Specifications the Agency's Specifications will take precedence. Obtain all materials for the selected proprietary retaining wall from the same company. Use only one proprietary retaining wall on the Project unless different proprietary retaining walls are specified.

Do not use materials from unlisted sources without written approval. Acceptance will be based on manufacturer's test results and certificates of compliance according to 00165.35, visual inspection and other criteria in this Section.

(d) Quality Control - Provide quality control according to Section 00165.

00596.11 Backfill - Furnish backfill meeting the requirements of Section 00510 and the following:

(a) Granular Drain Backfill Material - Provide granular drain backfill material according to 00430.11. Provide a Type 1 drainage geotextile according to Section 02320.

(b) Special Filter Material - Provide special filter material according to Section 02610.

(c) Gabion Retaining Walls - Provide a well-graded 4 inch to 10 inch rock fill material inside the gabion baskets meeting the requirements of 00390.11(b).

Provide granular wall backfill material behind the gabion baskets according to 00510.12.

(d) Metal Bin Retaining Walls - Provide granular structure backfill material for the interior cell of the metal bin retaining wall units according to 00510.13.

Provide granular wall backfill material behind the metal bin retaining wall units according to 00510.12.

(e) Leveling Pads - Provide granular structure backfill material for gravel leveling pads according to 00510.13.

(f) Segmental Retaining Wall Units - Provide granular structure backfill material for the interior cell of hollow segmental retaining wall units according to 00510.13.

Provide backfill material behind the segmental retaining wall units as specified.

(g) MSE Granular Backfill - Provide MSE granular backfill material meeting the following requirements:

(1) Gradation - Gradation shall meet all requirements in Section 02630 and Table 02630-1. Use either 1" - 0 or 3/4" - 0 base aggregate conforming to the requirements of 02630.10(a) through 02630.10(c). Test the MSE granular backfill at the frequency specified in the ODOT Manual of Field Testing Procedures (MFTP) for aggregate base material. Additionally, MSE granular backfill placed in the spread footing foundation support zone shall have between 90 to 100 percent passing the 3/4 inch Sieve for all "Separated Sizes" as determined by AASHTO T27.

(2) Other Requirements:

a. Material Passing No. 200 Sieve - The percent, by weight, passing the No. 200 sieve shall not exceed 15% when tested according to AASHTO T 27 and AASHTO T 11.

b. Plasticity Index - The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T 90.

c. Electrochemical Properties - The electrochemical properties of the material shall meet the following requirements:

Property	Limits	Test Procedures
pH	5.0 - 10.0	AASHTO T 289
Resistivity	5,000 Ω-cm (min.)	AASHTO T 288

MSE granular backfill material with resistivities of less than 5,000 Ω-cm but greater than 3,000 Ω-cm and meeting all other requirements may be accepted if they meet the following additional requirements:

Property	Limits	Test Procedures
Chlorides	100 PPM (max.)	AASHTO T 291
Sulfates	200 PPM (max.)	AASHTO T 290

d. Organic Content - The organic content shall meet one of the following conditions:

- Organic content as computed according to AASHTO T 267 for material finer than the No. 10 sieve does not exceed 1.0%.
- The ratio (expressed as a percentage) of the weight of organic material (as determined by AASHTO T 267) to the weight of the total sample does not exceed 0.75%.

00596.12 Gabion Baskets - Furnish gabion baskets meeting the requirements of Section 02340.

00596.13 Concrete:

(a) ODOT Standard Cast-in-Place Concrete Gravity Retaining Wall - Provide commercial grade concrete according to Section 00440.

(b) ODOT Standard Cast-in-Place Concrete Cantilever Retaining Wall - Provide structural concrete according to Section 00540.

(c) Leveling Pads - Provide commercial grade concrete according to Section 00440.

(d) MSE Retaining Wall Cast-in-Place Concrete Facades - Provide commercial grade concrete according to Section 00440.

(e) MSE Retaining Wall Precast Concrete Facing Panels - Provide commercial grade concrete according to Section 00440 and the following:

(1) Portland Cement Concrete - Use the class of concrete listed in the Special Provisions.

(2) Casting - Set soil reinforcement connection devices on the rear face of the precast panel and secure to prevent displacement during concrete placement and consolidation. Do not allow devices used to connect soil reinforcements to facing panels (e.g., loop embeds tie strips, etc.) to contact the face panel reinforcement steel. Place concrete in each panel without interruption and consolidate with an approved vibrator.

Use clear form oil throughout the casting operation.

(3) Curing - Follow the curing procedure given in the Special Provisions.

(4) Finish - Give the front face a general surface finish according to 00540.53(a), unless otherwise specified. Screed the back face to eliminate surface distortions and open pockets of aggregate.

(5) Tolerance - Manufacture all units within the following tolerances:

a. Panel Dimensions - Do not exceed a difference of 1/2 inch between diagonals. All other dimensions are not to exceed a difference of 3/16 inch. Angular distortion, with regard to the height of the panel, is not to exceed 1/8 inch in 3 feet.

b. Soil Reinforcement Connection Devices:

1. Tie Strips - Locate tie strip connection devices within 1 inch of the plan location.

2. Loop Embeds - Locate loop embeds within 3/16 inch of the plan location.

3. Retention Slots - Locate retention slots within 1 inch of the plan location. Slot openings are not to exceed 1/8 inch. Check the slot opening with the supplied "feeler" gauge according to the company's recommendations. Reject panels from which the "feeler" gauge is pulled from the slot.

c. Panel Face - Smooth formed surfaces are not to vary over 3/32 inch when measured over a length of 3 feet. Textured-finished surfaces are not to vary over 3/16 inch when measured over a length of 3 feet.

d. Rear Face - Eliminate surface distortions in excess of 1/4 inch.

(6) Acceptance of Panels - Acceptance will be according to 00540.17 except as follows:

- Acceptance of precast panels will be determined based on production sublots. A production sublot will be represented by a single compressive strength sample and will consist of either 40 panels or a single day's production, whichever is less. Cast one set of cylinders for each production sublot.
- Acceptability of the precast panel will be determined based on conditional compressive strength tests results, check tests, and visual inspection. Panels may be placed in the wall if 7-day initial strength exceeds 85% of the 28-day requirements. Final acceptance will be based on the 28-day test results.

(7) Marking - Clearly scribe on the rear face of each panel the date of manufacture, the production sublot number, and the piecemark.

(8) Handling, Storage, and Shipping - Handle, store, and ship all units in a manner that eliminates chipping, discoloration, cracks, fractures and connecting device damage. Support stored panels on firm blocking.

(9) Rejection - Any of the following defects will be cause for rejection:

- Imperfect molding
- Honeycombed or open texture concrete
- Exposed reinforcing steel
- Improperly installed soil reinforcement connection devices
- Broken or chipped concrete
- Excessive color variation on front face of panel
- Nonspecification strength
- Cross-sectional thickness of the wall facing component less than the minimum thickness indicated on the plans or working drawings

(f) Segmental Retaining Wall Units - Provide a minimum compressive strength after 28 days of 4,000 psi and a maximum absorption rate of 5% by weight.

(1) Portland Cement - Use portland cement meeting the requirements of 02010.10.

(2) Blended Cement - Use blended cement meeting the requirements of 02010.20.

(3) Aggregate - Use aggregate meeting the requirements of ASTM C 33.

(4) Tolerance - Molded dimensions are not to differ more than 1/8 inch from the manufacturer's published dimensions, except height, which is not to differ more than 3/16 inch.

(5) Color - Provide gray units unless specified otherwise.

(6) Finish - Provide split-face units unless specified otherwise.

Provide units that are sound and free of cracks or other defects that would interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction.

Provide units that are free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused light.

(7) Acceptance of Units - Acceptability will be determined based on compressive strength, moisture absorption, and dimension tests according to ASTM C 140 and visual inspection. Segmental retaining wall units may be placed in the wall if 7-day initial strength exceeds 85% of the 28-day requirements. Final acceptance will be based on the 28-day test results.

(8) Marking - Indicate the date of manufacture and the production lot number on each lot of segmental retaining wall units.

(9) Handling, Storage, and Shipping - Handle, store, and ship all units in a manner that eliminates chipping, discoloration, cracks and fractures.

(10) Rejection - Any one of the following defects will be cause for rejection:

- Imperfect molding
- Honeycombed or open texture concrete
- Broken, cracked or chipped units
- Extreme color variation on front face of unit
- Nonspecification strength
- Absorption

(g) Prefabricated Modular Concrete Blocks:

(1) Concrete - Provide concrete suitable for common structural applications. Concrete tests are not required.

(2) Grade - Provide Standard Grade blocks.

(3) Color - Provide gray blocks unless specified otherwise.

(4) Finish - Provide smooth face blocks unless specified otherwise.

Provide blocks that are sound and free of cracks or other defects that would interfere with the proper placement of the block or significantly impair construction of the wall.

Provide blocks that are free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused light.

(5) Tolerance - Molded dimensions are not to differ more than 1/4 inch from the manufacturer's published dimensions, except height, which is not to differ more than 5/32 inch.

(6) Handling, Storing, and Shipping - Handle, store, and ship all blocks in a manner that eliminates chipping, discoloration, cracks and fractures.

(7) Acceptance of Blocks - Acceptability will be determined based on tolerances specified in (5) of this subsection and visual inspection.

(8) Rejection - Any one of the following defects will be cause for rejection:

- Concrete not suitable for common structural applications
- Imperfect molding
- Honeycombed or open texture concrete
- Broken, cracked or chipped blocks
- Extreme color variation on front face of block

00596.14 Steel Reinforcement for Concrete - Furnish steel reinforcement for concrete meeting the requirements of Section 00530.

00596.15 Steel - Furnish structural steel meeting the requirements of Section 00560 and the following:

(a) Metal Bin Retaining Walls - Provide metal bin retaining walls according to Section 02350.

(b) Inextensible Soil Reinforcements, Facing Components and Attachment Hardware - Shop-fabricate true size and defect-free soil reinforcements, facing components and attachment hardware as follows:

Galvanize soil reinforcements, facing components and attachment hardware according to 02530.70, except where noted. If specified, epoxy coat according to AASHTO M 284 (ASTM A 775), except where noted.

(1) Reinforcing Strips - Use steel reinforcing strips of the required shape and dimensions conforming to ASTM A 36 or equal. Provide a minimum 2.0 ounce per square foot galvanized coating. If specified, provide a minimum 18 mils epoxy coating.

(2) Reinforcing Mesh - Furnish welded wire reinforcement according to 02510.40 supplemented and modified as follows:

a. Galvanized Reinforcement - Provide a minimum 2.0 ounce per square foot galvanized coating for welded wire embedded in either concrete or soil according to ASTM A 641.

b. Epoxy Coated Reinforcement - When specified, provide a Class A coating for welded wire reinforcement embedded in concrete and a Class B coating for welded wire fabric embedded in soil according to ASTM A 884.

(3) Tie Strips - Provide tie strips of steel conforming to the requirements of ASTM A 1011, Grade 50, or equivalent.

(4) Loop Embeds - Fabricate 1 inch loop embeds from cold drawn steel wire conforming to AASHTO M 32 (ASTM A 82). Weld loop embeds according to AASHTO M 55 (ASTM A 185). Galvanize loop embeds according to ASTM B 633 or equal.

(5) Fasteners - Use galvanized high-strength bolts according to 02560.20.

(6) Connectors - Fabricate connectors from cold drawn steel wire according to AASHTO M 32 (ASTM A 82).

00596.16 Geosynthetics - Furnish geosynthetics meeting the following requirements:

(a) Gabion Wall Filter - Provide Type 2 riprap geotextile according to Section 02320.

(b) Precast Concrete Facing Panel Joint Cover - Provide Type 1 drainage geotextile according to Section 02320.

(c) Extensible Soil Reinforcements:

(1) Geotextile - Provide geotextile according to the Special Provisions.

(2) Geogrid - Provide geogrid according to the Special Provisions.

00596.17 Elastomeric Bearing Pads for Precast Concrete Facing Panels - In horizontal joints between precast concrete panels, furnish either preformed ethylene propylene diene monomer (EPDM) rubber pads meeting the requirements of ASTM D 2000, M2AA 810 A13B33C12F17 having a durometer hardness of 80 $\pm$ 5, or neoprene elastomeric pads having a durometer hardness of 55 $\pm$ 5, or other bearing material as recommended by the supplier, certified by the manufacturer and approved by the Engineer.

00596.18 Timber - Furnish timber meeting the requirements of Section 00570.

00596.19 Piles - Furnish piling meeting the requirements of Section 00520.

Labor

00596.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CDT
- CEBT

Construction

00596.40 General:

(a) Proprietary Retaining Walls - Provide for a field representative from the selected proprietary retaining wall company to be present at the start of retaining wall construction. Supervisory personnel of the Contractor, the company field representative, and any subcontractors who are to be involved in the construction of the proprietary retaining wall shall meet with the Engineer for a retaining wall preconstruction conference. At this conference, discuss methods of accomplishing all phases of the work required to construct the proprietary retaining wall. If all representatives are not in attendance, the retaining wall preconstruction conference and start of retaining wall construction shall be rescheduled.

In addition to the retaining wall preconstruction conference, the company field representative shall be available as needed during the erection of the proprietary retaining wall to provide instructions and recommendations, and to assist the Contractor or Engineer. Follow instructions and recommendations of the representative if approved by the Engineer.

(b) All Retaining Walls - All retaining walls, regardless of design, shall conform to the applicable top of wall profile shown. Retaining walls detailed in the Agency-provided plans shall conform to the applicable bottom of wall elevations shown for walls without footings, the applicable top of footing elevations for walls with footings, or the applicable top of leveling pad elevations for walls with leveling pads. Verify existing ground elevations and bottom of wall elevations for proprietary retaining walls prior to final design.

00596.41 Excavation, Backfill, and Compaction Requirements:

(a) General - Perform structure excavation and backfill for all retaining walls according to Section 00510 to the limits and stages shown.

Construct all retaining walls on suitable foundation materials. Excavate any unsuitable foundation materials below elevations shown and backfill with suitable material as directed. Grade the foundation for the structure level for a width equal to the width of the footing or the bottom soil reinforcement and facing component thickness, or as shown. Do not reinforce overexcavated foundations with geosynthetic or similar materials without prior approval.

Do not construct backfill when the backfill, the foundation, or the embankment on which it would be placed is frozen, unstable, or not compacted, unless otherwise directed. Place backfill material in nearly horizontal layers not more than 8 inches thick or to the top of the facing component if the height of the facing component is less than or equal to 8 inches.

Unless otherwise specified, compact the entire surface of each layer in place with a minimum of three coverages, using equipment made specifically for compaction. Select compaction equipment based on the type of material being compacted and the layer thickness. Normal compaction equipment consists of sheepsfoot rollers, tamping foot rollers, grid rollers, pneumatic tired rollers, and vibratory rollers. Routing of hauling and grading equipment will not be accepted as adequate to achieve compaction.

Compact backfill material within 3 feet of the backface of the retaining wall using a low weight mechanical tamper, roller or vibratory system.

Avoid any damage or misalignment of retaining wall components as the backfill is placed. Remove any wall materials that become damaged during backfill placement and replace at no additional cost to the Agency. As directed, correct misaligned units not meeting the limits specified due to backfill placement at no additional cost to the Agency.

(b) Testing - Except for backfill material within 3 feet of the back face of the retaining wall, test for compaction as follows:

- **Moisture and Density** - Determine according to AASHTO T 310.
- **Optimum Moisture and Maximum Density** - Determine as required by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224.

Meet each of the following moisture content, density and deflection requirements:

- **Moisture Content** - Prepare material to within -4% to +2% of optimum moisture content at the time of compacting. Add water to material that does not contain sufficient moisture and thoroughly mix as directed. Remove excess moisture by manipulation, aeration, drainage, or other means before compacting.

- **Density:**

  - Compact MSE granular backfill to 100% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224.
  - Where spread footings for bridges or other structures are founded behind free standing retaining walls, including in or on MSE granular backfill material, compact the spread footing foundation zone to 100% of relative maximum density as determined by AASHTO T 99 Standard Proctor Method D, with coarse particle correction according to AASHTO T 224. The spread footing foundation zone depth is twice the footing width or 6 feet, whichever is greater, and extends a horizontal distance equal to the footing width beyond the outside bottom edge of the footing in all directions. Begin compaction of the backfill material at the backface of the wall or the wall facing component.

- **Deflection Requirement** - In addition to moisture-density testing, each compacted layer will be observed for deflection or reaction under moving loaded equipment according to ODOT TM 158 to verify that no soft or pumping areas remain in any layer or foundation soil. Correct all such areas at no additional cost to the Agency.

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 Agency-provided plans and approved working drawings, if applicable, and the company's field construction manual as approved, supplemented and modified as follows:

(a) General - Select and use the same style of mesh for the gabion panel bases, ends, sides, diaphragms, and lids; the same method of joining the edges of a single gabion unit; and the same method of tying successive gabion units together throughout each structure.

If the height of the constructed gabion wall is less than 95% of the design height, add additional gabion baskets as directed to attain the design height, at no additional cost to the Agency.

Place riprap geotextile according to Section 00350 and the following:

- Minimum overlap shall be 12 inches.
- Against the back of the gabion wall before placing backfill material.

(b) Assembly - Assemble each style of gabion by rotating the panels into position and joining the vertical edges with tie wire or alternate fasteners.

If twisted wire panels are tied with tie wire, join the selvage vertical edges with alternating single and double loops at 4 inch nominal spacing.

If welded wire panels are tied with tie wire, pass the tie wire through each mesh opening along the vertical edges joint and secure with a half hitch locked loop.

Leave no openings greater than 4 3/4 inches (line dimension) along the edges or at corners of tied or spiral bound gabions of either mesh style. Crimp the edges of spiral binding wire to secure the spiral in place.

If high tensile fasteners are used in lieu of tie wire, install one fastener in each mesh opening according to the manufacturer's recommendations.

(c) Placement - Set the empty gabions in place and connect each gabion to the adjacent gabion along the top and vertical edges with tie wire or spiral binders. Connect each layer of gabions to the underlying layer along the front, back and sides with tie wire or spiral binders in the same manner as specified for assembly of baskets. Common wall construction will not be allowed.

Before filling each gabion with rock, remove all kinks and folds in the wire fabric and properly align all baskets. Remove all temporary clips and fasteners. The assembled gabion baskets may be placed in tension before filling.

(d) Filling - Place the rock by hand or machine to ensure proper alignment, avoiding bulges and assuring a minimum of voids. All exposed rock surfaces shall have a smooth, neat appearance with no sharp edges projecting through the wire mesh.

Place the rock in layers to allow placement of internal connecting wires in each outside cell of the structure or when directed by the Engineer at the following intervals:

- None required for 1 foot high baskets
- At the 1/2 point for 1 1/2 foot high baskets
- At 1/3 points for 3 foot high baskets

Completely fill the basket so the lid will bear on the rock when it is closed. Secure the lid to the sides, ends, and diaphragms with tie wire or spiral binders in the same manner as specified for assembly of baskets.

(e) Repairs - During construction, repair and secure any breakage of the wire mesh that results in mesh or joint openings larger than 4 3/4 inches (line dimension). Make repairs using 13 1/2 gauge galvanized tie wire as directed.

Repair any damage to PVC wire coating in a manner that provides the same degree of corrosion resistance as the undamaged wire, according to the manufacturer's recommended repair procedures and as approved.

00596.44 Prefabricated Modular Retaining Walls - Erect retaining wall components according to the Agency-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 Agency-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 unreinforced cast-in-place concrete leveling pad at each foundation level as shown. Compact gravel leveling pads according to 00596.41(b). Cure cast-in-place leveling pads for a minimum of 12 hours before placing the segmental retaining wall units.

(b) Segmental Unit Installation and Backfill Placement - Place segmental retaining wall units so the final position is battered as shown. Place the first course of segmental units on top of and in full contact with the prepared leveling pad surface. If applicable, install shear connectors and place unit fill. Closely follow erection of each course of segmental units with placement of granular wall backfill material. Remove excess backfill from the top of the segmental units prior to installing the next course of units. Glue the uppermost row of segmental units or caps to underlying units with an adhesive recommended by the manufacturer. For walls in which the manufacturer does not provide an adhesive for this purpose use an epoxy adhesive from the QPL. Clean the completed wall face of foreign material deposits on exposed horizontal portions of the segmental units.

(c) Construction Tolerances - During construction of the wall and placement of segmental retaining wall units maintain a vertical tolerance and tangent horizontal alignment tolerance not in excess of 1 1/4 inch when measured with a 10 foot straightedge. Check the plumbness and tolerances of each course of segmental retaining wall units before erecting the next course.

00596.46 MSE Retaining Walls - Erect retaining wall components according to the Agency-provided plans and approved working drawings, if applicable, and the company's field construction manual as approved, supplemented and modified as follows:

(a) Leveling Pad:

(1) Precast Concrete Facing Panels - Provide a precast concrete leveling pad, or construct an unreinforced cast-in-place concrete leveling pad at each facing panel foundation level as shown. Place precast concrete leveling pads in full contact with the foundation. Cure cast-in-place leveling pads for a minimum of 12 hours before placing the wall facing panels.

(2) Segmental Retaining Wall Units - Construct a gravel or unreinforced cast-in-place concrete leveling pad at each facing unit foundation level as shown. Compact gravel leveling pads

according to 00596.41(b). Cure cast-in-place leveling pads for a minimum of 12 hours before placing the segmental retaining wall units.

(b) Facing Components - Place facing components so the final position is vertical or battered as shown. Place the first course of facing components on top of and in full contact with the prepared leveling pad surface. As backfill placement proceeds place the facing components and applicable hardware in successive horizontal courses in the sequence shown.

(1) Precast Concrete Facing Panels - Erect precast panels using the lifting devices connected to the upper edge of the panel. Attach geotextile joint cover as shown to the rear of the facing panels with an approved adhesive recommended by the company. Use a minimum 12 inch wide geotextile with a minimum overlap of 4 inches. Maintain the panels in position by means of temporary wedges or bracing according to the company's recommendations.

(2) Wire Facing Components - Attach soil retention material as shown to the rear of the facing component as recommended by the company and as approved.

(3) Segmental Retaining Wall Units - If applicable, install shear connectors and place unit fill. Remove excess backfill from the top of the segmental retaining wall units prior to installing the next course of units 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 QPL. Clean the completed wall face of foreign material deposits on exposed horizontal portions of the segmental units.

(c) Soil Reinforcement Components - Before placing the soil reinforcement components, compact the foundation according to 00596.41. If skewing of the soil reinforcements is required due to obstructions in the reinforced volume, submit design computations to the Engineer justifying the effect of skewing on the performance of the soil reinforcements.

(1) Inextensible Soil Reinforcement Components - Place the soil reinforcement components normal to the face of the wall unless otherwise shown or directed. Repair damaged galvanized or epoxy-coated components before placing backfill material, to provide a coating comparable to that provided by 02530.70 or AASHTO M 284 (ASTM A 775), respectively.

(2) Extensible Soil Reinforcement Components - Orient geosynthetic reinforcements with the highest strength axis normal to the face of the wall unless otherwise shown or directed. Prior to placing backfill, pull geosynthetic reinforcements taut, and anchor them. Geosynthetic reinforcements shall be continuous throughout their embedment lengths. Spliced connections will not be allowed.

a. Non-Proprietary Geosynthetic Wrapped-Face Retaining Walls - Construct geosynthetic wrapped-face retaining walls according to 00350.20, 00350.40 and 00350.41 supplemented as follows:

1. General - Begin wall construction at the lowest portion of the excavation and place each layer horizontally as shown. Complete each layer in its entirety before the next layer is started. Seams will be allowed only at the wall face. Either overlap geotextile sheets 24 inches minimum and perpendicular to the wall face, or sew seams parallel to the wall face according to 00350.41(a-3). Stretch the geotextile in a direction perpendicular to the wall face to eliminate slack before backfilling.

2. Wall Forming - Use a temporary form system at the wall face during construction. A typical temporary form system and a sequence of wall construction required will be shown.

Use pegs, pins, or the manufacturer's recommended method as approved, in combination with the forming system, to hold the geotextile in place until the cover material is placed.

(d) Backfill Placement - Closely follow erection of each course of facing components with placement of MSE granular backfill material. Construct adjacent general embankment layers at the same time the MSE layers are constructed.

Do not operate tracked or rubber tired construction equipment directly upon geosynthetic reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over geosynthetic reinforcement. Avoid sudden braking and sharp turning movements.

At the end of each day, if rain is anticipated, slope the MSE granular backfill away from the MSE retaining wall face to direct surface runoff away from the wall. Do not allow surface runoff from adjacent areas to enter the MSE retaining wall construction site.

(e) Construction Tolerances - During construction of walls and placement of facing components, maintain the following tolerances:

(1) Precast Concrete Facing Panels:

- Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 3/4 inch when measured with a 10 foot straightedge.
- Maximum allowable offset in any facing component joint shall be 3/4 inch.
- Horizontal, vertical and sloped joint openings between components shall be uniform, no larger than 1 1/4 inch, and no smaller than 5/8 inch.

(2) Wire Facing Components:

- Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 2 inches when measured with a 10 foot straightedge.

(3) Cast-in-Place Concrete Facades:

- Vertical tolerances and tangent horizontal alignment tolerances along the wall line shall not exceed 3/4 inch when measured with a 10 foot straightedge.

(4) Segmental Retaining Wall Units:

- Vertical tolerance and tangent horizontal alignment tolerance shall not exceed 1 1/4 inch when measured with a 10 foot straightedge.

Check the plumbness and tolerances of each course of facing components before erecting the next course.

Measurement

00596.80 Measurement - The quantities of retaining walls will be measured on the area basis, and will be the area shown, in a vertical plane, for each retaining wall. Field measurement of each retaining wall area will not be made. The quantity will be the theoretical area of each retaining wall unless changes are ordered in writing by the Engineer. If changes are ordered, an adjustment will be made only for the quantity difference involved in the ordered plan changes.

The estimated quantities of excavation, shoring, footings, leveling pads, and specified backfill will be listed in the Special Provisions.

The quantities of type "F" coping will be measured on the length basis, from end to end of coping.

The quantities of sidewalk coping will be measured on the area basis, from end to end and from top of curb to exterior edge of coping.

Excavation below elevations shown will be measured according to 00510.80(b).

Payment

00596.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Retaining Wall, Cast-In-Place Concrete	Square Foot
(b)	Retaining Wall, Gabion	Square Foot
(c)	Retaining Wall, Prefabricated Modular	Square Foot
(d)	Retaining Wall, Conventional Segmental	Square Foot
(e)	Retaining Wall, MSE	Square Foot
(f)	Retaining Wall, Contractor's Option	Square Foot
(g)	Type "F" Coping	Foot
(h)	Sidewalk Coping	Square Foot

Item (f) consists of two or more wall type options that would generally be paid for as individual walls under items (a) through (e). These options will be listed in the Special Provisions.

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

Excavation below elevations shown and backfill will be paid for according to 00510.90(c).

No separate or additional payment will be made for reinforcing steel and concrete in type "F" coping and sidewalk coping.

No separate or additional payment will be made for technical representatives, excavation, shoring, footings, leveling pads, specified backfill, or for wall drainage and filter systems, including perforated pipe, drain material, geotextile, and drain pipe, cast-in-place or precast standard coping, including coping reinforcing steel and concrete, and other appurtenances.

Section 00597 - Sound Walls

Description

00597.00 Scope - This work consists of furnishing and constructing sound walls at the locations shown or as directed.

Use one of the following sound wall types:

- Concrete block walls
- Precast concrete panel walls
- Concrete panel fence walls

00597.01 Variables - The amount and kind of work required to construct a sound wall varies according to the type of wall selected. Be responsible for determining the work required for each wall type and for the variables in quantities, including shoring, excavation, backfilling, excess material, staging work and other details of the work.

Materials

00597.10 Materials - Obtain all manufactured materials for the selected sound wall type from the same company. Only one type of wall will be allowed on the Project unless otherwise specified.

Store concrete masonry units and cementitious materials at the jobsite in a manner which will protect the materials from contact with soil and weather. Store mortar and grout materials in original unbroken packages.

00597.11 Concrete Block Sound Walls:

(a) Concrete Blocks - Furnish concrete blocks meeting the following requirements:

- Hollow, load-bearing blocks, graded N-1, f'm = 1,300 psi with 2,000 psi 28-day strength on net cross sectional area, according to ASTM C 90
- Kiln dried to 33% total absorption
- Split ribbed (York) pattern on exposed areas
- Standard block on unexposed areas
- Nominal 8 inch x 8 inch x 16 inch size

Do not tint concrete blocks. Use uniform colored blocks along the length of individual walls.

(b) Concrete Caps - Construct concrete caps meeting the following requirements:

- Nominal 4 inch x 8 inch x 16 inch size
- Same color as concrete blocks

(c) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(d) Concrete - For pile footings, furnish concrete according to Section 00440. For all other components, including spread footings, furnish concrete according to Section 00540.

(e) Mortar and Grout - Furnish mortar meeting the requirements of ASTM C 270 that attains an ultimate compressive strength of at least 2,500 psi at 28 days. Furnish coarse grout meeting the requirements of ASTM C 476 with a suitable consistency for pouring without segregation of materials.

(f) Preformed Expansion Joint Filler - Furnish expansion joint filler meeting the requirements of 02440.10.

(g) Fillers, Sealers and Damp-proofing - Furnish fillers, sealers, and damp-proofing materials from the QPL.

00597.12 Precast Concrete Panel Sound Walls:

(a) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(b) Concrete - For footings, furnish commercial grade concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.

00597.13 Concrete Panel Lock Fence Sound Walls:

(a) General - Furnish concrete panel lock fence material and necessary components. Provide the manufacturer's test results and certificate of compliance according to 00165.35.

(b) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(c) Concrete - For footings, furnish commercial grade concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.

Construction

00597.40 General - Perform structure excavation according to Section 00510 to the limits and stages shown. All sound walls, regardless of type, shall conform to the top of wall profile shown. Provide footings as shown or approved.

00597.41 Concrete Block Sound Walls:

(a) General - Construct all masonry walls plumb, level and true. Build walls in running bond pattern. Place masonry according to accepted standards of good practice and work in masonry construction and as shown.

If work is discontinued, protect the top of the wall with a well-secured waterproof cover.

Do not perform masonry work when the surrounding temperature is less than 35 °F unless provisions are made for heating and drying materials and for protecting the work.

Do not backfill walls until at least 24 hours after damp-proofing is applied.

Use clean, dry, ice-free, and frost-free masonry units. Do not dampen units before or during laying unless approved.

Place the first course of masonry on the footing in a full mortar bed. Mortar joints between units shall be 3/8 inch thick with full mortar coverage on vertical and horizontal face shells only. Vertical joints shall be shoved tight.

Discard mortar when:

- Not used within 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 inches by 3 inches.
- Rod or vibrate grout when placed.
- Position reinforcing steel and tie in place.
- Do not proceed with constructing the wall above a bond beam course until the vertical cells below the bond beam course and the bond beam course itself have been filled with grout.
- When the time interval between lifts will exceed one hour, stop the lifts 1 1/2 inches below the top of the course.

(2) High-Lift Grouting - When the wall is to be grouted full height or if the height to be grouted will exceed 4 feet, do the following:

- Leave cleanouts, with a minimum opening of 3 inches by 4 inches as shown, in the bottom course of the placement at each vertical cell. Keep cleanouts open until all mortar droppings have been removed and vertical reinforcing steel has been placed and inspected.
- Remove excess mortar from vertical cores and expose an unobstructed vertical hole with a dimension of at least 2 inches and a cross-sectional area of at least 10 square inches.
- Do not start grout work until 24 hours after the portion of the wall to be grouted has been constructed.
- Do not place grout in lifts greater than 4 feet in height. Rod or vibrate grout not later than 10 minutes after placing and before the preceding lift takes its permanent set. Extend rodding or vibrating 12 inches to 18 inches into the preceding lift.
- Do not begin grouting successive lifts until at least 30 minutes have elapsed after rodding or vibrating the preceding lift.
- If the time interval between lifts will exceed one hour, stop the lifts 1 1/2 inch below the top of the course.
- Place wire screen, small mesh, expanded metal lath or other approved material in mortar joints under each bond beam course to prevent filling vertical cells not intended to be filled.

(b) Waterproofing - Treat all masonry wall cap surfaces with a waterproofing application of a high-build filler and rubber sealer. Treat at least 14 calendar days after the wall is completed. Apply filler by spraying or rolling according to the manufacturer’s recommendations. Apply 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 Lock Fence Sound Walls - Construct concrete panel lock fence walls according to the manufacturer's recommendations.

Measurement

00597.80 Measurement - The quantities of sound walls will be measured on the area basis, to the nearest square foot, of the wall face area projected onto a vertical plane along one side of the wall.

Payment

00597.90 Payment - The accepted quantities of sound walls will be paid for at the Contract unit price, per square foot, for the item "Sound Walls".

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

No separate or additional payment will be made for excavation, backfill, footings, concrete, reinforcement, waterproofing, and damp-proofing.

Section 00599 - Concrete Slope Paving

Description

00599.00 Scope - This work consists of constructing concrete slope paving on bridge end slopes as shown, specified, or directed.

Materials

00599.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete 00440
Grout.....02080.40
Reinforcement.....00530

Construction

00599.40 Slope Preparation - Grade the slopes for slope and berm paving, and curbs to the lines and grades established. Finish the area to a smooth, firm, compacted condition.

Dispose of excess materials according to 00330.41(a-4).

If slopes constructed under a separate contract require additional materials to prepare slopes to the established lines and grades, furnish such materials as Extra Work according to Section 00196.

00599.42 Slope Paving - Pave slopes with 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 Section 00440 and Section 00530.

Measurement

00599.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Slope Paving - Concrete slope paving will be measured on the area basis, to the nearest square foot, on the slope paving surface for each bridge end slope.

(b) Berm Paving - Berm paving will be measured on the area basis, to the nearest square foot, on the berm paving surface for each berm.

(c) Slope Paving Curbs - Slope paving curbs will be measured on the length basis, to the nearest foot.

Payment

00599.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Concrete Slope Paving	Square Foot
(b)	Berm Paving	Square Foot
(c)	Slope Paving Curbs	Foot

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

Payment for furnishing additional embankment materials required for slope preparation constructed under a separate contract will be made as Extra Work.

PART 00600 - BASES

Section 00610 - Reconditioning Existing Roadway

Description

00610.00 Scope - This work consists of reconditioning and preparing existing subgrades, bases, surfacings and pavements on which an additional layer or course of material is to be placed, under the Contract. The work includes existing shoulders, cut ditches, road connections, approach roads, ramps, bridge decks if not provided for elsewhere, and other roadbed areas on which construction work under the Contract is to be performed.

Materials

00610.10 Materials - Materials required for reconditioning and preparation work may consist of selected soil, sand and gravel, aggregate subbase or base material, water, asphalt, asphalt and portland cement concrete surfacing, and other material as directed. Furnish the materials meeting the requirements of the Specifications of the applicable Sections.

00610.15 Quality Control - Provide quality control according to Section 00165.

Labor

00610.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CAgT
- CDT

Construction

00610.40 Removal and Replacement of Unsuitable Materials - Remove unstable or unsuitable materials in the subgrade, subbase, base, surfacing or pavement areas as directed and dispose of according to 00330.41(a-3). Perform the removal and disposal according to 00140.30. Replace the removed materials with successive courses of materials furnished for other purposes under the Contract. Furnish, place and finish these materials as specified or as directed. If no materials are available for replacement, perform the replacement work as Extra Work.

00610.41 Ditches and Subgrades - Clean, trim and restore existing cut ditches to designated cross section and condition. Reshape, water, process and prepare the existing subgrade to the lines, grades, slopes and cross sections established. Compact according to 00330.43.

00610.42 Aggregate Subbase, Base, and Surfacing - Reshape, water, process and prepare the upper layer of existing subbases, bases and surfacings to lines, grades and cross sections established. Compact to densities required for similar new work.

00610.43 Surfacings - Clean existing surfacings of all loose material, dirt and dust by brooming, flushing with water or other approved methods.

Measurement

00610.80 Measurement - No measurement of quantities will be made for reconditioning and preparation work.

Materials used in the replacement of unsuitable materials according to 00610.40 will be measured in the manner applicable to the pay item under which the materials are furnished.

Payment

00610.90 Payment - Payment for reconditioning and preparation work will be made at the Contract lump sum amount for the item "Reconditioning Existing Roadway".

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

Removal and disposal of unsuitable materials will be paid for according to 00140.30.

Materials used for replacement of unsuitable materials according to 00610.40 will be paid for at the Contract unit price for the material involved. If the Contract Schedule of Items does not identify pay items for the material, payment will be made according to 00140.30.

Water furnished and used in the watering work and in the flushing of surfaces and pavements will be paid for according to Section 00340. If the Contract Schedule of Items does not identify a watering pay item, no separate or additional payment will be made for water furnished and used in the watering work and in the flushing of surfaces and pavements.

When the Contract Schedule of Items does not indicate payment for the work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00620 - Cold Plane Pavement Removal

Description

00620.00 Scope - This work consists of removing existing pavement to prepare a foundation for placing new surfacing.

Equipment

00620.20 Equipment - Provide self-propelled planing machines or grinders:

- Capable of loosening pavement material.
- Capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing pavement or from independent grade control.
- With a positive means for controlling cross-slope elevations.
- With a totally enclosed cutting drum with replaceable cutting teeth.
- With an effective means of removing loosened material from the surface and preventing dust from escaping into the air.
- Capable of providing a true cross-slope grade that will allow placement of overlay pavement to a uniform thickness.

Construction

00620.40 Pavement Removal:

(a) General - Remove the existing pavement to the depth, width, grade and cross section shown or as directed. The use of a heating device to soften the pavement is not allowed.

(b) Depth 1 inch to 2 inches - If the depth of the existing pavement to be removed is 2 inches or less, but more than 1 inch and the section will be under traffic, schedule the work so the full width and length of travel lanes pavement can be removed during the same shift. Remove the shoulder area within 24 hours.

(c) Depth over 2 inches - If the depth of the existing pavement to be removed is over 2 inches and the section will be under traffic, schedule the work so the full width and length of the travel lanes and shoulders can be removed, leaving no longitudinal or transverse drop-offs, during the same shift.

(d) Pavement Removal Alternative - If unable to complete the pavement removal according to 00620.40(b) and (c), then within the same day construct a wedge of asphalt concrete, at a slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at intersections, points of beginning and ending of the milling operation, and around manholes, valve boxes and other structures. Longitudinal drop-offs of 1 inch or less do not require a wedge. Maintain wedges as long as the area remains under traffic or until pavement is replaced. Remove and dispose of wedges before placing new pavement.

(e) Warning Signs - Provide warning signs as required where abrupt or sloped drop-offs occur at the edge of the existing or new surface according to Section 00225.

00620.41 Surface Tolerance - Test with a 12 foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.

00620.42 Disposal of Materials - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of the material according to 00290.20 unless special sites are specified in the Special Provisions.

00620.43 Maintenance Under Traffic - If the cold planed pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the roadway.

Measurement

00620.80 Measurement - The quantities of cold plane pavement removal will be measured on the area basis, in place.

When the depth of pavement to be removed is variable, the depth as shown is an estimate and is approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00620.90 Payment - The accepted quantities of work performed under this Section will be made at the Contract unit price, per square yard, for the item "Cold Plane Pavement Removal, _____ Deep".

The depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

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

No separate or additional payment will be made for temporary wedges constructed, maintained, and removed under 00620.40(d), or for replacement of cutting teeth.

Section 00635 - Grid-Rolled Aggregate Subbase

Description

00635.00 Scope - This work consists of furnishing, placing, and compacting with a perforated or grid-type roller, one or more layers of aggregate mixed with water, on a prepared surface to the lines, grades, thicknesses and cross sections shown or established.

Materials

00635.10 Materials - Furnish grid rolled aggregate subbase rock material having a maximum size of 6 inches and meeting the following requirements:

- **Abrasion** - The source materials for aggregate subbase shall not exceed 45 percent wear when tested according to AASHTO T 96.
- **Sand Equivalent** - Aggregate subbase material shall have a sand equivalent of not less than 25 when tested according to AASHTO T 176.

Equipment

00635.20 Compacting Equipment - Provide perforated or grid-type metal twin-drum rollers meeting the following requirements:

- Drums with an outside diameter of at least 5 feet.
- Maximum drum width of 32 inches.
- Capable of a 15 ton loading. The specific loaded weight will be as directed.

Use self-propelled or tractor pulled type rollers of sufficient size to propel it at 15 miles per hour.

Construction

00635.40 Preparation of Foundation - Provide a firm surface on which aggregate subbase is to be placed according to Section 00320, 00330, or 00610 as applicable.

00635.42 Thickness and Number of Layers - If the required compacted depth of the subbase exceeds 8 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 8 inches.

00635.43 Shaping and Compacting - Compact each layer of the subbase by as many passes of the roller as necessary to attain the desired fracture and compaction of the material. Operate the roller at the highest speed possible without bounce and without unevenness of compaction.

Perform blading and watering as necessary to provide uniformity of crown, cross section, and compaction.

Apply water according to Section 00340 and as directed.

Maintenance

00635.60 Care of the Work - After constructing each layer and completing the subbase, 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 Contract work is completed.

Measurement

00635.80 Measurement - The quantities of grid-rolled aggregate subbase will be measured on the area basis, constructed to the full thickness. The thickness will be identified on the plans. The surface area will be determined by horizontal measurements. In areas where directed to grid-roll to thicknesses other than identified on the plans, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Payment

00635.90 Payment - The accepted quantities of grid-rolled aggregate subbase will paid for at the Contract unit price, per square yard, for the item "Grid-Rolled Aggregate Subbase, ____ inches Thick".

The thickness of the subbase will be inserted in the blank.

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

No separate or additional payment will be made for water used to bring the mixture to optimum moisture content or for water used in the care of the work.

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 Materials - Furnish aggregates of 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.

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 00641.40.

00640.41 Hauling and Placing - Transport the aggregate to the job site, add water to obtain proper moisture content, and place on the prepared surface or material by means acceptable to the Engineer.

Do not place shoulder aggregates on the top lift of newly constructed EAC or open-graded pavement.

00640.42 Thickness and Number of Layers:

(a) Base - If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.

(b) Shoulders - Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00640.43 Shaping and Compacting - Compact each layer of material placed in shoulder and base areas 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, raveling, or rutting, until it is covered with a following layer or until all work is completed.

Measurement

00640.80 Measurement - The quantities of aggregate will be measured on the weight basis, in the hauling vehicle.

Payment

00640.90 Payment - The accepted quantities of aggregates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Aggregate Base	Ton
(b)	Aggregate Shoulders	Ton

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

No separate or additional payment will be made for water used to obtain proper compaction and in the care of the work.

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 Materials:

(a) Base and Shoulder Aggregate - Aggregate for bases and shoulders shall be sized as specified. Base aggregate shall be dense-graded unless otherwise specified. Shoulder aggregates shall be either 1" - 0 or 3/4" - 0 size as the Contractor elects.

Furnish base and shoulder aggregates meeting the following requirements:

Dense-Graded Base Aggregate	02630.10
Open-Graded Aggregate	02630.11
Shoulder Aggregate	02640

(b) Subbase Aggregate - Aggregate for subbases shall be crushed or uncrushed, including sands, reasonably well graded from coarse to fine.

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.

(1) 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.

(2) Abrasion - The source materials for aggregate subbase shall not exceed 45% wear when tested according to AASHTO T 96 unless otherwise approved.

(3) 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 T 99 and AASHTO T 224. Proportions will be in percentages by weight and will be known as the "Mix Design". The amount of water required in the mix design will normally be within a range of 5% to 10% of the mixture, based on dry weight of the aggregates. The mixture furnished shall conform to the mix design with a tolerance in optimum water content of plus or minus 2%. Any mixture having water content in excess of 2% over the Mix Design may be accepted for use, according to 00641.80(d), 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 00150.25.

(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
- CAgT
- CDT

Construction

00641.40 Preparation of Foundation - Provide a firm surface or material, on which aggregates are to be placed, according to Sections 00320, 00330, or 00610 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) Aggregate Base Courses:

(1) Dense-graded Aggregates - Begin compaction of each layer of dense-graded aggregates immediately after the material is spread and continue until a density of not less than 100% of the maximum density has been achieved when tested according to the MFTP.

(2) Open-graded Aggregates - Compact the surface of each layer of open-graded aggregates using rollers conforming to 00641.24. Roll until there is no appreciable reaction or yielding under the compactor.

Shape and maintain the surface of each aggregate layer during the compaction operations to produce a finished surface meeting the requirements of 00641.45.

Apply additional water over the materials for proper compaction, according to Section 00340 and as directed.

(b) Aggregate Subbase and Shoulder Courses - Compact each layer of aggregate subbase and shoulder material until no reaction or yielding is observed under the compactor.

00641.45 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 inch.

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.

Maintenance

00641.60 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

00641.80 Measurement - The quantities of aggregate mixture will be measured on the weight basis, on the volume basis, or on the area basis according to the following:

(a) Weight Basis - When measurement is by weight, quantities will be measured in the hauling vehicle, after mixing.

(b) Volume Basis - When measurement is by volume, quantities will be measured in the hauling vehicle.

(c) Area Basis - When measurement is by area, the quantity will be the number of square yards of aggregate base constructed to the full thickness. The surface area will be determined by horizontal measurements. Each area constructed with varying thicknesses, as directed or shown, will be adjusted by converting it to an equivalent area at the pay item thickness on a proportionate volume basis.

(d) Adjustment of Water in Mixture - If the water in the aggregate mixture placed 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.

If aggregates are stationary plant mixed, no separate measurement will be made for water added at the plant to bring the material to optimum moisture content.

If aggregates are road mixed, water used to bring the mixture to optimum moisture content will be measured according to 00340.80.

Payment

00641.90 Payment - The accepted quantities of aggregates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Aggregate Subbase	Ton or Cubic Yard
(b)	Aggregate Base	Ton or Cubic Yard
(c)	_____ Aggregate Base	Ton or Cubic Yard
(d)	Plant Mix Aggregate Base	Ton or Cubic Yard
(e)	Plant Mix _____ Aggregate Base	Ton or Cubic Yard
(f)	Aggregate Shoulders	Ton or Cubic Yard
(g)	Aggregate Base, _____ Inches Thick	Square Yard

Items (b) and (d) will apply when the Contractor has the option of furnishing one or another of two or more designated sizes of aggregates.

In items (c) and (e), the designated size of aggregate to be used will be inserted in the blank.

In item (g), the depth of aggregate base will be inserted in the blank.

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

No separate or additional payment will be made for water used in the mixture, mixed and placed according to 00641.41(a), subject to the limitations of 00641.80(d).

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 00195.60, subject to the requirements of 00641.10, 00641.15, 00641.16(a), and subject to QA verification.

Section 00680 - Stockpiled Aggregates

Description

00680.00 Scope - This work consists of furnishing crushed rock or other aggregates in stockpiles at the places and in the manner specified.

Materials

00680.10 Sources of Material - Obtain the material to be furnished in stockpiles from sources according to 00160.60.

00680.11 Aggregates - Furnish aggregates meeting the following requirements:

(a) Aggregate Base and Shoulder Aggregate - Furnish aggregates in stockpiles of the sizes specified and conforming to the requirements of 00641.10.

(b) Emulsified AC Aggregate - Furnish aggregates in stockpiles of the following sizes or as specified:

1" - 1/2"
3/4" - 1/2"
1/2" - 1/4"
3/8" - 1/4"
3/8" - No. 4
3/8" - No. 8

Aggregates in stockpiles shall conform to the following requirements:

(1) Quality - Provide aggregates meeting the requirements of 00715.10(a), (c), (d), (e) and (f).

(2) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading for the designated size aggregate according to the following:

	Designated Sizes					
	1" - 1/2"	**3/4" - 1/2"**	**1/2" - 1/4"**	**3/8" - 1/4"**	**3/8" - No. 4**	**3/8" - No. 8**
Sieve Size	**Percent Passing (by weight)**					
1"	100	100				
3/4"	95 - 100	90 - 100	100			
1/2"	60 - 90	0 - 10	85 - 100	100	100	
3/8"	–	–	–	85 - 100	80 - 100	100
1/4"	15 - 30	0 - 2	0 - 15	0 - 15	10 - 40	–
No. 4	–	–	–	–	–	45 - 65
No. 8	0 - 7	–	0 - 4	–	0 - 6	0 - 10
No. 30	–	–	–	0 -2	0 - 2	–
No. 200	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2
No. 200 *	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1

* 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 Agency's quality assurance program. The Agency will perform aggregate production quality assurance according to the following:

(a) ODOT-Administered Projects - Quality assurance testing on projects administered by ODOT 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 Agencies other than ODOT will be at the discretion of the Agency or as specified.

Equipment

00680.20 Rock Crusher - Comply with the following:

(a) Permits - Before crushing rock for the Project, provide the Agency 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 crushed aggregates capable of discharging the materials without segregation.

Labor

00680.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT

Construction

00680.40 Preparation of Sites:

(a) Source Sites - Prepare and develop the source site according to the terms of the source permit and source development plan in the Special Provisions.

(b) Stockpile Sites - Clear, level, and prepare stockpile sites as directed.

00680.41 Piling of Materials - Place each separate designated size of material to be stockpiled at a given site in a separate stockpile. Locate each stockpile to occupy as small an area as practical, and separate each pile so that working room will be adequate for removing the materials later. Height of the piles shall not be less than 8 feet, nor side slopes flatter than 1V:1.5H, unless directed. Except in sand sheds, stockpile sanding materials to a height of 15 feet, or as directed.

Place the material in stockpiles with a minimum of segregation. Unless otherwise allowed, place the material in stockpiles in horizontal layers not more than 4 feet in thickness.

00680.42 Places of Delivery - Places of delivery and the tentative plans of distribution of the materials will be shown or specified.

00680.43 Agency's Right to Materials - If the Engineer finds it necessary, the Agency 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 Measurement - The quantities of each designated size of material will be measured according to the following:

- **Weight Basis** - When measurement is by weight, the quantities of each designated size of material will be measured on the weight basis, in the hauling vehicle.

- **Volume Basis** - When measurement is by volume, the quantities of each designated size of material will be measured on the volume basis, by cross-section measurement of the completed stockpiles, with no allowance for settlement or shrinkage.

00680.81 Materials Taken from Stockpiles Prior to Completion - Materials taken by the Agency according to 00680.43 will be measured in the Agency's hauling vehicles. If measurement is on the volume basis, the vehicle measurement will be converted to equivalent stockpile measurement at the ratio of 1.00 cubic yard, vehicle measurement to 0.95 cubic yard, stockpile measurement. If measurement is on the weight basis, the weight will be determined in the same manner and by the same means as used in determining the weight of materials stockpiled and paid for under the Contract.

Payment

00680.90 Payment - The accepted quantities of each size of specified material will be paid for at the Contract unit price, per ton or cubic yard, for the item "_____ Material In Stockpile".

The respective sizes of stockpiled aggregates will be inserted in the blank.

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

No separate or additional payment will be made for source development and clean-up, preparation of stockpile sites, hauling of stockpile materials, or placing materials in sand sheds.

PART 00700 - WEARING SURFACES

Section 00705 - Emulsified Asphalt Prime Coat and Emulsified Asphalt Fog Coat

Description

00705.00 Scope - This work consists of applying asphalt, with or without aggregate cover materials, to a prepared surface. The prime coat referred to in these Specifications is a penetration treatment to aggregate surfaces to coat and bind the material into a hard surface. The fog coat referred to in these Specifications is a treatment applied to existing asphalt concrete pavement surfaces to renew and seal the pavement surface.

Materials

00705.10 Aggregate Cover Material - When required by the Special Provisions, furnish 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.

Fine Cover	
Sieve Size	**Percent Passing (by Weight)**
3/8"	100
1/4"	90 - 100
No. 8	30 - 66
No. 30	8 - 28
No. 100	0 - 5

Coarse Cover	
Sieve Size	**Percent Passing (by Weight)**
1"	100
3/4"	90 - 100
3/8"	55 - 75
1/4"	40 - 60
No. 8	*

***** Of the fraction passing the 1/4 inch sieve, 40 to 60% shall pass the No. 8 sieve.

00705.11 Emulsified Asphalt - Furnish asphalt meeting the following requirements:

(a) General - Provide emulsified asphalt conforming to the requirement of ODOT's publication, "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Obtain samples of emulsified asphalt according to AASHTO T 40, prior to dilution with water, at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency, within 30 calendar days from the day the sample was taken.

(b) Prime Coat - Provide CSS-1, CSS-1h, or CMS-2S emulsified asphalt for the prime coat.

(c) Fog Coat - Provide CSS-1, CSS-1h, or HFRS-P1 emulsified asphalt for the fog coat.

For every part emulsified asphalt, add not more than one part water. Add water at point of supply or point of application as directed, and mix with emulsified asphalt. The exact proportion of added water will be determined in a manner acceptable to the Engineer.

Equipment

00705.20 Equipment - Provide a pressure distributor, hauling vehicles, and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in such number and capacities as will provide coordinated and uniform progress of the work.

00705.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained, and operated so the emulsified asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

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 0.20 to 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 0.10 to 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 calendar days after construction, as directed, before a succeeding course is placed upon it. If directed, traffic may be allowed to travel over the prime coat at any time after its construction. During the curing period, when in use by traffic and until it is covered by a succeeding course, maintain the prime coat to the specified shape and condition, as directed.

00705.61 Power Brooming Fog Coats - Following the applications of all aggregate cover material, carefully broom the entire surface unless brooming damages the fog coat, to remove loose aggregate that could damage vehicles. Use a minimum of 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 Measurement - The quantities of emulsified asphalt will be measured on the weight basis.

The quantities of aggregate cover material will be measured on the weight basis or on the volume basis in the hauling vehicle.

Payment

00705.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Emulsified Asphalt in Prime Coat	Ton
(b)	Emulsified Asphalt in Fog Coat	Ton
(c)	Aggregate Cover Material	Ton or Cubic Yard

Item (b) includes water required to dilute the emulsified asphalt, according to 00705.11(c).

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

No separate or additional payment will be made for materials used during the maintenance period.

Section 00706 - Emulsified Asphalt Slurry Seal Surfacing

Description

00706.00 Scope - This work consists of applying one or more layers of slurry seal consisting of emulsified asphalt, water, aggregate, and additives on a prepared surface as shown or directed.

00706.02 Abbreviations:

ISSA - International Slurry Surfacing Association

Materials

00706.10 Emulsified Asphalt - Furnish CQS-1h emulsified asphalt meeting the following requirements when tested according to AASHTO T 59:

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 CS_2 or TCE	97.5 minimum
Ductility at 77 °F, inch	15.7 minimum

00706.11 Polymer Modified Emulsion - Furnish CQS-1h polymer modified emulsion. The polymer modifier shall be either a solid synthetic rubber or latex material. Combine the polymer modifier with the base asphalt or asphalt emulsion, prior to loading at the manufacturing plant, at the minimum rate of 2.5% to 3% polymer solids by weight of asphalt. The polymer modified emulsion shall be compatible with the mix design developed for the conventional slurry seal. Each shipment of emulsified asphalt shall be accompanied by a certificate of analysis or certificate of compliance from the manufacturer.

00706.12 Aggregate - The aggregate used shall be clean, angular, durable, well graded and uniform. The aggregate shall consist of broken stone, crushed gravel, slag or a combination of them. To assure the material is totally crushed, 100% of the parent aggregate shall be larger than the largest stone in the gradation to be used.

Aggregate gradation shall meet one of the following types:

Sieve Size	TYPE I - Parking Areas, Urban and Residential Streets, Airport Runways Percent Passing	TYPE II - Urban and Residential Streets, Airport Runways Percent Passing	TYPE III - Primary and Interstate Routes Percent Passing	Stockpile Tolerance
3/8"	100	100	100	0
No. 4	100	90 - 100	70 - 90	± 5%
No. 8	90 - 100	65 - 90	45 - 70	± 5%
No. 16	65 - 90	45 - 70	28 - 50	± 5%
No. 30	40 - 65	30 - 50	19 - 34	± 5%
No. 50	25 - 42	18 - 30	12 - 25	± 4%
No. 100	15 - 30	10 - 21	7 - 18	± 3%
No. 200	10.0 - 20.0	5.0 - 15.0	5.0 - 15.0	± 2.0%

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 allowed unless approved. Water, not exceeding 11% by weight to asphalt emulsion, shall be used to develop a good mix.

(a) Laboratory Evaluation - Have the mix design prepared and tested by a laboratory which has experience in designing emulsified asphalt slurry seal surfacing. Determine the proportions of component materials and perform the tests described in 00706.15(b). The final mix design shall meet the limits described in 00706.15(b) and 00706.15(c).

(b) Mix Design Tests:

Test	Description	Specification
ISSA TB-106	Slurry Seal Consistency	
ISSA TB-139	Wet Cohesion, 30 minutes set	0.10 lb.-in. min.
(For quick-traffic systems)	60 minutes set	0.17 lb.-in. min.
ISSA TB-109	Excess Asphalt by LWT and	
(For heavy traffic areas only)	Sand Adhesion	1 lb./sq. yd. max.
ISSA TB-114	Wet Stripping	Pass (90% minimum)
ISSA TB-100	Wet Track Abrasion Loss One hour soak	1.5 lb./sq. yd. max.
ISSA TB-113	Mix Time *	Controllable to 180 sec. minimum

* 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 allowed.
- The percentage of aggregate passing each sieve shall be within the stockpile tolerance range as stated in 00706.12.
- The percentage of aggregate passing shall not go from the high end to the low end of the specified range of any 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** - Every 60,000 square yards.

- **Tanker** - Every 60,000 square yards.

- **Mixture** - To be taken directly out of pugmill every 60,000 square yards.

(c) Verification Testing - If comparisons of test results are outside the allowable differences, the Contractor and Engineer will investigate the reason. The Engineer may stop production while the investigation is in progress if the potential for pavement failure is present. The investigation may include review of calculation, testing of the remaining samples, review and observation of Contractor testing procedures and equipment, and a comparison of sample test results.

Equipment

00706.20 Equipment - Provide suitable surface preparation equipment, traffic control equipment, hand tools and any other support equipment required as necessary to perform the work.

00706.21 Mixing Equipment - The machine(s) shall be specifically designed and manufactured to lay slurry seal. Mix slurry seal in continuous pug mill mixers; a self-propelled machine specifically designed and manufactured to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive and water to a revolving blade mixer that discharges the thoroughly mixed product on a continuous flow basis. Concrete transit mixer trucks shall not be used. Minimum slurry seal machine size shall be 7 cubic yards. In the case of equipment failure have a minimum of 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 (for example; aggregate, mineral filler, additive, emulsified asphalt and water). Instruct the Engineer how to calculate the application rate per square yard utilizing the Contractor's proportioning devices.

(b) Calibration - Calibrate, in the presence of the Engineer, each slurry mixing unit to be used on the Project prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machines metering devices. No machine will be allowed to work on the Project until the calibration has been completed 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 - If required by Special Provision, rollers shall be self-propelled, steel-wheeled or pneumatic-tired type and be equipped with a water spray system. Steel-wheeled rollers shall be capable of providing a weight of not less than 2,400 pounds per foot width of the compression roll or rolls. Pneumatic-tired rollers shall be capable of exerting a ground pressure of not less than 80 pounds per square inch of tire contact area.

Labor

00706.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAT-I

Construction

00706.40 Weather Limitations - Do not apply the slurry seal if either the pavement or air temperature is below 50 °F and falling. The slurry seal may be applied when both the pavement and air temperature are above 45 °F and rising. Do not apply if there is a danger that the finished product will freeze before 24 hours. Do not apply when weather conditions prolong opening to traffic beyond a reasonable time. Do not apply in the rain. Replace slurry damaged by rain after application according to the Specifications, and as determined by Engineer, at no additional cost to the Agency. 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 Agency.

Prepare the pavement on which the slurry seal is to be placed as follows, as directed.

(a) Base Repairs - Where determined by the Engineer, excavate and replace surfacing materials according to Section 00748.

(b) Surface Repairs - Where the pavement is severely cracked, rutted, deformed or otherwise distressed, place a leveling course or patch using 3/4 inch or 1/2 inch dense graded asphalt concrete. The class of mix to be used shall conform to Section 00745. Place the mixture according to Section 00745.

(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 to the Agency.

ISSA TB112 gives a method to determine expected application rates.

The slurry seal mixture shall be of proper consistency at all times to provide the application rate required by the surface condition. The average application rate, as measured by the Engineer, shall be according to the following table:

	Recommended Use	Application Rate
TYPE I	Parking Areas, Urban and Residential Streets, Airport Runways	6.7 - 10.0 lbs./sq. yd.
TYPE II	Urban and Residential Streets, Airport Runways	10.0 - 16.7 lbs./sq. yd.
TYPE III	Primary and Interstate Routes	15.0 - 25.0 lbs./sq. yd.

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 to the Agency. 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 Agency 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 Agency.

00706.48 Rolling - If required by Special Provision, 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 according to the approved schedule, or an approved revision of the schedule, 48 hours prior to the specific work.

Remove all traffic control promptly when it is determined that the street may be open to traffic. Do not seal any street that requires closing overnight without the approval of the Engineer.

If the slurry seal does not cure in a timely manner and remains trackable overnight, apply a covering of 1/4 inch minus material to prevent tracking and related property damage prior to permitting traffic on the street at no additional cost to the Agency.

Be responsible for all damage to the uncured slurry or to private or public property due to tracking of the uncured material.

Measurement

00706.80 Measurement - Crack sealing will be measured on the length basis, of material in place.

Slurry seal will be measured on the area basis and calculated to the nearest square yard.

Asphalt concrete pavement repair will be measured according to 00748.80.

Payment

00706.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Slurry Seal Crack Sealing	Foot
(b)	Slurry Seal	Square Yard

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

Asphalt concrete pavement repair will be paid for according to 00748.90.

When the Contract Schedule of Items does not indicate payment for work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00710 - Single Application Emulsified Asphalt Surface Treatment

Description

00710.00 Scope - This work consists of applying emulsified asphalt and graded aggregates as shown or directed.

The surface treatment design will be designated on the plans or in the Special Provisions.

Materials

00710.10 Aggregates - Furnish aggregates meeting the following requirements:

(a) Size Designation - Provide the size of aggregate for the single application emulsified asphalt surface treatment design designated in the plans or Special Provisions according to the following:

Chip Seal Design	Size of Screenings
Fine	3/8" - No. 8
Single Size Medium	3/8" - 1/4"
Graded Medium	3/8" - No. 4
Coarse	1/2" - 1/4"

(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 AASHTO T 11. Provide grading for the designated single application emulsified asphalt surface treatment design according to the following:

Sieve Size	Coarse 1/2" - 1/4"	Single Size Medium 3/8" - 1/4"	Graded Medium 3/8" - No. 4	Fine 3/8" - No. 8
		Percent Passing (by Weight)		
3/4"	100			
1/2"	85 - 100	100	100	
3/8"	–	85 - 100	80 - 100	100
1/4"	0 - 15	0 - 15	10 - 40	–
No. 4	–	–	–	45 - 65
No. 8	0 - 4	–	0 - 6	0 - 10
No. 30	–	0 - 2	0 - 2	–
No. 200 (wet)	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0
No. 200 (wet) *	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0

* 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 solution according to AASHTO T 104.

(f) Durability - Provide aggregates meeting the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Maximum Values
Abrasion		T 96	30.0%
Degradation (coarse aggregate) Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(g) Harmful Substances - Provide aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(h) Taking Aggregates from Agency Stockpiles - When it is specified that aggregates are to be taken from Agency-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 Agency Property - Aggregates may be temporarily stockpiled at approved sites on Agency property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

00710.11 Emulsified Asphalt - Furnish polymer-modified emulsified asphalt or non-polymer-modified emulsified asphalt as specified for the single application emulsified asphalt surface treatment design designated in the plans or Special Provisions. When non-polymer-modified emulsified asphalt is designated, the Contractor may elect to substitute a polymer-modified emulsified asphalt, however, selection of the polymer-modified emulsified asphalt will not be cause for additional compensation.

(a) Non-Polymer-Modified Emulsified Asphalt - When non-polymer-modified emulsified asphalt is specified, use CRS-2 or HFRS-2 emulsified asphalt as the Contractor elects.

(b) Polymer-Modified Emulsified Asphalt - When polymer-modified emulsified asphalt is specified, use CRS-2P or HFRS-P1 as the Contractor elects.

(c) Acceptance of Emulsified Asphalt - Provide emulsified asphalt conforming to the requirements of ODOT's publication, "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for surface treatment use. For this reason limit pumping between the bulk storage tank, hauling transportation, field

storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Obtain samples of emulsified asphalt according to AASHTO T 40 at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. 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 Agency's quality assurance program. The Agency 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 Agency or as designated in the Special Provisions.

Equipment

00710.20 Equipment - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in sufficient number and capacities that will provide coordinated and uniform progress of the work.

Provide two-way radio communication between the asphalt distributor and chip spreader.

00710.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00710.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an aggregate segregator assembly. Chip spreaders without an aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified panel and without placing joints in the travel lanes.

00710.23 Compactors - Provide self-propelled pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the surface treatment operation. A minimum of 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 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00710.24 Power Brooms - Provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00710.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT

Construction

00710.40 Season and Weather Limitations - Do not apply emulsified asphalt when the pavement temperature is below 70 °F, or 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 all surface treatments damaged by weather during the first 24 hours after application at no additional cost to the Agency. The placing of single application emulsified asphalt surface treatments will not be allowed before July 1 or after August 31.

00710.41 Rate of Progress and Scheduling - Do not apply more surface treatment in any one day than can be broomed the following morning, unless approved by the Engineer. Provide a traffic control plan for approval by the Engineer if operations exceed 3 centerline miles or 6 lane miles per day.

00710.42 Preparation of Underlying Surfaces - Immediately before applying the emulsified asphalt, clean and dry the surface to be treated in a manner approved by the Engineer.

00710.43 Sequence of Operations - Construct the single application emulsified asphalt surface treatment with a single spread of emulsified asphalt followed immediately with a single spread of aggregate and initial rolling, unless otherwise directed by the Engineer. Surface treatment is not required for guardrail flares, driveways, or other irregular areas as directed.

00710.44 Application Rates - Apply the emulsified asphalt and spread the aggregate within the following ranges of rates for the specified surface treatment design. The exact application and spread rate will be determined by the Engineer.

Chip Seal Design	Emulsified Asphalt Application Rate (gal./sq. yd.)	Aggregate Spread Rate (cu. yd./sq. yd.)
Fine	0.25 - 0.40	0.004 - 0.009
Single Size Medium	0.40 - 0.65	0.005 - 0.015
Graded Medium	0.40 - 0.65	0.005 - 0.015
Coarse	0.33 - 0.70	0.009 - 0.018

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 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.

00710.46 Hauling and Spreading Aggregates - Spread aggregates at the rates specified in 00710.44.

Do not operate hauling and spreading equipment on uncovered emulsified asphalt. During the first hour after application of the emulsified asphalt and aggregate, operate at speeds no more than 10 mph and after the first hour, not more than 15 mph until otherwise allowed by the Engineer. Carefully operate

hauling equipment at all times, at moderate speeds that will not damage the new surface treatment or create a hazard to the traveling public. Route hauling equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the emulsified asphalt surface with aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this aggregate within 10% of specified rate. Using approved methods, remove or repair emulsified asphalt that has set or "broke" before being covered with aggregate, at no additional cost to the Agency.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the aggregate surface) on the aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of aggregates and remove any excess aggregates from the surface prior to resuming operations.

00710.47 Shaping and Compacting - After the aggregates have been placed on the emulsified asphalt, spread or remove all piles, ridges, or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of 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 Measurement - The quantities of aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

The quantities of emulsified asphalt will be measured on the weight basis.

The quantities of asphalt surface treatment of approaches will be measured on the unit basis for each street connection and road approach.

Payment

00710.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Aggregate in Emulsified Asphalt Surface Treatment	Ton or Cubic Yard
(b)	Asphalt in Emulsified Asphalt Surface Treatment	Ton
(c)	Extra for Emulsified Asphalt Surface Treatment Approaches	Each

Item (c) applies to the extra costs of placing the aggregates and asphalt in single application emulsified asphalt surface treatments only on street connections and road approaches. Payment will be in addition to payment made for the materials used in the work.

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

No separate or additional payment will be made for preparing the road surface, placing materials in final position, or brooming,

Section 00715 - Multiple Application Emulsified Asphalt Surface Treatment

Description

00715.00 Scope - This work consists of applying multiple layers of emulsified asphalt and graded aggregates, applied in successive spreads, to form a firm, finished surface as shown or directed.

The surface treatment design will be designated on the plans or in the Special Provisions.

Materials

00715.10 Aggregates - Furnish aggregates meeting the following requirements:

(a) Fractured Faces - Provide aggregates consisting of broken stone, crushed gravel, or a combination of both. Crush aggregate such that at least 90% by weight of the total aggregate retained on the No. 8 and larger sieves is fractured on two faces, as determined according to AASHTO TP 61.

(b) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide designated gradings for the specified multiple application emulsified asphalt surface treatment design according to the following:

	Designated Size			
Sieve Size	**1" - 1/2"**	**3/4" - 1/2"**	**1/2" - 1/4"**	**3/8" - No. 8**
	Percent Passing (by Weight)			
1"	100	100		
3/4"	95 - 100	90 - 100	100	
1/2"	60 - 90	0 - 10	85 - 100	
3/8"	–	–	–	100
1/4"	15 - 30	0 - 2	0 - 15	–
No. 4	–	–	–	45 - 65
No. 8	0 - 7	–	0 - 4	0 - 10
No. 200 (wet)	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0
No. 200 (wet) *	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0

* 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:

	Test Method		Maximum
Test	**ODOT**	**AASHTO**	**Values**
Abrasion		T 96	30.0%
Degradation (coarse aggregate)			
Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(f) Harmful Substances - Provide aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(g) Taking Aggregates from Agency Stockpiles - When it is specified that aggregates are to be taken from Agency-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 Agency Property - Aggregates may be temporarily stockpiled at approved sites on Agency property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

00715.11 Emulsified Asphalt - Furnish polymer-modified emulsified asphalt or non-polymer-modified emulsified asphalt as specified for the multiple application emulsified asphalt surface treatment design designated in the plans or Special Provisions. When non-polymer-modified emulsified asphalt is designated, the Contractor may elect to substitute a polymer-modified emulsified asphalt, however, selection of the polymer-modified emulsified asphalt will not be cause for additional compensation.

(a) Non-Polymer-Modified Emulsified Asphalt - When non-polymer-modified emulsified asphalt is specified, use CRS-2 or HFRS-2 emulsified asphalt as the Contractor elects.

(b) Polymer-Modified Emulsified Asphalt - When polymer-modified emulsified asphalt is specified, use CRS-2P or HFRS P1 as the Contractor elects.

(c) Acceptance of Emulsified Asphalt - Provide emulsified asphalt conforming to the requirement of ODOT's publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for surface treatment use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Obtain emulsified asphalt samples according to AASHTO T 40 at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. 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 00195.60 subject to meeting the requirements of 00715.10 and 00715.15.

00715.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of aggregates if verified by the Agency's quality assurance program. The Agency 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 Agency or as designated in the Special Provisions.

Equipment

00715.20 Equipment - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms, and other necessary equipment to ensure efficient operation and construction to meet specified results. Provide equipment in sufficient number and capacities that will provide coordinated and uniform progress of the work.

Provide two way radio communication between the asphalt distributor and chip spreader.

00715.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and

controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00715.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an aggregate segregator assembly. Chip spreaders without an aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified panel and without placing joints in the travel lanes.

00715.23 Compactors - Provide self-propelled, pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the multiple application emulsified asphalt surface treatment operation. A minimum of 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 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00715.24 Power Brooms - Provide pickup or nonpickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00715.30 Quality Control Personnel - Provide a certified technician in the following field:

- CAgT

Construction

00715.40 Season and Weather Limitations - Do not apply emulsified asphalt when the pavement temperature is below 70 °F, or 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 all surface treatments damaged by weather during the first 24 hours after application at no additional cost to the Agency. The placing of multiple application emulsified asphalt surface treatments will not be allowed before July 1 or after August 31.

00715.41 Preparation of Underlying Surfaces - Prepare underlying surfaces according to the following:

(a) Asphalt Surfaces - Immediately before applying the emulsified asphalt, clean and dry the surface to be sealed and trim the shoulders in a manner approved by the Engineer.

(b) Aggregate Surfaces - Bring aggregate bases and other bases or foundations, when constructed under the Contract, to the completed and finished condition according to the applicable Specifications.

Bring old bases and foundations, constructed by others, to the applicable condition according to Section 00610, and within 1/2 inch of established grade and cross section.

00715.42 Sequence of Operations and Application Rates - Construct the number of spreads, the size of aggregates, and the application rates for both emulsified asphalt and aggregates for the multiple application emulsified asphalt surface treatment design specified according to Table 00715-1. Vary the rates of spread as directed during the progress of the work to produce the best results. Surface treatment is not required for guardrail flares, driveways, or other irregular areas as directed.

Table 00715-1

Multiple Surface Treatment Design

Spreading Order and Rates of Spread*	**Fine Double Chip Seal**	**Medium Double Chip Seal**	**Type E-9 Oil Mat**	**Type E-11 Oil Mat**
First Course				
Emulsified Asphalt	0.20	0.25	0.30	0.30
1" - 1/2" Aggregate				0.015
3/4" - 1/2" Aggregate			0.014	
1/2" - 1/4" Aggregate		0.010		
3/8" - No. 8 Aggregate	0.008			
Second Course				
Emulsified Asphalt	0.30	0.30	0.35	0.35
1" - 1/2" Aggregate				0.015
1/2" - 1/4" Aggregate			0.010	
3/8" - No.8 Aggregate	0.006	0.007	0.002	0.002
Third Course				
Emulsified Asphalt			0.30	0.35
1/2" - 1/4" Aggregate				0.010
3/8" - No. 8 Aggregate			0.007	0.003
Fourth Course				
Emulsified Asphalt				0.30
3/8" - No. 8 Aggregate				0.007
Total Quantities				
Emulsified Asphalt	0.50	0.55	0.95	1.30
Aggregates	0.014	0.017	0.033	0.052

* The rates of spread are in the following units:

Emulsified Asphalt - gallons per square yard
Aggregates - cubic yards per square yard

(a) Type E-9 and E-11 Oil Mats - Use one of the following procedures as mutually agreed to by the Engineer and Contractor for Type E-9 and E-11 oil mats:

- Complete first and second course (and third course for Type E-11) of the oil mat throughout the entire section (including the dry key) to which the oil mat is to be applied. Square up these courses 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 allowed by the Engineer. Carefully operate hauling equipment at all times, at moderate speeds that will not damage the new surface treatment or create a hazard to the traveling public. Route hauling equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the emulsified asphalt surface with aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this aggregate within 10% of specified rate. Using approved methods, remove or repair emulsified asphalt that has set or "broke" before being covered with aggregate, at no additional cost to the Agency.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the aggregate surface) on the aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of aggregates and remove any excess aggregates from the surface prior to resuming operations. Stagger cut-offs of successive courses a minimum of 16 feet prior to the end of a proceeding course.

00715.45 Shaping and Compacting - After the aggregates have been placed on the emulsified asphalt and spread, remove all piles, ridges or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of 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 within 14 calendar days following notification at no additional cost to the Agency.

Measurement

00715.80 Measurement - The quantities of aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

The quantities of emulsified asphalt will be measured on the weight basis.

The quantities of asphalt surface treatment of approaches will be measured on the unit basis for each street connection and road approach.

Payment

00715.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Aggregate in Multiple Application Emulsified Asphalt Surface Treatment	Cubic Yard or Ton
(b)	Asphalt in Multiple Application Emulsified Asphalt Surface Treatment	Ton
(c)	Extra for Multiple Application Emulsified Asphalt Surface Treatment Approaches	Each

Item (c) applies to the extra costs of placing the aggregates and asphalt in emulsified asphalt surface treatment only on street connections and road approaches. Payment will be in addition to payment made for the materials used in the work.

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

No separate or additional payment will be made for preparing the road surface, placing material in final position, or blading and brooming.

Section 00730 - Emulsified Asphalt Tack Coat

Description

00730.00 Scope - This work consists of furnishing and placing emulsified asphalt on a prepared asphalt concrete, portland cement concrete, or other paved surface to ensure bond between lifts as specified.

Materials

00730.11 Emulsified Asphalt - Furnish CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-1, CRS-2, HFRS-2, or HFMS-2 as selected by the Contractor.

Furnish emulsified asphalt meeting the requirements of ODOT's publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for tack coat use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Dilution of the tack coat material may be allowed to a maximum 1:1 ratio. Determine the proportion of water to be added to the emulsified asphalt. Do not dilute the emulsified asphalt until the Engineer approves the dilution ratio. Add the water to the emulsified asphalt and mix according to the asphalt supplier.

Obtain samples according to AASHTO T 40 prior to dilution with water, if allowed, at the frequency indicated in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. Emulsified asphalt will be tested within 30 calendar days from the date it is sampled.

Equipment

00730.22 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the emulsified asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

Construction

00730.40 Temperature Limitations - Apply tack coat only when the surface temperature in the shade is not less than the appropriate minimum surface temperature according to 00735.40, 00744.40, or 00745.40 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 emulsified asphalt with a pressure distributor conforming to 00730.22, unless otherwise allowed. Apply the emulsified asphalt to the prepared surface at a rate between 0.05 and 0.20 gallons per square yard as directed and with the emulsified asphalt temperature between 140 °F and 185 °F as recommended by the manufacturer. Application rates for tack coat diluted according to 00730.11 will be increased as necessary to provide the same amount of residual asphalt as the application rates specified above.

Do not place hot mixed asphalt concrete pavement or emulsified asphalt concrete pavement on the tack coat until the emulsified asphalt separates from the water (breaks), but before it loses its tackiness.

Measurement

00730.80 Measurement - The quantities of emulsified asphalt cement used as tack will be measured on the weight basis.

Payment

00730.90 Payment - The accepted quantities of emulsified asphalt cement used as tack coat will be paid for at the Contract unit price, per ton, for the item "Emulsified Asphalt for Tack Coat".

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

No separate or additional payment will be made for water added to dilute the emulsified asphalt used as tack coat.

Section 00735 - Emulsified Asphalt Concrete Pavement

Description

00735.00 Scope - This work consists of constructing an emulsified asphalt concrete (EAC) pavement composed of aggregate and emulsified asphalt, plant mixed into a uniformly coated mixture, spread on a prepared base, covered with choke aggregate, and compacted to the lines, grades, thicknesses, and cross sections shown or established.

00735.05 Precrushing and Prepaving Conferences:

(a) Precrushing Conference - Supervisory personnel of the Contractor and any subcontractors who are to be involved in aggregate crushing of EAC aggregates shall meet with the Engineer at a mutually agreed time, to discuss methods of accomplishing all phases of the crushing work. The Crusher Supervisor and the Contractor's CAgT shall attend the meeting.

(b) Prepaving Conference - Supervisory personnel of the Contractor, including the CAT-I and any subcontractors who are to be involved in the paving work, shall meet with the Engineer at a mutually agreed time to discuss methods of accomplishing all phases of the paving work.

Materials

00735.10 Aggregates - Furnish aggregates for EAC meeting the following requirements:

(a) General - Scalp the rock material used to produce aggregates on a 3/4 inch sieve covering the entire screen deck (after it has passed through the primary crusher if quarry rock is used). The material remaining may be accepted for use by visual inspection. The Engineer may perform verification testing of the gradation. The material shall meet the following:

Sieve Size	Percent Passing (by Weight)
4"	95 - 100
3/4"	5 Max.

(b) Soundness - Provide coarse and fine aggregate with a weighted loss not exceeding 12% when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(c) Durability - Provide EAC aggregates meeting the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Maximum Values
Abrasion		T 96	30.0%
Degradation (coarse aggregate) Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(d) Fractured Faces - Determine fracture of aggregates according to AASHTO TP 61. Crush aggregate to provide at least two fractured faces on 90% of the material retained on a 1/4 inch sieve, and one fractured face on 75% of the material retained on a No. 8 sieve.

(e) Harmful Substances - Provide EAC aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(f) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading of EAC aggregate conforming to the following:

Sieve Size	Percent Passing (by Weight)	Leveling or Patching Percent Passing (by Weight)
1"	100	
3/4"	95 - 100	100
1/2"	60 - 90	95 - 100
1/4"	15 - 30	15 - 40
No. 8	0 - 7	0 - 10
No. 200	0.0 - 2.0	0.0 - 2.0
No. 200 *	0.0 - 1.0	0.0 - 1.0

* in gravels

If the aggregates are produced in two or more separate sizes, the gradation of the blended sizes shall conform to the above grading requirements.

(g) Stockpiling - Prepare the ground for the stockpile site to prevent contamination. Prevent segregation, as much as possible, when stockpiling and removing the aggregate.

00735.11 Emulsified Asphalt - Furnish CM-2, CMS-2S, or HFMS-2 emulsified asphalt meeting the requirements of ODOT's publication "Standard Specifications for Asphalt Materials". Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project. Acceptance of the selected emulsified asphalt is subject to the production of a suitable JMF.

Excessive delay in the use of the emulsified asphalt or excessive pumping of the emulsified asphalt may significantly reduce the viscosity and may make the material unsuitable for EAC use. Limit pumping between the bulk storage tank, hauling transportation, field storage tanks, and plant to an absolute minimum to maintain viscosity.

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 Agency, within 30 calendar days from the day the sample was taken.

00735.13 Job Mix Formula (JMF) - Provide a mixture comprised of aggregate and emulsified asphalt in the proportions established in the JMF. The emulsified asphalt content shall be between 5.0% and 8.0%, by weight, of the total aggregate. Vary the proportions of materials as directed.

The CMDT shall prepare, sign and submit a JMF and samples to the Engineer for each mixture required at least 10 calendar days prior to anticipated use in EAC, and according to the latest copy of the ODOT Contractor Mix Design Guidelines for Asphalt Concrete.

Furnish representative samples of material to be used in the mixture as follows:

Material	Amount
New Coarse Aggregate	55 pounds
Emulsified Asphalt Cement	4 quarts in 1 quart plastic containers

Provide a JMF meeting the following mixture requirements:

EAC Mixture

Air Voids, %	15 - 30 according to AASHTO T 269*
IRS	Report according to ODOT TM 313*
Percent Coating	90% minimum

* AASHTO T 269 and ODOT TM 313 procedures available from ODOT Materials Laboratory.

00735.14 Choke Aggregate - Furnish choke aggregate meeting the gradation below. Perform sieve analysis according to AASHTO T 27. Use crushed or uncrushed rock free of clay, loam or other harmful substances.

Sieve Size	Percent Passing (by Weight)
3/8"	100
1/4"	90 - 100
No. 8	30 - 66
No. 30	8 - 28
No. 100	0 - 5

00735.15 Aggregate Production Quality Control - Provide quality control during production of EAC aggregate according to Section 00165. Sampling and testing shall be performed by a CAgT at the minimum frequency indicated in the MFTP.

(a) Quality Control Compliance - Evaluate EAC aggregates for conformance according to the following:

(1) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(2) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(3) Preproduced Aggregate - Compliance of aggregates produced and stockpiled before the award of this Contract will be determined by either of the following methods:

- Continuing production records meeting the requirements of 00735.10, 00735.14 and 00735.15.
- Sampling according to AASHTO T 2 and testing the entire stockpile at the minimum frequency schedule indicated in the MFTP. The material shall meet the requirements of 00735.10, 00735.14 and 00735.15.

00735.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of EAC aggregates if verified by the Agency's quality assurance program. The Agency 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 Agency or as designated in the Special Provisions.

00735.17 EAC Mixture Production Quality Control - Provide quality control during production of EAC mixture according to Section 00165 and the following:

(a) Personnel Requirements - Maintain quality control by:

- Providing at least one CAT-I full-time at each plant site used to furnish mixture to the Project.
- Obtaining samples under the direct supervision of a CAT-I.
- Having all testing, data analysis and reporting of test results performed by a CAT-I.

(b) Laboratory Requirements - Furnish and maintain an ODOT certified laboratory at the plant site furnished with the necessary equipment and supplies for performing Contractor quality control testing.

The laboratory shall be on-site and operational prior to the beginning of EAC production. Provide laboratory equipment meeting the requirements of the test methods identified in these Specifications.

Calibrate all testing equipment according to the required test methods. The Engineer may inspect measuring and testing devices to confirm both calibration and condition.

(c) Plant Calibration - Calibrate the plant according to ODOT TM 322. The plant calibration shall be witnessed and documented by a CAT-I. Do not begin production until calibration tests indicate that the specified proportions can be obtained.

(d) Required Tests - Randomly sample and test the aggregate and emulsified asphalt during EAC mixture production according to Section 00165 and the MFTP.

(e) Quality Control Compliance - Evaluate EAC mixture for compliance according to Section 00165 and the MFTP.

00735.18 Acceptance of EAC Mixture - The Contractor's quality control tests will be used for acceptance of EAC mixture if verified by the Agency's quality assurance program. The Agency will perform EAC mixture 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 amount of quality assurance testing on projects administered by other Agencies will be at the discretion of the Agency or as designated in the Special Provisions.

Equipment

00735.20 EAC Mixing Plant - Mix the EAC at a plant capable of providing a mix of aggregate and emulsified asphalt of uniform proportions and consistency as designated.

Provide mixing plants with the following operating equipment:

- A positive control linking the aggregate and emulsified asphalt feed so that a constant ratio of emulsified asphalt to aggregate is maintained.
- Totalizers for the emulsified asphalt metering device and the aggregate scales.
- A metering device that can determine percent of emulsified asphalt in mixture at any time the plant is in operation.
- An adjustable emulsified asphalt spray bar.
- Provide and operate a mechanical sampling device that produces a representative sample of the quantity of material required for the appropriate tests, when sampling at or around crushing, screening, mixing plants, conveyors, or other similar mechanical equipment.

Proportion the aggregate by weight. Proportion the emulsified asphalt by either weight or metering. Provide equipment capable of feeding and maintaining a constant rate of aggregate within a tolerance of plus or minus 5%, by weight, of the designated amount, and feeding a constant rate of emulsified asphalt within plus or minus 0.5%, by weight, of the designated amount.

00735.21 Hauling Equipment - Provide hauling vehicles in good operating condition with tight, clean, metal beds and a cover. Equip beds of hauling vehicles with a positive system to prevent materials from leaking onto the surfaces over which the hauling vehicle travels. If leakage occurs, remove any spilled material and repair any damage according to 00170.85.

Coat the beds with a minimum amount of an approved material to keep the EAC from sticking to the beds. Do not use diesel oil. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.

Do not use vehicles that cause segregation or delay operations.

00735.22 EAC Pavers - Provide EAC pavers meeting the following requirements:

(a) Power and Support - Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

(b) Augers and Screed - Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

- Can spread and finish EAC to a uniform texture, in the specified widths, thicknesses, lines, grades, and cross sections.

- Will not segregate, tear, shove, or gouge EAC.
- Produce a finished surface to specified evenness and texture.

(c) Control System - Equipped with a paver control system which:

- Controls EAC placement to specified slope and grade.
- Maintains the paver screed in proper position.
- Provides specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

00735.23 Compactors - Provide self-propelled, steel-wheeled and pneumatic-tired rollers capable of reversing without backlash according to the following:

(a) Steel-Wheeled Rollers - Provide steel-wheeled rollers with:

- A gross static weight of at least 8 tons.
- A gross static weight of at least 6 tons for finish rolling.

(b) Pneumatic-tired Rollers - Provide pneumatic-tired rollers meeting the following:

- Be tandem, or multiple axle, multiple wheel type.
- Have smooth-tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width.
- Have a minimum load of 2,800 pounds per tire with tire inflation pressures of 45 psi to 90 psi.

00735.24 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders of adequate width to provide full coverage of the specified panel.

00735.25 Power Brooms - Provide pickup and/or nonpickup power brooms that have a positive means to control vertical pressure.

00735.26 Release Agents - Do not use diesel oil as a release agent to coat or clean equipment at the mixing plant, or on hauling equipment beds or compactors.

Labor

00735.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CAT-I
- CMDT

Construction

00735.40 Season and Weather Limitations - Place EAC from May 1 to August 31, inclusive, when the pavement temperature is 60 °F or above. Seasonal limitations for EAC will not supersede seasonal limitations for emulsified asphalt surface treatments on the Project.

Do not place EAC:

- When the underlying layer is frozen.
- During rain or other adverse weather conditions.

Correct mixtures damaged by weather by milling and replacement or other approved methods at no additional cost to the Agency.

00735.41 Rate of Progress and Scheduling - Do not begin work until there is enough mixing, hauling, spreading and compacting equipment on the Project to assure that the paving machine can place the EAC without stopping, as nearly as possible.

00735.42 Preparation of Underlying Surfaces - Clean all deleterious material, dirt and dust from existing and new bases, surfacings, and pavements in a manner acceptable to the Engineer.

Bring the existing surface to uniformity by patching irregular or depressed surfaces and potholes with EAC thoroughly compacted until it conforms with the surrounding surface. Prepare individual potholes for patching by cutting the edges vertically to the depth of the deepest portion of the hole.

When designated in the plans or Special Provisions, place leveling courses of EAC on existing pavements before constructing the final paving course. Perform the leveling work to the lines and grades established. Place leveling material with either a paving machine or motor grader as directed.

Apply a tack coat to the existing surface according to Section 00730 prior to placing EAC.

00735.43 Mixing:

(a) General - Mix the aggregate and emulsified asphalt until a uniform consistency is obtained. Use the temperature of the emulsified asphalt cement recommended by the supplier.

(b) Moisture - At the time it is mixed with the emulsified asphalt, provide aggregate with a moisture content adequate to allow distribution of the emulsion, but not so great that moisture or emulsion runs from the mixture. Provide special processing necessary to attain an acceptable moisture content at no additional cost to the Agency.

(1) No Moisture Problem - A visual moisture content determination by the Engineer will suffice when there are no apparent moisture problems.

(2) Moisture Problems - If there are unresolved moisture problems, the maximum allowable moisture shall be the saturated surface dry (SSD) moisture content for the aggregate submitted for the JMF, as determined by AASHTO T 84 and AASHTO T 85.

00735.44 Control of Grade - Use a floating beam device of adequate length and sensitivity on either or both sides of the paver to provide adequate reference to control the grade of the paver.

Where this method is impractical, manual control of grade for the paver will be allowed when approved.

00735.45 Hauling, Depositing, and Placing:

(a) Hauling - Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the Contractor matches the delivery rate of mixture with the capacity of the paving machine.

If rain or cold weather conditions are encountered any time between loading and placement:

- Suspend mixing operations.
- Cover the mixture in transit.
- Do not place mixture that is in transit until conditions improve, unless placed at Contractor's risk according to 00735.40.
- Take action to prevent emulsion run-off from entering drainage channels or facilities.

The EAC will be rejected before placing if it is found to be:

- Segregating or separating.
- Solidifying or crusting.

Work with the Engineer to make appropriate adjustments if an excessive amount of emulsified asphalt is leaking from trucks.

No more EAC will be accepted until corrective action has been taken.

Dispose of rejected loads at no additional cost to the Agency.

(b) Depositing - Deposit the EAC material in windrows from the hauling vehicles so segregation is prevented. Alternate methods of depositing may be used if specified in the Special Provisions or allowed by the Engineer.

Provide pick-up equipment that can:

- Pick up substantially all of the material deposited on the roadway.
- Be self-supporting, not exert any vertical load on the paving machine, or cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement.

(c) Placing - Place the EAC on dry, prepared surfaces with pavers meeting the requirements of 00735.22. Spread and finish to established widths, thickness, line, grade and cross section.

When approved, the EAC may be spread with other equipment and means where irregularities or obstacles make the use of specified equipment impractical.

00735.46 Compaction - Compact the EAC as follows:

(a) General - After the EAC has been spread, struck off, and surface irregularities or other defects remedied roll it uniformly until compacted as specified.

(b) Rolling - Compact the EAC with rollers conforming to 00735.23. Provide sufficient rollers of type and weight to compact the mixture while it is in a workable condition. Operate rollers at a uniform speed not more than 3 mph, with the drive roll or wheels nearest the paver.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, and gradually progressing towards the center, unless otherwise directed. On superelevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously paved lane, roll the longitudinal joint first, followed by the regular rolling pattern.

Do not make sharp turns or park rollers on the EAC. Stop each pass at least 5 feet longitudinally from preceding stops. Do not displace the line and grade of edges. Prevent the EAC from sticking to

the wheels and spotting or defacing the EAC by wetting them with a minimum of water or other approved material.

(1) Breakdown Rolling - Use nonvibratory, three-wheel steel, or tandem-wheeled-steel rollers. Make at least three complete roller coverages.

(2) Intermediate Rolling - Use a self-propelled, pneumatic-tired roller following the placement of choke aggregate according to 00735.47. Make at least two complete roller coverages with the pneumatic-tired roller immediately following application of choke aggregate.

(3) Finish Rolling - Use nonvibratory, tandem-wheeled steel rollers, and continue until roller marks are eliminated.

Compact areas inaccessible to rollers with mechanical tampers as directed.

00735.47 Choke Aggregate - Provide at least two choke aggregate trucks. After breakdown compaction and before intermediate compaction, place choke aggregate with a chip spreader capable of obtaining a rate between 0.003 to 0.006 cubic yard per square yard.

If aggregate ravels or picks from the fresh EAC pavement during rolling operations or after opening to traffic, cover immediately with additional choke aggregate and roll with a tandem-wheeled steel roller, unless otherwise directed.

Be prepared to place additional choke aggregate for a period of 48 hours after the fresh EAC pavement is open to traffic. Spread excess aggregate uniformly across the fresh EAC pavement by brooming or other suitable means.

00735.48 Longitudinal Joints - Bond, compact and finish the new EAC at longitudinal joints equal to the EAC against which it is placed.

(a) Location - Place EAC in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.

(1) Base Course - Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Do not construct longitudinal joints in the wearing course within the area or width of a traffic lane. On median lanes and on shoulder areas, construct joints only at lane lines or at points of change in the transverse slopes, as shown or as directed.

(b) Drop-offs:

- Provide warning signs and markings according to Section 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.
- If unable to complete the pavement without drop-offs according to 00735.48(c):
  - Construct and maintain a wedge of EAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.
  - Remove and dispose of the wedge before continuing paving operations.
  - Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. EAC for the temporary wedge will be paid for at the pay item price.

(c) Placing EAC Under Traffic - When placing EAC pavement under traffic, schedule work for the nominal thickness being laid as follows or as required by the Special Provisions:

(1) More Than 2 inches - Schedule work so at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.

(2) More Than 1 inch But Not More Than 2 inches - Schedule work so at the end of each working shift one panel of new travel lane pavement does not extend beyond the adjoining panel of new travel lane pavement more than the distance normally covered by each shift. At the end of each workweek complete the full width of the area to be paved, including shoulders, to the same elevation with no longitudinal drop-offs.

00735.49 Transverse Joints - Construct transverse joints according to the following:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified pavement courses, except leveling courses, as follows:

(1) Project Ends - Construct transverse joints at Project ends as shown or as directed.

(2) Temporary End Panel - Maintain pavement depth, line and grade at least 5 feet beyond the selected transverse joint location, and from that point wedge down on the appropriate slope until it meets the surface beneath the EAC, assuming a pavement course thickness of 2 inches, as follows:

- For wedges that will be under traffic for less than 24 hours, the wedge length shall be 8 feet (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, the wedge length shall be 25 feet (1V:160H taper rate).

When the pavement course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 5 feet or longer panel form the "temporary end panel".

(3) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, cutting or other approved methods.
- Remove EAC material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth panel at least 5 feet long, beginning at the sawed or cut joint, and taper it according to 00735.49(a-2) to zero thickness.

(4) Excess EAC - After completing a temporary end panel as specified, dispose of the unused remainder of EAC as directed. Payment will be made for the entire load of EAC, but will be limited to one load only per joint per panel.

(5) Resume Paving - When permanent paving resumes, remove the temporary end panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(6) Joint Requirements - Compact both sides of the joint to specified density. When tested with a straightedge placed across the joint, provide a joint surface meeting specified surface tolerances.

(b) Abutting Bridge Ends - Compact the EAC abutting bridge ends, and other rigid type structures, in the transverse and/or diagonal direction, as well as longitudinally, as directed.

Maintenance

00735.60 Correction of Defects - Correct all defects in material and work, as directed, at no additional cost to the Agency. Defects include segregation of materials, nonuniform texture and fouled surfaces preventing full bond between successive spreads of mixture. No adjustment in Contract time will be made for corrective work.

(a) Slicks - Remove and replace slicks immediately with suitable materials.

(b) Roller Damage Surface Repair - Correct all displacements of any course at once, with rakes and addition of fresh mixture when required, regardless of thickness.

(c) Other Defects - Remove, replace with fresh EAC, and compact to conform to the surrounding area all EAC that:

- Is loose, broken or mixed with dirt.
- Shows visually too much or too little asphalt.
- Is defective in any way.

If a seal coat is required by the Special Provisions, or if directed, remove and replace the EAC that contains defects, excesses, or deficiencies prior to placing the seal coat at no additional cost to the Agency.

00735.61 Brooming - Remove loose choke aggregate by carefully brooming the entire surface. Do this as directed by the Engineer, unless brooming damages the new EAC pavement.

Subsequent brooming the following two days may be directed by the Engineer to ensure that the surface is free of loose aggregate that could cause vehicle damage.

In curbed areas, use a pick up type power broom. On bridges, sidewalks and other areas off the roadway, remove all loose aggregates to the satisfaction of the Engineer.

00735.62 Curing - After each lift of EAC has been placed, allow the EAC to cure a minimum of 72 hours after laydown or as directed, before placing the next lift of EAC.

Finishing and Cleaning Up

00735.70 Pavement Smoothness - Furnish a 12 foot straightedge and/or a 12 foot rolling straightedge and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

Perform pavement smoothness testing immediately after initial brooming of choke aggregate.

(a) Single Course Construction - Test with the 12 foot straightedge parallel to and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch.

(b) Multiple Course Construction - Test the surface of the course on which the wearing course is placed according to 00735.70(a).

Test the wearing course of EAC with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout the Project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.

Also test the wearing course of EAC with a 12 foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, both wheel paths of the entire mile shall be tested.

00735.71 Correction of Pavement Roughness - Correct equipment or paving operation immediately when tests show the pavement smoothness is not meeting the tolerance in 00735.70.

Correct the surface roughness to the required tolerances by a means acceptable to the Engineer.

Complete correction of all surface roughness within 14 calendar days following notification unless otherwise directed at no additional cost to the Agency.

00735.72 Fog Coat - After the EAC has cured at least 14 calendar days, apply a fog coat to the EAC surface according to Section 00705. Place the fog coat at least one day prior to placing a single or multiple application surface treatment if a surface treatment is required by the Special Provisions.

00735.73 Emulsified Asphalt Surface Treatment - After the EAC has been placed and has cured at least 14 calendar days, apply a single or multiple application emulsified asphalt surface treatment according to Section 00710 or Section 00715 if required by the Special Provisions.

Measurement

00735.80 Measurement - The quantities of EAC will be measured on the weight basis. No deduction will be made for the weight of the emulsified asphalt used in the EAC.

The quantities of emulsified asphalt in the EAC will be measured on the weight basis.

The quantities of choke aggregate will be measured on the weight basis, or on the volume basis in the hauling vehicle.

Payment

00735.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Emulsified Asphalt Concrete Mixture	Ton
(b)	Emulsified Asphalt in Mixture	Ton
(c)	Choke Aggregate	Ton or Cubic Yard
(d)	Emulsified Asphalt Concrete in Leveling and/or Patching	Ton
(e)	Haul and Place Emulsified Asphalt Concrete Mixture	Ton
(f)	Haul and Place Choke Aggregate	Ton

Item (d) applies when EAC is used in leveling, patching, or leveling and patching.

Item (e) applies to EAC that is furnished by the Agency and hauled and placed by the Contractor.

Item (f) applies to choke aggregate that is furnished by the Agency and hauled and placed by the Contractor.

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

No separate or additional payment will be made for water used in brooming operations.

Section 00744 - Minor Hot Mixed Asphalt Concrete (MHMAC) Pavement

Description

00744.00 Scope - This work consists of constructing minor hot mixed asphalt concrete (MHMAC) pavement to the lines, grades, thicknesses, and cross sections shown or established.

00744.01 Abbreviations:

TSR - Tensile Strength Ratio
VFA - Voids Filled with Asphalt
VMA - Voids in Mineral Aggregate

00744.02 Definitions:

Minor Hot Mixed Asphalt Concrete (MHMAC) - A hot plant mixed, uniformly coated mixture of asphalt cement, graded aggregate and additives as required.

Level 1 MHMAC - MHMAC for use in applications with very low traffic and only limited exposure to trucks.

Level 2 MHMAC - MHMAC for use in applications with low traffic volumes and low volume truck traffic.

Level 3 MHMAC - MHMAC for use in applications exposed to moderate truck traffic.

00744.03 Reclaimed Asphalt Pavement (RAP) Material - Reclaimed HMAC pavement (RAP) material used in the production of new MHMAC is optional. No more than 30% RAP material will be allowed in the new MHMAC pavement.

Materials

00744.10 Aggregate - Furnish coarse, fine, and RAP aggregates for MHMAC meeting the following requirements:

Testing of aggregates for soundness, durability, and harmful substances will be at the discretion and expense of the Agency.

(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:

	Test Method		Aggregates
Test	**ODOT**	**AASHTO**	**Coarse**
Abrasion		T 96	30.0%
Degradation			
Passing No. 20 sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(c) Fractured Faces - Provide crushed aggregate with not less than the minimum number of fractured faces as determined by AASHTO TP 61 as follows:

	Percent of Fracture (by Weight)	
Type of Mix	**Material Retained on 1 1/2", 1", 3/4", 1/2" and No. 4 Sieve (two fractured faces)**	**Material Retained on No. 8 sieve (one fractured face)**
All Dense Graded MHMAC	75	75

(d) Harmful Substances - Do not exceed the following maximum values:

	Test Method		Aggregates	
Test	**ODOT**	**AASHTO**	**Coarse**	**Fine**
Lightweight pieces		T 113	1.0%	
Wood Particles	TM 225		0.10%	
Elongated Pieces (at a ratio of 5:1)	TM 229		10.0%	
Plasticity Index		T 90		0 or NP
Sand Equivalent		T176		45 min

(e) Coarse Aggregate - Produce coarse aggregate from crushed rock or other inert material of similar characteristics.

(f) Fine Aggregate - Produce fine aggregate from crushed rock or other inert material of similar characteristics.

Blend sand is allowed for Levels 1, 2, and 3 mixes. Do not blend more than 10% by weight of natural or uncrushed blend sand into the total fine aggregate unless approved. Provide a means of verifying and documenting the amount of blend sand added to the aggregate.

(g) RAP Aggregate - Use RAP aggregates in the MHMAC, according to 00744.03, that are no larger than the specified maximum allowable aggregate size before entering the cold feed. Blend the RAP material with new aggregate to provide a mixture conforming to the JMF within the tolerances specified.

00744.11 Asphalt Cement and Additives - Furnish the 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 Agency.

Asphalt in RAP material, when blended with new asphalt shall provide properties similar to the above specified asphalt. When RAP material is used at a rate of less than 15%, no adjustment to the new asphalt will be required. When utilizing RAP at a rate at or above 15%, the combined RAP and new

asphalt shall provide blended properties equivalent to the specified grade. Determine the blended properties according to ASTM D 4887. Determine asphalt cement properties for the RAP material from asphalt cement recovered from the RAP according to AASHTO T 170.

(b) Asphalt Cement Additives - When required by the JMF, add antistripping additives meeting the requirements below and satisfying the Tensile Strength Ratio (TSR) specified in 00744.13.

Additives to prevent stripping or separation of asphalt coatings from aggregates, and admixtures used to aid in the mixing or use of asphalt mixes or for experimental purposes, shall be standard recognized products of known value for the intended purpose and approved for use on the basis of laboratory tests. They shall have no deleterious effect on the asphalt material and be completely miscible. Do not use silicones as an additive.

00744.12 Mix Type and Broadband Limits - Mix type and broadband limits shall meet the following:

(a) Mix Type - Furnish the type(s) of MHMAC shown or as directed. The broadband limits for each of the mix types are specified in (b) below. When the plans allow an option of two types for a course of pavement, use only one type throughout the course.

(b) Broadband Limits - Provide a JMF for the specified mix type within the control points listed below:

Sieve Size	3/4" Dense		1/2" Dense		3/8" Dense	
	Control Points (% passing by Weight)		Control Points (% passing by Weight)		Control Points (% passing by Weight)	
	Min.	Max.	Min.	Max.	Min.	Max.
1"	100					
3/4"	90	100	100			
1/2"	–	90	90	100	100	
3/8"	–	–	–	90	90	100
No. 4	–	–	–	–	–	90
No. 8	23	49	28	58	32	67
No. 200	2.0	8.0	2.0	10.0	2.0	10.0

00744.13 Job Mix Formula (JMF) Requirements - Provide a JMF for the Project meeting the following criteria and that was either developed or verified within three years of the date the Contract was advertised:

	Level 1	Level 2	Level 3
Design Method	Superpave	Superpave	Superpave
Compaction Level	65 Gyrations	65 Gyrations	80 Gyrations
Air Voids, %	3.5	4.0	4.0
VMA, % minimum	1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0
VMA, % maximum	min + 2.0%	min + 2.0%	min + 2.0%
P No. 200 / Eff. AC ratio	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6
TSR, % minimum	80	80	80
VFA, %	70 - 80 3/8 inch: 70 - 80	65 - 78 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80

The JMF shall have been developed according to the ODOT Contractor Mix Design Guidelines for Asphalt Concrete or verified according to the ODOT Mix Design Verification process. Submit the proposed JMF and supporting data to the Engineer for review at least 10 calendar days before anticipated use. If acceptable, written acceptance will be provided. Perform a new TSR if the source of the asphalt cement changes.

00744.14 Tolerances and Limits - Produce and place MHMAC within the following JMF tolerances and limits:

Gradation Constituent	MHMAC Type 3/4"	1/2"	3/8"
1"	JMF ± 5% *		
3/4"	90 - 100%	JMF ± 5% *	
1/2"	JMF ± 5%	90 - 100%	JMF ± 5% *
3/8"	–	–	90 - 100%
No. 4	JMF ± 5%	JMF ± 5%	JMF ± 5%
No. 8	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 30	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 200	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%

* Maximum not to exceed 100%

Constituent of Mixture	MHMAC All Types
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 00744.12(b).

00744.16 MHMAC Acceptance - The mixture will be accepted by visual inspection by the Engineer. If the mixture is considered suspect, the Engineer may verify that the mixture is within tolerances and limits of 00744.14. When requested, obtain samples according to appropriate procedures in the MFTP under the observation of the Engineer at a frequency established by the Engineer. The Engineer will test for gradation, asphalt content, moisture, and RAP content (if applicable) according to procedures specified in 00744.14 and the MFTP. Take corrective action when testing shows that MHMAC is not within the tolerances and limits of 00744.14.

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 ton.

If steel-wheeled rollers are used for finish rolling, they shall have:

- A gross static weight of at least 6 ton.

(b) Vibratory Rollers - Vibratory rollers shall be:

- Equipped with amplitude and frequency controls.
- Specifically designed to compact MHMAC.
- Capable of at least 2,000 vibrations per minute.
- Have a gross static weight of at least 8 ton.

Do not operate in vibratory mode for lifts thinner than two times the maximum aggregate size for the type of MHMAC being compacted.

Labor

00744.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CAT-1
- CDT

Construction

00744.40 Season and Temperature Limitations - Place MHMAC when the temperature of the surface that is to be paved is not less than the temperature indicated:

Nominal Compacted Thickness of Individual Lifts and Courses as shown on the typical section of the plans	**All Levels**	**Level 1 and Level 2**	**Level 3**	
		All Courses	**Travel Lane Wearing Course**	**All Other Courses**
	Surface Temperature*	**From To Inclusive**	**From To Inclusive**	**From To Inclusive**
Dense Graded Mixes				
Less than 2 inches	60 °F	All Year**	3/15 9/30	All Year**
2 inches - 2 1/2 inches	50 °F	All Year**	3/15 9/30	All Year**
Greater than 2 1/2 inches	40° F	All Year**	3/15 9/30	All Year**
Temporary	40 °F	All Year**	All Year**	All Year**

* If placing MHMAC between March 15 and September 30, temperature requirement may be lowered 5 °F.

** Do not use field burners or other devices to heat the pavement surface to the specified minimum temperature.

00744.43 MHMAC Mixing Temperatures - Produce MHMAC within the temperature ranges recommended by the asphalt cement supplier for the grade of asphalt being used on the Project.

00744.44 Tack Coat - Construct a tack coat prior to placing each lift of MHMAC according to Section 00730. A tack coat is not required prior to placing MHMAC on aggregate base.

00744.49 Compaction - Immediately after the MHMAC has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly with rollers meeting the requirements of 00744.24 until compacted as specified.

Perform breakdown and intermediate rolling until the entire surface has been compacted by at least six coverages of the roller(s). Complete breakdown and intermediate compaction before MHMAC temperature drops below 180 °F, unless otherwise directed. Perform additional coverages for finish rolling until all roller marks are eliminated.

Maintenance

00744.60 Correction of Defects - Correct all defects in materials and work, as directed, at no additional cost to the Agency, as follows:

(a) Fouled Surfaces - Immediately repair, clean and retack fouled surfaces that would prevent full bond between successive lifts of mixture.

(b) Boils, Slicks, and Oversized Material - Immediately replace boils, slicks, and oversized materials with fresh mixture.

(c) Segregation - Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved.

(d) Roller Damage to the Surface - Immediately correct surface damage from rollers with additional fresh mixture or by other means approved.

(e) Longitudinal Joints - Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved.

(f) Other Defects - Remove and replace any MHMAC that:

- Is loose, broken, or mixed with dirt.
- Shows visually too much or too little asphalt.
- Is defective in any way.

00744.61 Longitudinal Joints - At longitudinal joints, bond, compact and finish the new MHMAC equal to the MHMAC against which it is placed.

(a) Location - Place the MHMAC in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.

(1) Base Course - Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Longitudinal joints shall not occur within the width of a traffic lane. They shall be located at either skip lines or fog lines unless approved. 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 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 00744.61(c) do the following:

- Construct and maintain a wedge of MHMAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.
- Remove and dispose of the wedge before continuing paving operations.
- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. MHMAC for the temporary wedge will be paid for at the pay item price.

(c) Placing MHMAC Under Traffic - When placing MHMAC pavement under traffic, schedule work for the nominal thickness being laid as follows:

(1) More Than 2 Inches - Schedule work so at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.

(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.

00744.62 Transverse Joints:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified pavement courses, except leveling courses, as follows:

(1) Temporary End Panel - Maintain pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate slope until the top of the course being laid meets the underlying surface (assuming a pavement course thickness of 2 inches) as follows:

- For wedges that will be under traffic for less than 24 hours, construct a 8 foot long wedge (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, construct an 25 foot long wedge (1V:160H taper rate).
- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. MHMAC for the temporary wedge will be paid for at the pay item price.

When the pavement course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 4 feet or longer panel form the "temporary end panel".

(2) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, cutting or other approved method.
- Remove the MHMAC material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth panel at least 4 feet long, beginning at the sawed or cut joint, and taper it on a 1V:50H slope to zero thickness.

(3) Excess MHMAC - After completing a temporary end panel as specified, dispose of unused, remaining MHMAC as directed. Payment will be made for the entire load of MHMAC, but will be limited to only one load per joint per panel.

(4) Resume Paving - When permanent paving resumes, remove the temporary end panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(5) Joint Requirements - Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances.

(b) Abutting Bridge Ends - Compact the MHMAC abutting bridge ends and other rigid type structures in the transverse 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, ± 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 QPL.

Finishing and Cleaning Up

00744.70 Pavement Smoothness - Furnish a 12 foot straightedge. Test with a 12 foot straightedge parallel to 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.

00744.75 Correction of Pavement Roughness - Immediately correct equipment or paving operation procedures when tests show the pavement smoothness does not comply with 00744.70. In addition, do the following:

(a) Methods - Correct surface roughness to the required tolerances, using one of the following methods as approved by the Engineer:

- Remove and replace the wearing surface lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades, and apply an emulsion fog seal as directed.

(b) Time Limit - Complete correction of all surface roughness within 14 calendar days following notification, unless otherwise directed.

Measurement

00744.80 Measurement - The quantities of MHMAC will be measured on the weight basis.

No deductions and no separate measurement will be made for asphalt cement, mineral filler, lime, anti-strip, or any other additive used in the mixture.

No separate measurement will be made for asphalt tack coat. An estimated amount of asphalt in tack coat will be listed in the Special Provisions.

Payment

00744.90 Payment - The accepted quantities of MHMAC incorporated into the project, whether or not recycled materials are used, will be paid for at the Contract unit price, per ton, for the item "Level ___, _____, MHMAC Mixture, _____".

The following will be inserted in the blanks:

- The level(s) of MHMAC (1, 2, 3) will be inserted in the first blank
- The type(s) of MHMAC (3/4 inch Dense, 1/2 inch Dense, 3/8 inch Dense), will be inserted in the second blank
- The words "in Leveling", "in Temporary", or "in Leveling and Temporary" will be inserted in the third blank when applicable

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

No separate or additional payment will be made for the asphalt tack coat.

No separate or additional payment will be made for sawing, cleaning, and filling joints on bridge deck overlays.

Section 00745 - Hot Mixed Asphalt Concrete (HMAC)

Description

00745.00 Scope - .This work consists of constructing one or more courses of hot mixed asphalt concrete (HMAC) pavement, plant mixed into a uniformly coated mixture, 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.

00745.01 Abbreviations:

MAMD - Moving Average Maximum Density
MDT - Maximum Density Test
MDV - Mix Design Verification
Gmm - Maximum Specific Gravity of Mixture
SDC - Surface Damp Condition
TSR - Tensile Strength Ratio
VFA - Voids Filled with Asphalt
VMA - Voids in Mineral Aggregate

00745.02 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 truck traffic.

Level 4 HMAC - HMAC for use in applications exposed to very heavy traffic volumes 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. A JMF adjusted according to 00745.16 is not considered a new JMF.
- The method for measuring compaction is changed.
- A new compaction specification limit is required according to 00745.49(b-3).
- 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 1,000 tons of HMAC.

Surface Damp Condition (SDC) - When the outside of the aggregates are damp with moisture, but little or no free water is present.

Wearing Course - The top lift of HMAC, regardless of thickness.

00745.03 Reclaimed Asphalt Pavement (RAP) Material - Reclaimed HMAC pavement (RAP) material used in the production of new HMAC is optional. No more than 30% RAP will be allowed in Level 1, Level 2, and Level 3 HMAC. No more than 30% RAP will be allowed in Level 4 base courses. No more than 20% RAP will be allowed in Level 4 wearing courses. RAP material will not be allowed in open graded HMAC.

The amount of asphalt cement in the RAP shall be established in the mixture design phase according to ODOT TM 323 and AASHTO T 308 or other method if approved by the Engineer. Additional testing may be requested at any time by the Agency or the Contractor during the production of the RAP mixture to verify the amount of asphalt cement in the RAP. Conduct new tests by a laboratory mutually agreed upon by the Agency and the Contractor. Pay the cost of additional testing by the party requesting the testing.

Materials

00745.10 Aggregate - Produce and stockpile aggregate as follows:

When requested by the Engineer, supervisory personnel of the Contractor and any subcontractors who are to be involved in HMAC aggregate crushing shall meet with the Engineer at a mutually agreed upon time to discuss accomplishing all phases of the crushing work.

Provide and stockpile new aggregates and RAP aggregates according to the following requirements:

(a) General - Produce and stockpile aggregate as follows:

(1) Separated Sizes - Advise the Engineer of the separated size(s) of coarse and fine aggregate that will be used and the proposed targets for each individual sieve size for each stockpile. A minimum of one coarse aggregate and one fine aggregate stockpile is required. If the Contractor wishes to produce coarse and fine aggregates in separated sizes other than those specified, request the proposed size changes in writing, and state the proposed target value and specified tolerance for each of the individual sieve sizes of the proposed materials.

The number of fine aggregate separated sizes selected by the Contractor does not relieve the Contractor of providing a JMF and producing HMAC meeting the air voids, VMA, and VFA requirements of 00745.13(b) and 00745.16(b-1-a). Perform recrushing, rescreening, or other special processing of the fine aggregates necessary to achieve the air voids, VMA, or VFA requirements at no additional cost to the Agency.

(2) Scalping - Scalp the rock on a 3/4 inch sieve screen deck (after it has passed through the primary crusher if quarry rock is used). The material remaining may be accepted for use by visual inspection. The Engineer may perform verification testing of the gradation. The material shall meet the following:

Sieve Size	Percent Passing (by Weight)
8"	95 - 100
3/4"	5 Max.

(3) 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.

(4) Durability - Provide aggregate not exceeding the following maximum values:

Test	Test Method ODOT	Test Method AASHTO	Aggregates Coarse
Abrasion		T 96	30.0%
Degradation			
Passing No. 20 sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(5) Fractured Faces - Provide crushed aggregate with not less than the minimum number of fractured faces as determined by AASHTO TP 61 as follows:

Type of Mix	Percent of Fracture (by Weight) Material Retained on 1 1/2", 1", 3/4", 1/2" and No. 4 Sieve (two fractured faces)	Material Retained on No. 8 sieve (one fractured face)
All Dense Graded HMAC, ATPB	75	75
All Open Graded HMAC	90	75

(6) Harmful substances - Do not exceed the following values:

Test	Test Method ODOT	Test Method AASHTO	Aggregates Coarse	Aggregates Fine
Lightweight pieces		T 113	1.0%	
Wood Particles	TM 225		0.10%	
Elongated Pieces (at a ratio of 5:1)	TM 229		10.0%	
Plasticity Index		T 90		0 or NP
Sand Equivalent		T176		45 min.[1]

[1] 50 min. for Level 4 HMAC

(b) Coarse Aggregate - Provide coarse aggregate meeting the following:

(1) General Requirements - Produce coarse aggregate from crushed rock or other inert material of similar characteristics.

(2) Separated Sizes - Allowable separated sizes of coarse aggregate are as follows:

Type of Asphalt Concrete Mixture	Allowable Separated Sizes 1 1/4" - 3/4"	3/4" - No. 4	3/4" - 1/2"	1/2" - No. 4
1" Dense	Yes	Yes	Yes	Yes
3/4" Dense, Open and ATPB	–	Yes	Yes	Yes
1/2" Dense and Open	–	–	–	Yes

(3) Grading - Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Establish the target values for each allowable separated size after a maximum of 10% of planned stockpile quantity has been produced. Produce the aggregate within the following listed tolerances (T):

	Separated Sizes			
	1 1/4" - 3/4"	**3/4" - No. 4**	**3/4" - 1/2"**	**1/2" - No. 4**
	Percent Passing (by Weight)			
Sieve Size	**T**	**T**	**T**	**T**
1 1/2"	- 1	–	–	–
1 1/4"	± 5	–	–	–
1"	± 10	- 1	- 1	–
3/4"	± 5	± 5	± 7	- 1
1/2"	–	± 8	± 8	± 5
3/8" *	–	–	–	–
No. 4	± 3	± 8	± 8	± 8
No. 8	–	± 5	± 5	± 5
No. 30	± 1	± 3	± 3	± 3
No 200	–	± 1.0	± 1.0	± 1.0

* Report percent passing sieve when no tolerance is listed

(c) Fine Aggregate - Provide fine aggregate meeting the following:

(1) General - Produce fine aggregate from crushed rock or other inert material of similar characteristics and if allowed, blend sand.

(2) Separated Sizes - Allowable separated sizes for fine aggregates are:

No. 4 - 0
No. 4 - No. 8
No. 8 - 0

(3) Grading - Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Establish the target values for each allowable separate size after a maximum of 10% of planned stockpile quantity has produced. Produce the aggregate within the following listed tolerances (T):

	Separated Sizes		
	No. 4 - 0	**No. 4 - No. 8**	**No. 8 - 0**
	Percent passing (by Weight)		
Sieve Size	**T**	**T**	**T**
3/8"	- 1	- 1	–
No. 4	± 7	± 10	- 1
No. 8	± 7	± 7	± 10
No. 30	± 7	± 5	± 8
No 200	± 3.0	± 2.0	± 4.0

(4) Combination of Fine Aggregate for Testing - Blend together fine aggregate produced in two separated sizes at a 1:1 ratio when testing for fine degradation, and sand equivalent.

(5) Blend Sand - No natural or uncrushed blend sand will be allowed in Level 4 HMAC unless approved. Blend sand is allowed for Levels 1, 2, and 3 mixes. For these mixes, establish the target gradation and produce all material within the following tolerances (T):

Sieve Size	Percent Passing (by Weight) T
3/8"	- 1
No. 4	± 5
No. 8	± 15
No. 30	± 20
No. 200	± 5.0

Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Do not blend more than 10% by weight of natural or uncrushed blend sand into the total fine aggregate to produce an allowable separated size unless approved. Provide a means of verifying and documenting the amount of blend sand added to the aggregate.

(d) RAP Aggregate - Blend the RAP material with new aggregate to provide a mixture conforming to the JMF within the tolerances specified.

(e) Stockpiling - Prepare the ground for the stockpile site to prevent contamination. Prevent segregation and contamination, as much as possible, when stockpiling and removing the aggregate.

(f) 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 and the MFTP. Sample before treating with hydrated lime, when lime is required.

(g) Preproduced Aggregate - Compliance of aggregates produced and stockpiled before the award date or notice to proceed of this Contract will be determined by (1) or (2) below. The material shall meet the requirements of 00745.10.

(1) Continuing production records meeting the requirements of Section 00165 and the MFTP.

(2) Sampling and testing of the entire stockpile according to Section 00165 and the MFTP.

00745.11 Asphalt Cement, Additives, and Aggregate Treatment - Furnish the following:

(a) Asphalt Cement - Use the grade of asphalt 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.

PG 64-22 or PG 64-28 asphalt cement may be substituted for the grade of asphalt cement specified in the Contract for guardrail flares, mailbox turnouts, road approaches, driveways, and non-travel lane areas of restricted widths that are less than 8 feet wide, excluding shoulders. Use of substitute asphalt cement for these areas will not require a new JMF.

(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 00745.13.

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.

(c) Aggregate Treatment - When lime treated aggregate is specified in the Contract Documents or required to satisfy the TSR specified in 00745.13, treat new crushed aggregates, except those in RAP materials, with dry hydrated lime meeting the requirements of ASTM C 1097. Treat aggregate as follows:

(1) General:

a. Mix the hydrated lime, water, and aggregate thoroughly in a pug-mill.

b. Determine the quantity of lime in aggregate for each sublot according to ODOT TM 321. If the rates of application specified in 00745.11(c-2-b) are not met, take corrective action. Document the corrective action and notify the Engineer.

(2) Treatment During HMAC Production:

a. Mix dry lime, water (if necessary to achieve SDC), and aggregates thoroughly in a pug-mill before they enter the paving plant dryer.

b. Proportions of hydrated lime and aggregate moisture (percents by weight of dry aggregates):

	Dense	**Open**
Hydrated Lime (%)	1.0	0.7
Lime Tolerance (%)	- 0.2/+ 0.5	- 0.2/+ 0.5
Moisture Content of Aggregate	SDC	SDC

00745.12 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 00745.12(b). 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

Sieve Size	**1" Dense**		**3/4" Dense**		**1/2" Dense**		**3/8" Dense**	
	Control Points (% passing by Weight)		**Control Points (% passing by Weight)**		**Control Points (% passing by Weight)**		**Control Points (% passing by Weight)**	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
1 1/2"	100							
1"	90	100	100					
3/4"	–	90	90	100	100			
1/2"	–	–	–	90	90	100	100	
3/8"	–	–	–	–	–	90	90	100
No. 4	–	–	–	–	–	–	–	90
No. 8	19	45	23	49	28	58	32	67
No. 200	1.0	7.0	2.0	8.0	2.0	10.0	2.0	10.0

Open Graded Mixes

Sieve Size	1/2" Open		3/4" Open		3/4" ATPB	
	Control Points (% passing by Weight)		Control Points (% passing by Weight)		Control Points (% passing by Weight)	
	Min.	Max.	Min.	Max.	Min.	Max.
1"			99	100	99	100
3/4"	99	100	85	96	85	95
1/2"	90	98	55	71	35	68
No. 4	18	32	10	24	2	10
No. 8	3	15	6	16	0	5
No. 200	1.0	5.0	1.0	6.0	0.0	2.0
Asphalt Cement	*	*	*	*	2.5	3.5

* Per JMF

00745.13 Job Mix Formula (JMF) Requirements - Do not begin production of HMAC for use on the project until the JMF is reviewed by the Engineer and written consent is provided to proceed. The JMF proposed for use on the project will be evaluated based on the criteria identified in 00745.13(b) and 00745.13(c) and the latest ODOT Contractor Mix Design Guidelines for Asphalt Concrete. For all mixes, complete TSR testing at least once per calendar year on mix from the first week of production of that JMF for that year. A new JMF is required if the asphalt cement grade, any additives, or the source of the aggregate change during production. A change in the source of asphalt cement requires a new JMF for open graded HMAC, but only a new passing TSR for dense graded HMAC.

Provide a range of proposed JMF targets to the CMDT. The CMDT will select targets from within the proposed range if all of the JMF requirements of 00745.13(b) are met.

(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

	Level 1	Level 2	Level 3	Level 4
Design Method	Superpave	Superpave	Superpave	Superpave
Compaction Level	65 Gyrations	65 Gyrations	80 Gyrations	100 Gyrations
Air Voids, %	3.5	4.0	4.0	4.0
VMA, % minimum	1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0
VMA, % maximum	min + 2.0%	min + 2.0%	min + 2.0%	min + 2.0%
P No. 200 / Eff. AC ratio	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6
TSR, % minimum	80	80	80	80
VFA, %	70 - 80 3/8 inch: 70 - 80	65 - 78 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80

	Open Graded Mixture	
	3/4" Open and 1/2" Open	3/4" ATPB
Design Method	ODOT	ODOT
Air Voids, %	13.5 - 16.0	–
Draindown, %	70 - 80	–
TSR *, minimum	80	–
Coating, %, minimum	–	90
VFA, %	40 - 50	

* Run the TSR for open graded mixtures on a surrogate dense graded mixture. If a dense graded JMF has been prepared for the same material sources in the last year, the results for the most recent TSR may be applied to the open graded mixture. If not, prepare the TSR test samples for a dense graded mix using the equivalent top size stone and materials from the same sources, which will represent the open graded mixture.

(c) Performance Test - For dense graded Level 3 wearing course mixes and all dense graded Level 4 mixes, the mix design submittal shall include the results of performance testing as outlined in the latest ODOT Contractor Mix Design Guidelines for Asphalt Concrete.

00745.14 Tolerances and Limits - For gradation, measure the sieves with a weighting factor of one or more according to 00745.95. Produce and place HMAC within the following JMF tolerances and limits:

Gradation Constituent	Dense-Graded HMAC Type				Open-Graded HMAC Type		
	1 "	3/4"	1/2"	3/8"	3/4"	1/2"	ATPB
1 1/2"	JMF ± 5%*						
1"	90 - 100%	JMF ± 5%*			99 - 100%		99 - 100%
3/4"	JMF ± 5%	90 - 100%	JMF ± 5%*		85 - 96%	99 - 100%	85 - 95%
1/2"	JMF ± 5%	JMF ± 5%	90 - 100%	JMF ± 5%*	55 - 71%	90 - 98%	35 - 68%
3/8"	–	–	–	90 - 100%	–	–	–
No. 4	JMF ± 5%	JMF ± 5%	JMF ± 5%	JMF ± 5%	JMF ± 5%	JMF ± 5%	JMF ± 5%
No. 8	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 30	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	JMF ± 4%	–
No. 200	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0 %	JMF ± 2.0%	JMF ± 2.0%

* Maximum not to exceed 100%

Constituent of Mixture	HMAC All Types
Asphalt Cement - ODOT TM 321 (Cold Feed/Meter)	JMF ± 0.20%
Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323	JMF ± 0.50%
RAP Content - ODOT TM 321	JMF ± 2.0%
Moisture content at time of discharge from the mixing plant - WAQTC TM 6	
Open-graded *	1.10% max.
Dense-graded	0.80% max.

* Does not apply to 3/4" ATPB

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the Control Points established in 00745.12(b). Full tolerance will be given for RAP content even if it exceeds the limits established in 00745.03.

Take corrective action when the RAP content exceeds the above tolerance. If the RAP content continues to be outside tolerance, stop production until a plan for corrective action is approved by the Engineer.

00745.16 HMAC Production QC/QA - The following provisions apply to all HMAC:

(a) Quality Control - Provide and maintain a quality control program as defined in Section 00165, the MFTP and according to the following:

(1) Personnel Requirements - Maintain quality control by:

- Obtaining samples under the direct supervision of a CAT-I.
- Having all testing, data analysis and reporting of test results performed by a CAT-I or an assistant technician under the direct observation of a CAT-I.
- Having a CAT-II available to make necessary process adjustments.

(2) Laboratory Requirements - Furnish and maintain an ODOT certified quality control laboratory. Furnish the laboratory with the necessary equipment and supplies for performing Contractor quality control testing. Calibrate all testing equipment according to the required test methods. The Engineer may inspect measuring and testing devices to confirm both calibration and condition.

The laboratory shall be operational prior to the beginning of HMAC production and be equipped with a telephone or cellular telephone, if either service is available. Provide laboratory equipment meeting the requirements of the applicable test methods identified in these Specifications and selected for use on the project.

(3) HMAC Production Sampling and Testing - Perform sampling and testing according to Section 00165 and the MFTP.

(4) Testing Frequency - Conduct the above testing program, once for each sublot, on randomly selected samples for each design mixture. (Do not obtain the first sample of the day in the first 25 tons of production.) If the random number indicates that the sample is to be obtained in the first 25 tons, sample at 25 tons. In addition, test the asphalt content at least once during each day of production. This requirement may be waived by the Engineer.

After the Mix Design Verification (MDV) testing requirements of 00745.16(b) have been met, the frequency for Maximum Specific Gravity (AASHTO T 209) testing may be reduced to only the first sublot produced each day, or a minimum of one test per day.

Provide "QC Program" sampling and testing frequencies (random numbers) to the Engineer prior to production. Provide QC test results to the Engineer by the middle of the following work shift.

When the Statistical Evaluation Method of 00745.95 is used, stop production when the pay factor for any constituent with a weighting factor greater than one falls below 0.75. Resume production when a plan for correction is accepted by the Engineer.

(b) Mix Design Verification (MDV):

(1) MDV Quality Control:

a. General - Perform MDV testing on projects with Level 3 or Level 4 dense graded HMAC and at least once per calendar year for each JMF. If MDV testing has been completed for the JMF previously, submit verification to the Engineer.

Perform MDV tests on every sublot and as required at start up according to 00745.16(b-1-c) and the MFTP. Perform gradation and asphalt content testing with each MDV test. Calculate the following values for each MDV test.

- Air Voids
- Voids in Mineral Aggregate (VMA)
- Voids Filled with Asphalt (VFA)
- P No. 200 / Effective AC (Pbe) Ratio

MDV testing may be discontinued when at least two running averages of four MDV results are within the limits given below:

	Average of	**Limit**
Air Voids	4 samples	JMF Target $\pm$ 1.0
VMA	4 samples	12.5 - 17.0 (3/4" Mix) 13.5 - 17.0 (1/2" Mix) 14.5 - 17.0 (3/8" Mix)
VFA	4 samples	Match 00745.13(b)
P No. 200 / Pbe	4 samples	0.8 to 1.6

Restart MDV testing when any individual Maximum Specific Gravity test deviates from the last (MAMD divided by 62.4 pounds per cubic foot) by 0.020 or more. Begin retesting according to the start-up MDV requirements of 00745.16(b-1-c). MDV testing may be discontinued again when the above criteria is met.

The CDT shall provide the results from the initial control strip to the CAT II for evaluation and comparison with the MDV results. If the MDV and density test results are contradictory, initiate an investigation. The CAT II shall recommend a plan to the Engineer for resolving the discrepancy based on the results of the investigation.

Perform a Tensile Strength Ratio (TSR) test (AASHTO T 283) on a sample obtained during the first two days of production after QC test results verify that HMAC constituents with a weighting factor greater than one according to 00745.95 are in tolerance. Provide test results to the Engineer within five calendar days of obtaining the sample. The TSR shall be within 20 points of the value reported on the JMF. Stop production and make adjustments if the TSR is 20 points or more lower than the design value. Restart production only after the Engineer has approved the proposed adjustments.

Take corrective action when required by the MDV start-up process of 00745.16(b-1-c). After the requirements of 00745.16(b-1-c) have been met, take corrective action if the MDV test results show that two consecutive individual samples are outside the above limits for air voids, VMA, or VFA. Document the corrective action and notify the Engineer. If test results continue to be outside the tolerance, stop production and make adjustments. Restart production only after the Engineer has approved the proposed adjustments. If the MDV test results are outside

tolerance, but the mixture meets the current requirements for gradation and asphalt content, an adjustment to the JMF targets is required. Do not start a new lot as a result of the adjustment.

A request for an adjustment to the JMF targets may be made to the Engineer by the Contractor's CAT-II. The requested change will be reviewed and documented by the Engineer. If acceptable, a revised JMF will be allowed. Clearly document the sublot test for which the adjusted targets are in effect. Adjustments for gradation shall not exceed the tolerances specified for the original JMF limits. Adjustments for AC content shall be within 0.5% of the original JMF. The JMF asphalt content may only be reduced if the production VMA meets or exceeds the above requirements. Adjustments for RAP content shall be within 5% of the original JMF, but shall not exceed the requirements of 00745.03. Regardless of these tolerances, the adjusted JMF shall be within the mixture specification control points of 00745.12. If a redesign of the mixture becomes necessary, submit a new JMF according to the requirements of these Specifications.

b. Laboratory Compactor - Use a Gyratory compactor for MDV when a Gyratory compactor is used to develop the JMF and for all other cases.

c. MDV Requirements at Start-Up - Conduct gradation and asphalt content tests for each MDV test. Perform MDV testing at the start-up of the JMF production according to the following process:

1. Obtain a sample during the first 100 tons of production and immediately perform MDV testing.

2. If air voids and VMA are within tolerance, then continue remaining MDV testing at the established random QC sublot interval until requirements of 00745.16(b-1) are met. If not, then go to step "3".

3. If air voids and/or VMA are out of tolerance according to 00745.16(b-1-a), then make adjustments and immediately obtain another sample and perform MDV testing. Go to step "4".

4. If air voids and VMA from the MDV testing in step "3" are within tolerance, then continue remaining MDV testing at the established random QC sublot interval until requirements of 00745.16(b-1) are met. If not, go to step "5".

5. If air voids from step "3" are more than plus or minus 1.5% from the target, then stop production immediately and make adjustments. If they are not, then go to step "6". Obtain approval of the Engineer before restarting production. Begin MDV testing again at step "1".

6. If air voids from step "3" are out of tolerance and 1.5% or less from the target, or the VMA from step "3" is out of tolerance, then make adjustments and immediately obtain another sample and perform MDV testing. Go to step "4".

Use the initial MDV sample as the first random QC sublot test. Subsequent MDV samples required due to failure of start-up criteria will be used for a sublot QC test if the sample is taken within 100 tons of the scheduled random QC sample location. If not, the MDV testing shall be performed separate from, and not included in, the random QC testing program. Complete all required MDV testing at no additional cost to the Agency.

(2) MDV Quality Assurance - The Engineer will observe and document the Contractor's performing of MDV test procedures and calculations. Immediately correct any deviations from the specified test procedures. The Engineer may conduct MDV assurance testing at any time.

(3) MDV for Open Graded HMAC - Adjust asphalt content and gradation targets for open graded HMAC during production as directed. The Engineer will document the sublot test for which the adjusted targets are in effect.

(c) Quality Assurance and Acceptance - Any quality assurance testing for Level 1 and Level 2 HMAC will be at the discretion of the Engineer. The Agency will provide quality assurance according to Section 00165 for Level 3 and Level 4 HMAC. When QA testing is performed, the Contractor's quality control results will be used for acceptance if they are within acceptable limits of the QA test results as defined by ODOT's Quality Assurance Program.

00745.17 Small Quantity Acceptance - When the quantity of HMAC in a lot is less than 2,500 tons, the Engineer may accept the HMAC according to Section 4(B) of the MFTP or by test results 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 00745.95 or may choose to sample the in-place material for further testing following 00745.17(b-3). 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 Contractor chooses to sample the in-place material, sample from a minimum of three random locations from the area represented by the lot in question under the observation of the Engineer. 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 00745.95. In no case will the CPF be above 1.0. Perform sampling and testing of in-place material at no additional cost to the Agency.

Equipment

00745.20 Lime Treated Aggregate Plant - When lime treated aggregate is specified, provide a mixing plant that includes:

(a) Pug Mill - A pug mill that mixes the aggregate and lime until the aggregate is uniformly coated and the lime is distributed throughout the aggregate.

Provide a system for adding water to the pug mill if necessary to achieve aggregate that is in SDC. This requirement may be waived by the Engineer if the stockpiled aggregates are watered to the satisfaction of the Engineer.

(b) Lime Metering Device - A lime metering or weighing device that determines the amount of lime incorporated within any selected time period. Provide a device that is of sufficient accuracy to supply lime within the tolerances specified in 00745.11(c).

00745.21 HMAC Mixing Plant - Provide HMAC plants that comply with the following:

(a) DEQ Permits - Before producing HMAC for this Contract at a new or revised plant location, provide the Engineer with copies of all permits according to 00160.70.

(b) Scales - Provide required scales to assure a uniform mixture. Check and adjust scales according to 00190.30.

(c) Vibratory Scalping Devices - Provide vibratory scalping devices ahead of the mixer to reject aggregate, RAP and lumps of cemented material that are detrimental to the mix.

(d) Asphalt Antistrip Additive Metering Device - When asphalt antistrip additive is added into the asphalt at the HMAC mixing plant, provide a means to weigh or meter the additive at a specified rate that has an accuracy of plus or minus 0.5%.

(e) Thermometers - Provide the following:

- A direct reading, full operating range thermometer in the asphalt feed line near the mixer unit
- A thermometric instrument that automatically registers the temperature of the materials at the discharge of the mixer

(f) Sampling Devices - Provide and operate a device that produces a representative sample of the quantity of material required for the appropriate tests when sampling at or around crushing, screening or mixing plants.

00745.22 Hauling Equipment - Provide hauling vehicles in good operating condition with tight, clean, smooth beds. 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 excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.

00745.23 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.

00745.24 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 minimum gross static weight meeting the requirements of 00745.24(a).

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 minimum gross static weight meeting the requirements of 00745.24(a).
- 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 psi to 90 psi
- Be fully skirted to reduce tire heat loss and mixture pick up.

(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

00745.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CAT-I
- CAT-II
- CDT
- CMDT

Construction

00745.40 Season and Temperature Limitations - Place HMAC during the dates indicated, and 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	Level 1 and Level 2	Level 3 and Level 4	
		All Courses	Travel Lane Wearing Course	All Other Courses
	Surface Temperature*	From To Inclusive	From To Inclusive	From To Inclusive
Open Graded Mixes				
Less than 2 inches	60 °F	3/15 9/30	3/15 9/30	3/15 9/30
2 inches and Greater	50 °F	3/15 9/30	3/15 9/30	3/15 9/30
ATPB	40 °F	All Year	NA NA	All Year
Dense Graded Mixes				
Less than 2 inches	60 °F	All Year**	3/15 9/30	All Year**
2 inches - 2 1/2 inches	50 °F	All Year**	3/15 9/30	All Year**
Greater than 2 1/2 inches	40° F	All Year**	3/15 9/30	All Year**
Temporary	40 °F	All Year**	All Year**	All Year**

* Do not use field burners or other devices to heat the pavement surface to the specified minimum temperature unless approved.

** If placing HMAC between March 15 and September 30, temperature requirement may be lowered 5 °F.

00745.41 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.

00745.42 Preparation of Underlying Surfaces - All bases and foundations on which the pavement is to be constructed shall meet the applicable Specifications and be approved prior to the start of paving. Recondition existing bases and foundations according to Section 00610. Trim broken or ragged edges to firm material when directed.

Treat all paved surfaces on and against which HMAC is to be placed with an asphalt tack coat, according to Section 00730. Immediately before applying the tack coat, clean and dry the surface to be tacked. Remove all material, loose or otherwise, that will reduce adhesion of the tack by brooming, flushing with water, or other approved methods.

Level and compact depressed areas with HMAC as specified or directed. Perform the leveling work as a separate operation and at the locations and to the extent as shown or directed. Spread the leveling material with a paving machine, unless otherwise directed.

Protect all existing structures from the overlay operation and check and clean as necessary after the overlay.

The pavement surface shall be dry prior to the preparation work and paving. Remove existing pavement markers, recessed markers, and pavement legends prior to paving. Remove pavement legends according to 00851.40.

00745.43 Drying and Heating Aggregates for HMAC:

(a) Burner Operation - Operate the burner used to heat the aggregates to completely burn the fuel so the aggregate and asphalt are not contaminated and the asphalt is suitably aged.

(b) Heating Temperatures - Establish the allowable mixing and placement temperature ranges by the JMF. Measure the mixture temperature at the discharge of the mixer. Measure the placement temperature behind the paver. The allowable production temperatures may be adjusted based on the asphalt cement supplier's recommendation if approved by the Engineer. The maximum mixture temperature of the HMAC and the minimum placement temperature shall be as follows:

	AC Temperature, °F	
Grading	**Maximum at Mixer**	**Minimum Behind Paver**
Dense	350	240
Open	350	205

Within the above limits, the Contractor (with approval of the Engineer) or the Engineer may adjust this temperature in 10 °F increments from the JMF as follows:

- **Up** - If the aggregate coating, moisture content, workability or compaction requirements are not attained.
- **Down** - If the aggregate coating, moisture content, workability and compaction requirements are attained.

00745.45 HMAC Storage - Temporary storing or holding of hot HMAC in storage silos will be allowed if the Contractor complies with the following:

(a) Flow Diverter - Provide a device to divert the flow of HMAC away from the silo when starting or stopping plant production, or at any other time necessary, so improperly proportioned mixture or incompletely mixed portions of the mixture do not enter the silo.

(b) Batcher - Equip storage silos with a batcher, rotating chute, or similar device to prevent segregation of HMAC as it enters the silo.

(c) Unheated Silos - Store HMAC in unheated silos only when the total elapsed time from the mixing to placing is less than six hours.

(d) Heated Silos - Store HMAC in heated, insulated silos no more than 72 hours only if an atmosphere is maintained in the silo at all times which prevents damage to the mixture or asphalt properties.

(e) Discharging AC and Loading Trucks - Discharge the HMAC and load trucks so segregation is prevented. If the HMAC is segregated, dispose of segregated HMAC and stop temporary storage of the HMAC at no additional cost to the Agency.

00745.46 Control of Line and Grade - Use a floating beam device of adequate length and sensitivity to control the grade of the paver. Where this method is impractical, manual control of grade will be allowed when approved.

00745.48 Hauling, Depositing, and Placing - Haul, deposit, and place HMAC as follows:

(a) Hauling - Cover HMAC if rain or cold air temperatures are encountered any time between loading and placement.

HMAC will be rejected before placing if one or more of the following is found:

- Below specified placing temperature limit
- Slumping or separating
- Solidifying or crusting
- Absorbing moisture

Dispose of rejected loads at no additional cost to the Agency.

Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

(b) Depositing - Deposit HMAC from the hauling vehicles so segregation is prevented.

When HMAC is windrowed, the pick-up equipment shall:

- Pick up substantially all of the HMAC deposited on the roadway.
- Be self-supporting, not exerting any vertical load on the paving machine, or causing vibrations or other motions which could have a harmful effect on the riding quality of the completed pavement.

(c) Placing - Alternative equipment and means may be allowed by the Engineer if the use of a paver is impractical.

Do not place HMAC during rain or other adverse weather conditions, unless allowed by the Engineer. HMAC in transit at the time adverse conditions occur may be placed if:

- It has been covered during transit.
- The HMAC temperature is satisfactory.
- It is placed on a foundation free from pools or flow of water.
- All other requirements are met.

When leveling irregular surfaces and raising low areas, do not exceed 2 inches actual compacted thickness of any one lift, except the actual compacted thickness of intermittent areas of 1,000 square feet or less may exceed 2 inches, but not more than 4 inches. This may require portions of the mixture to be laid in two or more lifts.

Place the mixture in the number of lifts and courses, and to the compacted thickness for each lift and course, as shown. Place each course in one lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any lift. Limit the minimum lift thickness to twice the maximum aggregate size in the mix.

Do not intermingle HMAC produced from more than one JMF. Each base course panel placed during a working shift shall conform to a single JMF. The wearing course shall conform to a single JMF, except for adjustments in the JMF according to 00745.16(b-1).

00745.49 Compaction, QC - 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, roll it uniformly until compacted as specified.

(1) Temperature - Complete breakdown and intermediate compaction before the HMAC temperature drops below 180 °F, unless otherwise directed or required based on the control strip. When the rolling causes tearing, displacement, cracking or shoving, make necessary changes in compaction temperature, type of compaction equipment, and rolling procedures.

(2) Rolling - Compact the HMAC with rollers conforming to 00745.24. Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature. Do not use equipment which crushes the aggregate. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material, 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 pneumatic rollers no faster than 3 mph. Operate vibratory rollers at frequencies of at least 2,000 vibrations per minute.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, gradually progressing to the center, unless otherwise directed. On superelevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling pattern. Do not make sharp turns or park rollers on hot HMAC. Stop each pass at least 5 feet longitudinally from preceding stops.

Perform finish rolling with rollers meeting the requirements of 00745.24(a) or 00745.24(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 control strip method is approved by the Engineer.

For Level 3 and Level 4 mixes, construct a control strip at the beginning of work on each JMF on the project according to ODOT TM 306. The purpose of the control strip is to determine the maximum density that can be achieved for the JMF, paving conditions, and equipment on the project, and to establish a target density when the control strip method of compaction is allowed by the Engineer.

A pneumatic tired roller is not required for Level 1 and Level 2 HMAC. The Contractor shall have at least one available pneumatic tired roller conforming to 00745.24(c) on the project and in good operating condition for Level 3 and Level 4 HMAC.

The CDT shall notify the Engineer and CAT II when the average density for a sublot exceeds 95% of MAMD. 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 with the nuclear gauge operated in the backscatter mode. Lots and sublots shall correspond with those defined in 00745.02. In addition, perform at least one density test each day of production. The additional testing may be waived by the Engineer.

a. Testing - After completion of the finish rolling, test according to WAQTC TM 8. Do not locate the center of a density test less than 1 foot from the panel edge. Complete density testing before traffic is allowed on the new mat.

b. Core Correlation of Nuclear Gauge Readings - Correlate each nuclear gauge on the Project when requested or required. New correlations are required if the aggregate source or the asphalt cement source changes. Apply correlation factors to all nuclear gauge readings for all dense graded mixtures placed on the Project. Cut the required cores and patch the core holes with dense graded HMAC. Determine the core correlation factor according to WAQTC TM 8 and ODOT TM 327.

Perform core correlation of nuclear gauge readings for each new lift when requested by the Engineer or Contractor. The party requesting the core correlation pays the costs of coring and lab testing of the cores The party performing nuclear gauge testing pays the costs of the nuclear gauge testing.

(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:

Course of Construction	Level 1, Level 2, and Level 3 HMAC	Level 4 HMAC
First Lift	91.0 *	92.0
Single	91.0 *	92.0
All Other	92.0	92.0

* If any part of the width of a lift at a station requires 91.0%, then the entire width of that lift at that station shall be 91.0%

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 or areas too small to establish a reasonable roller pattern.

(4) Control Strip Method - This method consists of constructing and testing a designated strip to establish optimum rolling procedures and target density. The target density is then used as a basis for acceptance of compaction of the HMAC.

a. Construction of 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 specified 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 00745.49(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 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 the 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 - Compaction to a specified density will not be required for leveling, patches, or where the nominal compacted thickness of a course of dense graded mixtures will be less than 2 inches.

Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the HMAC.

(d) Open Graded HMAC - Compaction of open graded HMAC to a specified density will not be required.

Use only steel-wheeled roller(s) for compaction. Continue the breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the HMAC.

(e) Other Areas - Compaction to a specified density will not be required on temporary surfacing (see 00745.50), guardrail flares, mailbox turnouts, road approaches, pavement repair, and areas of restricted width (less than 8 feet wide) or limited length, regardless of thickness. Compact these surfaces according to 00749.45.

Temporary

00745.50 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 materials and reclaimed materials, may be used, according to 00745.03. The Contractor is responsible for the quality of material furnished according to Section 00165 and for maintaining the surface in a condition appropriate for the facility. Mix used for temporary surfacing will not be eligible for price adjustment under 00745.95.

Maintenance

00745.60 Correction of Defects - Correct all defects in material and work, as directed, at no additional cost to the Agency, according to the following:

(a) Fouled Surfaces - Immediately repair, clean, and retack fouled surfaces that would prevent full bond between successive lifts of mixture.

(b) Boils, Slicks and Oversized Material - Immediately replace boils, slicks, and oversized material with fresh mixture.

(c) Segregation - Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved by the Engineer.

(d) Roller Damage to Surface - Immediately correct surface damage from rollers with additional fresh mixture or by other means approved by the Engineer.

(e) Longitudinal Joints - Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved by the Engineer.

(f) Nonspecification Compaction - Take immediate corrective measures when the specified compaction density is not being achieved.

(g) 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.

00745.61 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 00745.61(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 additional cost to the Agency. 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.

00745.62 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 additional cost to the Agency. 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 QPL.

Finishing and Cleaning Up

00745.70 Pavement Smoothness - Furnish a 12 foot straightedge and/or 12 foot rolling straightedge, and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

(a) Level 1 and Level 2 HMAC - Test with the 12 foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch.

(b) Level 3 and Level 4 HMAC:

(1) Single Course Construction - Test with the 12 foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch.

(2) Multiple Course Construction - Test the surface of the course on which the wearing course is placed according to (a) above.

Test the wearing surface with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout the project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.

Also test the wearing surface with a 12 foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, test both wheel paths of the entire mile.

(c) Utility Appurtenances - If the Contractor is required to construct or adjust utility appurtenances, such as manhole covers and valve boxes, the tolerances stated in (a) and (b) above apply. These tolerances do not apply at utility appurtenances adjusted by others.

(d) Shoulders and Paved Medians - Test the base and wearing course with the 12 foot straightedge parallel to and perpendicular to the centerline for shoulders and paved medians where permanent traffic barriers will be located. The pavement surface shall not vary by more than 1/4 inch.

00745.75 Correction of Pavement Roughness - Immediately correct equipment or paving operation procedures when tests show the pavement smoothness does not comply with 00745.70. 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:

(1) Base Course:

- Profile to a maximum depth of 0.4 inch with equipment meeting the requirements of 00620.20.
- Profile to a maximum depth of 0.4 inch with abrasive grinder(s) equipped with a cutting head comprised of multiple diamond blades.
- Remove and replace the base lift.

(2) Wearing Course:

- Remove and replace the wearing surface lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinder(s) equipped with a cutting head comprised of multiple diamond blades and apply an emulsion fog seal as directed.

(b) Time Limit - Complete correction of all surface roughness within 14 calendar days following notification, unless otherwise directed.

Measurement

00745.80 Measurement - The quantities of HMAC will be measured on the weight basis, with separate measurement being made for the asphalt concrete mixture and the asphalt cement contained in the mixture. No deduction will be made for lime or any other additive used in the mixture.

When RAP materials are used, measurement of the total asphalt quantity will be based on quality control tests averaged to the nearest 0.01%.

If an estimated bulk specific gravity for the aggregates is shown in the Special Provisions, determine the actual bulk specific gravity for the aggregates, recompute the quantities of HMAC to be used, and inform the Agency in writing. The quantities of HMAC will be adjusted accordingly with no adjustment in Contract unit prices. The provisions of 00140.20 and 00195.20 will apply.

00745.83 Other Items - When listed in the Contract Schedule of Items, extra or additional work for approaches, driveways, walks, and other miscellaneous structures will be measured according to 00749.80 through 00749.82.

If there is no separate item listed in the Contract Scheduled of Items for leveling work, the quantities will be included in the appropriate HMAC items.

No separate measurement will be made for lime.

Payment

00745.90 Payment - The accepted quantities of HMAC incorporated into the Project, whether or not recycled materials are used, will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Level ___, _____, _____, HMAC, _____	Ton
(b)	_____ Asphalt in _____ HMAC	Ton

In item (a), the following will be inserted in the blanks:

- 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 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 "Lime Treated" will be inserted in the third blank when applicable
- The words "in Leveling", "in Temporary", or "in Leveling and Temporary" will be inserted in the fourth blank when applicable

In item (b), the performance graded asphalt binder will be inserted in the first blank. The type(s) of HMAC will be inserted in the second blank. This item applies to all asphalt used in HMAC, including residual asphalt in RAP. Substituted asphalt cement described in 00745.11(a) will be paid for under the asphalt specified in the Contract Schedule of Items.

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

00745.93 Other Items - Unless indicated in the Contract Schedule of Items, no separate or additional payment will be made for the following:

- reconditioning existing roadway
- leveling work
- lime
- QC testing
- anti-stripping additives

When indicated by other pay items in the Contract Schedule of Items, separate payment will be made for the following:

- work described in 00745.42
- work described in 00749.91 and 00749.92

When a panel consists of both temporary and permanent courses, payment for the entire panel will be based on the permanent course.

No separate or additional payment will be made for sawing, cleaning, and filling joints on bridge deck overlays.

00745.95 HMAC Price Adjustments - The Composite Pay Factor (CPF), calculated according to 00165.40, 00745.16, and 00745.95, will be applied to the Contract unit price for pay items (a) and (b) of 00745.90 and to the applicable lot quantities. The CPF will be made available to the Contractor

within 24 hours of receipt of the required quality control test results. If less than three samples are tested, the CPF will be computed as outlined in 00745.17 and 00745.95, the maximum CPF for material represented by less than three samples will be 1.0.

To accommodate the lot definition of 00745.02, interpret the upper specification limit (USL) and the lower specification limit (LSL) in 00165.40 to allow adjustments to a JMF according to 00745.16 without changing lots. Include all material from the original JMF and revisions of that JMF in the statistical analysis unless a change in the lot is required by 00745.02. If JMF target values are modified according to 00745.16, the CPF will be calculated in the following manner:

- The adjusted target value will be evaluated as zero with the USL and LSL representing the allowable tolerances of 00745.14. All sample test values for the changed constituents will be compared to the target for each sublot. The differences between the target values and sample test values are the adjusted sample test values for each sublot. These will be analyzed for determination of the pay factor for the constituent.

The Pay Factor (PF) for compaction will be:

Type/Method	PF	Maximum PF
Normal Pavement		
Control Strip Method		1.00
MAMD Method		1.05
Thin Pavement	1.00	
Open-Graded HMAC	1.00	
Other Areas	1.00	

Use the following table to determine price adjustments in the CPF for constituents of HMAC.

Gradation Constituents	Dense Graded HMAC Type Weighting Factor (f)				Open Graded HMAC Type Weighting Factor (f)		
All Aggregate Passing	**1"**	**3/4"**	**1/2"**	**3/8"**	**3/4"**	**1/2"**	**ATPB**
1 1/2"	1						
1"	1	1			1		1
3/4"	1	1	1		1	1	1
1/2"	1	1	1	1	1	1	1
3/8"	–	–	–	1	–	–	–
No. 4	5	5	5	5	5	5	6
No. 8	5	5	6	6	5	6	7
No. 30	2	3	3	3	3	3	–
No. 200	10	10	10	10	10	10	10
Other Constituents							
Asphalt Content	26	26	26	26	26	26	26
Moisture Content	8	8	8	8	8	8	8
Compaction	40	40	40	40	40	40	40

Those HMAC constituents statistically evaluated will be eligible for a maximum PF of 1.05 (see 00165.50(b-1)), unless otherwise specified.

When the CPF is greater than 1.000 for material used in leveling courses for HMAC, it will be reduced as follows:

Reduction in CPF = (CPF-1) x 0.5

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 formulas:

(CPF - 1) x [(JMF% ÷ 100 x Asphalt Unit Price) + (HMAC Unit Price)] x (LQ) = ____

Where:

JMF% is the asphalt cement % from the JMF
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 - Furnish all sealant materials for crack repair of flexible pavements that is approved by the Engineer before being incorporated into the work. Before beginning work, furnish a complete written statement of the origin, composition and manufacturer of materials that are to be used.

Furnish hot-poured sealants of the type intended for use in sealing cracks in asphalt concrete pavement that meet the requirements of ASTM D 6690.

Equipment

00746.20 Equipment - Use proper sealing equipment for the specific material listed according to the manufacturer's recommendations. The equipment for sealing compounds shall be a melting kettle of the double boiler, indirect heating type, using oil as a heat-transfer medium. The kettle shall be an effective, mechanically operated agitator equipped with a positive, thermostatic temperature control.

Construction

00746.40 General - Provide traffic control according to Sections 00220 and 00225.

00746.41 Mixing and Heating - Follow the manufacturer's recommendations for application. Mix and heat the sealant materials to a minimum temperature of 280 °F. Do not heat the material above 400 °F.

00746.42 Installation Procedure - Where installation procedures, or any part of the procedures are required to be done according to the recommendations of the manufacturer of the sealing compound, submit catalogue data and copies of the recommendations before installing the materials.

Clean all cracks designated for sealing of loose and foreign matter. Use a hot lance to perform this cleaning. Use this wand to both clean and dry the crack just prior to sealing.

Do not place any sealant without the prior approval of the Engineer. The Engineer will inspect all cracks.

The face of the crack shall be surface dry, and the ambient and pavement temperatures shall both be at least 45 °F and rising at the time of application of the sealant.

Install the sealant so that the in-place sealant is well bonded to the pavement and free of voids or entrapped air.

Seal the cracks from the bottom up in a neat manner, so that upon completion of the work the surface of the sealant material is flush to 3/16 inch below the adjacent pavement surface. Refill or "spot" all low areas before continuing work.

Level sealant material flush to the surface with a 'V' shaped squeegee device. Squeegee the excess material so it does not exceed 1 1/2 inches on either side of the crack. If any sealant remains in the squeegee when the end of the crack is reached, distribute this excess material over the crack in a return motion.

00746.43 Cleaning and Sanding - Perform the following work when crack sealing prior to a hot mix asphalt overlay or to prevent traffic damage and "pickup":

- Completely cover the sealed cracks with a clean sanding material, then sweep the pavement surface and leave in a clean condition.
- Do not allow any traffic or construction equipment on the newly sealed cracks for at least one hour after placement of the sealant and refilling has been completed.

Measurement

00746.80 Measurement - The quantities of sealed cracks will be measured on either the length basis, or the weight basis.

Payment

00746.90 Payment - The accepted quantities of sealed cracks will be paid for at the Contract unit price, per foot or pound, as appropriate, for the item "Crack Sealing".

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

No separate or additional payment will be made for required cleaning and routing.

Section 00748 - Asphalt Concrete Pavement Repair

Description

00748.00 Scope - This work consists of excavating and removing existing asphalt concrete surfaces, aggregate bases, and aggregate subbases and constructing new subbases, bases, and asphalt concrete surfaces to the lines and grades shown or directed.

Materials

00748.10 Materials - Furnish materials meeting the following requirements:

Aggregate Base	02630
Aggregate Subbase	00641.10(b)
EAC	00735
HMAC	00745
Stone Embankment	00330.16
Subgrade Geotextile, Level B	02320
Water	00340

00748.16 Acceptance of Material - All material will be accepted by visual inspection by the Engineer. The Engineer may perform tests to verify that the materials meet the appropriate specifications.

Equipment

00748.20 Equipment - Provide appropriate equipment necessary to perform the work according to Sections 00320, 00330, 00340, 00350, 00641, 00735, and 00745.

Construction

00748.40 Excavation - Excavate and remove material to the lines and grades shown or directed. Dispose of the excavated material according to 00330.41(a-5).

00748.41 Geotextile - Place geotextile as shown.

00748.42 Embankment and Aggregate Backfill - Place the backfill to lines and grades shown or directed. Compact each layer of material until there is no reaction or yielding under the compactor.

00748.43 Asphalt Concrete - Place EAC or HMAC to the lines and grades shown or directed. Compact the EAC according to 00735.46. Compact HMAC according to 00745.49(e).

Measurement

00748.80 Measurement - The quantities of asphalt concrete pavement repair will be measured on the area basis, of surfacing area repaired to the full depth as shown. The surfacing area will be determined by horizontal measurements. In areas where directed to repair to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

EAC and HMAC will be measured according to 00735.80 or 00745.80 as applicable.

Payment

00748.90 Payment - The accepted quantities of asphalt concrete pavement repair will be paid for at the Contract unit price, per square yard, for the item " _____ inch Asphalt Concrete Pavement Repair".

The depth will be inserted in the blank.

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

EAC and HMAC will be paid for according to 00735.90 or 00745.90 as applicable.

No separate or additional payment will be made for excavation, geotextile, stone embankment, aggregate, and water.

Section 00749 - Miscellaneous Asphalt Concrete Structures

Description

00749.00 Scope - This work consists of furnishing and placing asphalt concrete in road approaches, street connections, driveways, guardrail flares, mailbox turnouts, raised traffic islands, sidewalks, footpaths, gutters, ditch linings, spillways, dikes, and other miscellaneous or minor items of asphalt concrete except asphalt curbs as shown, specified, or directed. These items in this Section will be collectively referred to as "structures". See Section 00480 for asphalt curbs.

This work does not include asphalt concrete construction on traffic lanes, auxiliary lanes, shoulders, median areas, tapers, widenings, parking areas, exit and entrance ramps, patching and leveling on similar areas.

00749.02 Limited Application - This Section applies only when separate pay items for the work appears in the Contract Schedule of Items according to 00749.91 and 00749.92, or when called for by the special provisions.

Materials

00749.11 Aggregate Base - Furnish aggregate base materials for base, foundation courses, leveling courses, and bedding meeting the requirements of Section 02630. If a designated size is not shown, or given, furnish either 1" - 0 or 3/4" - 0, as the Contractor elects.

00749.12 Asphalt Tack Coat - Furnish asphalt tack coat material meeting the requirements of Section 00730.

00749.13 Asphalt Concrete - Unless another class is shown, furnish Level 2, 1/2 inch Dense HMAC according to Section 00745. When conditions justify, the mixture may be varied, if approved. Acceptance will be based on testing the Engineer deems appropriate. Statistical analysis will not apply.

Equipment

00749.20 Equipment - Plant and equipment shall conform to Section 00745.

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 allowed, the Engineer may allow mixture to be placed by hand methods.

Construct all structures within the following lines and grades:

- 1 inch of true line
- 0.04 foot of established surface grade, cross section and slope
- 0.04 foot of specified thickness

00749.45 Compacting Asphalt Concrete - Compact asphalt concrete according to the following or as directed:

- Compaction to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the HMAC.
- Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to rollers conforming to 00744.24 or 00745.24, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

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 Measurement - Work performed under this Section will be measured by one of the methods described 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 according to the following:

- **Unit Basis** - Measurement will be the actual count of each location where the structure is constructed.

- **Area Basis** - Measurement will be the ground surface, limited to the neat lines of the structure, and converted to the nearest square foot,.

- **Length Basis** - Measurement will be from end to end of the pertinent structure along its longitudinal axis for each separate item or continuous run.

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 Contract Schedule of Items.

00749.82 Method "B" - Complete in Place Basis - Under this method, measurement will be of the structure complete in place.

Payment

00749.90 Payment - The accepted quantities of structures placed under this Section will be paid for at the Contract unit price, per unit of measurement, for the items listed in 00749.91 and 00749.92.

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate pay items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90 and 00641.90 as appropriate.

Payment for street connections, or the extra costs for them, which meet the criteria described in 00749.80 will be included in payment for the pavement items.

00749.91 Method "A" - Weight and Extras Basis - The items to be paid for under Method "A" are:

	Pay Item	Unit of Measurement
(a)	Extra for Asphalt Approaches	Each
(b)	Extra for Asphalt Drains	Each
(c)	Extra for Pedestrian Landings	Each
(d)	Extra for Asphalt Dikes	Foot
(e)	Extra for Asphalt Islands	Square Foot
(f)	Extra for Asphalt Walks	Square Foot
(g)	Extra for Asphalt Ditch Lining	Square Foot
(h)	Extra for Asphalt Slope Paving	Square Foot
(i)	Extra for Pavement Repair	Square Foot

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, and mailbox turnouts.

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 items to be paid for under Method "B" are:

	Pay Item	Unit of Measurement
(a)	Asphalt Approaches	Each
(b)	Asphalt Dikes	Foot
(c)	Asphalt Islands	Square Foot
(d)	Asphalt Walks	Square Foot
(e)	Asphalt Ditch Lining	Square Foot
(f)	Asphalt Slope Paving	Square Foot

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, and mailbox turnouts.

Item (c) includes raised traffic islands and traffic separators.

Item (d) includes sidewalks, footpaths, and narrow strips of asphalt concrete abutting curbs, not intended for vehicular use.

Item (e) includes gutters, ditch linings, spillways and other such structures specifically designed and provided for conveyance of surface water.

Payment will be payment in full for furnishing and placing all materials, including asphalt concrete and asphalt tack coat, and for furnishing all equipment, labor, and incidentals necessary to complete the respective structures in place as specified.

Section 00755 - Continuously Reinforced Concrete Pavement

Description

00755.00 Scope - This work consists of constructing continuously reinforced portland concrete pavement with metal reinforcement, and associated reinforced concrete pavement as shown and specified.

00755.01 Abbreviations:

GPT - Graphic Profile Test
LSL - Lower Specification Limit
PI - Profile Index
SSD - Saturated Surface-Dry
SSFC - Stationary Side Form Construction
SSTV - Sublot Strength Test Value
USL - Upper Specification Limit

00755.04 Aggregate Production and Prepaving Conference:

(a) Aggregate Production Conference - Supervisory personnel of the Contractor and any subcontractor's or supplier's who are to be involved in the aggregate production work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing aggregate production.

(b) Prepaving Conference - Supervisory personnel of the Contractor and any subcontractor's who are to be involved in the concrete paving work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving work.

Materials

00755.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510
Concrete Materials	02001
Curing Materials	02050
Epoxy and Nonepoxy Bonding Agents	02070
Epoxy and Nonepoxy Grouts	02080
Galvanizing	02530.70
Poured Joint Fillers	02440.30
Preformed Expansion Joint Filler	02440.10
Structural Steel	02530
Welded Wire Fabric	02510.40

00755.11 Classes of Concrete - Furnish Class 4000 - 1 1/2 paving concrete unless otherwise shown or indicated in the Special Provisions.

00755.13 Concrete Mix Designs - Prepare and submit either new mix designs or current mix designs for each class of concrete required according to Section 02001.

00755.15 Quality Control - Provide quality control according to Section 00165, Section 02001, and the following:

(a) Concrete Mixture - If the results of any test are outside of the specification limits, stop the placement of the load. Correct the load or reject it and do not incorporate it into the work. Test

subsequent loads before any further concrete placement. Correct the subsequent loads if any of the tests are still outside the specification limits. If the load cannot be corrected, reject it and do not incorporate it into the work. Testing of subsequent loads may return to the specified frequency when the test results from two consecutive loads are shown to meet the specification limits.

(b) Records - Deliver all batch tickets, water-cement ratio calculations, and all other records required to the Engineer upon availability but no later than the morning of the next day.

00755.16 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 Agency according to Section 00165.

(1) Aggregate Gradation - A stockpile contains specification aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level indicated in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled aggregates that contain non-specification aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(c) Plastic Concrete - Acceptance of the plastic concrete will be based on the tests performed by the Contractor's QCT, according to the tolerances and limits of Section 02001.

(d) Hardened Concrete - Acceptance of hardened concrete will be based on statistical analysis, according to Section 00165, of the compressive strength tests of the cylinders cast by the QCT. Test the cylinders at an ODOT certified laboratory.

(1) Random Sampling and Testing - Obtain samples from each sublot on a random basis. Cast a minimum of 3 cylinders. Cast and cure the test specimens according to AASHTO T 23 in 6 inch x 12 inch single-use plastic molds and test at 28 days according to AASHTO T 22.

(2) Lots - A lot is the total quantity of concrete produced for each mix design with the same specification limits of all constituents in each stage. Slipformed and nonslipformed concrete will be sampled and evaluated as separate lots.

In lots with less than three sublots, the valid individual cylinders each will be considered a sublot and statistically evaluated. Obtain at least one set of cylinders for each lot.

(3) Sublot Strength Test Value - The average of the 28 day compressive strength tests of the three cylinders will constitute the SSTV.

Any cylinders in a sublot showing definite evidence (other than low strength) of improper sampling, molding, curing or testing will be discarded, and the average of the strengths of the remaining cylinders will constitute the SSTV. If all three cylinders comprising a sublot are discarded, the lot will be evaluated on the basis of the reduced number of sublots.

If the compressive strength of the lowest strength cylinder in a sublot is lower than the average strength of the remaining cylinders in that sublot by more than 10%, that cylinder strength will be discarded and the average of the remaining cylinders will comprise the SSTV.

(4) Quality Level Analysis - Statistically analyze the SSTV's and determine the PF for each lot of concrete, except that there will be no USL, and the LSL will equal the specified design strength.

Equipment

00755.20 Batch Plant - Provide batch plants according to Section 02001.

00755.21 Mixers - Provide mixers according to Section 02001 except mix concrete in the batch plant mixer. Truck mixers may be used only as allowed in 00755.45.

00755.22 Hauling Equipment - Transport concrete in non-agitating equipment. Truck mixers may be used to transport concrete only as allowed in 00755.45. Hauling equipment shall conform to AASHTO M 157.12 or AASHTO M 157.11.6 when allowed.

00755.23 Paving Equipment - Provide self-propelled paving machines conforming 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 00755.49(a).

00755.24 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.

00755.25 Smoothness Testing Equipment - Provide all equipment and supplies for determining smoothness according to 00755.55.

(a) Straightedge - Provide two 12 foot straightedges.

(b) Profilograph - Provide a California type profilograph computerized or not computerized, complete with recorder, for determining the profile index of the pavement according to ODOT TM 770.

Have the profilograph on the Project, calibrated, in good working condition and ready for operation before construction of any concrete pavement begins. Provide a competent operator experienced in the operation of the equipment.

(c) Profilometer - Provide a profiling device that employs an accelerometer established inertial profiling reference and a laser height sensing instrument to produce a true profile of the pavement surface. The device shall be capable of reporting elevations with a resolution of 0.004 inch or finer at an interval of 6 inches or less. The unit shall be able to generate the equivalent California-type profilograph plot and values according to ODOT TM 770 as well as the locations and heights of bumps and dips as required in this Specification. The profilometer shall be calibrated, in good working condition, and ready for operation prior to performing smoothness measurements.

Provide competent and experienced operator(s) for the equipment. The profilometer operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the Project.

Labor

00755.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CSTT
- CCT
- QCT

Additional Contractor quality control responsibilities include the following:

- Provide and designate an individual who shall be present at the placement site at all times during concrete placements, and who is authorized and responsible for acceptance and rejection of materials.
- Reject loads which arrive at the jobsite without a batch ticket.
- Require the truck driver to record on the batch ticket and initial the amounts of water added in transit and at the jobsite.
- Reject plastic concrete that is outside of the specified limits.

Construction

00755.40 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 allowed to proceed.

Do not place PCC during periods of rain. Do not place PCC on frozen bases. Stop placement when descending air temperature falls below 35 °F. Do not begin placement until the air temperature is 35 °F in the shade and rising and is forecast to remain above 35 °F.

Protect the pavement from weather damage. Protect unhardened PCC from precipitation with protective material. When PCC is placed during cold weather and the air temperature is forecast to drop below 33 °F, prevent the concrete from freezing for a minimum of seven days after placement.

Remove and replace weather damaged pavement at no additional cost to the Agency.

00755.41 Preparation of Base:

(a) Condition - Before paving operations begin, bring the base on which the pavement is to be constructed to a finished condition required by the Specifications.

(b) Area - Bring the full width and length of the area on which the tracks of the paving equipment are to operate to the density and surface tolerance required of the base material.

00755.42 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 pay all costs to implement the change. Any changes require Engineer's approval.

00755.43 Placing Reinforcement:

(a) General - Place reinforcement as shown and specified. The Contractor's equipment hauling reinforcement to the site will not be allowed on the concrete subgrade or base.

The reinforcement shall be straight, clean, and free of scale or other matter which would interfere with its bonding to the concrete.

Place the reinforcement on support devices that maintain it in specified position during concrete placement. The use of tube feeding to place rebar in plastic concrete mix will not be allowed.

On areas where traffic is operating adjacent to concrete paving operations, do not lift reinforcement from the surface or place on supporting devices more than two hours before placing the concrete, unless otherwise approved by the Engineer.

(b) Deformed Bar Reinforcement - Tie or clip at every other transverse bar intersection, as a minimum, in a manner that does not allow for displacement. Tie or clip every lap splice as shown.

(c) Welded Wire Fabric - Store, handle and place with care to prevent distortion.

(d) Support Devices - Support devices used to hold reinforcement in proper position in the concrete shall:

- Hold the reinforcement within 11/2 inch of the vertical position shown.
- Not displace more than 2 cubic inches of concrete when embedded in the slab.

Obtain approval of the proposed support devices before use.

(e) Tie Bars - Place tie bars required for contact-type longitudinal joints by one of the following methods:

(1) By drilling the hardened concrete section and then inserting and grouting the tie bars into place. Drill the holes large and deep enough to insert the tie bars with adequate epoxy or nonepoxy grout. Take care not to damage the reinforcement when drilling the holes. Drill after the concrete attains enough strength so no damage to the concrete is caused by the drilling. Replace loose tie bars at no additional cost to the Agency.

(2) By inserting the tie bars into the plastic slipformed concrete before vibrating and finishing the concrete. The tie bars may be bent before insertion. Replace any loose tie bars by drilling and grouting, as described in 00755.43(e-1), at no additional cost to the Agency.

(3) By using threaded mechanical splice couplers from the QPL, or approved equal. Submit splices for approval before using. Rebar splices shall be:

- Accompanied by manufacturer's quality compliance certificate according to 00165.35.
- Installed according to manufacturer's recommendations.

00755.44 Handling, Measuring, and Batching Materials - The plant site, layout, equipment and provisions for transporting material shall be adequate to assure a continuous supply of material to the worksite.

(a) Aggregates - Stockpile and remove the aggregate from stockpiles in a manner that holds segregation to a minimum.

Do not use aggregates that become segregated, mixed with earth or foreign material, or contain lumps of hardened material. Thaw frozen aggregates or aggregates containing frozen lumps before use.

(b) Batching - Batch materials according to 02001.40.

00755.45 Mixing Concrete - Mix the concrete according to 02001.40. Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving equipment.

00755.46 Placing Concrete:

(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 damage to the subgrade or base due to the Contractor's operations to the satisfaction of the Engineer at no additional cost to the Agency. 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, except when 00755.50 applies.

(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.

(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, the vibratory and tamping elements shall also be stopped immediately. Apply no external force to the paver.

(e) 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 00755.43 and 00755.48.

(f) Reject Concrete Material - Reject concrete if it:

- Is not in place within one hour after being mixed.
- Has begun to take an initial set before placement.
- Has been retempered with water.

(g) Protect Surface - Equip supports of the slipform paver, and other equipment which ride on previously placed pavement to meet the requirements of 00755.60, to prevent marring, edge breaking or chipping of the previously placed pavement.

(h) Hand Operated Equipment - Use shovels, not rakes, to hand spread and distribute the concrete. Do not foul the concrete with foreign matter, or 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 each side of construction and expansion joints and any other areas as directed.

(i) Illumination - During hours of darkness, adequately illuminate work areas at no additional cost to the Agency.

00755.47 Test Strip - At the beginning of paving operations, construct one initial test strip of concrete pavement at least 0.1 mile, but not more than 0.2 mile in length at the specified paving width. Use the same equipment for the remainder of the paving. Do not perform further paving until the test strip is evaluated according to 00755.55. 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 00755.55.

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 and construct additional test strips at no additional cost to the Agency.

The Engineer may waive the initial test strip if the Contractor is proposing to use a batch plant mixer and paving equipment that were satisfactorily used on a Department project within the preceding 12 months and the mixer hasn't been altered or moved.

00755.48 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.

Construct all joints at right angles to the surface of the pavement. 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 - 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, 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.

(1) Continuously Reinforced Pavement - Furnish a self-supported working platform at each construction joint. This working platform shall be at least 4 feet wide and long enough to span the entire width of the pavement panel being constructed. Construct and support the platform so it does not rest upon or touch the reinforcing steel. Have the workers use this platform when working in the area around construction joints and do not walk on the reinforcing steel. Remove any debris or spilled concrete at and beyond the joint, and support the reinforcement in proper position.

Form construction joints with a special header board. Take care when forming construction joints to assure that the reinforcement and its supports are not displaced, distorted or otherwise disturbed. When concrete placement resumes, remove the header board so neither the reinforcement nor the bond between the reinforcement and the previously placed concrete is disturbed.

(2) Other Pavements - 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) Terminal Expansion Joints - Locate terminal expansion joints at the ends of runs of continuously reinforced concrete pavement and construct to the dimensions and details shown.

The concrete in sleeper slabs shall conform to 00755.11. The steel reinforcement shall conform to Section 02510.

Vibrate concrete in sleeper slabs until it is completely consolidated and the excavations are completely filled. Construct sleeper slabs at least 24 hours before paving operations, unless otherwise allowed. Cure the surfaces of sleeper slab concrete according to 00755.53 until covered with concrete pavement.

00755.49 Surface Finishing - After the concrete has been given a preliminary finish by the finishing devices in the slipform paving equipment, 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 00755.55(a). Lap each successive check with the previous check path by at least half the length of the straightedge. This longitudinal checking and correction on areas to be graphically profiled will be waived if it is successfully demonstrated that a pavement surface is otherwise produced which conforms to 00755.55(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 1/8 inch to 3/16 inch. Randomly space the markings from 1/2 inch to 1 1/4 inches as approved. Avoid overlaps of the texturing. Markings shall be transverse to the roadway centerline and full roadway width.

00755.50 Stationary Side Form Construction - Consolidate and finish according to 00755.51.

(a) Mandatory SSFC - Use stationary side form construction on the standard reinforced concrete pavement at the ends of structures.

(b) Optional SSFC - With the approval of the Engineer, pavement may be constructed between stationary side forms in:

- Areas inaccessible to slipform paving equipment.
- Irregular areas.
- Short sections of pavement which are necessary to facilitate traffic movement.

00755.51 Modification of Strike-off, Consolidation, Final Floating, and Surface Finishing - Where the width of pavement is narrow, tapering, or of irregular pattern not lending itself to being constructed by prescribed machine methods, the Contractor will be allowed to perform the strike-off, consolidation, final floating and surface finishing with equipment, tools, means, labor and methods other than those specified, provided the work meets with the approval of the Engineer and the following requirements:

- Without causing segregation, vibrate throughout the concrete being placed until it is uniformly consolidated.
- Strike off the concrete with templates or screeds designed and manipulated to shape the concrete to 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 00755.49. Keep the surface free from laitance, soupy mortar, marks or irregularities.
- Finish the surface according to 00755.49.

00755.52 Edge Tooling and Filling - Tool edges at transverse joints and longitudinal 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.

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, provided the filling is neat and blends inconspicuously with adjoining concrete. Prepare the area according to the grout manufacturer's recommendations.

00755.53 Curing Concrete - Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, cover and cure the entire exposed surface of the newly placed concrete for at least 72 hours according to one of the following provisions:

(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 the covering 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 equivalent to the sheeting and use:

(1) Polyethylene Film - Sheeting shall be clear or white.

(2) Waterproof Paper - Transverse laps shall be at least 18 inches, and cement longitudinal seams.

(3) Cotton or Jute Mats - Before placing, saturate the mats with water and keep fully wetted during the curing period.

00755.54 Longitudinal 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 cracks which are visible without magnification will be considered unacceptable and be repaired or removed as determined by the Engineer. Perform all remedial work at the no additional cost to the Agency.

00755.55 Surface Tolerance, Testing, and Correction - The surface of finished pavement shall not deviate from longitudinal and transverse smoothness more than the prescribed limits. Perform straightedge testing and graphic profile testing under the supervision of the Engineer with equipment furnished and operated by the Contractor as soon as the hardness of the concrete permits.

(a) Straightedge Testing and Tolerance - Longitudinal and transverse smoothness testing of the pavement surface shall be done 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 00755.55(b).

(b) Graphic Profile Testing (GPT) and Tolerance:

(1) General - Test the longitudinal surface of all traffic lanes, ramps, shoulders and bridges for smoothness by the graphic profile method according to ODOT TM 770. Before paving commences on the Project, demonstrate the profilograph or 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 ramps, 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 00755.95.

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 00755.47. The test strip may be comprised of pavement placed during the shift that the shutdown is ordered, but in no case shall it be less than 0.1 mile in length.

(2) Surface Test - Run the profilograph or profilometer over the full length of the Project and 50 feet beyond the Project ends to provide a complete graphic profile. This includes all concrete traffic lanes and auxiliary lanes.

Obtain profiles on the pavement surface along lines parallel to and approximately 3 feet from each edge and longitudinal joint(s) for 12 foot wide lanes and 4 feet from each edge and longitudinal joint(s) for 14 foot wide lanes. The intent is to provide a profile in each vehicle wheel path. Take profile(s) on transition areas of entrance and exit ramps 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 00755.55(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:

$$\text{Profile Index} = \frac{\text{Total Count} \times 0.10}{\text{Length of Full 0.10 Mile Segment or of Partial } * \text{ Mile Segment}}$$

* Report to the nearest 0.01 mile

(c) Correcting Deficiencies - Should testing described in 00755.49, 00755.51 and 00755.55 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 00755.49 or 00755.51 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 00755.51 or 00755.55(a) are not met, correct according to 00755.55(c-2-a) or 00755.55(c-2-b) and retest.

(2) Failure To Meet Graphic Profile Requirements - Correct any segment or partial segment that exceeds the requirements of 00755.55(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 - Remove the nonspecification concrete pavement as determined by the Engineer and replace with specification concrete pavement.

b. Grind - 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 00755.49(b), by transverse sawing with diamond blade saws.

Retest their entire length, according to 00755.55(b), all segments requiring corrective work with the profilograph or profilometer under the supervision of the Engineer. Perform all corrective work and graphic profiling, including traffic control, at no additional cost to the Agency.

00755.56 Pavement Thickness - Construct the pavement to the thickness shown. Pavement not so constructed will be subject to replacement according to 00755.57, or to payment at adjusted prices according to 00755.93.

(a) Sticking Measurements - Determine conformance with minimum thickness requirements by random sticking measurements of the plastic concrete according to ODOT TM 775 under the Engineer's observation. Report thickness to the nearest 0.1 inch.

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. When directed, take one sticking measurement at a randomly selected location in each unit and partial unit. Record measurements to the nearest 0.1 inch. Take the measurements:

- After consolidation and screeding and before the float finish.

- No closer than 2 feet from the panel edges.
- Within 10 feet longitudinally and 1 foot transversely from the calculated random location determined by the Engineer.

If a sticking is not obtained for a unit or a partial unit, or is not available to represent the area of pavement remaining after the limits of pavement over 1.0 inch deficient is determined, the measurement will be assumed to be the same as the preceding or following sticking measurement, that is nearest in distance.

(b) Thickness 0.5 Inch Deficient - If a sticking measurement indicates the pavement is 0.5 inch or more deficient in thickness, stop forward paving progress until appropriate adjustments are made or corrective action is taken.

(c) Coring Requirements - Perform required coring, or coring requested by the Engineer according to AASHTO T 24 and repair core holes as directed, at no additional cost to the Agency. 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 sticking measurements.

(1) Corrective Grinding Areas - If corrective grinding required by 00755.55(c) is performed at a sticking measurement site, obtain a core at the sticking 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 00755.55 is 7.0 inches per mile or less in each wheel path, a core is not required after corrective grinding is performed at a sticking measurement site within the segment or partial segment represented by the profile indexes.

b. Profile Index Greater 7.0 Inches Per Mile - If an original graphic profile index for a segment or partial segment determined by 00755.55 is more than 7.0 inches per mile for a wheel path, obtain a core, after corrective grinding has been performed, at a sticking measurement site within the segment or partial segment represented by the profile indexes if the sticking measurement is the specified depth or less.

(2) Cores Requested By Contractor - If the Contractor believes that a sticking measurement or a core 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 sticking measurement or core site in question and the same distance from centerline. The replacement core measurement will replace the original sticking or core measurement.

(d) Thickness Over 1.0 Inch Deficient - If a sticking measurement shows pavement over 1.0 inch deficient, obtain a core at the sticking measurement site. If this core, or a core determined by 00755.56(c-1), 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 00755.57 or no payment under 00755.93.

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.

00755.57 Deficient Pavement - Remove and replace pavement deficient in thickness by more than 1.0 inch, according to 00755.56(d), at no additional cost to the Agency. If allowed 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

00755.60 Protection of Concrete - 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.

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 testing at least three cylinders cured according to AASHTO T 23 (field cure) and tested according to AASHTO T 22.

(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 00755.55.

Measurement

00755.80 Measurement - The quantities of concrete pavement will be measured on the area basis. 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.

The quantities of terminal expansion joints will be measured on the length basis, along the center line of each expansion joint as constructed.

Payment

00755.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Continuously Reinforced Concrete Pavement	Square Yard
(b)	Continuously Reinforced Concrete Pavement _____ Inches Thick	Square Yard
(c)	Reinforced Concrete Pavement	Square Yard
(d)	Reinforced Concrete Pavement _____ Inches Thick	Square Yard
(e)	Terminal Expansion Joints	Foot

In items (b) and (d), the thickness of the pavement will be inserted in the blank when more then one thickness is required under the Contract.

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

No separate or additional payment will be made for sleeper slabs or splices in the terminal expansion joints required due to staged construction.

00755.92 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:

Price Adjustment = 0.3 x (PF - 1) x Unit Price

00755.93 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 00755.56, payment will be made at an adjusted price according to the following table:

Deficiency in Thickness (Inch)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	83%
0.31 to 0.40	76%
0.41 to 0.50	73%
0.51 to 0.75	63%
0.76 to 1.00	59%

No payment will be made for any area of pavement found deficient in thickness by more than 1.0 inch even though such pavement is allowed by the Engineer to remain in place under the provisions of 00755.57.

00755.95 Bonus Payment for Smoothness - 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 00755.55(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 00755.55(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 Contract Schedule of Items

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 Prepaving Conference:

(a) Aggregate Production Conference - Supervisory personnel of the Contractor and any subcontractor's or supplier's who are to be involved in the aggregate production work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing aggregate production.

(b) Prepaving Conference - Supervisory personnel of the Contractor and any subcontractor's who are to be involved in the concrete paving work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving work.

Materials

00756.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510
Concrete Materials	02001
Curing Materials	02050
Epoxy and Nonepoxy Bonding Agents	02070
Epoxy and Nonepoxy Grouts	02080
Galvanizing	02530.70
Poured Joint Fillers	02440.30
Preformed Expansion Joint Filler	02440.10
Structural Steel	02530
Welded Wire Fabric	02510.40

00756.11 Classes of Concrete - Furnish Class 4000 - 1 1/2 paving concrete unless otherwise shown or indicated in the Special Provisions.

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.

00756.15 Quality Control - Provide quality control according to Section 00165, Section 02001, and the following:

(a) Concrete Mixture - If the results of any test are outside of the specification limits, stop the placement of the load. Correct the load or reject it and do not incorporate it into the work. Test

subsequent loads before any further concrete placement. Correct the subsequent loads if any of the tests are still outside the specification limits. If the load cannot be corrected, reject it and do not incorporate it into the work. Testing of subsequent loads may return to the specified frequency when the test results from two consecutive loads are shown to meet the specification limits.

(b) Records - Deliver all batch tickets, water-cement ration calculations, and all other records required 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 Agency according to Section 00165.

(1) Aggregate Gradation - A stockpile contains specification aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level indicated in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level indicated in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled aggregates that contain non-specification aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(c) Plastic Concrete - Acceptance of the plastic concrete will be based on the tests performed by the Contractor's QCT, according to the tolerances and limits of Section 02001.

(d) Hardened Concrete - Cast and cure the test specimens according to AASHTO T 23 in 6 inch x 12 inch single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test 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 00150.25.

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

00756.20 Batch Plant - Provide batch plants according to Section 02001.

00756.21 Mixers - Provide mixers according to Section 02001 except mix concrete in the batch plant mixer. Truck mixers may be used only as allowed in 00756.45.

00756.22 Hauling Equipment - Transport concrete in non-agitating equipment. Truck mixers may be used to transport concrete only as allowed in 00756.45. Hauling equipment shall conform to AASHTO M 157.12 or AASHTO M 157.11.6 when allowed.

00756.23 Paving Equipment - Place the PCC with either a slip form paving machine, a paving machine riding on stationary side forms, or both as the Contractor elects. Provide self-propelled paving machines that conform to the following:

(a) Placer/Spreader - Provide a Placer/Spreader that will:

- Receive the concrete mixture in its hopper on the shoulder area.
- Deliver the concrete mixture to the slipform paver and uniformly spread at the proper thickness for the full width of the area being paved.
- Not segregate the concrete mixture or displace the reinforcing steel.

(b) Slipform Paver - Provide a Slipform Paver that is:

- Equipped with electronic or hydraulic controls to automatically control line and grade from both sides.
- Able to vibrate, consolidate and finish the slab to proper grade and cross section for the full width and depth of the concrete being placed.
- Equipped with vibrating tubes or arms to work in the concrete.
- Equipped with sliding forms held together rigidly to prevent them from spreading.
- Equipped with sliding forms long enough so that slumping of the concrete does not exceed 1/4 inch, according to 00756.49(a).

(c) Paving Machine - If a paving machine riding on stationary side forms is used, conform to the following:

- The machine used for initial strike-off and consolidation of PCC shall be self-propelled, screening type and shall ride on and be guided by steel side forms or the edge of contiguous PCC pavement. The machine shall be designed and operated to strike-off, consolidate and compact the PCC to prescribed line, grade and cross section. Make provision to prevent chipping or marring previously placed PCC.

- Vibratory equipment shall be of the surface pan type or internal type with immersed tube or multiple spuds. The vibrator shall provide full slab width vibration to the concrete at frequencies of not less than 3,500 impulses per minute and as necessary for proper consolidation and compaction.
- Floating and finishing machines shall be self-propelled and shall ride on and be guided by steel side forms or the edge of contiguous PCC pavement. The machine shall provide floating action to the PCC surface by means of screeds, floats, rollers or combinations of them. 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) Profilograph - When required, provide a California type profilograph, computerized or not computerized, complete with recorder for determining the profile index of the pavement according to ODOT TM 770.

Have the profilograph on the Project, calibrated, in good working condition and ready for operation before construction of any concrete pavement begins. Provide a competent operator experienced in the operation of the equipment.

(c) Profilometer - Provide a profiling device that employs an accelerometer established inertial profiling reference and a laser height sensing instrument to produce a true profile of the pavement surface. The device shall be capable of reporting elevations with a resolution of 0.004 inch or finer at an interval of 6 inches or less. The unit shall also be able to generate the equivalent California-type profilograph plot and values according to ODOT TM 770 as well as the locations and heights of bumps and dips as required in this specification. The profilometer shall be calibrated, in good working condition, and ready for operation prior to performing smoothness measurements.

Provide competent and experienced operator(s) for the equipment. The profilometer operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the project.

Labor

00756.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CAgT
- CCT
- CSTT
- QCT

Additional Contractor quality control responsibilities include the following:

- Provide and designate an individual who shall be present at the placement site at all times during concrete placements, and who is authorized and responsible for acceptance and rejection of materials.

- Reject loads which arrive at the jobsite without a batch ticket.
- Require the truck driver to record on the batch ticket and initial the amounts of water added in transit and at the jobsite.
- Reject plastic concrete that is outside of the specified limits.

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 allowed 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 additional cost to the Agency.

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 pay all costs to implement the change. Any changes require the Engineer's approval.

00756.43 Placing Dowel Bars - Provide smooth, round dowel bars. Coat with plastic, grease, heavy oil, or other approved material that will neither bond with nor be harmful to the PCC. Place dowels in a supporting framework that holds the dowels parallel with each other, parallel with the surface of the pavement and perpendicular to the joint. Maximum alignment tolerance shall be 5 degrees or 3/16 inch in the length of the dowel. Place dowels within 3/8 inch of the center of the slab vertically.

00756.44 Handling, Measuring, and Batching Materials - The plant site, layout, equipment and provisions for transporting material shall be adequate to assure a continuous supply of material to the worksite.

(a) Aggregates - Stockpile and remove the aggregate from stockpiles in a manner that holds segregation to a minimum.

Do not use aggregates that become segregated, mixed with earth or foreign material or contain lumps of hardened material. Thaw frozen aggregates or aggregates containing frozen lumps before use.

(b) Batching - Batch materials according to 02001.40.

00756.45 Mixing Concrete - Mix materials according to 02001.40. Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving equipment.

00756.46 Placing Concrete - Place concrete by either the slip form method as described in (a), (b), (c) and (d) below, or by the stationary side form method as described in (e) below.

(a) Delivery To Spreader - Deliver the concrete from the hauling vehicles to the placer/spreader hopper on the shoulder area. Do not permit equipment hauling concrete on the subgrade or on the base, except for a minimum number of approved right angle or near right angle crossings. Correct damage to the subgrade or base due to the Contractor's operations, to the satisfaction of the Engineer, at no additional cost to the Agency. 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, or disturb joint devices during such operations. Furnish hand operated mechanical vibrators satisfactory to the Engineer. Use these vibrators to consolidate the concrete pavement at least 6 feet on each side of construction and expansion joints and any other areas as directed.

(j) Illumination - During hours of darkness, adequately illuminate work areas at no additional cost to the Agency.

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 and construct additional test strips at no additional cost to the Agency.

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.

00756.49 Surface Finishing - After the concrete has been given a preliminary finish, check the surface of the fresh concrete in the longitudinal and transverse direction with a 12 foot straightedge. Correct surface deviations more than allowed by 00756.55(a). Check at interval 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. Check the transverse direction as required. Use of a proof rod 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).

(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 inch to 1/8 inch. Randomly space the markings from 1/2 inch to 1 1/4 inches 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.

00756.51 Modification of Strike-off, Consolidation, Final Floating, and Surface Finishing - Where the width of pavement is narrow, tapering or of irregular pattern, not lending itself to being constructed by prescribed machine methods, the Contractor will be allowed to perform the strike off, consolidation, final floating, and surface finishing with equipment, tools, means, labor and methods other than those specified, provided the work meets with the approval of the Engineer and the following requirements:

- Without causing segregation, vibrate throughout the concrete being placed until it is uniformly consolidated.
- Strike-off the concrete with templates or screeds designed and manipulated to shape the concrete to 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 QPL 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 moistureproof 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 be repaired or removed as determined by the Engineer. Perform all remedial work at no additional cost to the Agency.

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, ramps shoulders and bridges for smoothness by the graphic profile method according to ODOT TM 770. Before paving commences on the Project, demonstrate the profilograph or 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 ramps, 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 00756.95.

b. Daily GPT - If the average profile index exceeds 7.0 inches per mile for all segments and partial segments of pavement constructed in any day's production, discontinue paving operations and construct one or more test strips as described in 00756.47. The test strip may be comprised of pavement placed during the shift that the shutdown is ordered, but in no case shall it be less than 0.1 mile in length.

(2) Surface Test - Run the profilograph or profilometer over the full length of the Project and 50 feet beyond the Project ends to provide a complete graphic profile. This includes all concrete traffic lanes and auxiliary lanes.

Obtain profiles on the pavement surface along lines parallel to and approximately 3 feet from each edge and longitudinal joint(s) for 12 foot wide lanes and 4 feet from each edge and longitudinal joint(s) for 14 foot wide lanes. The intent is to provide a profile in each vehicle wheel path. Take profile(s) on transition areas of entrance and exit ramps 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:

$$\text{Profile Index} = \frac{\text{Total Count} \times 0.10}{\text{Length of Full 0.10 Mile Segment or of Partial } * \text{ Mile Segment}}$$

* 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 nonspecification concrete pavement as determined by the Engineer and replace with specification concrete pavement.

b. Profile with abrasive grinder(s), equipped with a cutting head comprised of multiple diamond blades. The Engineer will determine and mark the areas to be profiled. For all areas corrected by grinding, restore the required surface texture as specified in 00756.49(b) by transverse sawing with diamond blade saws.

Retest their entire length, according to 00756.55(b), all segments requiring corrective work with the profilograph or profilometer under the supervision of the Engineer. Perform all corrective work and graphic profiling, including traffic control, at no additional cost to the Agency.

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 according to AASHTO T 24 and repair core holes as directed, at no additional cost to the Agency. 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, according to 00756.56(d), at no additional cost to the Agency. If allowed 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 T 23 (field cure) and tested according to AASHTO T 22.

(c) The surface of the concrete is protected from scarring or abrasion and kept free of stones, loose mortar and other matter apt to be deleterious to the concrete in the paths of equipment.

(d) The pavement meets all of the requirements of 00756.55.

Measurement

00756.80 Measurement - The quantities of concrete pavement will be measured on the area basis. The area will be determined by measuring the width and length of each separately constructed panel of pavement. The width is the design width or measured edge-to-edge width on the surface of the pavement whichever is less. The length is the horizontal measurement from end to end of pavement along the center line of the strip.

The measurement of extra thickness of pavement, as shown or as ordered, will be determined by conversion on a proportionate volume basis to an equivalent number of square yards of specified thickness pavement.

Payment

00756.90 Payment - The accepted quantities of plain concrete pavement will be paid for at the Contract unit price, per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Plain Concrete Pavement, Undowelled, ____ Inches Thick	Square Yard
(b) Plain Concrete Pavement, Dowelled, ____ Inches Thick	Square Yard

The thickness of pavement will be inserted in the blank.

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

No separate or additional payment will be made for construction joint reinforcement bars, tie bars, dowel bars, curing materials, and saw cutting.

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:

Price Adjustment = 0.3 x (PF - 1) x 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:

Deficiency in Thickness (inch)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	83%
0.31 to 0.40	76%
0.41 to 0.50	73%
0.51 to 0.75	63%
0.76 to 1.00	59%

No payment will be made for any area of pavement found deficient in thickness by more than 1.0 inch even though such pavement is allowed by the Engineer to remain in place under the provisions of 00756.57.

00756.95 Bonus Payment for Smoothness - If a profilograph or profilometer is used according to 00756.55 a bonus payment of up to 1.5% will be made to the Contractor for each 0.1 mile segment or partial segment of pavement except shoulders, as determined in 00756.55(b) if:

- The profile index for each wheel path is 7.0 inches per mile or less.
- No individual deviation is 0.3 inch or more.
- The average of the 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 Contract 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 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510
Commercial Grade Concrete	00440
Dowels	02510.50
Epoxy Bonding Agent	02070
Metal Pipe Handrail	02830
Preformed Expansion Joint Filler	02440.10
Welded Wire Fabric	02510.40

00759.11 Aggregate Base - Furnish aggregate base materials for base, foundation courses, leveling courses, or bedding meeting the requirements of Section 02630. If a designated size is not shown or given, furnish either 1" - 0 or 3/4" - 0, as the Contractor elects.

00759.12 Sidewalk Ramp Treatment - Furnish truncated dome detectable warning surfaces for sidewalk ramps and accessible route islands from the QPL.

Use only adhesives recommended or supplied by the manufacturer.

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.

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 Surfacings - Provide expansion joints:

- Between driveways and concrete pavement.
- Transversely in walks opposite expansion joints in adjoining curbs and elsewhere so the distance between joints does not exceed 45 feet.
- Transversely in walks at a distance of 16 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 or 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 Surfacings - Finish concrete surfaces to smooth and uniform texture by troweling, floating and cross brooming. Lightly groove or mark surfaces into squares or other shapes to match markings on similar existing surfaces in the vicinity, as directed.

On all sidewalk ramps and accessible route islands, install truncated domes as shown. Place according to the manufacturer's recommendation.

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.

Measurement

00759.80 Measurement - The quantities of structures constructed under this Section will be measured according to the following:

- **Volume Basis** - Measurement will be limited to the neat lines of the structure.
- **Area Basis** - Measurement will be limited the neat lines of the structure.
- **Length Basis** - Measurement will be along the face of the structure, from end to end including curb tapers or depressed lengths at driveways and ramps.
- **Each Basis** - Measurement will be by actual count.

Payment

00759.90 Payment - The accepted quantities of structures will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Concrete Curbs, _____	Foot or Cubic Yard
(b)	Concrete Islands	Square Foot
(c)	Concrete Driveways	Square Foot
(d)	Concrete Driveways, Reinforced	Square Foot
(e)	Concrete Walks	Square Foot
(f)	Monolithic Curb and Sidewalks	Square Foot or Foot
(g)	_____ Concrete Surfacing	Square Foot
(h)	Concrete Stairs	Cubic Yard
(i)	Concrete Bus Shelter Pads	Each
(j)	Concrete Mowing Strip	Foot

In item (a) the type of curb will be inserted in the blank, if appropriate.

Item (b) includes traffic separators.

Items (c) and (d) include monolithic curb at driveway locations.

Items (e) and (f) include sidewalk ramps.

In item (g) the specified thickness, or type, of concrete surfacings will be inserted in the blank, if appropriate.

Item (h) includes pipe handrail.

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

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate pay items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90 or 00641.90 as appropriate.

PART 00800 - PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES

Section 00810 - Metal Guardrail

Description

00810.00 Scope - This work consists of constructing metal guardrail and metal median barrier to the lines and grades shown or established and includes the assembly and erection of all components, parts and materials complete at the locations shown or directed.

Metal guardrail and metal median barrier will be referred to in this Section as "guardrail". The types of guardrail will be shown.

Materials

00810.10 Materials - Furnish materials meeting the following requirements:

Guardrail Anchor Hardware	02820.40
Guardrail Hardware	02820.30
Metal Beam Rail	02820.10
Metal Posts	02820.20
Wood Guardrail Blocks	02110.20
Wood Guardrail Posts	02110.10

Use guardrail terminals from the QPL conforming to the National Cooperative Highway Research Program (NCHRP) Report 350.

00810.11 Posts - Posts, except as specified for use on bridges or otherwise shown or directed, may be of steel or wood, as the Contractor elects. Once a type has been selected, use it throughout the continuous run of guardrail except in the transitions and terminals.

00810.12 Median Barrier on Bridges - Metal median barrier on bridge decks shall be comprised of metal beam rail, metal posts and hardware, conforming to 00810.10.

At expansion joints on bridge decks, the slots in the rail member for post bolt and rail joint bolts shall be of special dimensions as shown.

00810.13 Guardrail Anchors - Guardrail anchors shall be steel.

00810.14 Condition of Materials - All materials will be subject to inspection of condition at the latest practical time available before or during incorporation of materials in the work.

00810.15 Salvaged Materials - Materials salvaged as part of removal work on the Project may be reused in new construction, if the Engineer determines the materials conform to current design, 00810.10 and the following:

(a) Wood Posts - Wood posts shall be structurally sound, treated and free from damage that would affect their strength and durability. Do not incorporate into the work any post damaged to the extent that untreated wood is exposed.

(b) Metal Beam Rail Members - Metal beam rail members shall be unpainted, straight and free of breaks, kinks, dents, damage to galvanized coating, or any other damage that would affect the integrity of the member. If paint is removed from metal beam rail members salvaged from the Project, remove the paint at a location outside of the highway right of way, and in a manner that will not damage the galvanizing. Repair minor damage to galvanizing according to 00810.43.

Construction

00810.40 Timing and Coordination of Work - Time and coordinate construction of guardrail to hold disturbance of bases, surfacings and pavements to a minimum.

Place all salvaged metal guardrail or metal median barrier materials in continuous runs.

Do not leave posts installed for guardrail and median barrier exposed to traffic for more than 24 hours before installing the rail members, rail end pieces and anchors and tightening all bolts, except replacement rail shall be installed according to 00310.40(a).

00810.41 Excavation and Backfill - Subject to 00810.42, excavate to the lines, grades and depths shown or established. Make cuts through pavement by mechanical means, such as knife-edge cutters or rotary drills. Make cuts below the pavement by auger or other means that will prevent undue disturbance of abutting areas. Avoid fouling existing bases and pavements. Repair or replace, as directed, all materials that become fouled, at no additional cost to the Agency. Remove water and unsuitable material that would impair stability of the backfill, from areas to be backfilled.

In areas occupied by aggregates, bituminous material and pavements, backfill with like materials to the same thickness and density as the adjacent materials. In other areas, backfill with granular backfill materials meeting the requirements of 00330.14. Place all backfill in layers not exceeding 6 inches and compact each layer to a firm, dense condition.

Remove, replace, repair, or restore, as directed, adjoining areas that become misshapen or disturbed during excavating and backfilling operations at no additional cost to the Agency. Dispose of excess materials according to 00330.41(a-4).

00810.42 Installation of Posts and Anchors - Place posts and anchors as shown. If directed, install 8 foot guardrail posts. Set posts in excavated holes or drive them in place. If posts are driven through the bases, surfacings, or pavement, repair all damage as directed. Remove and replace posts, anchors or other components damaged during installation with sound components. Firmly set all posts at proper line, grade and spacing within a tolerance of 1/2 inch. Rigidly attach anchors, terminals and connections to other structures as shown.

When metal posts are required over box culverts, cattle passes, equipment passes or other concrete structures, place steel posts, base plates, or base plate concrete anchors as shown or directed.

00810.43 Erection of Rails and Other Components - Normally, all fabrication of metal beam rail members and other components shall be done in the shop or by the manufacturer. Limit field cutting, drilling and other field fabrication to the minimum and perform in a manner that will not impair the appearance or structural quality of the material. Burning new holes in metal beam rail members will not be allowed.

Restore to specified condition, surface finishes and protections that are damaged before or during erection. Repair the cut ends of galvanized bolts, rail elements and back-up plates, and any holes drilled or punched after galvanizing according to ASTM A 780. Minimum zinc content for Method A2 is 94% on the dry film.

Toe nail blocks to post with two 10d, galvanized, flat head nails to prevent rotation.

Draw tight all bolts. Bolts shall be of sufficient length to extend slightly beyond the nuts.

00810.45 Painted Guardrail - Projects that include the removal and dismantling of painted metal guardrail require that environmental protection and worker safety precautions be established. If painted guardrail is reused in any application, comply with DEQ/EPA and OSHA regulations pertaining to paint removal.

Measurement

00810.80 Measurement - The quantities of guardrail items constructed under this Section will be determined as follows:

- **Length** - Measurement will be on the length basis, measured by one of the following methods:
  - **Count Method** - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a "standard section" is defined as 12 1/2 feet of complete guardrail or median barrier, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post, and added to the total calculated length of the standard sections for each run.
  - **Length Method** - Measurement will be from center to center of end posts, or as otherwise shown, along the line and grade of each run of each type.
- **Unit** - Measurement will be by actual count.

Payment

00810.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	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 ____ Foot Posts	Each
(i)	Guardrail Posts	Each

In item (a), the type of guardrail will be inserted in the blank . Item (a) includes all posts including steel, base plates, and base plate concrete anchors.

Items (a) and (b) include constructing the respective items except for:

- end pieces
- anchors
- transitions
- extra costs involved in constructing guardrail connections to existing bridges
- terminals

In item (c), the type of anchor will be inserted in the blank.

In item (d), the type of guardrail end piece will be inserted in the blank.

Item (e) includes preparing the bridge rail or concrete barrier for the transition and includes posts, rail elements, terminal connectors, connection plates, anchor bolts, and all necessary appurtenances and hardware.

Item (f) includes preparing the bridge rail or concrete barrier for the connection and installing the terminal connectors when there is no guardrail transition item and includes connection plates, anchor bolts, and all necessary appurtenances and hardware.

In item (g) the type of terminal will be inserted in the blank. Item (g) includes guardrail terminals, posts, anchors, rails, guards, end pieces, struts, soil tubes, and all necessary appurtenances and hardware.

In item (h) the length of post will be inserted in the blank. Item (h) includes installing 8 foot long or longer posts instead of standard 6 foot long posts, The extra costs for the longer posts are costs that are not covered and included in the unit price for one or more of the other listed pay items.

Item (i) includes only installing posts when upgrading or repairing existing guardrail installations.

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

No separate or additional payment will be made for excavation and backfill.

Section 00811 - Cable Barrier

Description

00811.00 Scope - This work consists of furnishing and installing cable barrier to the lines, grades, and at the locations shown or directed.

Materials

00811.10 Cable Barrier - Furnish cable barrier from the QPL. Provide all cable barriers on the Project from the same manufacturer regardless of the number of runs of cable barrier required and regardless of the types of cable barrier required.

Use pre-cast or cast-in-place concrete docketed foundation line posts. Furnish and place concrete meeting the requirements of Section 00440.

00811.11 Cable Barrier Terminals - Use the following options as specified:

- **Option 1** - Use cable barrier terminals from the QPL that matches the system used.
- **Option 2A** - Tie the cable barrier to new guardrail as approved by the cable barrier manufacturer.
- **Option 2B** - Tie the cable barrier to existing guardrail as approved by the cable barrier manufacturer.

Equipment

00811.20 Tension Measuring Device - Measure the cable barrier tension with a manufacturer supplied measuring device. At the completion of the Project, the measuring device becomes the property of the Agency at no additional cost to the Agency.

Labor

00811.30 Manufacturer's Representative - If it is a requirement of the manufacturer to have a manufacturer's representative on-site during installation, provide the services of a manufacturer's representative at no additional cost to the Agency.

Construction

00811.40 Cable Barrier - Install cable barrier according to the manufacturer's directions at the locations shown. Cable anchors and cable overlap as shown are approximate. Locate and overlap the actual anchor according to manufacturer's instructions.

Keep a tension log and give it to the Engineer upon completion of installation. The tension log shall show the time, date, location, ambient temperature, and the final tension readings, and be signed by the person performing the tension readings. Provide a copy of the manufacturer's recommended tension chart along with the tension log.

Perform all tension checks or adjustments required by the manufacturer within a 30 day period of installation.

00811.41 Cable Barrier Terminals - Place terminals according to the manufacturer's directions, at locations shown, and as required by the cable barrier manufacturer to meet their minimum requirements. Ensure that there is compatibility between terminals and the cable barrier system installed.

00811.42 Placement - Place the concrete anchors and footings, and backfill them at least two weeks prior to tensioning the cables. Set the concrete anchors into the excavation as shown. Set the bottom of the anchor so it has full and even bearing in the surface under it. Excavate and backfill according to 00810.41.

Maintenance

00811.60 Training - After installation, provide at least one 4 hour manufacturer presented training session to Agency maintenance personnel at no additional cost to the Agency.

Measurement

00811.80 Measurement - The quantities of cable barrier will be measured on the length basis, from center of end post to center of end post along the line and grade of each separate run. Measurement will be made through the ends of the terminals and guardrail connections.

The quantities of cable barrier terminals and cable barrier guardrail connections will be measured on the unit basis.

Payment

00811.90 Payment - The accepted quantities of cable barrier will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Cable Barrier, Test Level 3	Foot
(b)	Cable Barrier, Test Level 4	Foot
(c)	Cable Barrier Terminals	Each
(d)	Cable Barrier Guardrail Connections	Each

Items (c) and (d) include all special rail elements, brackets, posts, and all necessary appurtenances and hardware.

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

Section 00812 - Adjusting Guardrail

Description

00812.00 Scope - This work consists of adjusting existing guardrail by raising it to the proper height to conform to the applicable standard drawings.

Materials

00812.10 Materials - Replace rail members, posts, or other materials that are damaged with material meeting the requirements of 00810.10. Replace materials damaged by the Contractor's operations at no additional cost to the Agency.

Construction

00812.40 General - Reinstall adjusted guardrail components during the same day they are removed. Repair minor damage to galvanizing according to ASTM A 780. Minimum zinc content for Method A2 is 94% on the dry film.

Adjust the existing guardrail by one or both of the following methods:

(a) Posts Remain in Place - Remove the existing rail members and blocks in a manner that will not damage galvanizing; drill new bolt holes in posts (if needed); treat existing and new holes with a preservative from the QPL; reinstall the rail members and blocks; and perform such other work as may be required and shown.

(b) Raise Posts - Remove and reinstall posts at the proper height, or raise posts to the proper height and set firmly by working grout or other materials under the post in a manner satisfactory to the Engineer.

Measurement

00812.80 Measurement - The quantities of adjusted guardrail will be measured on the length basis, of existing guardrail adjusted. Measurement will be by one of the following methods:

- **Count Method** - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this subsection, a "standard section" is defined 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, to the nearest foot, and added to the total calculated length of the standard sections for each run.

- **Length Method** - Measurement will be from center to center of end posts, or as otherwise shown, along the line and grade of each run of each type to the nearest foot.

Payment

00812.90 Payment - The accepted quantities of adjusted guardrail will be paid for at the Contract unit price, per foot, for the item "Adjusting Guardrail".

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

Section 00815 - Bollards

Description

00815.00 Scope - This work consists of furnishing and installing bollards at locations shown or as directed.

Materials

00815.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete	00440
Granular Drain Backfill	00430.11
Reflective Sheeting	02910.30

00815.11 Posts and Sleeves - Use Schedule 40 steel posts and sleeves conforming to ASTM A 53.

00815.12 Plates, Shapes, Fasteners, and Hardware - Use plates and shapes conforming to ASTM A 36. Use fasteners and hardware conforming to ASTM A 449.

00815.13 Galvanizing - Hot-dip galvanize all metal components after fabrication according to AASHTO M 111 (ASTM A 123) or AASHTO M 232 (ASTM A 153), as applicable.

00815.14 PVC Pipe - Use Schedule 40 PVC pipe.

Construction

00815.40 Bollards - Install bollards as shown or as directed.

Measurement

00815.80 Measurement - The quantities of bollards will be measured on a unit basis.

Payment

00815.90 Payment - The accepted quantities of bollards will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Bollards	Each
(b)	Removable Bollards	Each

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

No separate or additional payment will be made for excavation work.

Section 00820 - Concrete Barrier

Description

00820.00 Scope - This work consists of constructing precast and fixed form cast-in-place portland cement concrete barrier, to the lines and grades shown or established.

Materials

00820.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete .....00440, except as provided in this Section
Concrete Coating 02210
Deformed Bar Reinforcement 02510.10
Portland Cement Grout 02080.40
Preformed Joint Filler 02440.10

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 02690.30(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 02690.20(d). Test results shall be no more than one year old.

(b) Hardware - Pins, bolts, and dowels shall conform to ASTM A 449 and shall be hot-dip galvanized according to AASHTO M 232 (ASTM A 153).

(c) Loop Bars - Fabricate loop bars from ASTM A 36, hot-rolled round bar and hot-dip galvanize according to AASHTO M 232 (ASTM A 153) and ASTM A 143.

(d) C-shape Connectors - Furnish perforated C-shape connectors fabricated from ASTM A 36 channel, hot-dip galvanized after fabrication according to AASHTO M 232 (ASTM A 153) and ASTM A 143.

(e) Identification - Permanently cast into the top surface or into the side lower vertical face of each precast concrete barrier piece an identifying code consisting of the initials of the barrier manufacturer, the date of casting and the form number. Barrier pieces without identifying code will not be accepted.

00820.12 Re-use of Concrete Barriers - Used precast concrete barriers may be placed in permanent installations according to the following:

(a) New Barrier Used for Temporary Application - New precast concrete barriers used in temporary applications on the Project may be reused in permanent installations, provided they:

- Are in good condition, without visible cracks, chips or spalls.
- Present a surface of uniform texture and appearance.
- Are free of markings, except as required by 00820.11(e).
- Are given two coats of a water-based coating material meeting the requirements of 02210.30(c) after installation in final position.

(b) Barrier Used on Previous Projects - Precast concrete barriers used on previous projects may be reused in permanent installations, provided they meet all the requirements of this Section and, prior to delivery to the Project Site:

- The Contractor furnishes documentation required by 00165.10(b).
- Barriers are restored to like-new condition, without visible cracks, chips, spalls or corroded loops.
- Barriers present a surface of uniform texture and appearance.
- Barriers are free of markings, except as required by 00820.11(e).

Apply 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 additional cost to the Agency.

00820.15 Quality Control - Provide quality control according to Section 00165.

Labor

00820.30 Quality Control Personnel - Provide a certified Quality Control Technician (QCT).

Construction

00820.40 General - Construct cast-in-place barrier using fixed forms unless specifically directed otherwise. Use the same barrier design in any continuous run of barrier.

00820.41 Line and Grade - Place precast barrier sections on the pavement surface. New pavement surfaces placed as a part of this Project shall meet the appropriate smoothness requirement prior to placing the barrier. If corrective work is required for existing surfaces to receive concrete barrier, it will be paid for separately as Extra Work.

Place the barrier sections so that the joints offset no more than 1/4 inch transversely and no more than 1/2 inch vertically.

Construct the top and face of finished barriers true and straight. The top surface of the barriers shall be uniform width and free from humps, sags, or other irregularities. When a 12 foot straightedge is laid on the top or face of the barrier, the surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade breaks or curves. To compensate for variations in the roadway grade and cross slope, adjust the height of the barrier at no additional cost to the Agency.

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 latex paint from the QPL as follows:
  - Apply first coat at an application rate of 150 square feet per gallon.
  - Allow first coat to air dry for one hour.
  - Apply second coat at the 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. 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 latex paint from the QPL. Use additional coats as necessary to provide uniform coverage and appearance. Clean and thoroughly saturate with water the surfaces to be coated. Coat while damp. The second coat may be applied when the previous coat does not adhere to the fingers when touched lightly.

00820.47 Replacement or Price Reduction - Remove and replace barrier represented by cylinders that fail to meet the minimum strength requirement, at no additional cost to the Agency. If the Engineer determines the low-strength barrier is suitable for the purpose intended, the barrier may be accepted according to 00150.25.

00820.48 Inspection - Fabrication of barrier outside of the State of Oregon creates additional inspection costs to the Agency. The Contractor's payment for barrier will be reduced according to 00165.91.

Measurement

00820.80 Measurement - The quantities of concrete barrier will be measured on the length basis, according to the following:

- **Cast-In-Place Barriers** - Cast-in-place barrier will be measured along the line and grade of each separate run, including terminal sections and transition sections.

- **Precast Barriers** - Precast barrier will be the laying length of a standard section, as shown on the applicable standard drawing, multiplied by the number of standard sections installed in each separate run. Non-standard sections, terminal sections and transition sections will be measured separately and added to the total length of standard sections.

Payment

00820.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Concrete Barrier	Foot
(b)	Concrete Barrier, Tall	Foot

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

No separate or additional payment will be made for excavating and backfilling concrete barrier buried ends.

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.

- Furnish glare shields from the QPL.
- Furnish steel base plate brackets fabricated from ASTM A 304 stainless steel or merchant quality mild carbon steel. Mild carbon steel brackets shall be hot-dip galvanized after fabrication according to AASHTO M 111 (ASTM A 123).
- Furnish bolts, nuts, inserts, washers and other necessary assembly hardware made from ASTM A 304 stainless steel or mild carbon steel. Equip exposed hardware with vandal-resistant lock nuts or similar. Furnish mechanical inserts, if used, suitable for dynamic application. Galvanize carbon steel assembly hardware according to AASHTO M 111 (ASTM A 123).

All base plate brackets and necessary assembly hardware installed in a continuous run shall be of the same material.

Construction

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. Space modular unit anchor bolts as recommended by the manufacturer.
- 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 - The quantities of glare shields will be measured on the length basis, along the line and grade of each run.

Payment

00822.90 Payment - The accepted quantities of glare shields will be paid for at the Contract unit price, per foot, for the item "____ inch Glare Shields".

The length of the blades will be inserted in the blank.

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

Section 00830 - Impact Attenuators

Description

00830.00 Scope - This work consists of furnishing and installing impact attenuators for permanent installations.

00830.02 Required Submittals - If placement or method of installation of impact attenuators is different than the manufacturer's recommendations, submit stamped shop drawings, including concrete components, according to 00150.35.

Materials

00830.10 Materials - Furnish impact attenuators from the QPL and as specified.

The following types of impact attenuators are allowed:

Type A: Gating device, Test Level 3, for Shoulder use only, Narrow Width, Regular Maintenance

Type B: Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance

Type C: Non-Gating device, Test Level 2, for Shoulder, Gore and Median uses, Narrow Width, Regular Maintenance

Type D: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance

Type E: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance

Type F: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance

Type G: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance

Type H: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Low Maintenance

Type J: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance

Type K: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Low Maintenance

Concrete shall meet the requirements of the manufacturer, or if the manufacturer makes no recommendations, concrete shall met the requirements of Section 00440. Reinforcement shall conform to Section 00530.

All hardware, epoxy resin, and miscellaneous items shall be according to the manufacturer’s recommendations

Construction

00830.40 General - Construct and surface finish concrete according to Section 00440.

Prepare surfaces, mix, and place epoxy grout for epoxy grout pad construction according to the manufacturer's recommendations.

Assemble and install impact attenuator systems according to the manufacturer's recommendations and shop drawings.

Measurement

00830.80 Measurement - The quantities of impact attenuators will be measured on the unit basis, by actual count at each location a system is installed.

Payment

00830.90 Payment - The accepted quantities of impact attenuators will be paid for at the Contract unit price, per each, for the item "Impact Attenuator, Type _____ ".

The type of impact attenuator will be inserted in the blank.

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

No separate or additional payment will be made for transitions, concrete bases, and object markers.

Section 00840 - Delineators and Milepost Marker Posts

Description

00840.00 Scope - This work consists of furnishing and installing delineators and milepost marker posts at locations shown or established.

Materials

00840.10 Materials - Furnish materials meeting the following requirements:

Barrier Markers	From QPL
Flexible Delineators	From QPL
Galvanized Support Posts	From QPL
Reflective Sheeting for Delineators	From QPL

00840.11 Target Members:

(a) General - The target members shall be of aluminum alloy conforming to the requirements of ASTM B 209, "3xxx" or "5xxx" series with "Hxx" approximately half-hard temper, suitable for enameling by continuous roller or other acceptable method. The aluminum sheet from which targets are fabricated shall have a nominal thickness of 0.050 inch, subject to standard manufacturer's tolerances. Provide well finished targets, free of burrs, irregularities and turned edges. When resting on a plane surface, the targets shall not show warp, twist or variation from the surface in excess of 1/4 inch.

(b) Surface Preparation and Enameling - Clean and prepare each surface of each target member for enameling according to one of the following procedures:

(1) Cleaning - Type A Solvent Cleaning or Type B, Method 1 Alkaline Cleaner Chemical Treatment, ASTM D 1730, with water rinsing. During rinsing, as evidence of proper cleaning, the cleaned surface shall retain a continuous film of water.

(2) Chemical Treating - Type B, or Methods 5, 6, or 7 chemical conversion coating, or Method 8 Acid-Bound Resinous Treatment, ASTM D 1730.

(3) Anodic Treating - Type C, Method 1 Sulfuric Acid Anodic or Method 2 Chromium Trioxide Anodic, ASTM D 1730.

(4) Enameling - Give each surface of each target member that has been cleaned and treated as specified above, and is ready for enameling either:

- 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 inch x 13 3/4 inch target member may be furnished with a white finish on one side and a yellow finish on the other side, if the Contractor so elects.

(d) Testing Baked Enamel:

(1) Adhesion Test - The adhesion test shall conform to ASTM D 3359, Method B. The enamel shall meet or exceed "4B" adhesion rating. One test is to be made on each face of each test specimen.

(2) Pencil Hardness Test - The pencil hardness test shall conform to ASTM D 3363. The enamel shall have a gouge hardness rating of not less than "H". One test is to be made on each face of each test specimen.

(e) Acceptance - Acceptance of target members will be according to 00165.35, 02850.20 and the following:

(1) Pretested Stock - A supplier may qualify an identified lot of target members for use by the Agency by complying with the requirements of 00840.11(a) through 00840.11(d). This lot may then be subdivided for shipment to several projects. The sublots may be accepted on the basis of certification by the supplier that the identified lot of target members had been qualified by the Agency's Materials Laboratory.

(2) Target Members - If target members are not from a qualified lot, furnish target members for testing as follows:

- For acceptance testing, a lot shall consist of target members of the same color from a single production run.
- Test specimens will be sampled at random by the Engineer as follows:

Lot Size	Number of Target Test Specimens
Up to 1,000	1 per 100 or fraction of 100
1,000 to 10,000	10 plus 1 per 500 or fraction of 500
More than 10,000	30 plus 1 per 1,000 or fraction of 1,000

- Allow the Engineer to sample the target members for test specimens, at no additional cost to the Agency for the specimens.
- If a test specimen fails any test, the lot will be resampled for the same number of test specimens and retested. If a specimen of the second sample fails any test, the lot will be rejected.

Accompany each shipment of target members with a quality compliance certificate, as described in 00165.35, verifying that the materials furnished are represented by a lot that has been sampled and tested by ODOT and met the Contract requirements. The certification shall include the ODOT inspection report number

Construction

00840.40 Lines, Grades, and Preparation Work:

(a) Delineator Posts - Install delineator posts to the lines, grades and spacings shown and as established. To avoid difficult installation at any individual post site, the spacing may be varied 5% in either direction and may deviate from line by 6 inches in either direction. Remove vegetative growth, litter and debris from the post sites.

(b) Milepost Marker Posts - Locate and install milepost marker posts as shown.

00840.41 Installation of Posts - Set posts firmly into the ground and vertical. Remove and discard posts that become split, cracked, twisted, or bent, or whose tops become badly misshapen during installation.

(a) Embedment Depth - Field verify post length. Posts set in sandy, gravelly or other unconsolidated material may require an anchor system or need to be longer to provide adequate anchorage. Posts may be shortened to avoid unnecessary penetration in solid rock or in large rock fragments. If set in rock, drill a 9 inch deep hole, 1 inch greater in diameter than the large dimension of the post, and grout in place with a fine mortar grout.

(b) Guardrail Locations - At wood guardrail post installations, attach Type 4 delineators (alternate 1, plastic or alternate 2, steel) to the wood guardrail posts as shown on the standard drawings . At metal guardrail post installations, Install full length Type 1, 1U, or 2 ground mounted delineators behind the rail, adjacent to metal guardrail posts.

(c) Concrete Barrier Locations - At concrete barrier installations, attach Type 5 delineators to the concrete barrier according to the manufacturer's recommendations and as shown on the standard drawings.

00840.42 Target Members for Delineator Posts - Assemble, fasten, set and align target members and reflective material appropriate to the type and color of delineators as shown. Attach reflective sheeting to the targets as recommended by the manufacturer.

00840.43 Signs For Milepost Marker Posts - Assemble, fasten, set, and align signs as shown.

Finishing and Clean Up

00840.70 General - Remove and dispose of excess excavated materials, litter, and debris resulting from the operations according to 00290.20. Finish the surface around the support to match the surrounding surface or as shown.

Measurement

00840.80 Measurement - The quantities of delineators and milepost marker posts will be measured on the unit basis.

Payment

00840.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

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

In item (a) the type of delineator will be inserted in the blank regardless of the color or number of reflectors and targets.

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

No separate or additional payment will be made for preparation work, earthwork, grouting, backfilling, and cleaning up.

Milepost marker signs will be paid for according to 00940.90.

Section 00850 - Common Provisions for Pavement Markings

Description

00850.00 Scope - This work consists of furnishing, preparing, and installing all forms of pavement markings.

Materials

00850.10 Materials - Furnish the following materials from the QPL:

- Adhesive for Pavement Markers
- High Performance Pavement Markings
- Methyl Methacrylate
- Pavement Markers
- Reflective Elements*
- Marking Paint
- Marking Tape
- Thermoplastic

* Reflective elements used with materials other than marking paint are not required to be from the QPL. Use reflective elements according to the manufacturer's recommendations.

Equipment

00850.20 Equipment - Use equipment acceptable by the marking material manufacturer for the method specified and the following:

(a) Equipment for Pavement Legends and Bars - Use manual or automatic application equipment.

(b) Equipment for Longitudinal Lines - Use applicators, sprayers or extruders made specifically for applying the specified pavement marking material at a uniform width and thickness on the roadway surface.

Except for tape applications, use automatic bead applicators that place a uniform layer of beads on the line.

Use equipment capable of placing two parallel lines simultaneously with variable spacing between the two lines and capable of placing the entire width of a line in one pass.

Use a three-gun system for applying sprayed markings.

Hand units are allowed for tape applications only.

(c) Equipment for Inlaid/Grooved Markings - Use grinding equipment with diamond grinding heads and shot-blasting equipment to create a smooth, flat-bottomed cut of uniform depth.

Labor

00850.30 Manufacture's Representative - For Sections referencing 00850.30, provide the services of a manufacturer's representative on-site during the installation, authorized to sign a warranty on behalf of the manufacturer.

00850.31 Manufacturer-Certified Installers - For Sections referencing 00850.31, provide installers certified by the marking materials manufacturer for the specified marking material and method. Do not begin installation prior to receiving the Engineer's approval.

Construction

00850.40 Projects Without Striping Plans - For projects without striping Supplemental Drawings, replace striping to match existing pavement markings in-kind. Document existing striping by survey according to Special Provision 00305. Submit survey documentation to the Engineer seven calendar days prior to loss of existing pavement markings.

00850.41 Projects With Striping Plans - For projects with striping Supplemental Drawings, install striping as shown.

00850.42 Pre-Striping Conference - Meet with the Engineer and striping subcontractor, if striping is done by a subcontractor, two weeks prior to beginning striping work to discuss methods and practices of accomplishing all required striping work. Submit the following in writing five calendar days before the pre-striping conference for approval:

- A striping schedule showing areas and timing of work, and placing of material.
- A list of materials proposed for use and the application method.
- A copy of the manufacturer's installation instructions and Material Safety Data Sheets (MSDS).
- Proof of installer's certification for those Sections referencing 00850.31.
- Equipment specifications.
- A spill recovery plan including:
  - Name, address, and phone number of the Contractor's contact with the DEQ.
  - Name, address, and phone number of the persons certified and on-call to do clean-up.

00850.43 Prepare and Prime Pavement - Prepare pavement surfaces according to the following:

- **Existing Pavement Surfaces** - When required by the pavement marking manufacturer, remove pavement markings from existing pavement surfaces that will adversely affect the bond of new pavement marking material to the roadway surface according to Section 00851.

  Remove all other contaminants from existing pavement surfaces that may adversely affect the installation of new pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the pavement with a high-pressure system to remove extraneous or loose material.

- **New Asphalt Concrete Surfaces** - Remove contaminants from new AC surfaces that may adversely affect the installation of the pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to new asphalt concrete that is sufficiently cured according to the manufacturer's recommendations.

- **New Portland Cement Concrete Surfaces** - Remove curing compounds and laitance by an approved mechanical means. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to concrete that has reached a minimum compressive strength of 3,000 psi and that is sufficiently cured according to the manufacturer's recommendations.

After the pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

00850.44 Alignment Layout - Place control points for lines every 50 feet on tangent and every 25 feet on a curve. Using these control points, layout a continuous narrow guideline for each line, along one edge of, or uniformly offset from the intended permanent line location. Do not proceed with installation until the guidelines are approved by the Engineer.

For inlaid/grooved markings, indicate the exact grind-out location with a 4 inch wide line as the guideline. For broken lines, lane drop lines, and dotted lines, use 10 feet, 3 feet, and 2 feet long sections respectively, at the cycle length shown. For solid lines, use a continuous line. Use marking paint from the QPL applied at a thickness of 6 mils. Reflective elements are not required.

00850.45 Installation - Apply pavement marking materials to clean dry pavement surfaces and according the following:

- Place material according to the manufacture's recommendations.
- Place parallel double lines in one pass.
- Place the specified width of lines in one pass.
- The pavement surface shall not be visible in the striped areas.
- The top of pavement marking shall be smooth and uniform.
- Skip line ends shall be square and clean.
- Place pavement marking lines parallel and true to line.
- Place skip lines so that they are in cycle with at least one end of any adjacent project.
- Place markings in proper alignment with existing markings.
- Immediately clean up marking material dribbled beyond the cutoff.

For inlaid/grooved markings, grind the slot as shown. For each grinder operator and piece of equipment, obtain the Engineer's and manufacturer representative's approval of the slot within the first 150 feet for solid lines and within the first 300 feet for skip lines. Do not proceed with grinding until the slot is approved. Repeat this process for each new grinder operator or new piece of equipment used.

After grinding, obtain the Engineer's and manufacturer representative's approval before placing marking material. Clean the slot by shot blasting. Remove metal shot-blasting residue by magnetic sweeping, and clean the area with high pressure air immediately before placing the marking material.

00850.46 Placement Tolerance - Allowable tolerances for installation are:

- **Lateral location on roadway:** 1/2 inch on tangents; 1 inch on curves
- **40 foot skip cycle length:** $\pm$ 2 inches for skip length, $\pm$ 2 inches for gap length
- **12 foot skip cycle length:** $\pm$ 3/4 inch for skip length, $\pm$ 1 inches for gap length
- **8 foot skip cycle length:** $\pm$ 1/2 inch for skip length, $\pm$ 3/4 inches for gap length
- **Skip Cycle:** A tolerance of 1/10 of the skip line length on the first skip line of a run, but it shall be on cycle within one skip

- **Double lines:** Parallel, with a gap tolerance of ± 1/2 inch
- **Width of lines:** + 3/8 inch, - 1/16 inch
- **Thickness of lines:** + 5 mils, - 3 mils
- **Divergence of parallel double lines:** ± 3/8 inch

00850.47 Quality Control - Record the following readings for each type and color of marking material and the locations where they were taken. Submit the results to the Agency within one day of taking the readings.

(a) Placement Tolerances - Measure the following at the time of installation or application:

- For inlaid/grooved markings, measure the depth of the slot every 300 feet.
- For surface applied markings, except paint and tape applications, measure the thickness of the lines, at 300 foot intervals. Thickness is measured from the top of the pavement marking to the top of the wearing surface. Marking material placed in a depression left by pavement line removal will not be included in measuring the thickness of the line.

(b) Curing of Material - Rate the line, markings, and pavement marker adhesive at the time of installation and 14 calendar days after placement to determine if the material has properly cured. Note any soft spots, abnormally darkened areas, or other indications that the line has not properly cured.

(c) Retroreflectivity - Use a retroreflectometer to measure the retroreflectivity within 48 hours of curing and 14 calendar days after placement, except for paint applications:

- At 300 foot intervals for longitudinal lines.
- At each pavement legend/bar. Take ten individual readings per pavement legend/bar. If the Project has more than ten pavement legend/bars, measure a minimum of ten legends/bars or 10% of the total number of legends/bars, whichever is greater. The legends to be measured will be selected by the Engineer.
- Estimate the bead embedment depth for longitudinal lines and pavement legends/bars at the same location as the retroreflectivity reading.

Temporary

00850.50 General - Protect all applied markings from traffic until sufficiently cured so as not to be damaged or tracked by traffic movements.

Finishing and Clean-up

00850.70 Disposal of Waste - Waste material becomes the property of the Contractor at the point or origin. This includes all grindings and all removed marking material. Dispose of waste according to 00290.20.

00850.71 Removal and Repair of Unacceptable Work - Remove unacceptable materials according to Section 00851. If more than one repair is required in a single 300 foot section, grind and repair the entire 300 foot section.

00850.75 Manufacturer's Warranty - For Sections referencing 00850.75, furnish a Warranty from the manufacture signed by the manufacture's representative.

The Warranty period will start on the date the Engineer accepts the work and authorizes final payment.

The Warranty shall recite that the manufacturer will repair or replace, at the discretion of the Engineer and at no additional cost to the Agency, all pavement markings that drop below the minimum required retroreflectivity, show insufficient color stability, or fail to bond, within 6 months of the Agency's request to do so.

Perform Warranty repair work when weather permits. At the discretion of the Agency, temporary pavement markings may be required, at the manufacturer's expense, to protect traffic until repairs can be made.

When the Agency makes a written request to the manufacturer for repair or replacement, the Warranty period will stop until the required repairs or replacements are made and accepted.

Section 00851 - Pavement Marking Removal

Description

00851.00 Scope - This work consists of removing markings from the pavement surface.

Construction

00851.40 General - Remove non-durable pavement markings by hydroblasting, steel shot blasting, or grinding so that the pavement surface is not damaged below a depth or 1/8 inch. Remove durable marking by steel shot blasting or grinding the pavement surface to a depth no greater than 1/8 inch, creating a smooth, flat slot of uniform depth.

Remove pavement markings the same day permanent markings are applied. Use vacuum shrouded equipment or other equally effective containment procedures. Dispose of all waste materials according to 00290.20.

Measurement

00851.80 Measurement - The quantities of pavement line removed will be measured on the length basis, to the nearest foot. Pavement line removed will be based on a nominal width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis.

The quantities of pavement bars removed will be measured in the area basis, to the nearest square foot, for each stop bar and crosswalk bar removed.

The quantities of pavement legends removed will be measured on the unit basis, by actual count. One legend is considered to include all letters, characters, and all markings associated with the particular pavement legend.

Payment

00851.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Pavement Line Removal	Foot
Pavement Bar Removal	Square Foot
Pavement Legend Removal	Each

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

No separate or additional payment will be made for removing existing pavement markings when directed by the pavement marking manufacturer, for the preparation of applying new pavement markings.

Section 00855 - Pavement Markers

Description

00855.00 Scope - In addition to the requirements of Section 00850, install reflective and non-reflective pavement markers according to the following Specifications.

Construction

00855.40 Pavement Markers:

(a) General - Install reflective (Type I) and nonreflective (Type II) markers as shown.

(b) Surface Preparation - Remove contaminants from the wearing course surface which would adversely affect the bond of the adhesive.

Sandblast or steel shot blast the pavement surface to remove all surface contaminants. Use a blast of clean air to remove all loose particles from the surface.

(c) Installation - Apply pavement markers to a clean, dry surface.

Do not install markers spanning a pavement joint or crack. Adjust spacing between the markers to avoid installation of markers across a joint or crack.

Place the adhesive uniformly on the prepared pavement surface or on the bottom of the marker in a quantity sufficient to result in a complete coverage of the area of contact of the marker with no voids present and a slight excess of material after the marker has been pressed in place.

Place the marker in position and apply pressure until firm contact is made with the pavement. Visually inspect the installation to ensure that a small bead approximately 1/8 inch thick forms around all edges and corners and the marker is fully supported on a pad of adhesive. Immediately remove excessive adhesive on the pavement, and adhesive on the exposed surfaces of the markers.

Completely remove adhesive from the surfaces of pavement markers using an approved adhesive remover.

00855.41 Recessed Pavement Markers:

(a) Surface Preparation - Construct grooves in the pavement to neat lines conforming to width, length and depth shown, and prepare the surface according to 00855.40(b).

(b) Installation - Install the pavement markers in the grove as shown and according to 00855.40(c).

Measurement

00855.80 Measurement - The quantities of pavement markers and recessed pavement markers will be measured on the unit basis, for each type of marker.

Payment

00855.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

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

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.

No separate or additional payment will be made for constructing pavement grooves, pavement preparation, adhesive, and clean-up.

Section 00856 - Surface Mounted Tubular Markers

Description

00856.00 Scope - This work consists of furnishing and installing permanent surface mounted tubular markers as shown or directed.

Materials

00856.10 Materials - Furnish surface mounted tubular markers from the QPL.

Construction

00856.40 General - Install surface mounted tubular markers straight and true to line at the spacings shown. In addition to bolting the base of the surface mounted tubular marker to the surface, bond the surface mounted tubular marker to the surface using an adhesive recommended by the manufacturer according to the manufacturer's recommendations.

Measurement

00856.80 Measurement - The quantities of permanent surface mounted tubular markers will be measured on the unit basis.

Payment

00856.90 Payment - The accepted quantities of permanent surface mounted tubular markers will be paid for at the Contract unit price, per each, for the item "Permanent Surface Mounted Tubular Markers".

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

Section 00857 - Rumble Strips

Description

00857.00 Scope - This work consists of forming rumble strips by constructing indentations in the pavement surfacing as shown or directed.

Equipment

00857.20 Equipment:

(a) Continuous Rumble Strips - Form continuous rumble strips using a rotary type cutting head with a maximum outside diameter of 24 inches. Provide a cutting head length that matches the rumble strip width as shown (8 inches and 16 inches as appropriate). Arrange the cutting head cutting tips in a pattern that provides a relatively smooth cut (approximately 1/16 inch between peaks and valleys). Attach the cutting heads to the power unit in a manner that allows the tool to self-align with the slope of the shoulder and any irregularities in the shoulder surface. The cutting equipment shall be capable of cutting rumble strips while moving in the same direction as the flow of traffic.

(b) Transverse Rumble Strips - Form transverse rumble strips using a rotary type cutting head 5 1/2 inches long. Arrange the cutting head cutting tips in a pattern that provides a relatively smooth cut (approximately 1/16 inch between peaks and valleys). Attach the cutting heads to the power unit in a manner that allows the tool to self-align with the slope of the travel lane and any irregularities in the travel lane surface. The cutting equipment shall be capable of cutting rumble strips perpendicular to the travel lane.

Construction

00857.40 Construction - All cuttings and other debris resulting from the rumble strip operation becomes the property of the Contractor. Dispose of cutting debris according to 00330.41(a-5). After removal of the debris, thoroughly clean the pavement by sweeping to remove dust and other foreign matter.

Measurement

00857.80 Measurement - The quantities of continuous rumble strips will be measured on the length basis, to the nearest 0.01 mile. Measurement will be made along each shoulder on which the rumble strips are constructed. Breaks in the rumble strips at intersections, interchange ramps, or other locations shown will not be measured.

The quantities of transverse rumble strips will be measured on the unit basis, by actual count of rumble strip clusters.

Payment

00857.90 Payment - The accepted quantities of rumble strips will be paid for at the Contract unit price, per unit of measurement, for the following items:

(a) Continuous Rumble Strips ..... Mile
(b) Transverse Rumble Strips..... Each

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

Section 00860 - Longitudinal Pavement Markings - Paint

Description

00860.00 Scope - In addition to the requirements of Section 00850, install painted longitudinal pavement markings according the following Specifications.

Construction

00860.45 Installation - Apply painted longitudinal pavement markings as follows:

- Apply two separate applications of painted longitudinal pavement markings. Retrace the second application directly over the first application, within 1/16 inch as follows:
  - Apply the second application after 2 hours but within 48 hours of the first application.
  - For yellow colored markings, apply the second application in the opposite direction of the first application. For white colored markings, apply the second application in the same direction of the first application.
- Apply each painted marking application at a thickness of 15 mils wet, equivalent to 17 gallons per mile for a 4 inch wide solid stripe.
- Apply reflective elements for each application at a minimum rate of 5 pounds per gallon of paint. Embed, by means of paint wicking, a minimum of 80% of the reflective elements in the paint to a minimum depth of 50% of their diameter.

Minimum initial retroreflectivity shall be the following:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Measurement

00860.80 Measurement - The quantities of painted longitudinal pavement markings will be measured on the length basis, to the nearest foot. Painted longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00860.90 Payment - The accepted quantities of painted longitudinal pavement markings will be paid for at the Contract unit price, per foot, for the item "Longitudinal Pavement Markings - Paint".

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

Section 00865 - Longitudinal Pavement Markings - Durable

Description

00865.00 Scope - In addition to the requirements of Section 00850, install durable longitudinal pavement markings according to the following Specifications.

Labor

00865.30 Manufacture's Representative - Provide a manufacturer's representative according to 00850.30.

00865.31 Manufacturer-Certified Installers - Provide certified installer's according to 00850.31.

Construction

00865.40 General - Before installing, and in the presence if the Engineer, conduct a performance test by applying a 150 foot test section on roofing felt. Do not place permanent material without the Engineer's approval of the performance test. Additional performance tests may be required. Conduct performance tests at no additional cost to the Agency.

00865.45 Installation - Place permanent markings only when the manufacture's representative determines that the pavement is ready for the pavement marking material.

Apply reflective elements at a rate to obtain the following minimum initial reflectivity readings:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Apply marking materials by one or more of the following methods:

- **Method A: Profiled Markings** - Place lines and bumps straight and square.
- **Method B: Non-Profiled Markings** - Apply with extrusion process. Sprayers, or ribbon type applications will not be allowed.
- **Method C: Protected Inlaid Markings** - Place the specified marking material so the slot is filled from edge to edge, with the thickness of the marking material as specified. Make the marking flat or slightly convex on top.
- **Method D: Profile Wet Weather Markings** - Place lines and bumps straight and square.
- **Method E: Non-Profile Wet Weather Markings** - Install non-profile wet weather markings as shown.
- **Method F: Spray Markings** - Apply two separate applications of spray markings one half the total specified thickness per application. Retrace the second application directly over the first application within 1/16 inch.
- **Method G: Pavement Marking Tape** - Apply pavement marking tape as follows:
  - **Hot-Laid Installation** - Apply the tape to the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finishing rolling of the mat.

- **Grooved Installation** - Grind slot depth to 110 mils to 125 mills with a smooth, uniform, flat bottom. Apply tape into slot.

Do not place tape continuously on longitudinal pavement joints.

00865.75 Manufacturer's Warranty - Furnish a Warranty according to 00850.75 and the following:

- **Warranty Period** - The Warranty period shall be three years for surface mounted thermoplastic, and four years all other methods and materials in this Section.

- **Retroreflectivity** - Markings shall maintain a minimum retroreflectivity of 150 mcd/m^2/lx for white and 125 mcd/m^2/lx for yellow.

- **Color Stability** - Use Federal Color Chart PR-1 to determine color stability. Yellow markings shall meet 33538 Federal yellow. White markings shall have a minimum daylight reflectance of 84.

- **Adhesion** - A cumulative 5% or greater loss of line due to non-adhesion on any 300 foot segment of marking will constitute failure of the material in that segment.

Measurement

00865.80 Measurement - The quantity of durable longitudinal pavement markings will be measured on the length basis, to the nearest foot. Durable longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00865.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Method A (Profile)	
(a) Methyl Methacrylate, Profile, 90 mils, Extruded	Foot
(b) Methyl Methacrylate, Profile, 120 mils, Extruded	Foot
(c) Thermoplastic, Profile, 90 mils, Extruded	Foot
(d) Thermoplastic, Profile, 120 mils, Extruded	Foot
Method B (Non-Profile)	
(e) Methyl Methacrylate, Non-Profile, 90 mils, Extruded	Foot
(f) Methyl Methacrylate, Non-Profile, 120 mils, Extruded	Foot
(g) Thermoplastic, Non-Profile, 90 mils, Extruded	Foot
(h) Thermoplastic, Non-Profile, 120 mils, Extruded	Foot
Method C (Inlaid)	
(i) Methyl Methacrylate, Protected Inlaid, Extruded	Foot
(j) Thermoplastic, Protected Inlaid, Extruded	Foot
(k) Methyl Methacrylate, Protected Inlaid, Wet Weather Pattern, Extruded	Foot
(l) Thermoplastic, Protected Inlaid, Wet Weather Pattern, Extruded	Foot

Method D (Profile Wet Weather)

(m) Thermoplastic, Wet Weather Pattern w/ Bumps, Extruded ..... Foot
(n) Methyl Methacrylate, Wet Weather Pattern w/ Bumps, Extruded..... Foot

Method E (Non-Profile Wet Weather)

(o) Thermoplastic, Wet Weather Pattern, Extruded..... Foot
(p) Methyl Methacrylate, Wet Weather Pattern, Extruded ..... Foot

Method F (Spray)

(q) Methyl Methacrylate, Non-Profile, 90 mils, Sprayed ..... Foot
(r) Methyl Methacrylate, Non-Profile, 120 mils, Sprayed ..... Foot
(s) Thermoplastic, Non-Profile, 90 mils, Sprayed..... Foot
(t) Thermoplastic, Non-Profile, 120 mils, Sprayed..... Foot

Method G (Pavement Marking Tape)

(u) Pavement Marking Tape, Hot-Laid ..... Foot
(v) Pavement Marking Tape, Wet Weather Pattern, Hot-Laid ..... Foot
(w) Pavement Marking Tape, Grooved ..... Foot
(x) Pavement Marking Tape, Wet Weather Pattern, Grooved..... Foot
(y) Pavement Marking Tape, Pattern, Hot-Laid..... Foot
(z) Pavement Marking Tape, Pattern, Grooved..... Foot

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

Payment for work done under this Section will be limited to 75% of the amount due until the Agency has received the signed warranty.

Section 00866 - Longitudinal Pavement Markings - High Performance

Description

00866.00 Scope - In addition to the requirements of Section 00850, install high performance longitudinal pavement markings according to the following Specifications.

Labor

00866.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

00866.31 Manufacturer-Certified Installers - Provide certified installer's according to 00850.31.

Construction

00866.40 General - Before installing, and in the presence if the Engineer, conduct a performance test by applying a 150 foot test section on roofing felt. Do not place permanent material without the Engineer's approval of the performance test. Additional performance tests may be required. Conduct performance tests at no additional cost to the Agency.

00866.45 Installation - Place markings only when the manufacture's representative determines that the pavement is ready for the pavement marking material.

Do not place the pavement markings on longitudinal pavement joints.

Apply reflective elements at a rate to obtain the following minimum initial reflectivity readings:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Apply marking material by one or more of the following methods:

- **Method 1: Spray Markings** -If more than one application is required to obtain the thickness specified, place additional applications directly over previous applications, within 1/16 inch.

- **Method 2: Protected Inlaid Markings** - Grind the slot to the correct depth, and in proper alignment. Place the specified marking material such that the slot is filled from edge-to-edge with the thickness of the marking material as specified. Make the marking flat or slightly convex on top.

00866.75 Manufacturer's Warranty - Furnish a Warranty according to 00850.75 and the following:

- **Warranty Period** - The Warranty period shall be for one year.

- **Retroreflectivity** - Marking shall maintain a minimum retroreflectivity of 150 mcd/m^2/lx for white and 125 mcd/m^2/lx for yellow.

- **Color Stability** - Use Federal Color Chart PR-1 to determine color stability. Yellow marking shall meet 33538 Federal Yellow. White marking shall have a minimum daylight reflectance of 84.

- **Adhesion** - A cumulative 5% or greater loss of line due to non-adhesion on any 300 foot segment of marking will constitute failure of the material in that segment.

Measurement

00866.80 Measurement - The quantities of high performance pavement markings will measured on the length basis, to the nearest foot. High performance pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00866.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Modified Urethane, 25 mil, Sprayed	Foot
(b)	Modified Urethane, Protected Inlaid	Foot

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

Payment for work under this Section will be limited to 75% of the amount due until the Agency has received the signed Warranty.

Section 00867 - Transverse Pavement Markings - Legends and Bars

Description

00867.00 Scope - In addition to the requirements of Section 00850, install pavement markings for legends and bars according to the following Specifications.

Labor

00867.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

Construction

00867.40 General - Install staggered continental crosswalks and bike lane stencils, as shown, using Type B-HS or Type C-HS marking material only.

00867.45 Installation - Place permanent markings only when the manufacture's representative determines that the pavement is ready for the pavement marking material.

Transverse joints will be allowed with no overlap or gap allowed at the joint.

Minimum initial retroreflectivity shall be 250 mcd/m^2/lx.

Apply one or more of the following marking material types:

- **Type A: Liquid, Hot-Laid Thermoplastic Material** - For pavement bars, apply the thermoplastic material to the pavement by a spray or extrusion method, to the full width shown, in a single application. For pavement legends, apply the thermoplastic material to the pavement by a spray method, to the full width shown, in a single application. Pavement markings shall be 90 mils to 120 mils in thickness, exclusive of projecting surface-applied reflective elements, with a continuous and uniform cross sectional configuration, and with the upper surface slightly arched.

  Separately apply reflective elements to the material as it is placed at a sufficient rate to obtain an initial reflectivity reading of 250 mcd/m^2/lx. Locate the dispenser behind the pavement marking extrusion die and uniformly distribute the reflective elements over the entire width of the thermoplastic material

- **Type B: Preformed, Fused Thermoplastic Film** - Install preformed, fused thermoplastic film as shown. Install Type B - HS, preformed fused thermoplastic film high skid, that has intermixed reflective elements with factory installed crushed glass or aggregate on the surface.

- **Type C: Cold-Applied Plastic Film (Tape)** - On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

  Apply Type C - HS, cold applied plastic film that has intermixed reflective elements with factory installed crushed glass or aggregate on the surface. On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

- **Type D: Methyl Methacrylate** - Apply the methyl methacrylate material to the pavement by a gravity and extrusion method, to the full width shown, in a single application. Pavement markings shall be 90 mils to 120 mils in thickness, exclusive of projecting surface-applied reflective elements, with a continuous and uniform cross-sectional configuration, and with the upper surface slightly arched. Provide intermixed reflective elements.

Separately apply reflective elements to the material as it is placed at a sufficient rate to obtain an initial reflectivity reading of 250 mcd/m^2/lx. Locate the dispenser behind the pavement marking extrusion die and uniformly distribute the reflective elements over the entire width of the methyl methacrylate material.

00867.75 Manufacturer's Warranty - Furnish a warranty according 00850.75 and the following:

- **Warranty Period** - The warranty shall be for 18 months.
- **Retroreflectivity** - Markings shall maintain a retroreflectivity of 100 mcd/m^2/lx.
- **Color Stability** - White markings shall have a minimum daylight reflectance of 84.
- **Adhesion** - 5% or greater loss of marking due to non-adhesion will constitute failure.

Measurement

00867.80 Measurement - The quantities of pavement legends will be measured on the unit basis, by actual count.

The quantities of pavement bars will be measured on the area basis, to the nearest square foot, for each stop bar and crosswalk bar.

Payment

00867.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pavement Legend, Type ____ : Arrows	Each
(b)	Pavement Legend, Type ____ : "ONLY"	Each
(c)	Pavement Legend, Type ____ : "SCHOOL"	Each
(d)	Pavement Legend, Type ____ : "SCHOOL CROSSING"	Each
(e)	Pavement Legend, Type ____ : "SCHOOL XING"	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 Bar, Type ____	Square Foot

In items (a) through (j), the type of pavement marking materials will be inserted in the first blank.

In item (i), the name of the legend will be inserted in the second blank.

Item (a) includes single or multiple headed arrows as required.

Item (f) includes a R x R Symbol and three 24 inch wide white pavement bars as shown.

Item (j) includes the pavement bars for stop bars and crosswalk bars.

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

Payment for work under this Section will be limited to 75% of the amount due until the Agency has received the signed warranty.

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 00910, 00920, and 00930 as required.

Protect specific service signs (business logos) and TODS from damage, whether the signs are to remain in place or are placed on temporary supports, until reinstalled on permanent supports. Repair or replace damaged signs at no additional cost to the Agency. 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 00290.20.

Measurement

00905.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00905.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Remove Existing Signs	Lump Sum
(b)	Remove and Reinstall Existing Signs	Lump Sum

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

Section 00910 - Wood Sign Posts

Description

00910.00 Scope - This work consists of furnishing and installing preservative treated wood sign posts at the locations shown or as directed.

Materials

00910.10 Materials - Furnish wood posts of either Douglas fir or Hem fir meeting the following requirements:

Posts.....02110.40
Preservative Treatment of Posts.....02190

Construction

00910.40 Post Holes - Excavate post holes to the lines and grades established and to the depth shown or to a depth necessary to achieve the required mounting height, whichever is greater. If necessary, obtain the required depth by blasting. Do not set the post until the location, lines and grades of the holes have been approved. Align the post to a vertical position in the hole and backfill the hole. Backfill with selected general backfill meeting the requirements of 00330.13. Place in layers not greater than 6 inches. Solidly ram and tamp the layers into the excavated area around the post. Dampen during placement if too dry to compact properly. On completion of the work, replace and finish the surface around the post to match the surrounding surface.

Measurement

00910.80 Measurement - The quantities of wood sign posts will be measured on the volume basis, to the nearest 0.01 foot board measure (FBM), using nominal sizes and lengths of each wood post installed. Post volume will be determined by multiplying the nominal post size by the commercially available length shown on the standard drawings. For calculation purposes, post length will be determined by rounding the installed length to the nearest higher commercial length.

The estimated wood post lengths will be indicated on the plans. Final lengths of wood posts will be determined or verified by the Engineer prior to fabrication.

Payment

00910.90 Payment - The accepted quantities of wood sign posts will be paid for at the Contract unit price, per foot board measure (FBM), for the item "Wood Sign Posts".

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

No separate or additional payment will be made for route marker frames, wind bracing, or special sign brackets.

Section 00920 - Sign Support Footings

Description

00920.00 Scope - This work consists of constructing major and minor sign support footings of the dimensions and design shown and at the locations shown or directed.

Materials

00920.10 Materials - Furnish materials for constructing sign support footings meeting the following requirements:

Anchor Bolts	02560.30
Backfill (unless otherwise directed)	00510.10 or 00510.11
Commercial Grade Concrete	00440
Conduit	02920.10 through 02920.12
Reinforcement	00530

Construction

00920.40 Excavation and Backfill - Excavate and backfill footings according to Section 00510.

Finish the surface of backfill to match the existing surface. Where required, reinstall curbs and pavement markings.

00920.41 Concrete - Construct concrete sign foundations according to Section 00440 and the applicable portions of 00540.48(a).

Pour concrete spread footings and concrete shaft footings against undisturbed material or backfill with selected granular backfill material according to 00510.11. Compact to 95% maximum density according to 00330.43 or as shown.

During concrete placement, accurately and securely hold in place all anchor bolts or post stubs until the concrete has set.

Remove forms and place subsequent loading according to Table 00540-1.

00920.42 Reinforcement - Fabricate and place steel reinforcement according to Section 00530.

00920.43 Conduit - Fabricate and install conduit according to Sections 00960, 00970, and 00990.

Measurement

00920.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Estimated quantities of concrete for minor sign supports and estimated quantities of excavation, backfill, concrete, reinforcement, and miscellaneous metal for major sign supports will be listed in the Special Provisions. Miscellaneous metal includes anchor rods and associated hardware, templates, and anchor plates.

Payment

00920.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Sign Support Footings".

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

Section 00930 - Metal Sign Supports

Description

00930.00 Scope - This work consists of furnishing, fabricating, galvanizing, and erecting metal sign supports.

00930.01 Definitions and Terms:

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.

Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, and Square Tube Breakaway Sign Supports - The complete structure is composed of post stub, base plates, metal post, sign support members, and fasteners, but does not include the sign support footings.

90 Degree Rotational Sign Supports - The complete structure is composed of post stubs, base plates, posts, rotator connection, sign support members, and fastenings, but does not include the sign support footings.

Pipe Sign Supports and Square Tube Sign Supports - The complete structure is composed of metal post, sign support members and fasteners, but does not include the sign support footings.

Truss Sign Bridges, Monotube Sign Bridges, Butterfly Sign Structures and Monotube Cantilever Sign Structures - The complete structure is composed of base plates, support columns, cantilever arms, trusses, horizontal beam, sign support arms, supporting brackets, and fasteners, but does not include the sign illumination equipment, maintenance walkways and sign support footings.

Bridge Structure Mounts - The W-shapes or special detailed attachments used for mounting signs to bridge structures, and includes all necessary support brackets, arms, and fasteners, but does not include sign illumination equipment and maintenance walkways.

Exit Number Sign Mounts - The S-shape, spacers, special mounting brackets, and fasteners, necessary to install the exit number signs.

Signal Pole Mounts - The complete support including horizontal and vertical arms, supporting brackets, and fasteners.

Adjustable Sign Mounts - The complete support is adjustable horizontally and vertically to facilitate signal pole mast arm and pole mounting of flat sign sheets. The bracket consists of cast aluminum and galvanized steel elements, stainless steel straps, and fasteners.

Vertical Sign Mounts on Existing Structures - The additional or replacement vertical members and fasteners necessary to install a new sign onto an existing major sign support.

Secondary Sign Mounts - This group includes tubes, S-shapes, channels, plates, and fasteners necessary to install secondary signs.

Major Sign Supports - This group includes Truss Sign Bridges, Monotube Sign Bridges, Butterfly Sign Structures, and Monotube Cantilever Sign Structures.

Minor Sign Supports - This group includes Multi-Post Breakaway Sign Supports, Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, Square Tube Breakaway Sign Supports, 90 Degree Rotational Sign Supports, Pipe Sign Supports, and Square Tube Sign Supports.

00930.02 Working Drawings - Submit six copies of unstamped working drawings according to 00150.35 for all structural metal work. Submit six copies of stamped designs, details, plans, and calculations according to 00150.35 for all engineered details and drawings that are not prepared by the Agency but are required by the Contract Documents and Specifications for the Project prior to fabrication. Include the Field Verification of Post Lengths form for Major Sign Supports, available from the Engineer. Material ordered or work done before the Engineer finishes and returns the documents will be at the Contractor's risk.

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 Agency's maintenance forces to replace all or part of the commercially manufactured sign structures, under routine or emergency maintenance, by direct reference to the information furnished by the Contractor.

Working drawings are not required for the following types of steel supports:

- Multi-Post Breakaway Sign Supports
- Triangular Base Breakaway Sign Supports
- Signal Pole Mounts
- Exit Number Sign Mounts
- Secondary Sign Supports
- Route Marker Frames
- Square Tube Sign Supports

Working drawings for these supports will be provided by the Agency's Engineer of Record. Use the Field Verification of Post Lengths form, available from the Engineer, to provide the necessary site data to the Engineer of Record for use in producing working drawings. All work done, or materials ordered, before receiving working drawings from the Engineer of Record will be at no additional cost to the Agency.

00930.09 Identifying Tags - Overhead and butterfly sign support structures, except structure mounts, shall have stainless steel or brass identifying tags attached to all posts, arms, and truss sections. The tags shall be at least 1/16 inch thick. Tag lettering shall be at least 1/4 inch in height, and shall be stamped into the tag. Tags shall be attached with stainless steel pop rivets of at least 3/16 inch nominal body diameter. Do not locate pop rivet holes within 6 inches of welds. Post tag shall be located approximately 5 feet above the baseplate. Holes for pop rivets shall be drilled prior to hot-dip galvanizing. Remove excess hot-dip galvanizing from holes and repair according to ASTM A 780.

Tags shall include the following information:

- Structure number
- Manufacturer
- Month and year of manufacture
- Highway number and mile point

Materials

00930.10 Materials - Furnish structural steel materials meeting the applicable portions of Section 02530, with weights and sizes as shown or specified.

Furnish galvanized bolts, nuts, hardened washers, and direct tension indicators meeting the requirements of Section 02560, except the rotational capacity test of 02560.60(a) does not need to 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 allowed.

(c) Welding - Weld steel sign structures according to AWS D1.1. The fabricator shall inspect welds according to with details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 5.15 WELDING CONNECTIONS in AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Submit all testing procedures for Engineer's review prior to starting inspection. Submit certified copies of inspection reports to the Engineer for review.

If requested by the Engineer, additional weld inspection may be required upon arrival of the material at the job site. If defects are found by this additional inspection, the Contractor shall be responsible for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.

(d) Bolt Installation - Do not reuse galvanized high strength bolts. Other high strength bolts may be reused, if approved, but not more than once. Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts will not be considered a reuse.

Provide all high strength bolts with hardened washers under the element (nut or bolt head) turned in tightening. If a high strength bolt is installed in an oversized or short slotted hole in an outer ply, use a hardened washer. If a high strength bold is installed in a long slotted hole in an outer ply, use a plate washer or a continuous bar made of structural grade steel at least 5/16 inch thick with standard holes. Make the washer or bar sufficiently large to completely cover the slot after installation.

Protect fasteners from dirt and moisture at the jobsite. Do not remove the lubricant that is present in as-delivered condition. Clean and relubricate fasteners that accumulate dirt according to 02560.70.

(1) Bold Installation for Slip Bases (Breakaway) - Furnish, at no additional cost to the Agency, a calibrated torque wrench of a capacity appropriate to the size of the high-strength bolts installed and tightened. Confirm the accuracy of the calibrated torque wrench through calibration by an approved testing agency at least once a year.

Remove any dirt and moisture from the lubricated fasteners, and recoat the lubricated fasteners with a fresh, second coat of lubricant immediately before tightening. Tighten the bolts, in the presence of the Engineer, to the minimum torque or tension shown to seat the bolts in the base plate slots. After all the bolts in the slip base are tightened, loosen each bolt and retighten to the prescribed torque or tension shown in the same order as the initial tightening.

(2) Bolt Installation for Slip-Critical Connections - Tighten high strength bolts by direct tension indicator method unless noted otherwise. The calibrated torque wrench method of final tightening is not acceptable. Use of direct tension indicators is not allowed with Type 3 high-strength bolts in AASHTO M 270, Grade 50W (ASTM A 709, Grade 50W; ASTM A 588), unpainted weathering steel connections.

a. Direct Tension Indicator Tightening - Install new and unused direct tension indicator washers meeting 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 washer to turn during tightening. Bring each bolt to a snug-tight condition as indicated by partial compression of the direct tension indicator protrusions. Then tighten all fasteners in the connection, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening before final tightening to deform the protrusion to nil gap or as specified.

A "nil gap" is defined as the condition that exists when at least half of the spaces between the direct tension indicator protrusions refuse entry to a 0.005 inch feeler gauge, and a visible gap exists in at least one space.

b. Turn-of-Nut Tightening - During all turn-of-nut tightening, proceed systematically from the most rigid part of the connection to the free edges. Tighten all bolts until they are simultaneously snug tight and the connection is fully compacted. Snug tight is defined as the tightness that exists when all plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a worker using a 12 inch long wrench. Following this initial operation, further tighten all bolts in the connection by the amount of rotation specified in Table 00560-3 in Section 00560. During the tightening operation do not permit rotation of the part not turned by the wrench.

(e) Bolt Inspection:

(1) General - The Engineer will observe the installation and tightening of bolts to determine that the selected tightening procedure is properly used and that all bolts are tightened, and in the case of direct tension indicators that the correct indication of tension has been achieved. Bolts may reach tensions substantially above the value given in Table 00560-1 in Section 00560, but this will not be cause for rejection.

(2) Direct Tension Indicator Method - Provide the Engineer full opportunity to witness installation of bolted connections. The Engineer will periodically observe the installation and tightening operations to ensure that proper procedures are being adhered to.

Upon completion of a bolted joint, the Engineer will determine that all bolts have been tightened. A minimum of 10%, but not less than 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 are acceptable by the inspector, no additional bolt tightening inspection is required. If turn-of-nut tightening has been performed without being witnessed by the inspector, use the following inspection procedure:

- In the presence of the Engineer, use an inspection wrench, which may be a calibrated torque wrench.
- Place three bolts of the same grade, diameter and condition as those under inspection individually in a calibration device capable of indicating bolt tension. Use a hardened washer under the part turned in tightening each bolt.
- Tighten each bolt specified in the paragraph above in the calibration device by any convenient means to an initial condition equal to 20% of the required tension, and then to a tension not less than 5% greater than specified for its size in Table 00560-1 in Section 00560. Tightening beyond the initial condition shall not produce greater nut rotation than 1.5 times that allowed in Table 00560-3 in Section 00560. Then apply the inspecting wrench to the tightened bolt and determine the torque necessary to turn the nut or head 5 degrees, 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 - The mount shall allow vertical adjustment for positioning the sign and shall rotate to plumb the sign. Use galvanized or stainless steel nuts, bolts and washers for fasteners.

Measurement

00930.80 Measurement - No measurement of quantities will be made for metal sign supports.

Estimated quantities of structural steel will be listed in the Special Provisions. If field verified post lengths increase or decrease by more than 25% of the length specified, adjustments to the Contract lump sum amount will be made according to 00190.10(h).

Payment

00930.90 Payment - The accepted quantities of metal sign supports will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Major Sign Supports	
(a) Truss Sign Bridge	Lump Sum
(b) Monotube Sign Bridge	Lump Sum
(c) Butterfly Sign Structures	Lump Sum
(d) Monotube Cantilever Sign Structures	Lump Sum
Mounts	
(e) Bridge Structure Mounts	Lump Sum
(f) Exit Number Sign Mounts	Lump Sum
(g) Signal Pole Mounts	Lump Sum
(h) Adjustable Sign Mounts	Lump Sum
(i) Vertical Sign Mounts on Existing Structures	Lump Sum
(j) Secondary Sign Mounts	Lump Sum
Minor Sign Supports	
(k) Multi-Post Breakaway Sign Supports	Lump Sum
(l) Triangular Base Breakaway Sign Supports	Lump Sum
(m) Pipe Breakaway Sign Supports	Lump Sum
(n) Square Tube Breakaway Sign Supports	Lump Sum
(o) 90 Degree Rotational Sign Supports	Lump Sum
(p) Pipe Sign Supports	Lump Sum
(q) Square Tube Sign Supports	Lump Sum

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

No separate or additional payment will be made for route marker frames or special sign brackets.

Section 00940 - Signs

Description

00940.00 Scope - This work consists of furnishing, fabricating, and erecting traffic signs of the types shown.

00940.02 Types of Signs - Traffic signs are classified by sign type according to the descriptions in 02910.02. Use either retroreflective, reflective, or nonreflective sign sheeting as shown and according to 02910.02.

Use sign sheeting colors conforming to the Federal Highway Administration "Color Specifications for Retroreflective Sign and Pavement Marking Materials". In addition, specified color coordinates shall be subject to visual matching by the Engineer to determine that all panels in any one sign match.

00940.03 Drawings - Copies of working drawings for non-standard signs will be made available to the Contractor by the Engineer. Standard signs called for in the Contract Documents shall be constructed using drawings available in FHWA's "Standard Highway Signs" (FHWA English Version) or ODOT's "Sign Policy and Guidelines for the State Highway System". The ODOT sign policy is available for purchase from the ODOT Procurement Office, Salem.

Materials

00940.10 Materials - Furnish materials for signs meeting the requirements of Section 02910.

Construction

00940.40 General - Finished signs shall conform to the designs shown or specified.

Choose the substrate material from the following table:

Sign Size	Acceptable Substrate Materials
Up to 4 feet x 5 feet	Sheet aluminum Plywood Extruded aluminum panels
From 4 feet x 5 feet to 4 feet x 8 feet	Plywood Extruded aluminum panels
Over 4 feet x 8 feet	Extruded aluminum panels
Over 8 feet in any dimension	Extruded aluminum panels

Street name signs mounted on signal pole mast-arms, and EXIT ONLY panels riveted to extruded aluminum panels, may exceed the width limit of 4 feet for sheet aluminum substrate.

See Table 02910-1 in Section 02910 for sheet aluminum thicknesses for various sizes of signs.

Fabricate all components of each individual sign with sheeting from the same supplier, to ensure that all components are compatible, and are warrantable by the manufacturer. Removable legend does not have to be fabricated with sheeting from the same supplier as the background sheeting on the sign panels.

Construct standard signs as shown in the FHWA "Standard Highway Signs" manual or in ODOT's "Sign Policy and Guidelines for the State Highway System".

00940.41 Aluminum Panel Sign Fabrication:

(a) General - Fabricate aluminum panel signs as shown or specified. Do not round corners of panels outside the border. Reinforced sheet aluminum signs will not be allowed. All aluminum used for sign panels shall be new material.

(b) Extruded Aluminum - Each panel of extruded aluminum panel signs shall be a continuous section. Apply the sign sheeting to the extrusion a sufficient distance around the edge to ensure that no aluminum surface is visible on the face of the sign.

(c) Sheeting - The sign sheeting applied to the extrusions shall be the background color of the sign.

(d) Legend - Signs consisting of only one extrusion may use permanent legend.

(e) Transparent Paste - Do not use transparent paste background on extruded aluminum signs.

00940.42 Sheet Aluminum Sign Fabrication:

(a) General - Cut the sheet aluminum sign to size and shape as shown or specified. The sign shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication.

Before application of retroreflective, reflective, or nonreflective sheeting, treat the entire surface of the sign with a conversion film according to the sheeting manufacturer's recommendations.

(b) Mounting Holes:

(1) On Posts - Signs having a vertical dimension of less than 48 inches and mounted on wood or metal posts shall have at least 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.

(2) On Extruded Aluminum Signs - Provide a minimum of eight mounting holes for sheet aluminum signs mounted on extruded aluminum signs.

00940.43 Plywood Sign Fabrication - Perform all fabrication with saw blades that do not tear plywood grain. Cut all holes clean and uniform. Splicing will not be allowed unless specified. Locate mounting holes so that the mounting hardware will not cover any portion of the legend. Provide mounting holes for signs according to 00940.42(b).

After fabrication and before the application of retroreflective, reflective, or nonreflective sheeting, seal all edges with plywood sealer tinted to match the color of the panel overlay material. Where retroreflective, reflective, or nonreflective sheeting is to be applied, prepare the surface of the sign according to the sheeting manufacturer's recommendations.

00940.44 Retroreflective, Reflective, or Nonreflective Sheeting Application - Apply the sheeting according to the sheeting manufacturer's recommendations on extruded aluminum panel signs. Up to 25% of the extruded aluminum panel signs required in the plans will be allowed one manufacturer's splice for each sign. One patch will be allowed for each 50 square feet of sign to a maximum of three patches for each sign. Patches shall be between 3/4 inch and 3 3/8 inches in diameter. No Contractor splices will be allowed.

On all other signs, manufacturer's splices will not be allowed except as noted on approved shop drawings, or when sign dimensions exceed the sheeting manufacturer's capabilities. Make these splices horizontal with the upper section of sheeting overlapping the lower by a minimum of 3/8 inch on encapsulated lens sheeting, and butt splice prismatic lens sheeting with no appreciable substrate visible. The use of overlaid transparent paste or electronic cuttable film will not be allowed on overlapped splices. No Contractor splices will be allowed.

00940.45 Legend Installation:

(a) General - The word "legend" means the entire message and border for a sign. A group of words, numbers 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:

Legend Series	Word Spacing
B	(0.531) H
C	(0.625) H
D	(0.836) H
E	(1.000) H

H = height of upper case letter

Spacing between symbols shall conform to FHWA "Standard Highway Signs" unless otherwise shown.

Space all lines equally between side borders unless otherwise shown. Space the legend vertically as shown. For diamond shaped signs, space between lines in the legend a minimum of one half the average letter height and space between the message and the borders equally so the message is centered on the sign.

(b) Attachment - Attach removable legend to aluminum panels using aluminum, domed head, 1/8 inch diameter, self-plugging blind rivets. Remove aluminum shavings from the sign face before attaching the legend. The entire sign will be rejected if any shavings are left beneath the legend. Drill 0.128 inch diameter holes in the removable legend and sign panel as shown on the "Mounting Details for Removable Legend" standard drawings.

Apply screened legend according to the sheeting manufacturer’s recommendations. Apply cut-out legend according to 00940.44.

Attach 1 inch retroreflective removable border sections by placing two rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inches apart, centered in the section. Corner border sections shall be attached with a minimum of five rivets, two rivets 1/2 inch from each end, and the remaining rivet centered in the middle of the section.

Attach 2 inch retroreflective removable border sections by placing two rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inch apart, along the top and bottom edge of the section. Corner border sections shall be attached with a minimum of five rivets, two rivets 1/2 inch from each end, and the remaining rivet centered in the section.

(c) Border Sizes - Unless otherwise shown, the width of the sign borders shall be according to the following:

Maximum Letter Size	Border Width
5" Capital or Upper Case	1/2 inch
8" or 10 2/3" Upper Case	1 inch
10" or 12" Capital	1 inch
13 1/3" or 16" Upper Case	2 inches
15" or 16" Capital	2 inches

The corner radii shall be approximately one-eighth of the least dimension of the sign. Determine the corner radii by rounding this approximate value to the nearest 1 1/2 inches, 3 inches, 6 inches, 9 inches, or 12 inches.

Except for the corners, mount the border flush with the edge of the sign. Do not round the corners of the aluminum panels.

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 Erecting - Erect all signs at the locations staked and as shown or directed. Do not erect individual signs until the sign is complete with legend. Signs not mounted as shown or directed will not be accepted.

Erect the signs so the sign face is vertical, unless otherwise directed.

When signs are installed on supports 10 feet or less from the edge of guardrail, curb, or shoulder, set them to reflect 3 degrees 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 degrees toward traffic.

The closest edge of any column or overhead sign structures shall be as shown.

Where signs are mounted to supports by bolting through the sign, a sheeting manufacturer approved lubricant may be used on the nylon and metal washers to prevent sign sheeting deformation. Replace damaged signs, or signs with sheet deformation, with new signs at no additional cost to the Agency.

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.

Measurement

00940.80 Measurement - The quantities of signs will be measured on the area basis, by multiplying the height by width, using the dimensions shown. No deductions will be made for irregular shapes cut from the rectangle.

Route markers and other signs fastened to the face of larger signs will be measured as separate signs.

Payment

00940.90 Payment - The accepted quantities of signs will be paid for at the Contract unit price, per square foot, for the item "Type _____ Signs In Place".

The type of sign will be inserted in the blank.

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

Payment for work done under this Section will be limited to 75% of the amount due until the Agency has received the signed warranties required by 02910.75.

Section 00941 - Sign Covers

Description

00941.00 Scope - This work consists of covering sign faces as shown, specified, or directed.

Materials

00941.10 Materials - For permanent signs, furnish sign covers from the QPL or porous cloth covers pre-approved by the sign sheeting manufacturer. Do not use plywood.

For temporary signs comply with Section 00225.

Construction

00941.40 Fabrication - Fabricate sign covers in one piece, unless otherwise directed. Make them large enough to completely cover the sign, and capable of easy attachment to the sign without damaging the sign face.

00941.41 Installation - Lap covers over all sign edges and secure to the sign or support as recommended by the sign sheeting manufacturer.

00941.42 Alternate - The Contractor may elect one or more of the following as alternate methods subject to approval:

- Install signs in conjunction with the movement of the traffic flow.
- Remove demountable legend from signs and re-install legend as directed.
- Remove entire sign and store in a vertical position for future reinstallation.

Measurement

00941.80 Measurement - No measurement will be made for sign covers.

Payment

00941.90 Payment - No separate or additional payment will be made for sign covers or for the alternate methods listed in 00941.42. Payment will be included in payment made for the appropriate items under which this work is required.

Section 00950 - Removal of Electrical Systems

Description

00950.00 Scope - This work consists of removing existing electrical systems as shown or specified.

00950.02 Definitions:

Electrical Systems - Electrical systems will be described in the Special Provisions.

Construction

00950.40 General - Remove existing electrical systems in the order directed.

Keep existing electrical systems to be removed in operation until the new electrical systems are ready to be turned on or as directed. Keep authorized downtime to a minimum. Perform the changeover with a minimum disruption to traffic.

Remove existing materials, as specified or approved, which interfere with or which are incompatible with new construction before completion of the new construction. Notify the Engineer at least four calendar days in advance of removal.

00950.41 Removal and Abandonment - Remove from the right of way conductors, junction boxes, wood poles, and foundations. Dispose of materials according to 00290.20. Abandon conduit by removing all wiring, elbows, and risers.

If a foundation is shown as abandoned, remove the top of the foundation, anchor bolts, and conduits to a depth not less than 2 feet below the adjacent finished ground line. Backfill resulting holes with material equivalent to the surrounding material. Finish and blend the surface area to the adjacent surface area.

Repair all holes or damage to existing surfacing caused by removal of existing installations as directed at no additional cost to the Agency.

Measurement

00950.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00950.90 Payment - Payment for work performed under this Section will be made by either method "A" or method "B" as follows:

- **Method "A"** - Method "A" will be used when existing electrical systems are removed and replaced with new electrical systems. Under method "A" no separate payment will be made for removal of electrical systems.

  Payment for removal of existing electrical systems will be included in payment made for the appropriate new electrical system.

- **Method "B"** - Method "B" will be used when existing electrical systems are removed and are not replaced with new electrical systems. Under method "B" payment will be made at the Contract lump sum amount for the item "Removal of Electrical Systems".

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

Section 00960 - Common Provisions for Electrical Systems

Description

00960.00 Scope - This work consists of furnishing and installing materials for electrical systems and for modifying existing systems.

00960.01 Regulations, Standards, and Codes - All electrical materials and workmanship shall conform to the following standards where applicable:

- American National Standards Institute (ANSI)
- International Municipal Signal Association (IMSA)
- Underwriter's Laboratories, Inc. (UL)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Electrical Code, Oregon Amended (NEC)
- Standards of the American Society for Testing and Materials (ASTM)
- Local laws

Wherever reference is made to any of the standards mentioned above, the reference means the code, order, or standard in effect on the date the Project is advertised unless otherwise shown or specified in the Specials Provisions.

Do not begin 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 six copies of:

- A list of materials the Contractor proposes to install. List all material shown or specified by manufacturer's name, size, and identity number of each item. Supplement the list with other data, including but not limited to, detailed scale drawings.
- Wiring diagrams for all circuits and any nonstandard or special equipment.
- Brochures, technical bulletins, parts lists, service instructions, working drawings and other technical information relative to products proposed for use on the Project.
- Use materials from the current list of acceptable materials. The updated list is available from the Engineer. Mark the list according to the instructions on it. The list eliminates the need for most catalogue cutsheets.

All engineered details and drawings which are not prepared by the Agency, but are required in the Contract Documents, shall be submitted for review prior to fabrication. Submit stamped designs, details, plans, and calculations according to 00150.35.

Upon completion of the installation, submit six copies of all changes made from the original plans. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

Materials

00960.10 Materials - Furnish electrical materials meeting the requirements of Section 02920.

Furnish concrete meeting the requirements of Section 00440.

Labor

00960.30 Licensed Electricians - According to the Oregon Administrative Rule 918-282-0120(1), every person engaged in the installation of electrical equipment and wiring systems shall possess a valid Oregon Electrical Supervising or Journeyman's License, or be registered as an Electrical Apprentice. Every person who installs electrical systems on the Project shall submit a copy of his or her electrical license or apprentice registration to the Engineer prior to performing any work.

Construction

00960.40 General - The Agency will continue normal maintenance and operations of the existing systems including the furnishing of electrical energy.

00960.41 Excavation:

(a) General - Remove and replace sidewalks, paved surfaces, and other materials as needed. Place the conduit under curbs without disturbing curbs. Replace and finish all surfaces to correspond with the existing surfaces. Restore all disturbed landscaping and underground systems to original condition. Use hand excavation if directed.

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 with an approved pavement cutting saw to a depth of at least 2 inches along the neat boundaries of the area to be removed. Cut sharp and well-defined pavement edges with no evidence of cracking, delaminating, or stressing.

(b) Excavation for Pedestal and Cabinet Foundations - Make all excavations to the neat lines of the foundations. Hand excavation may be required. Place the concrete directly against the sides of the excavation in undisturbed or well-compacted material.

(c) Excavation for Conduit - Excavate and backfill conduits as follows:

Minimum Cover from Finished Surface [1]

Type of Conduit	Roadway and Shoulders	Other Areas
Metal	24 inches	18 inches
Rigid Nonmetallic	30 inches	18 inches

[1] Use permit depths if greater than these.

(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. 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.

(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 30 feet beyond the centerline of every track or other distance as required by the railroad.

(f) Disposition of Waste Materials - Dispose of all waste materials according to 00330.41(a-5).

(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 - For rigid nonmetallic conduit, provide bedding, cover, and backfill according to the following:

a. Bedding - Place 2 inches of sand blanket in trench bottom before placing conduit.

b. Cover - Cover conduit with 2 inches of additional sand blanket.

c. Backfill - Backfill according to the following:

1. New Roadway and Shoulder - Place selected granular backfill material in layers not greater than 6 inches thick. Compact the selected granular backfill material according to 00405.46(c-2).

2. Existing Roadway and Shoulder - Backfill all conduit trenches with CLSM according to Section 00442. Place to an elevation 6 inches below the surface of the existing pavement or to the bottom of the existing pavement, whichever is lower. When this method is used the sand blanket may be omitted.

3. Unpaved Areas - Place selected granular backfill material in layers not greater than 6 inches thick. Compact the selected granular backfill material according to 00405.46(c-2) to the top of trench, surrounding ground level or upper limit of excavation. The sand blanket requirement of a. and b. above may be deleted as approved when excavated material does not contain large, angular stones that could fracture or dent conduit.

d. Pavement - Place and compact AC and PCC according to Sections 00744, 00745, 00755, and 00756, as applicable, and the following:

1. Existing Non-roadway Pavement - Match existing surfacing thickness.

2. Existing Roadway and Shoulder - Match existing surfacing thicknesses or provide a minimum surfacing thickness of 6 inches, whichever is greater.

3. Finish - Finish to a smooth riding surface.

(2) Rigid Metal Conduit - For rigid metal conduit, provide backfill according to 00960.41(g-1-c) and 00960.41(g-1-d) except the sand blanket is not required.

00960.42 Conduit:

(a) General - Conduit runs shown on the plans are for bidding purposes only. Locations may be changed to avoid obstructions. Larger size conduit than specified may be used at the option and cost of the Contractor. Use the same size conduit for the entire length, outlet to outlet.

Use non-metallic or rigid metal conduit as shown or specified.

Install a No. 16 AWG THWN stranded copper wire with orange base and blue tracer in all conduits as a locate wire, even if not shown. Extend the wire 2 feet beyond conduit ends and install a wire nut. Do not join multiple locate wires under a common wire nut.

In areas to be paved or landscaped, place all conduit before paving or landscaping.

If corrosive soil conditions exist, coat metallic conduit with a non-metallic coating or wrap with corrosion protection tape at least 10 mils thick.

(b) Conduit on Wood Poles - Mount conduit on 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 steel strap, drilled and tapped with galvanized bolts. Place straps no more than 3 feet apart. After tightly drawing steel bands, cut and fold under the ends to eliminate protruding edges.

(d) Conduit in Foundations - Use fiberglass conduit and extend it as follows:

- 2 inches to 3 inches vertically above the top of the foundation
- 10 inches to 12 inches horizontally beyond edge or vertically below the foundations

(e) Underground Conduit Installation - Make conduit runs continuous between any pole, junction box, or cabinet. Do not cover conduit runs until inspected. Permanently mark all underground conduit runs by installing an underground marking tape directly over the conduit.

The underground marking tape shall be:

- Placed 6 inches ± 1 inch below the surface.
- Continuous between pole bases, junction boxes and cabinet locations.

(f) Elbows - Use a standard factory bend where a conduit bend is required that:

- Has a radius of at least six times the inside diameter of the conduit.
- Is bent without crimping or flattening.
- Is fiberglass conduit.

(g) Conduit Ends and Couplings - Ream the ends of all conduits to remove burrs and rough edges. Make cuts square and true so the ends will fit together for their full circumference. Slip joints or running threads will not be allowed for coupling conduit. Plug or cap all conduit ends until wiring is installed. After wiring is installed install duct seal compound or precut closed cell polyethylene foam that will prevent debris from entering the conduit system.

(1) Metallic Conduit - Paint the following with rust-preventative coating:

- Threads on all metal conduit
- Areas where the coating has been damaged so underlying metal is exposed.
- Exposed, ungalvanized threads resulting from field cuts.

(2) Nonmetallic Conduit - Connect nonmetallic conduit with solvent welds. Use a nonmetallic female threaded connector to connect nonmetallic conduit to metallic conduit.

(3) Riser - Provide and install conduit risers within junction boxes according to the following:

- Use PVC conduit risers with fiberglass elbows.

(4) Bushings - Provide and install bushing according to the following:

- **Push on PVC End Bell** - Use push on PVC end bells with fiberglass elbows, PVC risers, nonmetallic junction boxes with nonmetallic lids.
- **Metallic Bushing** - Use metallic bushings with rigid metallic elbows, metallic risers, and junction boxes containing circuits less than 25 V.
- **Metallic Bonding Bushing** - Use metallic bonding bushings with rigid metallic elbows, metallic risers, and junction boxes containing 25 V or greater circuits.

(h) Conduit in Junction Boxes:

(1) General - Install conduit in junction boxes according to the following:

- Enter through the bottom of boxes.
- Enter the box from the direction of the run.
- If shown, terminate conduit 1 inch inside the box wall when entering through the side walls.

(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 when installed in pavement or earth.
- Use lock nuts and a metallic bushing for metal conduit entrances when installed in cast in place portland cement concrete walls, barrier, or structures.
- Be cut with a hole saw.
- Repair damage to galvanizing.

(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 polyethylene pull line.

Include 3 feet of slack in the polyethylene pull line within the conduit and 3 feet outside the conduit.

(j) Existing Conduit - Use existing conduit only where shown. Clean existing conduit, without conductors, with a mandrel or cylindrical wire brush, and blow out with compressed air before incorporating into the new system.

(k) Conduit In or On Structures - Install conduit in or on structures as shown. Use expansion fittings at all expansion joints in or on a structure.

(l) Installation by Horizontal Directional Drilling - If jointed conduit is used, verify the joints have not separated by pulling a mandrel through the conduit after installation.

00960.43 Foundations:

(a) General - Construct foundations for pedestals, posts, and cabinets according to Section 00440 and the applicable portions of 00540.48(a). 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, using a manufacturer's recommended template until the concrete sets.
- Maintain rebar clearances during concrete pour.

Make no adjustment of anchor bolts after concrete has set.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until removed.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

Where breakaway bases are specified, the post stub projection shall not exceed the limits shown.

(b) Treatment for Aluminum-Concrete Contact - Separate the aluminum from the concrete with one layer of 30 pound nonperforated, asphalt-saturated felt. 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, or, if not shown, no more than 300 feet apart. The Contractor may, at no additional cost to the Agency, install additional junction boxes to facilitate the work.

The tops of junction boxes installed in the ground or in sidewalk areas shall be flush with the surrounding grade or top of curb. Where practical, place pull boxes shown behind curbs against the back of the curb. If installed in the roadway or shoulder, leave the top of junction box 1/2 inch below the pavement surface. If installed outside roadways or shoulders, install a portland cement concrete apron around the junction box.

In boxes having an open bottom, construct a sump of reasonably well graded 3/4" - 0 crushed gravel, 12 inches deep covering the approximate area of the box. Do not install conductors until the sump has been constructed.

(b) Junction Box Locations - Mark the location of all flush-mounted junction boxes installed in unsurfaced areas with a Type 1 delineator, placed 3 feet behind the box, or as directed. Use white targets with black, 3 inch, series "B" letters reading "JCT. BOX". Reflectors are not required.

00960.45 Cable and Wire - Arrange wiring neatly within cabinets and junction boxes. Use electrical lubricants when inserting conductors in conduit. Before pulling wires through underground conduit runs, blow the conduit out with 120 cubic feet per minute compressed air.

Before cable and wire installation, clean all existing and new conduit with 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 allowed at the terminating end points for pulling only.

Pull all wire on a straight line with the conduit opening to prevent damage to wire and cable insulation. If pulls are made with poles or controller cabinet in place, use a pulley device to achieve a straight pull.

00960.46 Wiring Practices:

(a) General - Install electrical system and electrical system components in a neat and workmanlike manner.

(b) In-Line Fuse Holder - Insulate terminal ends using either heat shrink tubing or electrical insulating rubber tape over-wrapped with electrical vinyl plastic tape as specified.

00960.48 Coating - Coatings shall conform to all applicable portions of Section 00594. Do not paint equipment fabricated of aluminum, stainless steel, or hot-dipped galvanized material, except as shown or specified.

00960.49 Electrical Service:

(a) General - Service points shown on the plans are approximate only. The exact location will be determined in the field. Wiring connections to the terminal screws on the circuit breakers and contactors shall make full contact under the screw head. Size and depth of power service conduit shall be as specified by the supplying power company.

Equip each service cabinet with a solid copper neutral bus and the number and size of switches or circuit breakers shown or specified. Notify the local serving utility before making any connections to utility poles.

As a part of each service installation, furnish and install a meter base approved by the serving utility (with cover, if required by the utility), when shown.

(b) Circuit Breakers - Provide circuit breakers of the rating shown or specified.

00960.50 Grounding and Bonding:

(a) General - Make all ground rods, metal conduit, metal poles, grounding wire, metallic junction boxes, metallic junction box covers, and cabinets mechanically and electrically secure to form a continuous, effectively grounded and bonded system. Ground/bond wire shall be No. 6 AWG stranded copper wire or as shown.

(b) Ground Rods - Drive ground rods into the ground with the top about 6 inches below the finished grade at the ground rod locations. Ground each above ground metallic structure with a separate ground rod. The equipment ground rod may be placed in the foundation if shown, or in the first junction box nearest the equipment.

(c) Services and Cabinets - Bond the neutral conductor, the control cabinets, and the metal base to the grounding electrode system.

(d) Structure Mounted Poles and Cabinets - Bond all poles and cabinets mounted on structures or walls to a common ground rod at the end of the structure. Ground the system at the first convenient acceptable location off the structure.

(e) Wood Poles - Bond all metallic conduit, messenger cable, terminal cabinet, and other metallic parts within 10 feet of the ground line.

(f) Nonmetallic Conduit - In all nonmetallic conduit, run a ground/bond wire continuously between all poles, pedestals, posts, and cabinets. Bond wires are not required in conduit that only contains circuits that operate at less than 25 volts.

(g) Metallic Junction Boxes and Lids - Bond metal junction boxes and lids to form a continuous effectively grounded and bonded system with metallic conduit, grounding wire, metal standards and controller cabinets. Leave enough slack in the bond wire connected to the lid to allow complete removal of the lid. Junction boxes only containing circuits that operate at less than 25 V do not need to be bonded.

00960.70 Electrical Energy - Obtain the required permits and have the power service inspected by the utility providing power. Arrange for the utility to make the electrical hookup. When agreeable to the Agency and the local power company, power consumption for traffic signals may be flat-rated.

Electrical energy costs will be billed to the Agency or those named in the construction agreement for permanent installations. Do not use for construction purposes electrical energy billed to the Agency or other agencies.

Section 00962 - Metal Illumination and Traffic Signal Supports

Description

00962.00 Scope - This work consists of furnishing, fabricating, galvanizing, and installing materials for illumination and traffic signal supports and foundations. The location of illumination/signal material shown is approximate, with exact locations established in the field.

00962.01 Regulations, Standards, and Codes - All designs and workmanship shall conform to the following standards where applicable:

- AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- AWS D1.1

Wherever reference is made to any of the standards mentioned above, the reference means the code, order, or standard in effect on the date the Project is advertised unless otherwise shown or specified in the Specials Provisions.

Do not begin installations until all permits are obtained and copies are given to the Engineer.

00962.02 Calculations and Drawings - Within 30 calendar days after execution of the Contract, submit at least six copies of:

- Pre-approved manufacturing shop drawings
- Calculations and shop drawings of all nonstandard poles
- Calculations and installation drawing of all nonstandard pole foundations

All engineered details and drawings which are not prepared by the Agency, but are required in the Contract Documents, shall be submitted for review prior to fabrication. Designs, details, plans, and calculations shall be stamped and submitted according to 00150.35.

Upon completion of the installation, submit six copies of all changes made from the original plans. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

00962.05 Design - Design all traffic signal and illumination poles according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

(a) Traffic Signal Mast Arm Supports - Design non-standard poles and foundations according to the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 4th Edition" with 2001, 2002, and 2003 interim revisions. Design factors include:

Basic wind speed (3 second gust) .....110 mph
Gust factor (G).....1.14
Importance Factor (Ir) .....1.0 (50 year recurrence interval)
Fatigue Category II

(b) Traffic Signal Strain Pole Supports - Design non-standard poles and foundations according to the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and

Traffic Signals 4th Edition" with 2001, 2002, and 2003 interim revisions. Design factors include:

Basic wind speed (3 second gust) .....110 mph
Gust factor (G).....1.14
Importance Factor (Ir) .....1.0 (50 year recurrence interval)

Fatigue design is not required.

(c) Illumination Supports - Design non-standard Luminaire slip base, fixed base, and high mast poles and foundations according to the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 1994". Design factors include:

Basic wind speed (fastest mile per hour) .....100 mph

Materials

00962.10 Materials - Furnish materials meeting the following requirements:

Anchor Rods 02560.30
Commercial Grade Concrete 00440

Furnish steel pole materials meeting the requirements of 02530 modified as follows:

- Provide steel sheet for pole and arms meeting the requirements of ASTM A 595, Grade A or B, ASTM A 572, or approved equal.
- Provide all other steel sheet and plate meeting the requirements of ASTM A 36 or ASTM A 572, or approved equal.
- Supplementary Requirement S18 (ASTM A 6), maximum tensile strength, is required.
- Galvanized base plates and small and hidden pieces do not require controlled silicon content.

Construction

00962.41 Excavation - Protect all existing pipes that become a part of a foundation as directed by the Engineer or local utility company.

Do all excavation, backfilling and resurfacing work necessary to complete the work. This includes removal and replacement of curbs, sidewalks, paved surfaces and other materials. On completion of the work, replace and finish all surfaces to correspond with the existing surfaces.

Furnish, place, and remove any shoring required to prevent caving of walls.

When excavating in paved areas, cut with an approved pavement cutting saw to a depth of at least 2 inches along the neat boundaries of the area to be removed. Cut sharp and well-defined pavement edges with no evidence of cracking, delaminating, or stressing.

Restore all disturbed landscaping and underground systems to original condition upon completion of the work at no additional cost to the Agency. Use hand excavation if directed.

(a) Excavation for Poles Foundations - Make all excavations for pole foundations to the neat lines of the foundations. Hand excavation may be required. Place the concrete directly against the sides of the excavation in undisturbed or well-compacted material.

(b) Disposition of Waste Materials - On completion of the work, dispose of all waste materials according to 00330.41(a-5).

00962.43 Foundations - Construct foundations according to Section 00440 and the applicable portions of 00540.48(a). Place concrete as follows:

- With a continuous pour.
- To the elevation shown or directed.
- With conduit ends and anchor rods held securely in proper vertical position and height with the manufacturer's recommended template until the concrete sets.

Make no adjustment of anchor rods after concrete has set. Any adjustment made may be cause for rejection of the foundation.

Maintain rebar clearances during concrete pour.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until removed. Use a steel template to accurately locate the anchor rods and hold them plumb and in proper alignment. Out-of-position anchor rods and anchor rods installed more than 40V:1H out of plumb are cause for rejection of the foundation. Field bending of anchor rods and field modification of the base plate are not allowed.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

Where 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 will extend deeper than shown, the extra foundation depth will be paid according to Section 00196.

(a) Design of Illumination Pole Foundations - Design non-standard foundations according to the Rutledge method using a S1 allowable average soils stress of 1,500 pounds per square foot unless site conditions do not meet poor soil requirements as listed in the Rutledge method.

(b) Design of Non-Standard Foundations - Design non-standard foundations according to the Agency's Traffic Structures Design Manual

(c) Installation of Traffic Signal Pole Foundations - Construct drilled shafts according to Section 00963.

00962.46 Steel Illumination and Signal Poles - Metal poles include vertical posts, signal mast arm, luminaire arms, connection hardware, and anchor rods. Do not erect poles until the Engineer has made a visual inspection of pole welding.

Fabricate entrance openings in metal poles and arms, including handholes, before galvanizing, except as shown for mounting traffic signal material.

(a) Design - Design all metal poles with self-supporting upsweep arms similar to the details shown.

(b) Pole Height - Before poles are ordered, the Engineer will check the pole heights in the field and verify that the specified luminaire mounting heights above pavement are provided. Provide upsweep

bracket arms of lengths shown in the Metal Light Pole Table or shown on the plans. Provide traffic signal poles of heights as shown or specified. Height of poles requiring slip plate bases is the length of shaft above the slip plate.

(c) Mast Arm - Install mast arms for traffic signals and signs according to details provided by the manufacturer. Use proper type and size of mounting appurtenances that correctly fit the pole furnished, or as shown. Provide self-supporting mast arms without tie rods or braces. Provide tapered mast arms that are either round, 8 sided, 12 sided, or 16 sided.

All mast arms shall allow wiring entrances directly into the pole from inside the mast arm.

(d) 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. Provide the mast arm rise according to the Metal Light Pole Table, or as shown or specified.

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. Provide tapered arms that are either round, 8 sided, 12 sided, or 16 sided.

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.

(e) Deflection - The horizontal dead load deflection at the top of the poles shall not exceed 1% of the pole length (2% for strain poles).

(f) 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.

(g) Welding - Weld steel illumination and signal poles according to AWS D1.1. The fabricator shall inspect welds according to details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 5.15 WELDING CONNECTIONS in AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Submit all testing procedures for Engineer's review prior to starting inspection. Submit certified copies of inspection reports to the Engineer for review.

If requested by the Engineer, additional weld inspection may be required upon arrival of the material at the job site. If defects are found by this additional inspection, the Contractor shall be responsible

for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.

(h) Welding Steel After Galvanizing - No field welding of galvanized steel will be allowed. The effected piece shall have the existing galvanizing removed from the heat effected area before welding. Perform the weld, remove the galvanizing totally from the entire piece, and hot-dip galvanized it. Submit the following data, stamped according to 00150.35, for review:

- Explanation for modification
- Name of shop performing the work
- Welding procedure
- Description of the work that will be performed
- Name of the shop performing the hot-dip galvanizing

(i) Identifying Tags - Attach a stainless steel identifying tag to all poles. Provide tags that are at least 1/16 inch thick. Tag lettering shall be at least 1/4 inch in height, and be stamped into the tag. Attach tags 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. Locate the pole tag approximately 24 inches below the top of the mast arm or messenger cable attachment point. Locate the tag on the side of the pole furthest from the intersection. Drill holes for pop rivets prior to hot-dip galvanizing. Remove excess hot-dip galvanizing from holes and repair according to ASTM A 780.

Include the following information on the tags, if applicable:

- Manufacturer
- Month and year of manufacture
- Lum Arm Yield (ksi)
- Lum Arm thickness (inch)
- Mast Arm Yield (ksi)
- Mast Arm thickness (inch)
- Pole Yield (ksi)
- Pole thickness (inch)
- Base Plate Yield (ksi)
- Anchor Rod Yield (ksi)

(j) Erecting Metal Poles - Erect metal poles on concrete foundations and according to the recommendations of the pole manufacturer and as shown. Exercise reasonable care to prevent marking the finish and damaging poles.

Install all joint traffic signal and illumination poles so the distance from the pavement to the light center is as shown or specified. Use the same tapered design for traffic signal and street light arms.

Bolt protrusion on slip base poles shall not interfere with the breakaway action of pole. File sharp edges smooth and repair according to ASTM A 780.

(1) Repair Damaged Finish - Repair damaged galvanizing according to ASTM A 780. Minor scratches less than 3 inches long by 3/16 inch wide or an area of 1/2 square inch can be repaired with the sprayed zinc method.

(2) Assembly of Supports and Bolt Tightening - Nuts shall have full thread engagement.

a. Anchor Rods for Signal Supports and Fixed Base Luminaire Supports - After foundation concrete strength and curing requirements are satisfied and after inspection of the foundation, pole installation may begin.

Lubricate anchor rods and nuts according to 02560.70. Estimate the required rake, if any, and set the lubricated leveling nuts accordingly, so that when pole installation is complete and all appurtenances are installed on the pole, the top of the pole is plumb with the base of the pole.

Lift the pole into position on the leveling nuts and washers. Make sure all leveling nuts and washers are in full contact with the base plate.

Install washers and lubricated top nuts, and bring to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Several passes may be required to obtain uniform snug tightness.

When all anchor rods are snug tight, proceed with installation of arms and other appurtenances, if not previously installed. When installation of arms and appurtenances is complete, and the pole is plumb as defined above, final anchor rod tightening may begin. If the pole is not plumb, adjust as required and repeat snug tightening as described above. As a safety measure, provide crane support of the pole until anchor rods tightening is completed.

Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate each top nut past snug tight by the amount shown in "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 rods.

b. Anchor rods 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.

Furnish, at no additional cost to the Agency, 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.

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 rods are snug tight, proceed with the "Slip Base Bolting Procedure" as shown. When the slip base bolting procedure is complete, final anchor rod tightening may begin. As a safety measure, provide crane support of the pole until anchor rod 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 rod past snug tight by the amount indicated in paragraph "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 rods.

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 4-bolt connections to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate the top nut of each anchor rod past snug tight by the amount indicated in paragraph .d below. Several passes may be required to obtain uniform snug tightness.

Install high-strength 8-bolt connections according to 00930.40(d).

d. Final Tightening - Required final tightening of anchor rods and high-strength bolts are shown in the following Table:

Connection Type	Rotation Past Snug Tight
ASTM A 307 Anchor rods	30° (1/12 turn)
ASTM A 449 Anchor rods	60° (1/6 turn)
ASTM F 1554 Gr. 55 Anchor rods	60° (1/6 turn)
ASTM A 325 4-bolt connection	60° (1/6 turn)

(3) Bolt Inspection - The Engineer will observe the installation and tightening operations to ensure that proper procedures are followed. All inspections will be visual and no testing will be conducted.

Top surface of bolts or rods that are not flush or extend passed the top of the nut requires the rejection of the installation.

00962.48 Coating - Coat according to all applicable portions of Section 00594.

00962.50 Grounding and Bonding:

(a) Metal Poles - For fixed 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".

For slip base poles, do not allow the grounding wire to 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.

Section 00963 - Signal Support Drilled Shafts

Description

00963.00 Scope - This work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts for signal supports according to these Specifications.

00963.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ soil, rock or a casing.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00963.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

Materials

00963.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete	00440
Reinforcement	00530 and 02510

00963.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A 252 or ASTM A 36. Test each heat of steel at 40 °F with a minimum absorbed energy requirement of 15 foot pounds. 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.

00963.19 Quality Control - Provide quality control according to 00512.19.

Labor

00963.30 Personnel Qualifications - Perform the drilled shaft construction work using a company and personnel experienced in drilled shaft construction work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the companies experience relevant to the project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth, and all special construction techniques required. Before the preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last five years, with drilled shafts of diameters and depths equal to or larger than those shown in the plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- On-site supervisors shall have at least two years experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and scope to those shown in the plans and in similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.

- Drill operators shall have at least one year experience in the construction of drilled shaft foundations.

The Engineer will respond within 21 calendar days after receipt of the submittal. Do not begin work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors or drill operators to the Engineer, who will have seven calendar days to respond to each request. Additional costs resulting from the suspension of work due to the changing of personnel will be the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of work will be allowed.

Construction

00963.40 Submittals - Provide the following submittals to the Agency for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 calendar days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.
- A review of equipment suitability based on the Contractor's understanding of the site subsurface conditions. Include a project history of the drilling equipment that demonstrates the successful use of the equipment for drilled shafts of equal or greater size in similar subsurface conditions.
- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include details of the methods and materials used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the casing and surrounding soil, if permanent casing is specified. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft (if applicable).
- Details of the proposed method(s) for ensuring drilled shaft stability during excavation and concrete placement.
- Unstamped 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 on the type, number and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction.
- Evidence that the proposed materials conform to all applicable Specifications.
- Details of concrete placement, including proposed operational procedures for pumping and tremie methods.
- Detailed procedures for temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and equipment for casing installation and removal.
- Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.
- Methods for protecting existing structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 calendar days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the

work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 calendar days for approval of modifications. Do not begin drilled shaft construction work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the Agency. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or materials 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.

00963.41 Drilled Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least seven calendar days before beginning any shaft construction work at the site to discuss construction procedures, schedules, staging, personnel, equipment to be used, and other elements of the approved shaft installation plan as specified in 00963.40. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the temporary casing, placing the steel reinforcing bars, and placing the concrete.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, an additional meeting shall be held before any additional shaft construction operations are performed.

00963.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown. Determine the drilled shaft dimensions and alignment with approved methods.

Frequently check the plumbness alignment and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Correct out-of-tolerance drilled shafts at no additional cost to the Agency, and no extension of the Project completion date will be granted. Materials and work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for as Extra Work.

00963.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls for the full depth of the excavation, using approved materials, equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer's satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation:

- Is stabilized at the bottom, sides and surface to prevent soil caving or swelling or a reduction of soil strength, and
- Is covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.

(b) Protection of Existing Structures - Protect existing structures according to 00512.43(b).

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

(d) Unexpected Drilled Shaft Obstructions - Remove unexpected drilled shaft obstructions according to 00512.43(d).

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid as Extra Work.

(f) Clean Out - Clean out drilled shafts according to 00512.43(h).

00963.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel extending from 3 inches above the bottom of the shaft excavation to the elevation shown. The reinforcing cage may be supported on the bottom of the shaft excavation if approved. Support the reinforcing cage to prevent distortion or settlement during concrete placement. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement, unless otherwise approved.

(c) 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 00963.40.

00963.47 Concrete - Furnish and place concrete according to the following:

(a) Concrete Placement - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Immediately prior to concrete placement ensure the shaft clean out requirements are met according to 00963.43(f).

Place concrete according to 00540.48(a) and continuously until concrete at the top of the shaft is free of water, soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation. Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement 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.

Unless otherwise approved, allow a maximum of 60 minutes between concrete placements and 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.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter not less than 8 inches. For placement by concrete pump, use hose with inside diameter not less than 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) Wet Shaft Concrete Placement - Perform wet shaft concrete placement according to 00512.47(c).

(c) Concrete Curing and Cleaning - Allow the exposed top of concrete to cure a minimum of seven days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the plans.

(d) Casing Removal - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00963.42. Casing that cannot be extracted during or immediately after the concrete placement operation may be cause for rejection of the shaft.

00963.48 Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts.

00963.49 Scheduling and Restrictions - Do not proceed with additional shafts until the first drilled shaft has been approved. 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.

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

Measurement

00963.80 Measurement - The quantities of signal support drilled shafts will be measured on the length basis, by the vertical excavated length from the bottom of the shaft to the ground surface. If directed to construct drilled shafts below the elevations shown, the drilled shaft will be measured from the revised bottom of shaft.

Payment

00963.90 Payment - The accepted quantities of signal support drilled shafts will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	36 Inch Diameter Signal Support Drilled Shaft	Foot
(b)	42 Inch Diameter Signal Support Drilled Shaft	Foot

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

No separate or additional payment will be made for:

- excavating the shafts and disposing of the excavated material
- furnishing, placing, splicing and removing temporary shaft casing and forms
- concrete and all reinforcement

Section 00970 - Highway Illumination

Description

00970.00 Scope - In addition to requirements of Section 00960 and Section 00962, install highway illumination according to the following Specifications.

00970.02 Equipment List and Drawings - Submit six copies of isocandela diagrams indicating the vertical light distribution, vertical control limits and the lateral light distribution classifications for each type of luminaire submitted for approval. Include a letter from the luminaire manufacturer detailing lamp socket position with respect to lamps and refractors furnished for each Illuminating Engineering Society (IES) light distribution type specified.

Upon request, submit one copy of luminous intensity distribution data in IES format on a compact disk or using electronic mail for each type of luminaire submitted with the following:

- **Vertical angles** - Provide data in increments of 5 degrees or less for the vertical angles of 0 to 90 degrees, inclusive.
- **Horizontal angles** - Use a maximum of 10 degree increments for all horizontal angles.

Complete description data is required.

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 is shown 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. 12 AWG Type XHHW or THWN wire from the control cabinet to the photoelectric relay.

Use 3 conductor No. 10 type TC cable from the pole base to luminaire ballast. Use 2 conductors for luminaire ballast connection and 1 conductor for circuit grounding at the luminaire. Extend and securely connect electrical circuit grounding for each circuit connected to the luminaire end.

For double arm illumination pole, two sets of wires shall be installed separately from the pole base to each luminaire end. Do not splice wires inside the illumination pole except at the pole base.

Wires from the ballast to the lamp holders shall conform to the manufacturer’s recommendations.

00970.43 Photocontrol Electronic Relay - Install the photocontrol electronic relay on either the control cabinet or on the metal pole as shown.

Use 1 1/4 inch welded hub in top of cabinet to install photocontrol electronic relay with minimum 24 inch long galvanized metal conduit and twistlock plug. When photocontrol relay is attached on the side of the cabinet, use LB type conduit outlet body, 1 1/4 inch galvanized metal conduit riser, and galvanized channel support for the riser. Riser conduit shall be minimum 2 feet above the top of the control cabinet. Secure field installed relay and conduit extensions against vandalism and ensure they are rain tight.

When photocontrol relay is installed on metal pole, use welded hub outlet located 180 degree from luminaire arm, threaded close nipple and 1 1/4 inch LB type conduit outlet body. Locate the hub 30 feet above base plate or as shown.

Mount the relay away from adjacent light units, and orient the light sensitive relay's window 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 luminaires, install the decals on the bottom side of the luminaire or on the arm adjacent to the luminaire, whichever is more visible, as directed.

For wall-mounted luminaires, install the decals vertically on the luminaire housing or adjacent to the luminaire on the wall, as directed.

For pendant-mounted luminaires, install the decals horizontally on the ballast housing or externally at the top portion of the reflector if a remote ballast installation.

(2) Lamp Size and Identification Decal Code - Use the lamp size and color codes that conform to the following:

Tables 00970-1 A and B - Lamp Decal Code
High Intensity Discharge Lamps

TABLE 00970-1 A

Lamp Wattage	Identifying Number
50	5
70	7
100	10
150	15
175	17
200	20
250	25
310	31
400	40
750	75
1000	x1

TABLE 00970-1 B

Lamp Type	Background Color
Phosphor-Coated Mercury	White
High Pressure Sodium	Gold - Yellow
Clear Metal Halide [1]	Red
Phosphor-Coated Metal Halide [1]	Green
Induction Lamp	Orange

[1] In addition, metal halide lamp targets shall include a 1/2 inch wide by 3 inch long strip of pressure sensitive, flat top, wide angle reflective tape to show lamp burning position requirements. Apply tape 1/2 inch from the lamp size target as follows:

Lamp Burning Position	Target Color
Any position	None
Base up to horizontal	None
Base down to horizontal	Gold
Position-oriented-mogul socket (POM)	Red

00970.45 Pole Identification - Identify luminaire poles with a numbered label corresponding to the pole numbers on the highway 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.

Install labels on poles so they are visible from a passing vehicle.

Maintenance

00970.60 Maintaining Existing and Temporary Illumination Systems - Protect existing illumination systems and approved temporary replacements. Shutdown of a system may be allowed for alterations or final removal, as approved. Lighting system shutdowns shall not interfere with the regular lighting schedule. Notify the Engineer before performing any work on existing systems.

Determine the exact location of existing conduit runs and pull boxes before using equipment that may damage such facilities or interfere with any system.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, keep the existing systems in operation until the final connection to the modified circuit is made. The modified circuit is to be complete and operating by nightfall of the same day the existing system is disconnected.

Finishing and Testing

00970.70 Field Test - Operate the completed lighting system or subsystem continuously for seven consecutive days and an additional seven days normal burn afterwards. When the lighting performance is satisfactory, the Contractor may be relieved of maintenance responsibility according to 00170.80(b).

Before completing the work, conduct the following tests on all lighting circuits in the presence of the Engineer.

- A Megger test on each circuit between the conductor and ground with all switchboards, panelboards, fuse holders, switches, receptacles and overcurrent devices in place. Record all readings. Furnish the Engineer with one copy of the test results identifying observed readings with their respective circuits.
- Test the insulation resistance between conductor and ground. Resistance shall be as follows on circuits with total single conduction length of:
  - 2,500 feet and over - at least 6 MΩ
  - Less than 2,500 feet - at least 8 MΩ

Measurement

00970.80 Measurement - No measurement of quantities will be made for work performed under this Section.

The estimated quantities of lighting poles and arms will be listed in the Special Provisions. If plan changes by more than three feet are made to pole lengths or arm lengths or if field verified pole lengths or arm lengths increase or decrease by more than three feet, adjustments to the Contract lump sum amount will be made according to 00190.10(h). Adjustments will be made only for the increased or decreased length greater than three feet.

Payment

00970.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pole Foundations	Lump Sum
(b)	Lighting Poles, Fixed Base	Lump Sum
(c)	Lighting Poles, Slip Base	Lump Sum
(d)	Lighting Pole Arms	Lump Sum
(e)	Luminaires, Lamps, and Ballasts	Lump Sum
(f)	Switching, Conduit, and Wiring.	Lump Sum
(g)	Refurbishing and Reinstalling Existing Illumination Systems	Lump Sum

Item (a) includes all concrete foundations for lighting poles.

Item (f) includes all switches, conduit, cabinets, wiring, delineators, and other items required to construct the lighting system as specified.

Item (g) includes all refurbishing, reinstalling, and other work as specified and not included in the removal of existing illumination.

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

No separate or additional payment will be made for labeling the lights or poles.

If shown or specified as part of the work for concrete bridges or retaining walls, all conduit, junction boxes, cabinets, and other items permanently encased within concrete bridges and retaining walls, as well as pole foundations incorporated into a bridge or wall, will be included in payment made for the appropriate bridge and wall items.

00970.92 Electrical Energy Costs - All electrical energy costs for the lighting systems or subsystems will be paid for by the Agency.

Section 00990 - Traffic Signals

Description

00990.00 Scope - In addition to requirements of Section 00960 and Section 00962, install traffic signals according to the following Specifications.

Materials

00990.10 Backer Rod and Loop Sealant - Furnish backer rod material and hot-melt loop sealant from the QPL.

Construction

00990.40 Cable and Wire:

(a) General - Install wire and cable according to 00960.45 and the following:

Install wire and cable between terminal blocks without splicing, except for loop wire to loop feeder cable.

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

In mast arm poles, use control cable from the pole terminal cabinet to vehicle signal heads and signs. Run a separate No. 14 AWG cable as required for each signal head. If existing cables or equipment are damaged by the Contractor's operations, immediately notify the Engineer and the affected owner.

Tape the ends of unused conductors with insulating vinyl plastic tape.

(b) Control Cable Attachment - Use self-locking cable ties to attach cables to the messenger cable. Tighten to remove gaps between the control cable and the messenger cable. After tightening, trim all excess material.

(c) Messenger Cable - Install the eyebolts through the entire pole. Pull the shoulder of the eye tight against the front face of the pole.

(d) Tether and Stabilizer Cable - Tighten cables to limit signal and sign movement. Install Agency furnished S-hooks between the eyebolt and turnbuckle.

(e) Interconnect Cable:

(1) Labels - Label all interconnect cable with approved bronze or plastic labels, permanently and ruggedly attached. The labels shall be embossed with the cable identification number if shown. Additionally, labels used on utility facilities shall bear the legend "TRAFFIC SIGNAL". Label all ends of cables. Label all overhead cable in each direction away from the point of attachment, 2 feet from utility poles. Do not install labels until the Engineer approves the labels and attachment mechanism. Label all cables in the interconnect terminal cabinets and at terminal panel locations.

(2) Installation - Use approved cable guides, feeders, shoes and bushings to prevent damage to the cable during installation. Do not pull cable over edges or corners, over or around obstructions or through unnecessary curves or bends.

Cable 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.

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.

(3) Aerial Cable - Use terminal cabinets for aerial pole entrance of interconnect cable.

Match the sag as closely as possible with wires already on poles to minimize movement in windstorms and conflict with adjacent wires.

Use a cable grip on the jacketed messenger when pulling and tensioning. Pull and tension cable without damaging the jacket. When separating the messenger on figure-8 cable from the jacketed conductor assembly for dead-ending or splicing, split the web using approved tools designed for this task.

At corners and run ends, dead-end the messenger strand with approved automatic dead end connectors. Cut the strand and remove the jacket, exposing enough strand so that the ends of the strands coming through the chucks of both vises can be overlapped and bonded together to form a continuous ground. Use a one-bolt guy clamp to bond the strand ends together. Remove unused strand.

(4) Underground - In transition areas from overhead to underground, continue the aerial cable underground to the nearest termination panel. If figure-8 type cable is used for overhead locations, strip the messenger wire from the cable, using approved tools, where the cable is within a conduit, pole or cabinet.

Pull the necessary length of cable to be installed from pull point to pull point skipping any intermediate junction box, handhole, or other opening in underground system. 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. Obtain the Engineer's approval of the storage methods to be used.

(5) Testing - Test interconnect cable according to 00990.70(i).

00990.41 Cabinet:

(a) Signal Circuit Overhead Terminal Cabinets - Mount signal circuit terminal cabinets as shown.

In each cabinet, install the number of sectional terminal blocks needed for the circuits, plus two spare terminal blocks. These spares are not to be used by the Contractor. Divide the number of terminal blocks required as evenly as possible among the mounting brackets in the cabinet.

Terminate only one wire in each termination point. If necessary, add additional terminals of the same capacity to accommodate additional taps. If additional terminals are required, use a factory jumper between the terminals.

Enter on the marking strip the wire number and/or letter as coded at the terminal strips in the controller cabinets. Use only mechanically printed labels.

Use weatherproof compression fittings in the bottom of the cabinets for cable entrances.

(b) Flasher Cabinet - Cabinets shall contain the devices shown.

(c) Power Service Cabinet - Install traffic signal service cabinets so that the meter placement is acceptable to the local power company if shown.

(d) Cabinet Protection - Keep interiors of all cabinets clean and free of dust, dirt, moisture, and other foreign matter.

00990.42 Indication Equipment:

(a) Standard Vehicle Signal Heads - Standard traffic signal heads shall be one-way, three-section heads, adjustable through 360 degrees about a vertical axis, and designed for the method of mounting shown or specified. Furnish heads complete, including lamps, lenses, LED modules, visors, reflectors, sockets, backboards and mounting appurtenances.

Vehicular signal heads shall be:

- Designed so they can be suspended from mast arms or span wires, or mounted on brackets or pedestals as required.
- Equipped with positive lock rings and fittings designed to prevent the heads from turning due to external forces.
- Equipped with all necessary appurtenances for the type of mounting required.

Tighten all backboards and visors securely against the signal head.

(b) LED Traffic Signal Modules - Fit modules into all types of traffic signal heads without the need to modify the head.

(c) Optically Programmed Vehicle Signals - Conform to all applicable portions of 00990.42(a). A complete vehicle signal includes the required number of signal sections with optical components, individual intensity control, cutaway visor, backboard, and mounting hardware.

Optically programmed vehicle signals shall:

- Use lamps of the type and wattage recommended by the signal manufacturer.
- Permit selective programming of the visibility zone of the projected indication anywhere within 15 degrees of the optical axis of each signal section.

When mounted on span wires, install additional washers on the hanger to shoe attachment pin to limit the lateral movement of the hanger.

(d) Pedestrian Signal Heads - All relevant portions of 00990.42(a) and 02925.65 apply to pedestrian signal heads.

(e) Flashing Beacon Signal Heads - Flashing beacons shall:

- Conform to all applicable portions of this subsection.
- Be of single-section construction.
- Be equipped for the type of mounting shown.

Use the size of lamps specified in 02925.51.

Mount single-section heads on span wires as shown for three-section heads.

(f) Suspension of Signal Heads - Suspend vehicle and pedestrian signal heads as shown.

(g) Signal Head Covers - Cover mounted vehicle signal heads and pedestrian signal heads at all times until the signal installation is ready for continuous operation.

00990.43 Traffic Signal Detection Devices:

(a) Pedestrian Push Buttons - Mount pedestrian push buttons on a pole, pedestal or post whose foundation directly abuts an asphalt concrete or portland cement concrete landing or walkway. Install push buttons in an H-frame mount 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 1/2 inch wide for loop wire.

Saw cuts shall have smooth bottoms, with no edges due to differences in cut depth.

Limit saw cut angles to 90 degrees or less to limit the bend in loop wire. Cuts shall not create islands of pavement less than 2.5 square feet in area.

Flush cuts thoroughly with a high-pressure water stream immediately after sawing, and before the cuttings dry. Blow cuts free of water, debris, rock, and grit with high-volume or high-pressure air. Slots may also be cleaned by means of a high-pressure water injection/vacuum extraction system. Remove all cuttings from the Project.

Dry cuts before placing wire. Remove rocks or other material that may be wedged in the cut.

Two sets of twisted pair loop wires may be installed in a single saw cut, as long as the minimum cover shown is provided and adequate pavement depth is available. The Engineer may limit the allowable saw cut depth and width to avoid damage to the pavement.

On new open-graded AC wearing courses install loops in the base lift, or in the existing surfacing if it is to be overlaid, and after milling has been completed.

In an existing open-graded AC surface, the saw cut and installation shall be as shown.

(2) Wire - Place a permanent plastic label on each loop feeder cable indicating the loop numbers, in indelible ink, as shown on the Loop Detector Wiring Diagram. Place labels within 4 inches of the end of the jacket at each end of the loop feeder cables.

Do not remove the outside jacket and shield of loop feeder cables more than 6 inches from the end, inside the controller cabinet. Solder all loop feeder conductor terminations from field wiring in signal controller cabinets after crimp lugs have been installed. Crimp lugs used for loop wire field terminals may be insulated or non-insulated. Terminate loop feeder shield drain wire to the cabinet input panel grounding bus nearest the feeder wire termination points.

(3) Installation - The Engineer will mark or approve the center point location of all loops to be installed. Do not place wire in saw cuts until the cuts have been inspected by the Engineer.

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. Twist the loop wire pair together 4 to 6 twists for each foot from the exit point of the loop to the splice point of the loop feeder cable or termination point in the controller cabinet as shown. Use one continuous, unbroken length of loop feeder cable from the loop wire splice point to the cabinet.

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 12 inch centers. Hold-downs shall fit snugly in saw slots.

After placing the wire, perform loop resistance testing before filling the slots with hot-melt sealant. Install the sealant in slots according to the manufacturer's instructions 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.

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 sealants 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.

Sealants that crack or pull away from the saw cuts after curing will be rejected.

(4) Splice - Splice loop wires to feeder cable in junction boxes. Connect loop wires to loop feeder cable with a screw on silicon grease filled wire connector. Remove 4 inches to 6 inches of feeder cable outer jacket, drain wire and shield. Do not damage the conductor insulation. Offset splices to ensure they do not make contact with each other. Strip feeder and loop conductors back about 1/2 inch. Cover the splice with a two piece plastic enclosure flooded with silicon grease.

(5) Resistance Testing - The resistance to ground of the loop and loop feeder combinations, tested with a 500 V wire insulation Megger tester, shall be 500 MΩ or greater when checked both before placing the sealant and after the sealant has set.

(6) Loop Sensitivity - Loops shall be sensitive to bicycles. After installation is complete the Engineer will test each loop.

00990.44 Traffic Control Signs - The type of sign and method of mounting will be as shown or specified. Signs shall conform to 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 cable that runs continuously without splices from the detector unit to the controller cabinet.
- Not include emitter units.

00990.47 Railroad Interconnect - Run the circuit conductors in underground electrical conduit of the size shown. Terminate the conduit at the railroad cabinet at the location and in the manner directed by the railroad company. Extend the ends of the wire at least 3 feet beyond the end fitting of the supplied conduit. All other work inside the railroad cabinet is the responsibility of the railroad.

Do not work in the immediate vicinity of the railroad cabinet without first notifying the Engineer and receiving permission. The Agency 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 (see 00170.01(e)).

Finishing

00990.70 Testing and Turn-on - This work includes the testing traffic signal control equipment, testing traffic signal installations, and turning on completed traffic signal installations.

(a) Delivery of Control Equipment - Provide manuals, diagrams, and other documents as required by the Agency. 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 cost, to the Contractor. Include the following information with equipment shipments:

- Contractor
- Supplier
- Manufacturer
- Location
- Contract number
- Agency for which the equipment is to be tested. For agencies other than ODOT, 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 Systems 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 Agency 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 no cost to the Contractor.

The control equipment will be tested in three categories: physical, functional, and environmental as specified in the Standard Specification for Microcomputer Signal Controller. ODOT will require six weeks for completion and evaluation of the testing.

(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 cost, to the Contractor.

Replace rejected control equipment with 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 Agency 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.

The Agency will be responsible for delivery and installation of the other control equipment, such as controller units, input devices, switch packs, monitor units, miscellaneous plug-in devices and auxiliary devices not physically wired to the controller cabinet.

Other control equipment that the Agency is to install will be stored at the test facility until the signal installation is ready to be turned on.

(g) Field Testing - Field testing of traffic signal installations will be performed by Agency electrical crews. Notify the Engineer one week in advance of the anticipated signal completion date. The Engineer will notify the Agency's Traffic Systems Services Unit and the Agency'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.

Information on Agency 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 Agency will turn on the signal within one week after completion of corrections identified during field testing.

Be present at the Project Site.

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 maintaining agency.

(i) Interconnect System Testing:

Test each new 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, furnish the test results and the test data to the Engineer. Conduct tests, as described below, for all cable conductors, including spares, the cable shield, and all field terminations.

In addition to testing the complete system, perform the following tests for each cable circuit:

(1) Continuity - Perform a continuity measurement for each conductor and the cable shield in the system. Conductor resistance shall not be more than 10 Ω per 1,000 feet for each cable pair and shield of the communications cable. Measure the resistance with an ohmmeter having a minimum input impedance of 10 MΩ/V. Record the resistance of each pair and furnish to the Engineer as described above.

(2) Isolation - Perform an isolation measurement for each conductor and cable shield in the system. Measure the insulation resistance with all connections to the conductor or shield under test removed and all other conductors in the cable grounded. Make the measurement with a DC potential of not less than 360 V nor more than 550 V, continuously applied for one minute. Insulation resistance of each cable conductor and the shield shall exceed 1,000 MΩ per mile. Use an insulation resistance (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 - Provide a one year Contractor warranty according to 00170.85(b). This Contractor warranty does not replace or reduce other warranties, including manufacturer's warranties, that are longer than one year.

Measurement

00990.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

00990.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Traffic Signal Installation	Lump Sum
(b)	Traffic Signal Modification	Lump Sum
(c)	Loop Detector Installation	Lump Sum
(d)	Ramp Meter Signal Installation	Lump Sum
(e)	Interconnect System	Lump Sum
(f)	Flashing Beacon Installation	Lump Sum
(g)	Automatic Traffic Recorder Installation	Lump Sum

Item (a) includes furnishing and installing all items of the traffic signal system, including the fire preemption system, the controller, the controller cabinet equipment, and the detection system.

Item (b) includes furnishing and replacing or installing items for an existing traffic signal installation.

Item (c) includes furnishing and installing a complete traffic loop detector installation for an existing installation, including required controller equipment.

Item (d) includes furnishing all items of the ramp meter signal system, including the controller and controller cabinet equipment.

Item (e) includes furnishing all the interconnect system.

Item (f) includes furnishing and installing all items of the flashing beacon system.

Item (g) includes furnishing and installing all items of the automatic traffic recorder system.

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

No separate or additional payment will be made for replacement of disturbed earthwork, base, and surfacing.

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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 occurring in its natural habitat without direct or indirect human actions.

Noxious Weed - All weed designated by the Oregon State Weed Board as injurious to public health, agriculture, recreation, wildlife, or all public or private property. The Oregon Department of Agriculture (ODA) will be the authority in determination of noxious weed species.

Pure Live Seed (PLS) - The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is excluded.

Riparian - Related to the bank, shore, or water-influenced areas of a watercourse or water body.

Sensitive Areas - Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.

Specified Weeds - All noxious weeds as defined above, and all plant species identified in the Special Provisions or on the plans as a species to be removed.

Waters of the State - See ORS 468B.005 for "Waters of the State" definition.

Weed - A plant that is undesirable where it is growing.

Weed Free - For these Specifications, "Weed Free" is defined as the following maximum amount of living weeds per square yard:

- Zero "Type A" or "Type T" Noxious Weeds
- One "Type B" Noxious Weed
- One of each non-noxious weed listed in the Special Provisions

The ODA Noxious Weed Policy and Classification System lists Type "A", "B", and "T" Noxious Weeds.

Weed Management Area (WMA) - A defined project area with Specified Weeds to remove, including areas where weeds begin growing because of project-associated ground disturbance. A WMA may be the entire project site or any portion, including material source and disposal sites as shown.

Materials

01030.11 Topsoil - Furnish topsoil meeting the requirements of 01040.14.

01030.12 Soil Conditioners, Amendments, and Bio-Amendments - Furnish soil modifiers meeting the requirements of 01040.15, 01040.16, and 01040.17.

01030.13 Seed - Furnish seed meeting the following requirements:

(a) Label - Deliver all seed in standard, sealed containers. Label each container with the following:

- The kind and variety of each seed of 3% or more in a mixture, by weight. Be sure that seed mix labels include the words "mixture" or "mixed seed" when the seed is a mixture
- The country or state where the seed is grown
- The lot number or other lot identification
- The total percentage, by weight, of other crop seed
- The total percentage, by weight, of weed seed
- The total percentage, by weight, of inert matter
- Statement of "No Noxious (weed) Found"
- For each named seed:
  - Percentage of germination
  - Percentage of hard (non-living) seed, if more than 1%
- Percent of PLS for each kind of seed
- Percent and kind of other crop
- Month and year of seed test
- Net weight of contents
- Name and address of seed labeler or seller
- Origin for each seed (state or foreign country)
- If seed inoculant is used, the claimed date that inoculant effectiveness ends
- For treated seeds (if any):
  - Statement that the seeds have been treated
  - Name of all chemical used in the treatment
  - Description process used in the treatment
  - Warning statement for all residual chemicals used
- Net weight of each container
- For seeds listed as native, date and location of collection of source (first generation) seed
- For native seeds specified to be collected for direct use on a project, label containers with the date and location of collection sites for each seed species

Alternate label requirements may be identified in the Special Provisions for certain native plant seeds.

(b) Quality - Furnish seed meeting the following requirements:

- The seed and labeling complies with Oregon Seed Law and Federal Seed Act.
- The seed has been tested within 18 months of the planting date.
- The seed is not sprouted, moldy, or showing evidence of having been wet or otherwise damaged.
- The seed is labeled as "Oregon Certified Seed" or the equivalent from another state when identified in the Special Provisions. Information about certified seed is available from County Extension Offices, Oregon State University, and the Oregon Department of Agriculture.

(c) Pure Live Seed - Obtain the amount of seed to apply by using the purity and germination percentages from the label on actual bags of seed to be used on the Project.

To calculate the amount of seed to be applied:

- Obtain the PLS factor - Multiply the seed label germination percentage times the seed label purity percentage.
- Divide the specified PLS rate by the PLS factor.

Example: A PLS seeding rate of 10 pounds per acre is specified. The seed label shows a purity of 80% and germination is 90%. After converting percentages to decimals, 0.80 x 0.90 equals a factor of 0.72. The specified PLS rate, 10 pounds per acre, divided by the factor of 0.72 equals 13.88. In order to meet a PLS seeding rate of 10 pounds per acre, about 14 pounds of seed needs to be applied per acre. For a seed mix, make this calculation for every seed to obtain the total amount to be applied.

(d) Inspection - Each lot of seed is subject to inspection upon delivery to the Project. Seed that is not labeled or that does not conform to the Specifications will be rejected and shall be replaced at no additional cost to the Agency.

(e) Mixes - Furnish seed mixes that meet the labeling, quality and inspection requirements stated above. Submit all other proposed seed or seed mixes for consideration and receive written approval before seeding work begins. Replace rejected seed before planting.

(f) Types of Seed Mixes - Seed mixes, quantities, standards, seeding rates, and other information will be included in the Special Provisions for each type of seed mix.

The following are the functional categories of seed mixes that may be included on projects (a category may have multiple functions on a project site):

- **Temporary Seeding** - To provide short-term control of soil erosion until permanent seeding is performed or all potential for erosion is removed.
- **Permanent Seeding** - The final seeding, or only seeding performed for erosion control.
- **Lawn Seeding** - Seeding for areas where finished turf appearance is desired.
- **Wildflower Seeding** - Seeding to develop growth of wildflowers. The seed mix will typically contain grass or other plant seed to provide erosion control.
- **Plant Seeding** - Seeding which typically includes more than just grass species, such as seeds of woody or herbaceous plants.
- **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.

- **Wetland Seeding** - To vegetate existing or constructed wetlands with native plant species.

- **Native Plant Seeding** - Seeding to restore native vegetation.

(g) Availability - Provide a list of seed sources for all specified seeds within 60 calendar days after execution of the Contract. Verify that all specified seed has been located and will be available for use on the Project.

01030.14 Fertilizer - Furnish standard, commercial grade fertilizer meeting the following requirements:

(a) General - Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate that includes the container weight, the percentage of each ingredient, and the source of each component in the mixture. Ensure that each container is labeled with a quality compliance certificate that meets the applicable requirements of Section 00165.

Furnish fertilizer according to State and federal regulations. Fertilizer is subject to testing by the State Department of Agriculture.

(b) Type of Fertilizer - Provide the following fertilizer:

(1) West of the Cascades - Furnish 22-16-8 inorganic fertilizer analyzing 22% nitrogen, 16% phosphoric acid, 8% soluble potash, and including a minimum of 2% sulfur. Furnish fertilizer containing not less than 50% available water-insoluble, controlled-release nitrogen derived from one of the following sources:

- Urea formaldehyde (Nitroform)
- Isobutylidene Diurea (IBDU)
- Polymer coated urea (no sulfur)

(2) East of the Cascades - Furnish 22-10-5 inorganic fertilizer analyzing 22% nitrogen, 10% phosphoric acid, 5% soluble potash, and including a minimum of 10% sulfur. Furnish fertilizer containing not less than 50% available water-insoluble, controlled-release nitrogen derived from one of the three sources stated for West of the Cascades above.

(3) Statewide, Near Water - For application within 50 feet of open water, furnish 22-2-11 low-phosphorus fertilizer analyzing 22% nitrogen, 2% phosphorus, and 11% potassium which releases slowly over an eight to nine month period. Furnish fertilizer containing a minimum of 60% available water-insoluble, controlled-release nitrogen derived from one of the three sources stated for west of the Cascades above. Furnish phosphorus and potassium that is coated to allow a minimum of 95% controlled-release.

01030.15 Mulch - Furnish mulch materials free of all weed or plant seeds and containing no substances detrimental to plant life. The kind of mulch material(s) acceptable for use will be shown on the plans, listed in the Special Provisions, or will be as approved. Furnish mulch meeting the following requirements:

(a) Hydromulch from Cellulose, Wood, or Straw Fiber - Furnish cellulose fiber produced from virgin wood, straw, or paper fiber product from the QPL. Furnish wood or straw mulch processed so the fibers remain uniformly suspended under agitation in water and the fibers have moisture-absorption and percolation properties. Ship hydromulch in packages of uniform weight, plus or minus 5%, and labeled with the manufacturer's name and air-dry weight.

(b) Straw - Unless otherwise specified, furnish straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass singly or in combination. Cereal grain straw from barley, oat or wheat may be allowed upon approval of the Agency. Provide straw that is not moldy, caked, decayed or of otherwise low quality. Submit certification from the supplier that the straw is free of noxious weed seeds or plant parts. Acceptable documentation is any one of the following:

- The straw source is an "Oregon Certified Seed" field.
- The straw is certified by a recognized program accepted by the Oregon Department of Agriculture as being weed free.
- Seed lab test results of seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content.

(c) Tracer - For hydromulch application, include enough green dye so applied mulch is easily visible.

01030.16 Tackifier - Furnish a commercial quality tackifier containing no agent toxic to plant life. Furnish tackifier of either a liquid stabilizing emulsion or a dry powder tackifier meeting the following requirements:

(a) Liquid Stabilizer Emulsion - Tackifier with a base material of liquid, polyvinyl acetate polymers, using emulsion resins and containing not less than 55% total solids by weight. Furnish tackifier containing no polyacrylates or polyvinyl acrylics. The emulsion shall, when diluted with water and upon drying, allow exchange of air and moisture to the seeds and have an effective life of 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)

01030.17 Pesticides - Submit proposed pesticides and receive approval before using. Submit a copy of the manufacturer's federal registered label and, if requested, a Material Safety Data Sheet. The Agency reserves the right to restrict chemicals from being used on Sensitive Areas.

Labor

01030.30 General:

(a) Weed Control Coordinator - Submit certification at the preconstruction conference that the weed control coordinator meets the following minimum requirements:

- Demonstrates ability to identify noxious and other weed species commonly seen in Oregon. Some examples of potentially acceptable credentials are at least one year conducting weed surveys in Oregon or Washington State or a degree in botany or horticulture from an accredited institution.
- Has successful weed control experience, with similar duties to those stated under typical duties below, on at least three construction or vegetation management projects. Two examples of acceptable certification are an Oregon Pesticide Consultant License or Oregon Landscape Contractor's License held in the individual's name.

Typical duties of the weed control coordinator include the following:

- Identify Specified Weeds.
- Prepare and update the Weed Control Work Plan (WCWP).
- Coordinate Contractor's weed removal work and records.
- Resolve weed control issues as the Contractor's representative.
- Determine when Specified Weed content exists in disposable materials and ensures the materials are disposed of at an approved off-site facility.

(b) Pesticide Applicator - Submit certification before application of pesticide work begins, that when chemical weed control is used, that each applicator possesses an Oregon Commercial Pesticide Applicator's License held in the individual's name. Submit a certification each time a new applicator begins application work on the Project.

Construction

01030.40 General - Notify the Agency not less than 24 hours in advance of seeding operations. Do not begin seeding until prepared slopes in an area have been approved for seeding. Do not perform seeding during windy weather or when the ground is frozen, excessively wet, or otherwise not tillable.

Do not disturb or damage existing desirable vegetation to be left in place. Do not disturb areas previously seeded and mulched, with the exception of disturbances caused by stage construction. If previously seeded areas are disturbed, rework and reseed as directed, at no additional cost to the Agency.

Remove all non-approved plants resulting from the seed mixes provided for the Project at no additional cost to the Agency, including erosion protection required during reseeding.

01030.41 Area Preparation - Refer to 01040.48 for area preparation for the following kinds of seeding:

- Temporary Seeding - Method E
- Permanent Seeding - Method D
- Wildflower Seeding - Method B
- Plant Seeding - Method B
- Water Quality Seeding - Method B
- Wetland Seeding - Method B
- Lawn Seeding - Method C
- Native Plant Seeding - Method B

01030.42 Weed Control - When the Contract Schedule of Items includes an item for "Weed Control", remove and prevent regrowth of Specified Weeds, weed plant parts, and weed seeds from areas within the Project limits.

Do not harm or disturb existing native or ornamental vegetation, unless directed to do so. Do not compact soil with heavy equipment in areas where soil will not be disturbed for roadway or other construction.

If a pesticide has been approved for use, apply according to federal and State laws, including conditions and requirements of the federal registered pesticide label.

(a) Weed Control Work Plan - Depending on project conditions such as location, sensitive environments, permit requirements, jurisdictional regulations, or other items, there may be limits on

the use of chemicals or other weed control methods. Before submitting the initial WCWP, determine if there are restrictions or all potential for restrictions on weed control methods on project sites. At the preconstruction conference, submit a WCWP with the following:

- Name and contact information for the approved weed control coordinator.
- WMA's with existing Specified Weeds mapped on project plan sheets where possible.
- Botanical and common name of each species of weed to be removed.
- The proposed methods of weed removal and continuing control for each weed species listed.
- Schedule of weed control measures.
- Request to use wheeled or tracked construction equipment in sensitive areas.

If changes of the WCWP are necessary, resubmit a revised WCWP for approval before proceeding.

(b) Weed Control Inspections - Inspect the project for new growth of specified weeds at least monthly and apply weed control measures as appropriate. This requirement may be waived by the Engineer during the period that weeds are fully dormant. To ensure satisfactory weed removal, the last WMA inspection will occur at least 30 days after growing season has begun or as directed.

At a minimum, schedule weed control inspection with the Agency at the following times:

- After approval of WCWP and prior to beginning weed control within a WMA.
- Monthly.
- Upon request by the Agency to discuss non-compliant weed control work.
- After completing weed control at material sources and disposal sites.

(c) Remove and Control of Weeds - Remove and control weeds according to the following:

(1) All areas:

- At least three calendar days prior to beginning weed control activities, walk through each WMA with the Engineer and confirm the identity, location, type, and approximate number of Specified Weeds. Verify that control methods in the WCWP are acceptable as planned for each WMA before proceeding with weed control activities.
- Remove Specified Weeds and receive approval prior to beginning construction or equipment mobilization in that area. As much as practicable, ensure that weed seeds or reproducing plant parts such as vines, runners, or rhizomes don't remain or become disbursed during control activities.
- As soon as practicable, place weeds and related materials in an approved container and transport to an approved offsite disposal facility according to applicable laws and regulations. During transport, ensure that materials are fully enclosed at all times to prevent escape.
- Keep a record of all weed material loads transported off the Project and submit documentation from the approved disposal facilities that a corresponding number of weed material loads were disposed of at that facility.
- Keep WMA's Weed Free including weeds not initially present in the walk through.

(2) Sensitive Areas:

- Unless otherwise approved in writing, use only hand or light mechanical weed control methods within 50 feet of Sensitive Areas. Hand methods include the use of hand tools. Light mechanical methods include the use of hand carried, motorized machinery.

- Inside Sensitive Areas, obtain approval before using wheeled or tracked construction equipment. Requests will be approved only when all vegetation in the area will be cleared, such as under new roadways or slopes.
- The Engineer will be the authority in the determination of Sensitive Areas.

(d) Weed Control Corrective Work - If corrective work for areas identified as deficient by the Engineer is not completed within a 15 calendar day period, the Engineer may suspend the work according to 00180.70. If the Contactor's weed control work is determined to be unsatisfactory, the Agency reserves the right to do the work at the Contractor's expense.

01030.43 Temporary and Permanent Seeding:

(a) Temporary Seeding - Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again. Provide fertilizer, mulch, water, and other amendments necessary to ensure establishment. Ensure that temporary seeding work achieves the coverage of live plants required by 01030.60 by the end of the next permanent seeding date stated in 01030.43(b). If this coverage is not achieved, or if the Agency determines that it is not effective in stabilizing the soil from erosion, stabilize the area with other temporary stabilization methods as described in 00280.42 at no additional cost to the Agency.

(b) Permanent Seeding - Perform this seeding during the permanent seeding dates shown below. If work done within the seeding dates does not provide coverage according to 01030.60, re-seed according to 01030.48 and as directed. The dates for permanent, wildflower, plant, water quality, wetland, lawn, and native plant seeding are as follows:

- **West of the Cascades** - March 1 through May 15 and September 1 through October 31. If new lawn areas are regularly watered, they can be seeded from March 1 through November 15.
- **East of the Cascades** - October 1 through February 1. If new lawn areas are regularly watered, they can be seeded from March 1 through October 31.
- **Wetland (Statewide)** - September 1 through October 31 and March 1 through April 30.

Permanent seeding outside the these dates requires written authorization from the Agency. Approval to seed outside these dates will only be given when physical completion of Project work is imminent and environmental conditions are conducive to satisfactory growth. For permanent seeding done outside the seeding dates, ensure that the coverage of live plants required by 01030.60 is achieved no later than 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 no additional cost to the Agency.

01030.44 Fertilizer:

(a) Inorganic - Apply 22-16-8 or 22-10-5 inorganic fertilizer at the rate of 400 pounds per acre.

(b) Low-Phosphorous - Apply 22-2-11 polymer coated urea low-phosphorus fertilizer at the rate of 200 pounds per acre.

01030.45 Soil Testing - Test soil according to 01040.13.

01030.46 Topsoil and Wetland Topsoil - Construct topsoil areas according to 01040.43 and 01040.44, as appropriate.

01030.47 Soil Amendments and Bio-Amendments - Incorporate soil amendments and bio-amendments into the seeding operation according to 01040.45 and 01040.46, as appropriate.

01030.48 Application - The following application methods are acceptable for both temporary and permanent seeding:

(a) Hydroseeding, Fertilizing, Hydromulching, and Tacking - Apply seed, fertilizer, mulch, and tackifier as follows:

Use hydraulic equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the equipment and application method provides a uniform distribution of the slurry. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.

(1) Hydroseeding Operation - Perform hydroseeding according to the following:

a. One-step Operation - Apply materials in one step only for the following situations:

- When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.
- When treating small areas according to 01030.48(e). Double the amount of seed to compensate for seed suspended above soil by the mulch.

b. Two-step Operation - Except for the one-step method situations in 01030.48(a-1-a), use the two-step method for all hydroseeding operations:

1. Step 1 - Apply seed, fertilizer, and tracer. The seed and fertilizer may be applied separately or together. If hydromulch is used as a tracer, apply it at a rate of 500 pounds per acre.

2. Step 2 - Apply mulch and tackifier. Hydromulch, if used as a tracer in Step 1, will be included as part of the specified hydromulch rate specified in 01030.48(a-3).

(2) Seed - Thoroughly mix seeds when more than one kind is to be used.

(3) Mulch - Apply hydromulch at the following rates based on dry fiber weight:

a. Slopes Flatter Than 1V:2H - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

b. Slopes 1V:2H or Steeper - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.

(4) Tackifier for Cellulose Fiber Applications - Use one of the following:

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

b. Dry Powder Tackifier - Apply at the following rates unless the manufacturer recommends a greater rate of application:

1. Slopes flatter Than 1V:2H - 60 pounds per acre mixed with hydromulch fibers at the rate specified.

2. 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 no additional cost to the Agency.

(2) Dry Mulch - Evenly apply straw mulch within 24 hours after seeding and fertilizing. In areas not accessible to heavy equipment or hose, apply straw mulch by hand or other approved method.

Place straw mulch approximately 2 inches deep, in loose condition, which requires approximately 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 straw 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 a uniform surface cover effective at preventing erosion by one of the following:

1. 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.

2. 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 or more than 6 inches wide, and are rounded to prevent withdrawing the straw from the soil. Use a roller with enough weight to incorporate the straw sufficiently into the soil providing a uniform surface cover.

(c) Drill Seeder - Apply seed and fertilizer with a grass seed drill that works fertilizer into the soil and places seed under about a 1/4 inch soil cover.

(d) Seeding Over Mulched Areas - If an area has been previously mulched for erosion control or temporary seed and mulch is present on the soil surface, double the amount of each seed type used.

Apply seed and fertilizer hydraulically and add a green dye to the mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

- Mulch is punched into the soil by mechanized means.
- It is necessary to hold down mulch with netting or like material.
- The slope is 1V:1.5H or steeper and a slurry mixture would tend to run down the slope.
- Mulch is removed prior to seeding.

(e) Optional Temporary or Permanent Seeding - Upon approval, the following may be used to stabilized disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:

(1) Seed - Seed the disturbed area with the seed mix at the rate of 2 pounds per 1,000 square feet. Seed may be spread by mechanical spreader according to 01030.48 (b-1-c).

(2) Cover - Cover seeded areas with one of the following:

- Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly and apply commercial tackifier or netting to hold in place.
- Bark mulch spread uniformly at an approximate depth of 1/2 inch. Use well-decomposed mulch for seed mulching.
- Suitable open-weave, biodegradable erosion control matting installed according to manufacturer's instructions.
- Hydromulch applied in one step according to 01030.48(a).

(3) Fertilizer - Fertilize according to 01030.44.

01030.49 Work Quality:

(a) Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used. Use protective covering on structures and objects where coverage and stains would be objectionable and when tacking agents are used with mulch. Protect vehicles and people from drifting spray. If equipment and methods of application result in wasting material, make corrections to prevent waste.

(b) Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto areas occupied by rock base, rock shoulders, plant beds, or other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.

(c) Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

Maintenance

01030.60 General - Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the establishment period. The minimum living plant coverage standards for acceptance of seeding in a planted area are as follows:

- **Temporary Seeding** - 70% coverage of ground surface.
- **Permanent Seeding** - 90% coverage of ground surface.

- **Wildflower and Wetland Seeding** - 70% coverage of ground surface.
- **Water Quality and Lawn Seeding** - 100% of ground surface.
- **Woody or Other Plant Seeding** - See Special Provisions for minimum living plant coverage.
- **Native Plant Seeding** - See Special Provisions for minimum living plant coverage.

01030.61 Establishment Period - The seeding establishment period is as follows:

(a) Erosion Control Seeding - For temporary and permanent seeding done solely for erosion control, the establishment period begins upon acceptance of the initial seeding work and ends upon satisfactory plant growth and coverage of the seeded areas according to 01030.42 and 01030.60.

(b) All Other Seeding - Establishment periods for wildflower, plant, water quality, lawn, wetland, native plant, 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 all necessary reseeding is completed and accepted during the following seeding season.

01030.62 Establishment Work:

(a) Erosion Control Seeding - Select and provide establishment work for erosion control seeding from 01030.62(b) necessary to provide performance described in 01030.60.

(b) All Other Seeding - Ensure the establishment of wildflower, lawn, plant, water quality, wetland, native plant, and permanent seeding by the following:

(1) Protection - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at no additional cost to the Agency. Obtain approval of protective methods used.

(2) Fertilizing and Watering - Apply fertilizer according to 01030.44. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the Agency.

(3) Weed Control - Remove Specified Weeds prior to plants going to seed and keep WMA's and seeded areas "Weed Free" throughout the establishment period.

(4) Mowing - Mowing is required for lawn seeding and water quality seeding. Do the first mowing of grass when soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1 1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval. The approval may be granted if:

- Mowing is done with a mulching blade.
- There are no weed seeds in the mulch.
- Mulch is not detrimental to the growth of grass.

(5) Repair and Restore - Repair and restore soil grades and re-seed damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the Agency.

Finishing and Clean Up

01030.70 Cleanup - Remove weeds, trash, debris, stones, and other extraneous matter from seeded areas as directed and dispose of according to 00290.20.

01030.71 Waste Disposal - Protective coverings used on structures and all waste materials associated with seeding, fertilizing, mulching, and associated activities become the property of the Contractor at the point of origin. Dispose of these waste materials according to 00290.20.

Measurement

01030.80 Measurement - The quantities of seeding and associated work performed under this Section will be measured according to the following:

- **Unit Basis** - Unit basis items will be measured by actual count.
- **Area Basis** - Area basis items will be measured on the ground surface.

Payment

01030.90 Payment - The accepted quantities of seeding and associated work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Weed Control	Acre
(b)	Seeding Mobilization	Each
(c)	Temporary Seeding, _____	Acre
(d)	Permanent Seeding, _____	Acre
(e)	Wetland Seeding, _____	Acre
(f)	Water Quality Seeding, _____	Acre
(g)	Plant Seeding, _____	Acre
(h)	Native Plant Seeding, _____	Acre
(i)	Wildflower Seeding, _____	Acre
(k)	Lawn Seeding	Acre or Square Yard
(l)	Fertilizing	Acre
(m)	Mulching	Acre

Item (a) includes all work associated with the WCWP.

Item (b) includes all labor and transportation of materials and equipment, each time the Contractor mobilizes as required for all hydraulically or airborne applied seeding, fertilizing, and mulching.

In items (c) through (i), the type of seed mix, such as Mix No. 1, if applicable, will be inserted in the blank.

Items (c) through (k) include preparing the seed bed, soil preparation, seeding, fertilizing, mulching, applying tacking agent, and all establishment work.

When temporary seeding, applied according to 01030.43(a), is later accepted as permanent seeding according to 01030.43(b), payment will be made only one time under the permanent seeding pay item. No separate payment will be made for the initial seeding.

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

No separate or additional payment will be made for:

- mobilization for application by blowers, mechanical spreaders, or hand spreading
- inspections or maintenance
- seeding mobilization if it is not included in the Contract Schedule of Items

Partial payments for permanent seeding, regardless of type, will be made as follows:

- At completion of seeding ……70%
- At completion of seeding 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 for native plant definition.

Noxious Weed - See 01030.02 for noxious weed definition.

Ornamental Plant - A desirable plant species that is not native, or a plant propagated in such a way that it does not carry genetic characteristics of the species that are native to the area where it is planted.

Plant Establishment Period - A period of time, that is part of the planting work, that ensures satisfactory growth and establishment of plants.

Permanent Wilting Point - The level of soil wetness at which point a plant wilts and can no longer recover its sustainable 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 for weed definition.

01040.03 General - Ensure that work meets the following requirements:

(a) Existing Vegetation - Do not disturb existing desirable vegetation that is to remain or is designated for protection, unless approved by the Agency prior to construction.

(b) Pesticide Applicators License and Chemical Registration - Furnish evidence to the Agency that each applicator is licensed for the specific class of chemical being applied. Also, furnish evidence that any chemical is registered for the proposed use by the Oregon Department of Agriculture according to ORS Chapters 452, 561, 570, and 634.

(c) Weather Conditions - Planting work will not be allowed during the following conditions, unless otherwise approved:

- **Cold weather** - When air or ground temperatures are expected to be below 32 °F.
- **Hot weather** - When air or ground temperatures are expected to be above 88 °F.
- **Wet weather** - When the ground reaches saturation, except as approved when planting wetland plants.
- **Windy weather** - When wind velocity exceeds 25 mph.

(d) Work Performed During Unacceptable Conditions - If any work occurs during unacceptable weather conditions, the Contractor may be required to provide the following services at no additional cost to the Agency:

(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 Agency 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 Work Plan (WCWP) according to 01030.42(a)
- 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 Agency. If any part of the PWP become unworkable at any time during construction, notify the Agency, then submit a revised plan. Do not proceed with the planting work until approved by the Agency.

(b) Notice for Inspections - Notify the Agency a minimum of 24 hours prior to each required inspection.

(c) Site Conditions - Ensure that the area is properly prepared prior to the start of the planting operation.

(d) Utility Locate - Coordinate all existing utility locations according to Section 00150.

(e) Utility Use - Provide required water and electricity for planting and plant establishment at no additional cost to the Agency unless an approved Agency source is available.

(f) Verification - Verify actual ground dimensions prior to construction. Notify the Agency of any discrepancies before beginning work.

Materials

01040.10 General - Submit a list of Project materials for approval according to 01040.04(a) before arranging for procurement of any materials. For materials not approved, submit a list of alternate materials for approval. Materials installed without approval will be subject to removal and replacement with acceptable material at no additional cost to the Agency.

Substitute materials may be allowed if proof of equivalent quality, suitable product specifications, manufacturer's literature and other detailed information is furnished to the Agency 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 Agency.

01040.13 Soil Testing - Furnish the following kinds of soil testing and reports:

(a) Soil Fertility Test and Soil Amendment Report - Prior to planting, furnish a soil fertility analysis of existing soils performed by a certified testing lab. Prior to planting, adjust soil amendment and fertilizer applications as recommended by the soil amendment report and as approved by the Agency.

(1) Sampling - Take five samples per acre 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 Agency prior to construction.

(1) Sampling - Take five samples per acre 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:

Test	Minimum Requirements
Percent active bacterial and fungal biomass	between 5% and 25% activity
Total bacterial biomass	6×10^8 per gram of dry soil
Total fungal biomass	100 μg for grasslands 200 μg for shrubs or perennials 300 μg for forested areas
Protozoa	5000 per gram of soil
Beneficial nematodes	20 per gram of soil (No root-feeding nematodes)

Determine if anaerobic or compacted conditions are present, based on the assessment of total bacterial biomass, percent bacterial activity, and protozoan biomass.

If the soil contains biomass numbers lower than these levels, apply amendments and inoculates according to the soil ecology lab recommendations in the soil bio-amendment report in 01040.13(b-3).

(3) Soil Bio-Amendment Report - Provide a report summarizing sampling locations and procedures. Include the soil ecology lab report of the soil organism assessment and the recommendations for:

- Inoculation of missing organisms groups to the soil.
- Amendment with food resources for organism groups with too low of a biomass.
- Reduction of undesirable groups, or groups with the biomass too high for the optimal growth of the desired plants.
- Any adjustments to the bio-amendments required for the types of plants being planted.

01040.14 Topsoil - Furnish topsoil containing no substance detrimental to the growth of plants and that is free of plants designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds. Unsuitable topsoil, or topsoil placed by the Contractor without approval in areas to be planted, may be required to be replaced at no additional cost to the Agency.

20 days before furnishing any type of topsoil, do the following:

- Give the Agency notice of intent to use the source.
- Provide access to the source for Agency inspection.
- Provide one 20 pound representative soil sample of each topsoil type for testing of particle size range and organic matter by the Agency, unless otherwise specified.
- Obtain approval of the source before excavation of topsoil begins.

(a) Selected Topsoil - Furnish native topsoil from the required excavations meeting the requirements of 00330.10 or from other Agency-controlled lands. The general limits of topsoil materials will be indicated on the plans. The Agency 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-Agency controlled lands that, when tested according to AASHTO T 88, meeting the following limits:

Standard Sieve Analysis

Particle Size Range	Percent Retained (by Weight)
Larger than 2"	0
2" - 3/4"	0 - 5
3/4" - No. 4	0 - 20
No. 4 or less	0 - 100

Of the fraction passing the No. 4 sieve, excluding organic material, furnish topsoil that conforms to the following limits:

Hydrometer Analysis

Particle Size Range	Percent (by Weight)
No. 4 - No. 200	5 - 70 (Retained)
No. 200 - 2 µm	20 - 80 (Retained)
Less than 2 µm	5 - 30 (Passing)

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.

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 Agency 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 Agency 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 life forms detrimental to plant life and receive approval prior to use on the Project. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. The following are typical soil bio-amendments that may be identified in the soil bio-amendment report:

(a) Bacterial Food Amendments:

- Simple sugars such as brown sugar, brown syrups, or molasses
- Plant extracts of Yucca or Nettle, usually containing sap of the plant comprised of a combination of simple sugars, proteins, and carbohydrates
- Fulvic acids
- Yeast, including baker's yeast, brewer's yeast, and champagne yeast
- Kelp meal
- Rock dust

(b) Fungal Food Amendments:

- Cellulose
- Lignin
- Humic acids - brown to dark brown products (black is not acceptable)

(c) Protozoa Food Amendments:

- Bacteria
- Hay infusions - A method of growing protozoa for soil inoculation by using hay in water

(d) Nematode Food Resources - Nematodes come as four types: bacterial-feeders, fungal-feeders, root-feeders, and predatory nematodes. Predatory nematodes eat other nematodes, while the name of the other groups indicate what organisms they eat.

The primary source of material containing a wide diversity of beneficial nematodes is good compost. Provide certification that the compost contains beneficial nematodes and does not contain root-feeding or other detrimental nematodes.

(e) Mycorrhizal Inoculates - Commercially produced ectomycorrhizal and endomycorrhizal fungi that improve plant root absorption of soil nutrients.

(f) Microbes - Commercially produced product designed to enhance microbiological activity in the soil by the addition of beneficial and essential microbes. Commercial products may also contain vitamins, amino acids, plant growth hormones, micronutrients, and plant stress relievers.

(g) Earthworms - Common earthworms that are either "Red Wigglers" or "Night Crawlers" delivered in peat moss or other damp medium.

01040.18 Fertilizer - The soil amendment and bio-amendment reports will recommend fertilizer types and application rates. When identified in the report furnish commercial fertilizer meeting the requirements of 01030.14 and the following:

(a) Organic - Organic fertilizer 5-4-3, analyzing 5% nitrogen, 4% available phosphoric acid, and 3% soluble potash.

(b) Plant Bags and Tablets - Plant bags or tablets containing 20-10-5, or approved equal, may be used instead of granular fertilizer in pit planting.

Furnish plant bags or tablets that are controlled-release with a minimum one-year release period. Chemical formulation, rates and use will be approved by the Agency.

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 Agency may authorize use of other references such as the "Sunset Western Garden Book", the "Flora of the Pacific Northwest", by Hitchcock, or the "Manual of California Plants", by Jepson.

Furnish plants that conform to the applicable requirements of the current issue of the "American Standard for Nursery Stock", published by the American Association of Nurserymen. When a conflict exists between this publication and the Specifications, the Specifications will prevail.

(b) Quality - Provide plants that are healthy, first-class representatives of their species or variety, free from disease and insect pests, with top growth that is well developed and free of disfiguring knots, sun scalds, bark abrasions, wind or frost injury or any other objectionable features.

Furnish plants that are acclimated to the specific project environmental site conditions prior to planting. Store all container-grown and balled and burlapped (B&B) plant materials acquired for fall planting a minimum of 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 Agency, at any time and place. The Agency will make no plant material inspection at the source, except as it may elect. Notify the Agency of each delivery of plants to the Project site no less than 24 hours ahead of delivery. Do no planting until the plants have been inspected and approved for use. Any planting done without prior approval of the plants will be considered in violation of these Specifications.

The presence of noxious weeds in the soil accompanying plants or at the nursery source will be cause for rejection of any or all plants from that source.

(e) Availability - Furnish a list of nursery sources for all specified plants within 90 calendar days after execution of the Contract. Verify, by this list, that all specified plant material has been located and will be available for use on the Project. If applicable, see 01040.19(g) for alternate requirements.

(f) Plant Substitution - No substitution of plant materials will be allowed unless written evidence is submitted that a specified plant or material cannot be obtained and has been unobtainable since the execution of the Contract. If substitution is allowed, it will be by written approval from the Agency for the nearest acceptable variety, size and grade. Make any request for substitution in writing to the Agency 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.

(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 meeting the requirements of 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 Agency 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 Agency. 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 Agency. The following are some types of materials that fall under the category of "mulch", and may be used on projects:

(a) Bark Mulch - Ground, shredded or broken particles from the bark of fir, pine or hemlock trees which is free of non-bark debris, harmful bacteria, disease spores, pests and substances toxic to plant growth. Provide mulch that is the standard trade size known as "medium fine mulch".

(b) Cinder Mulch - Crushed lava cinders, screened to an approximate size between 3/16 inch to 5/8 inch. Furnish cinders free of fines and other non-cinder material.

(c) Straw Mulch - Provide straw mulch according to 01030.15.

(d) 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.

(e) 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 allowed only upon approval of the Agency. Select and apply chemical herbicides according to all applicable Federal, State and local laws, as well as the WCWP requirements of the PWP. 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 Sensor - 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 uptake potential. Instrument is to include all accessories necessary to perform a plant moisture stress test.

(b) Timed-Release Water - Containerized moisture retension chemical in the form of a solid gel delivered in biodegradable cartons. Typical ingredients are 97.85% water, 2% cellulose and 0.15% aluminum sulfate.

(c) Moisture Retention Chemicals - Granular chemical that are typically cross-linked potassium based polyacrylate or polyacrylamide copolymers. Provide commercial quality product from the QPL.

01040.23 Miscellaneous Items - Furnish miscellaneous items meeting the following requirements or provide commercial-quality products from the QPL. Obtain approval from the Agency prior to use.

(a) Anti-transpirant - Apply liquid anti-transpirant spray to all appropriate deliverable plant materials, prior to transport.

(b) Boulders - Furnish boulders of indigenous materials, with source, dimensions, and other characteristics as shown.

(c) Browsing Protectors - Flexible, semi-rigid plastic or metal mesh, brown or light green in color, with stake supports.

(d) Game Repellent - A commercial nontoxic spray that makes vegetation unpalatable for animal forage.

(e) Root Barrier - A root barrier designed to contain and control root intrusion into unwanted areas.

(f) Tree Grates - Tree grates complete with frames, all required attachment hardware, and at least one issue of any specialty key or tool that is required to open or move the item for maintenance.

(g) Tree Stakes and Ties - Rough sawn tree stakes of 1 1/2 inches x 1 1/2 inches 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 Agency before planting. The Agency 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 (West of the Cascades) - 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 Agency approval.

Do not place lawn sod before March 15 or after September 30 without written Agency approval.

01040.42 Planting Season (East of the Cascades) - Perform all plant installation work from October 15 to November 30, unless otherwise specified. Container-grown materials located within irrigated areas may be planted at other times, depending upon written Agency 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 Agency 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 are 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 Agency instructions or in undesignated places will not be paid for and removal may be required at the discretion of the Agency.

(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 exceed13 feet high, to maintain and preserve soil organism vitality.

(b) Subsoil Preparation - Excavate or grade areas to receive selected wetland topsoil as shown on the plans and finish as smooth as practicable through one pass of standard construction equipment. Have subsoil preparation inspected and approved by the Agency 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 specified on the plans. Make as smooth as practicable without excessive soil compaction. After spreading, have the area inspected and approved by the Agency 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 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 endomycorrhizal and ectomycorrhizal fungi.
- Mycorrhizal Inoculation (Root Dip) - Apply root dip material containing live endomycorrhizal and ectomycorrhizal 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 Agency approval, at the type and rate as follows:

Plant Bags/Tablets

Plant	Rate	Size
Tree	3 per tree	3/4 ounce
Shrub	2 per shrub	3/4 ounce
Vine/Ground Cover	1 per plant	3/16 ounce

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 Agency.

01040.48 Planting Area Preparation - All planting areas shall be Weed Free before planting or seeding operations begin. Identify, kill, and remove plants according to 01030.62(b-3).

Prepare planting areas according to the following methods, or as otherwise specified:

(a) Method "A" (Cultivated Planting Areas, Non-lawn) - Cultivate plant beds to a depth of 2 inches. Thoroughly mix 52 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 Agency determines are too steep to cultivate, plants may be planted in individual planting holes prepared using method "B".

(b) Method "B" (Non-Cultivated Planting Areas) - Spray existing weeds and non-desirable vegetation with herbicide to kill all top growth and roots in areas not requiring cultivation. Use herbicides that have limited residual toxicity to permit safe planting as required under the Contract. Do not spray or otherwise harm plants to be saved. After inspection and approval, remove the dead top growth of plant material within 2 inches of the surface and dispose of according to Section 00320. Replace plants to be saved that are damaged by herbicide application at no additional cost to the Agency.

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 Agency.

(c) Method "C" (Sod Lawn and Seeded Lawn Areas) - Cultivate existing ground to a depth of 6 inches, achieving a loose and friable condition suitable for fine grading. Remove all vegetation, rocks larger than 2 inch diameter, clods, roots, sticks, debris, and other matter detrimental to the growth of sod.

Uniformly spread soil conditioners, soil amendments, soil bio-amendments, and fertilizer evenly over the area and thoroughly rototill into the soil to a depth of 4 inches. Apply at rates recommended by soil testing, or as follows:

Material	Rate (per 100 square yards)
Soil Conditioner	1/2 cubic yard
Fertilizer	10 pounds
Lime (Western Oregon only)	40 pounds

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 Agency 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 Agency is complete. Replace plants not meeting the requirements of the Specifications with plants as specified or otherwise directed, at no additional cost to the Agency. Initial approval of plant materials for planting by the Agency 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 Agency. If standing water is present within a plant pit, notify the Agency 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 larger than the root ball, whichever is greater. Dig shrub plant pits a minimum of 1 foot larger than the root ball diameter. Dig pits to the same depth as the root ball, root mass, or container. Spread root systems of bare root plants and container 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 Agency. Remove all labels, tags and attachment materials from the plants before final inspection.
- Set upright growing plants straight and plumb, and prostrate growing plants level to the ground surface. Set all plants so that, after settlement, they are at the same level as when growing in the nursery or container.
- Place the backfill then add soil amendments, soil bio-amendments, and fertilizers as recommended by the soil amendment and bio-amendment reports. Moisten backfill completely after placing to eliminate air pockets and minimize settlement of the backfill. Form a shallow (2 inch high) water-holding saucer in the soil around the plant unless directed otherwise.
- Balled and burlapped plants may be placed with the root ball wrapping removed or, if all materials are untreated and fully biodegradable, left in place. If the root ball wrapping (burlap) is left around the plant, completely remove all tie wire, string or twine and fold down the burlap from the top half of the root ball.
- Perform any required pruning using good horticultural practice appropriate to the type of plant. Prune to remove all dead, damaged, crossed or rubbing twigs and branches, and to compensate for loss of roots during planting. Make cuts close to the parent stem, but not flush or through the bark "knob" at the branch joint. Do not prune terminal ends of tree leaders without approval of the Agency.
- Apply bark or wood chip mulch of the type and depth as shown. Correct contamination of new mulch due to the Contractor’s operations at no additional cost to the Agency. 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 Agency.
- Do not disturb protected existing vegetation unless approved by the Agency prior to construction.
- Dig pits for street trees that have hard surfaces around them so the crown of the root ball is 3 inches below the finished surface of the surrounding grade.
- Water deciduous trees that are 1 1/2 inches or larger in diameter, conifer trees that are over 4 feet in height, and all shrubs at a minimum frequency identified in the Special Provisions.

01040.50 Special Planting Requirements:

(a) Transplanted Specimen Plants - Use the following methods for transplanting specimen plants, unless otherwise specified:

(1) Mechanical Digging - Use a "Vermeer" type of tree spade or approved equal. Move only during the season that the tree is dormant. Treat deciduous plants with anti-transpirant prior to excavation. Confirm with the Agency 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 Agency 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 Agency 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 Agency 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 Agency. 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 Agency of the potential need for adjustment to the planting.

01040.52 Placing Sod Lawn - Place sod only after approval of the Agency. 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 510 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 Agency 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 Agency (raking may be required).

Keep bark mulch off plants, structures, roadways, shoulders, walks, and lawns. Uncover all plants covered by mulch material as soon as possible and leave the site in a neat, clean and finished appearance. When planting vines or groundcover, rake bark mulch away from planting pits so that the bark is not contaminated. After planting, evenly spread excess soil and rake bark mulch back into place.

Replace bark mulch that is displaced or blown away, and correct to the specified depth any bark mulch placed to a greater than specified depth, at no additional cost to the Agency.

Spread rock or cinder mulch to a depth of 2 inches after planting trees and shrubs.

(b) Non-Ornamental Plant Bed Areas - Apply mulch according to one of the following methods:

(1) Straw Mulch - Spread grass straw mulch to a nominal 2 inch depth and tackify, after planting of tubeling plants and seeding as required.

(2) Wood Chips - Spread wood chips to a nominal depth of 2 inches. Add 15 pounds of Ammonium Nitrate/1000SF to neutralize nitrogen loss.

01040.54 Water - Water all plants at intervals as required to maintain and promote healthy growth. Avoid excessive watering of shrub bed areas that may leach herbicide and damage adjacent lawns or desirable or protected vegetation. Repair all lawn vegetation damage at no additional cost to the Agency.

(a) Pressure Moisture Stress Sensor - When a pressure moisture stress sensor is specified, the Agency will test a 1% to 5% representative sample to ensure that the moisture stress level is below 20 bars of pressure and inform the Contractor if any material exceeds this limit. Any plant material found to have greater than 25 bars of pressure will be considered to be under extreme moisture stress. Provide sufficient water within 24 hours to bring the plant into normal range. The Agency will retest to determine the new representative pressure. Plant material that have 30 bars or greater will be considered to have reached its permanent wilting point. Replace all such material during the next planting period. Testing will occur mid-day 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 Agency 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.

(c) Moisture Retention Chemicals - Utilize moisture retention chemicals according to the manufacturer's recommendation, depending upon specific applications.

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 Agency 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 degrees 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 root ball.

(j) Trunk Wraps - Wrap tree trunks with the specified wrap, covering all exposed trunk between finish ground and the first whorl of tree branches.

01040.56 Cleanup During Construction - Maintain the Project in a neat, orderly condition. Remove unsightly construction materials at the end of each working shift. Clean all pavement surfaces of mud, debris, or other materials that may, in the opinion of the Agency, cause problems. If material is not removed, the Agency reserves the right to have the cleanup work performed and deduct the value of this work from the monies otherwise due the Contractor.

Plant Establishment

01040.70 General - The Contractor is responsible for the survival of all plant material until the end of a plant establishment period of one calendar year. The plant establishment period will begin when all the original planting is complete. The original planting is considered complete when all the plant material has been planted to the satisfaction of the Agency.

Establishment period work includes removing all plants that have reached their permanent wilting point, are dead, dying, or which do not meet Specifications, and replacing them with healthy plants. All plants in place after this replacement will be recognized as the original planting and will be subject to the establishment specifications. Repair, restore, and replace all plantings that have been damaged by vehicles, vandalized, and stolen according to 00170.80**.**

01040.71 Plant Care and Success Criteria - During the plant establishment period, maintain plants in a vigorous growing condition by regularly doing the following:

- Watering and fertilizing sufficiently to promote growth.
- Weeding, cultivating, pruning, and repairing.
- Adjusting tree stakes and guys.
- Controlling weeds before they seed according to 01040.48.
- Controlling pests and noxious weeds before the reproductive cycle.
- Removing dead or non-vigorous plants.
- Replacing missing plants.
- Re-mulching of plant bed areas.

The determination of a successful plant establishment period will be made at periodic plant establishment inspections. A successful planting establishment for each inspection is defined as follows:

- All plants are surviving and have vigorous growth.
- Plants are free of insects and disease.
- Plants show signs of continuing health.
- Plants have not reached permanent wilting point.

At the discretion of the Agency, 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 Agency. Mark the plot corners with permanent markers such as re-bar, including date and identification. Delineate a minimum of three plots per acre of new planting area.

The use of representative plots is intended to simplify the measurement of planting establishment work. If work within the representative plots does not accurately reflect the condition of the entire planting area(s), the Agency reserves the right to reject all establishment work.

01040.72 Periodic Inspections - During the plant establishment period, the Agency will make three plant establishment inspections jointly with the Contractor at the following times:

- Spring, early May
- Summer, mid July
- Fall, late September

Depending on when the establishment period begins, one of the above inspections will be the final inspection.

During each plant establishment inspection, the Agency may determine, based upon the specified success criteria, that corrective work is required. If so, the Agency will provide the Contractor with a written notice of required corrective work sent by hand-delivery or mail.

01040.73 Corrective Work - Complete all corrective work within 15 calendar days after receiving the written notice of the required corrective work to be taken. The 15 day requirement excludes those days the Agency determines to be impractical for working.

The Contractor will be allowed to replace plants outside the Planting Season to perform corrective work after each periodic inspection.

Provide plant replacements of the same variety, size, and quality as specified for the original plants, unless otherwise approved.

Notify the Agency when the corrective work is complete. When the corrective work has been re-inspected and is completed to the satisfaction of the Agency, the appropriate partial payment due the Contractor will be made.

If the Contractor does not perform the corrective work within the 15 day period after written notification, excluding those days the Agency determines to be impractical for working, the Agency may have the corrective work done by others and deduct the entire cost of the corrective work from monies due or to become due the Contractor under the Contract.

01040.75 Weed Control - Provide weed control according to 01030.42.

01040.77 Plant Establishment (Ornamental Areas) - In addition to these plant establishment requirements, perform the following:

(a) Watering, Fertilizing, and Mulching - Water all plants at the required intervals using the installed permanent or temporary irrigation systems, or such means as has been established for the Project. Avoid excessive watering of shrub areas adjacent to lawns that may leach herbicide and damage the lawn. Repair damaged lawns at no additional cost to the Agency.

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) Sod Lawn - Mow, cut and fertilize sod lawns 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. Final acceptance of sod lawn areas will depend on its health and condition. Keep sod lawns mowed to a height between 1 1/2 inches 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 - Perform weed control activities according to 01030.42.

(c) Soil Testing and Corrective Soil Amendments - If specified for the original planting, have a soil test performed by a soil ecology lab between the second and third periodic inspection. Present the recommendations to the Agency at the third inspection. Apply the amendments as recommended by the soil test report and as directed by the Agency.

01040.79 Final Inspection - After plant replacement work and any other required work has been completed, the Agency will make a final inspection. Ensure that all plant materials, planting beds and other facilities are according to the Specifications as a prerequisite for acceptance.

Measurement

01040.80 Measurement - The quantities of plantings and associated work performed under this Section will be measured according to the following:

(a) Soil Testing - Soil testing will be measured on the unit basis for each test that is completed and accepted. Soil testing includes the required sampling, testing, analyses, and reports for one or more of the following:

- Soil particle size range test.
- Soil fertility test and soil amendment report (including chemical analysis, acidity, salinity).
- Soil ecology analysis and soil bio-amendment report.

(b) Topsoil and Wetland Topsoil - Topsoil and wetland topsoil will be measured on the volume basis in the hauling vehicle.

Topsoil taken from the required excavations according to 00330.10 will be measured according to 00330.82.

(c) Soil Conditioners - Soil conditioners will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

(d) Plant Materials - Plant materials will be measured according to one of the following:

- **Unit Basis** - Under this method, plant materials will be measured on a unit basis.
- **Average Area** - This method may be used when a plant bed area is greater than or equal to 3,000 square yards and will be measured as follows:
  - The total plant bed area will be measured along the ground surface by the foot and calculated to the nearest square yard.
  - A total number of 30 square yard plots will be calculated.
  - 1% to 5% of the plant bed area will be selected and staked as 30 square yard representative plots.

- All the plants in each staked representative plot will be counted. Unless otherwise approved, if the number of plants in a plot exceeds the number of required plants of the representative plot, the number of required plants will be used to represent the plot.
- Based on the results of the plant count, the average number of plants per plot will be calculated.
- The quantities of each item will be based on the calculated average number of plants per plot multiplied by the number of plots in the total plant bed area.

(e) Sod Lawn - Sod lawn will be measured on an area basis on the ground surface and calculated to the nearest square yard.

(f) Mulch - Mulch will be measured on the volume basis in the hauling vehicle, or on the weight basis.

(g) Miscellaneous - Miscellaneous items will be measured as follows:

- **Tree Grates** - Tree grates will be measured on a unit basis. One grate includes two half grates, frame, hardware, tree guards, and appurtenances.
- **Woody Course Debris** - Woody course debris will be measure on a unit basis.
- **Boulders** - Boulders will be measured on a unit basis or on the weight basis.
- **Root Barrier** - Root barrier will be measured on the length basis.
- **Weed Control Geotextile** - Weed control geotextile will be measured on the area basis on the ground surface and calculated to the nearest square foot.

Payment

01040.90 Payment - The accepted quantities of plantings and associated work performed under this Section will be paid for according to the following:

(a) Soil Testing - Soil tests will be paid for at the Contract unit price, per each, for the item "Soil Testing".

Payment includes mobilization, soil sampling, testing, analyses, and preparation of the soil amendment and bio-amendment reports.

(b) Topsoil and Wetland Topsoil - Topsoil, not taken from required excavations, will be paid for at the Contract unit price, per cubic yard, for the item "Topsoil".

Wetland topsoil, taken from either the Project excavations or imported from other sites, will be paid for at the Contract unit price, per cubic yard, for the item "Wetland Topsoil".

Topsoil taken from required 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 nondesignated areas or which is contrary to the Agency's instructions.

(c) Soil Conditioners - Soil conditioners will be paid for at the Contract unit price, per cubic yard, for the item "Soil Conditioner".

(d) Plant Materials - Plants will be paid for at the Contract unit price, per each, for the appropriate items listed in the Contract Schedule of Items. Plant materials will be listed by caliper size, size of container, or other size, or condition shown.

Transplanted plants will be paid for at the Contract unit price, per each, for the item "Transplanted Specimen Plants".

Partial payments for plant materials will be made as follows:

At the time of the original planting	30%
After the first plant establishment inspection	10%
After the second plant establishment inspection	10%
After the third plant establishment inspection	10%
At completion of the establishment period	40%

Partial payments made throughout the establishment period will be made for all surviving and replaced plants.

Upon completion of the establishment period, full payment will be made for all surviving and replaced plants, except for corrective work performed by others according to 01040.73 The Agency will pay the Contract unit price only once for the specified quantity, whether or not plants are replaced.

If the Contractor requests partial payment for plant materials on hand, payment will be made according to 00195.60.

(e) Sod Lawn - Sod lawn will be paid for at the Contract unit price, per square yard, for the item "Sod Lawn".

(f) Mulch - Mulch will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Bark Mulch	Cubic Yard
Cinder Mulch	Cubic Yard
Wood Chip Mulch	Cubic Yard
Grass Straw Mulch	Ton
Rock Mulch	Ton

(g) Miscellaneous - The accepted quantities of miscellaneous items will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Tree Grates	Each
Woody Course Debris	Each
Boulders	Each or Ton
Root Barrier	Foot
Weed Control Geotextile	Square Foot

01040.90(g)

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

No separate or additional payment will be made for:

- soil amendments
- lime, gypsum, or trace minerals
- soil bio-amendments
- fertilizer
- herbicides
- anti-transpirants
- game repellant
- browsing protectors
- pesticides
- trunk wraps
- tree stakes and ties
- water
- timed-released water
- pressure moisture stress sensors
- mulch materials required as part of replacement planting
- corrective work during the plant establishment period

Section 01050 - Fences

Description

01050.00 Scope - This work consists of constructing:

- Fences, gates, and gateways of barbed wire, woven wire fabric, chain link fabric, or combinations, to the lines and grades shown or directed.
- Protective fences, on and off structure as shown or directed.

All dimensions shown on the plans are horizontal and vertical measurement. Actual quantities required for the installation may be greater depending on the slope of the terrain.

01050.01 Definitions:

(a) Fences - Fence, gates, gateways, and appurtenances, regardless of kinds and types.

(b) Gates - Swinging units to provide an opening in the fence line.

(1) Single Gate - A unit of 16 feet or less.

(2) Double Gate - Two single gate units used together for an opening of more than 16 feet.

(c) Gateway - Supported fence wire or fabric stretched between gate posts and fastened by bars, wire hinges and locking devices.

(d) Panel - That portion of fence between adjacent posts.

(e) Run - As used in this specification, run is defined as follows:

- **Fences, gates, and gateways** - The length of fence between end posts, intermediate end posts, corner posts, and gate posts.
- **Bridge protective fence** - A section of fence150 feet or less in length.

Materials

01050.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510.10
Barbed Wire	03010.10
Chain Link Fabric	03010.30
Commercial Grade Concrete	00440
Fence Gates	03010.60
Fence Grounding	03010.50(e) and (f)
Fence Posts, Braces, and Appurtenances	02110.30, 03010.50
Guardrail Elements	02820.10
Pickets	03010.31
Protective Fence Materials, On and Off Structures	03010.75
Vinyl Clad Fabric	03010.40
Woven Wire	03010.20

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.

Schedule the installation of fencing or provide temporary fencing or other adequate means to prevent livestock from entering the Project right-of-way, easements and/or adjoining properties according to 00170.92.

At bridges, cattle 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 Agency property lines, with posts set on Agency property. If directed, center concrete footings and fence posts 1 foot from the right-of-way or property line on Agency property.

Clear, grub and prepare the fence line area. Remove all shrubs, brush, snags, down timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with fence construction. If directed, preserve trees and geographic features on fence lines by varying the fence alignment to miss them.

Fill or excavate ground surface irregularities which interfere with maintaining specified clearance above ground surface of the bottom wire of the fence. Limit the width as necessary to provide a clear way for the fence.

Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil, or not less than 18 inches deep in rock. Prevent disturbance of original ground at the sides and bottom of the excavation.

Clear and grade gate openings to permit the gate to swing in a horizontal plane according to 01050.48.

Dispose of materials removed under these provisions, including excess excavation, in a satisfactory manner.

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, and chain link fence posts in concrete footings. Set all other posts firmly in the ground or in concrete footings as the Contractor elects.

Set posts to the depths shown. Reasonable variation in depths will be allowed and posts may be appropriately shortened or left slightly high, as approved by the Engineer, to:

- Avoid unnecessary penetration or excavation in rock or other unusually firm material.
- Obtain desired grades along the fence.

Set all posts vertical, except on curved alignment set posts slightly off vertical, as directed, to offset the pull of the fence fabric and wires.

(1) Driven Posts - Posts which are set by driving shall be free of damage when set. Remove and replace any driven posts which are split, twisted or bent, or have a 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 allowed provided that not more than two fabric or separate wire splices, spaced at least 50 feet apart, occur in any one run of fence. Use wrap or telephone type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than 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 Protective Fence for Bridges - If welding of special connections for protective fence is required, pre-qualification of welders will not be required and inspection of welding will be visual.

01050.47 Fence Grounding:

(a) General - Except for bridge protective fence, provide at least one "ground" for each run of fence and place at any post within the run according to 00960.50(b). Fence grounding for bridge protective fence is not required.

Fasten each line of barbed wire, alternate longitudinal wires of fence fabric, and the rails and tension wire of chain link fences to the ground wire by clamps. Clamp the ground wires to the grounding rods.

(b) At Electrical Lines - Ground the fence directly below the point of crossing at each location where an electric transmission, distribution or secondary line crosses over the fence.

Ground the fence at each end or gate post or at intervals not to exceed 500 feet when an electric transmission, distribution or secondary line runs parallel or nearly parallel to and within 100 feet of the fence.

01050.48 Gate Installation:

(a) Metal Gates - Install metal gates and fittings between gate posts previously set as specified. Firmly attach the fittings to the posts and gates. Hinge each single gate in a manner which will prevent removal of the gate without tools. Set the gate in an approximately horizontal plane to swing freely inward and outward, and so it can be fastened securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings.

Gates shall swing open at least of 90° in each direction.

(b) Gateways - Construct gateways of the same material as the fence and as shown. Construct wire splices according to 01050.44(b). Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

01050.49 Removing and Rebuilding Fence - Remove and rebuild existing fences as shown or directed. Construct fences to approximately the same condition as the original fence. Salvage the materials in existing fences to be removed and rebuilt and incorporate in the rebuilt fences. Replace fence materials damaged beyond reuse at no additional cost to the Agency. Firmly reset posts to the staked alignment. Post spacing and the number of wires to be strung and stapled to the posts shall be the same as the original fence. Furnish and use new staples or clips to fasten the wires to the posts.

Measurement

01050.80 Measurement - The quantities of fences, protective fences, gates, and associated items performed under this Section will be measured according to the following:

(a) Barbed and Woven Wire Fence and Gateways - Barbed wire fence, woven wire fence, and barbed and woven wire fence will be measured on the length basis. Gateways will be considered as fence of the type which adjoins them, and will be measured as a continuing part of that type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates. Where existing fences are extended to intersect the new fence, the length of extension, from point of joining to the center of the new end post, will be measured and included for payment, if similar in design or type to a Pay Item, otherwise this work will be paid for according to 00140.60.

(b) Metal Gates for Barbed and Woven Wire Fence - Metal gates for barbed and woven wire fence will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of gates for barbed wire and woven wire fence gates will be by width. The width will be the width of opening the gate is to fit.

(c) Chain Link Fence - Chain link fence will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

(d) Metal Gates for Chain Link Fence - Chain link fence metal gates will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of chain link fence gates will be by width and height. The width will be the width of opening the gate is to fit.

(e) Protective Fence for Bridges - Bridge protective fence will be measured on the length basis. Measurement will be between beginning and ending locations as shown.

(f) Removing and Rebuilding Fence - Removing and rebuilding existing fence will be measured on the length basis, including gates. Measurement will be from center to center of posts, measured along the line and grade of fence removed and reconstructed.

Payment

01050.90 Payment - The accepted quantities of fences, protective fences, gates, and associated items performed under this Section will be paid for according to the following:

(a) Barbed and Woven Wire Fence - Barbed and woven wire fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Type ____ Fence	Foot
(b)	____ Foot Single Gates	Each
(c)	____ Foot Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In items (b) and (c) the width of the gate opening will be inserted in the blank.

(b) Chain Link Fence - Chain link fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Chain Link Fence	Foot
(b)	____ Chain Link Fence with _____	Foot
(c)	____ Foot x ____ Inch Chain Link Single Gates	Each
(d)	____ Foot x ____ Inch Chain Link Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In item (b) the type of fence will be inserted in the first blank and the type of material or pickets used for screening will be inserted in the second blank.

In items (c) and (d) the width of the gate opening will be inserted in the first blank and the height of gate be inserted in as the second blank.

(c) Protective Fence for Bridges - Bridge protective fence will be paid for at the Contract unit price, per foot, for the item "____ Foot Type ____ Protective Fence".

The height of the fence will be inserted in the first blank. The type of fence will be inserted in the second blank.

(d) Removing and Rebuilding Fence - Removing and rebuilding fence will be paid for at the Contract unit price, per foot, for the item "Removing and Rebuilding Fence".

New material necessary to complete the rebuilding of fence will be included in payment made for the removing and rebuilding fence item.

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

Payment for materials, equipment, and labor involved in constructing panels of fence additional to normal fence construction at waterways and at ground surface depressions, according to 01050.44(e) and (f), will be paid for according to Section 00196.

Section 01070 - Mailbox Supports

Description

01070.00 Scope - This work consists of removing and maintaining mailboxes and supports at temporary locations during construction, and installing mailboxes and newspaper boxes affected by construction on new supports at permanent locations as shown or directed.

Materials

01070.10 Reinforcement - Furnish reinforcement for concrete collars meeting the requirements of Section 00530.

01070.11 Concrete - Furnish concrete for concrete collars meeting the requirements of Section 00440.

01070.12 Tube Support Frame - Furnish tube support frames meeting either of the following requirements:

- Requirements of ASTM A 500, Grade B, and galvanized according to AASHTO M 111 (ASTM A 123).
- Tensile requirements of ASTM A 53, Grade B, and galvanized with a minimum 0.9 ounce per square foot coating, as tested according to ASTM A 90, on the exterior surface followed by a chromate conversion coating and a cross link polyurethane acrylic coating. A zinc base corrosive resistant interior coating shall also be applied.

01070.13 Mounting Brackets and Hardware - Furnish mailbox mounting brackets, angles, adapter plates, and hardware as shown and galvanize according to AASHTO M 232 (ASTM A 153). Furnish mounting brackets for newspaper boxes as shown on the standard drawings.

01070.14 Post Mounting Socket - Furnish Flush V-Wing Post Mounting Socket manufactured by Foresight Industries of Cheyenne, Wyoming, or an approved equal.

Construction

01070.40 General - Protect and maintain mailboxes and supports at locations accessible to the delivery agent and as convenient as possible for the public being served. This may require removing and relocating the mailboxes and supports more than once to maintain service. When roadway construction is completed, install the mailboxes and newspaper boxes on new supports in their permanent locations as shown or directed.

Repair damaged galvanized surfaces, such as the cut end of the tube support frame or drilled holes, according to 02420.10(d), except add 1 1/2 ounces of leafing aluminum powder to each quart of high zinc dust content paint.

Install mounting brackets of the proper size to fit each existing mailbox.

If multiple supports are furnished for fewer than 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 00290.20.

Measurement

01070.80 Measurement - The quantities of mailbox supports and concrete collars will be measured on the unit basis of each kind of mailbox support and the number of concrete collars, regardless of size, installed in permanent locations.

Payment

01070.90 Payment - The accepted quantities of mailbox supports and collars will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Single Mailbox Supports	Each
(b)	Multiple Mailbox Supports	Each
(c)	Mailbox Concrete Collars	Each

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

No separate or additional payment will be made for:

- removing existing mailbox supports
- providing temporary installations
- installing new supports in permanent locations
- installing owner-furnished mailboxes and newspaper boxes

Section 01090 - Gravel Beds and Blankets

Description

01090.00 Scope - This work consists of preparing areas for gravel beds and gravel blankets, and furnishing and placing soil sterilant, weed control geotextile, and gravel bed aggregates or gravel blanket aggregates at locations shown or directed.

Materials

01090.10 Soil Sterilant - Furnish products with current legal labels listing active ingredients, which may include simazine, diuron, bromacil, sulfometuron-methyl, or from the QPL. Submit a sample of the proposed soil sterilant's registered label to the Engineer for approval before using.

01090.11 Weed Control Geotextile - Furnish the following weed control geotextiles:

- "Weed-Chek Landscape Mat"
- 3 ounce, UV stabilized, non-woven, polypropylene fabric
- 3.75 ounce, UV stabilized, needle-punched, polypropylene fabric
- Weed control geotextile from the QPL

01090.12 Aggregates - Furnish clean, uncrushed, nearly round rock for gravel beds and gravel blankets meeting the following gradation requirements:

Sieve Size	Gravel Bed 3/4" - 1/2"	Gravel Blanket 1 1/2" - 1/2"
	Percent Passing (by Weight)	
2"		100
1 1/2"		80 - 100
1"	100	0 - 15
3/4"	80 - 100	–
1/2"	0 - 10	0 - 5

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 Measurement - The quantities of gravel beds will be measured on the volume basis.

The quantities of gravel blankets will be measured on the area basis by surface measurement of the material in place, limited to the established neat lines and grades.

Payment

01090.90 Payment - The accepted quantities of gravel beds and gravel blankets will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Gravel Beds	Cubic Yard
(b)	Gravel Blanket	Square Yard

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

No separate or additional payment will be made for excavation, soil sterilant, or weed control geotextile.

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 no additional cost to the Agency.

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 allowed 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. 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:

Used for	**Class or Schedule**
Main and lateral lines	Class 200 or Schedule 40 PVC
Irrigation sleeves	Schedule 40 PVC
Caps	Schedule 80 PVC
Direct bury pipe, not in sleeves, placed under road beds or other paved areas	Schedule 40 PVC

Unless otherwise specified, furnish entire Project with one pipe class or schedule type.

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 Agency. Be responsible for coordinating water meter needs in a timely fashion with the Agency.

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 weight. 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 psi 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. 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.
- Heat-shrinkable insulating tubing manufactured for use in irrigation electrical systems. Furnish heat-shrink tubing of a mastic-lined, heavy-wall, polyolefin cable sleeve.

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 using continuous No. 14 gauge, single strand locator wire that is blue in color. Provide marking tape 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 Agency. Bring any velocities exceeding 5 feet per second created by pipe sizes shown on the plans to the attention of the Agency before beginning construction. Correct excess velocities existing after construction, or caused by changes from the plans, at no additional cost to the Agency, 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. Comply with the requirements of 00150.50.

01120.42 Excavation - Excavate trenches no wider than necessary to lay the pipe or install the equipment. Keep the top 6 inches of topsoil, if applicable, separate from subsoil and replace this topsoil as the top layer when backfilling. Provide smooth trench bottoms of sand or other material, free from rocks and unsuitable material. Excavate trenches in rock or other unsuitable material at least 6 inches below the required depth and backfill with sand or other suitable material free from rocks.

Exercise care when excavating near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, hand excavate and tunnel the pipe trench. When large roots are exposed, wrap them with heavy burlap for protection and to prevent excessive drying. When digging trenches by machine adjacent to trees having roots 2 inches and less in diameter, hand trim the sides of the trench, making a clean cut of the roots. Treat all cut and trimmed roots 1/2 inch or larger in

diameter with an approved tree wound dressing. Backfill trenches having exposed tree roots within 24 hours unless protected by continuously moist burlap or canvas.

Place detectable marking tape and tracer wire in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits installed under existing or planned pavement. Use tape widths recommended by the manufacturer for the burial depth.

Pipe installation using a "pipe puller" may be approved if there is adequate topsoil depth and the topsoil is free of rock. Obtain the Engineer's approval before using a pipe puller. Include any resultant changes in material or design with the request for use of this method.

If unforeseen bedrock is encountered during excavation that prevents the pipe from being buried at the specified depth, immediately bring it to the attention of the Engineer.

01120.43 Piping - Backfill all pipe between the top of the pipe and finished grade with a minimum of 18 inches of fill according to 01120.49. Where possible, place mains and laterals or section piping in the same trench. Separate all pipes by at least 2 inches. Place all pipe lines a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, fences, traffic barriers or walls unless otherwise approved.

Place marking tape and tracer wire above all pressurized mainline, according to the manufacturer's instructions.

Place all live mains to be constructed under existing pavement in sleeves jacked under the pavement, unless otherwise shown. Place all PVC pipe installed under pavement in pipe sleeves of Schedule 40 PVC, unless steel sleeving is shown or specified. Furnish pipe caps of Schedule 80 PVC. Install sleeves 2 feet below subgrade when passing under roadways. Extend sleeves 2 feet beyond the edge of gravel, edge of sidewalk or back of curbs. Mark sleeves with a 2 feet piece of No. 4 rebar driven flush with the ground or other adjacent surface. Place PVC caps over both ends of sleeves but do not glue. Solvent-weld sleeve sections. Pipe bedding and backfill shall conform to Section 00405. Extend the sleeve a minimum of 12 inches beyond the edge of pavement. Perform all jacking operations according to an approved jacking plan. If obstacles are encountered during required jacking, notify the Engineer, who may authorize corrective measures according to 00140.60. Provide for complete drainage of all pipe lines with manual drain valves installed at section low points. Drain valves may not be shown on the plans.

01120.44 Pipe Jointing:

(a) General - During construction, plug or cap pipe ends to prevent entry of dirt, rocks and other debris.

(b) Galvanized Steel Pipe - Ensure that galvanized steel pipe has clean cut, well fitted standard pipe threads. Ream all pipe to its full diameter and remove burrs before assembly. Construct threaded joints using either a non-hardening, non-seizing multipurpose sealant, teflon tape, or paste as recommended by the pipe manufacturer. Make all threaded joints tight with wrenches, without using handle extensions. Clean and remake joints that leak with new material. Use of caulking or thread cement to make joints tight will not be allowed.

(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 degrees. 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 as shown and 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 allowed 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. If adjustments are 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 allowed 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 Final Acceptance. (see 00150.95)

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 until Final Acceptance. (see 00150.95)

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 on 8 1/2 inches by 11 inches, 11 inches by 17 inches, or 22 inches by 36 inches sizes. 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. Show locations of drain valves, if any, on the drawings. 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 Measurement - No measurement of quantities will be made for work performed done under this Section.

Payment

01120.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Irrigation System".

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

No separate or additional payment will be made for excavation, backfill, electrical service, and system orientation.

Section 01140 - Potable Water Pipe and Fittings

Description

01140.00 Scope - This work consists of constructing potable water pipe and fittings 16 inches and smaller in diameter within a public Right-of-Way or easement.

Materials

01140.10 Materials - Furnish materials meeting the following requirements:

Bolted, Sleeve-Type Couplings for Plain End Pipe.....02475.60
Commercial Grade Concrete in Thrust Blocks.....00440
Detectable Marking Tape and Wire 02470.60
Ductile Iron Pipe Fittings.....02475.20
Ductile Iron Pipe 02470.20
Polyethylene Encasement 02470.50
Polyvinyl Chloride (PVC) Pipe fittings - 4 inch and larger 02475.40
Polyvinyl Chloride (PVC) Pipe fittings - under 4 inch 02475.45
Polyvinyl Chloride (PVC) Pipe - 4 inch and larger 02470.40
Polyvinyl Chloride (PVC) Pipe - under 4 inch 02470.45
Reinforcement 00530
Restrained Joints.....02475.50
Steel Pipe Fittings - 6 inch and larger.....02475.30
Steel Pipe Fittings - under 6 inch.....02475.35
Steel Pipe - 6 inch and larger 02470.30
Steel Pipe - under 6 inch 02470.35
Tie Rods 02485.60

01140.11 Handling Pipe and Fittings - Handle pipe and fittings to prevent damage or contamination 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 a manner satisfactory to the Engineer. Damaged or contaminated pipe and fittings will be rejected. Immediately separate all damaged or contaminated pipe and fittings and remove from the job site.

(a) Thread Protection - Protect threaded pipe ends with couplings or other means until laid. Inspect the pipe and fittings for defects.

(b) Temporary Storage - Store pipe on cradles to prevent entry of dirt, other foreign material, or contamination. Keep the pipe or pipe joint free of dirt, other foreign material, or contamination during handling or laying operations. Remove, clean, and relay any pipe or fitting that has been installed with dirt, foreign material, or contamination in it. At times when pipe laying is not in progress, close the open ends of pipe with watertight plugs or by other approved means to ensure cleanliness.

01140.12 Cutting Pipe:

(a) General - Use short lengths of pipe supplied by the manufacturer whenever possible to provide the proper spacing of valves, tees or special fittings.

(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.

Construction

01140.40 Trench Work - Excavate trench, prepare bedding, install 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 materials to enter the pipe at any time.

(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.

(c) Extra Trench Excavation - Changes in the alignments or grades of the potable water pipes from those shown or specified may be necessary because of unplotted utilities, or for other reasons. If directed to adjust, correct, relocate, or in any way change the line and grade, make such changes according to these Specifications.

(d) Grade and Alignment Changes - When pipeline grade is lowered in excess of 12 inches below the grade shown, or when pipeline horizontal alignment is changed by more than 12 inches after the original trench has been excavated, the additional excavation and backfill so required will be classified as extra trench excavation. The additional backfill material shall match the class used in the original trench.

(e) Installation in Paved Areas - If pipe is installed within paved areas to be preserved, perform the installation according to Sections 00405 and 00495.

01140.41 Laying Pipe:

(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) Curves - 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 the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the plans will indicate maximum lengths that can be used. Do not exceed 80% of the manufacturer's printed recommendations for the amount of deflection at each pipe joint when pipe is laid on a horizontal or vertical curve. Where field conditions require deflection or curves not anticipated by the plans, the Engineer will determine the methods to be used.

(2) Pipe Laying Procedure - When ductile iron pipe is laid on a curve, join the pipe in a straight alignment and then deflect it to the curved alignment. On approval, make trenches wider on curves for this purpose.

(c) Polyethylene Encasement - Where shown, lay ductile iron pipe with a polyethylene encasement. Install polyethylene encasement according to AWWA C105 and the manufacturer's recommendations.

(d) Steel Pipe - Install steel pipe according to the manufacturer's recommendations. Lay steel pipe on curves in the same manner described above for ductile iron pipe.

(e) Polyvinyl Chloride (PVC) Pipe - Install PVC pipe according to AWWA C605 and the manufacturer's recommendations.

(1) Bends - Bend PVC pipe 12 inches and smaller to allow for slight changes in direction. The minimum bending radius shall be according to AWWA C605. Axial deflection at the pipe joints will not be allowed.

(2) Large Diameter Pipe - For 14 inch and 16 inch diameter pipe, accomplish slight changes in direction by axial deflection of the pipe joint not to exceed 80% of the manufacturer's recommendation. Use fittings for joint deflections greater than 80% of the manufacturer's recommendation.

(f) Water and Sanitary Sewer Separation - Comply with OAR 333 regulations governing horizontal and vertical separation between water and sanitary sewer facilities for installation of new water lines and appurtenances. Submit any proposal for variance in writing. Include in the proposal 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. The proposal will be reviewed and approved by the Engineer. Each variance will be addressed in a case-by-case basis.

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 approved lubricant as specified by the pipe manufacturer.

Mark pipe not furnished with a depth mark before joint assembly.

(b) Steel Pipe Under 6 Inches - Brush-coat exposed threads after jointing with an approved asphalt coating.

01140.43 Polyethylene Encasement:

(a) Installation - Install polyethylene encasement according to AWWA C105 except as modified by these Specifications. Wrap polyethylene encasement loosely around the pipe, fittings, and couplings, and secure with 2 inch wide polyethylene adhesive tape. Cover joints or seams in the polyethylene encasement using 2 inch wide polyethylene adhesive tape. The polyethylene encasement need not be watertight, but do not expose any part of the pipe or coupling to the backfill. Exercise care during backfilling to prevent puncturing or otherwise damaging the polyethylene 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 exiting polyethylene encasement a minimum of 3 feet and seal the overlaps with 2 inch wide polyethylene adhesive tape.

01140.44 Thrust Restraint:

(a) Concrete Thrust Blocks - Place concrete thrust blocks as shown, at bends, tees, dead ends, and crosses. Pour 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.

(b) Restrained Joints - Where indicated or approved by the Engineer, restrain joints at bends, tees dead ends, crosses, and all pipe joints within the indicated or specified distance on each side of the bends, tees, dead ends, and crosses. Install joint restraint systems according to the manufacturer's recommendations.

01140.45 Marking Tape and Wire:

(a) Installation - Install marking tape and wire over all nonmetallic water lines, including service connections. Place a continuous solid copper wire along the top of all water pipe, including service lines. Secure to the top of the pipe at maximum 10 foot intervals using 6 inch strips of 2 inch wide duct tape. Tie all splices and make them electrically continuous and waterproof. Provide access to terminal ends of the wire at all valve boxes, meter boxes, fire hydrants, and vaults. The result of this installation shall be a continuous wire circuit electrically isolated from ground. Place the marking tape approximately one foot above the top of the pipe for its full length.

(b) Accessibility - Make ends of wire accessible in water meter boxes, valve boxes or casings, or outside the foundation of buildings where the pipe enters the building. Provide wire access at locations no more than 1,000 feet apart.

(c) Testing - Test for continuity and isolation from ground in the wire after all work has been completed on the test section. Perform intermediate testing after backfilling operations and prior to surface restoration work. Test continuity between access locations by use of a temporary wire connecting test points in-line with an ohmmeter. Measure resistance with an approved ohmmeter that has been properly calibrated. The continuity of a test section will be accepted if the resistance of the test section does not exceed 5 ohms for each 500 feet of location wire being tested. Measure isolation from ground with an approved 1000 volt Megger, applied for one minute. The isolation of a test section will be accepted if the isolation resistance of the test section is at least 10 megohms. Locate and repair all breaks or defects in the wire and re-test until specified results are obtained.

01140.46 Blowoff Assemblies - Construct blowoff assemblies as shown and at the locations shown.

01140.47 Connections to Existing Mains - Make necessary arrangements with the Engineer in advance of connections to existing water mains. Assemble all materials, equipment and labor necessary to properly complete the work before starting.

(a) Notification - If the connection to the existing system involves turning off the water, notify the residents affected by the shutoff. The Engineer will advise which property owners are to be notified.

(b) Permission - The work to perform the connection may need to be carried out during times other than normal working hours. Do not operate any valves on the existing system without specific permission of the Engineer.

(c) Connection Arrangements - Piping arrangements shown are suggestions. For connection by any other arrangement, furnish a detailed sketch for approval not less than two weeks prior to the expected construction.

(d) Uninterrupted Service - Once work is started on a connection, proceed continuously without interruption, and as rapidly as possible, until completed. Shutoff of mains will not be allowed overnight, over weekends, or on holidays.

(e) Cutting Main Lines - Cut existing water mains according to 01140.12. Remove the portions of pipe to provide for the installation of the required fittings at the points of connection. Repair all damage to existing joints in piping to remain in-service. Determine the exact length of the existing

water main that is to be removed. Bevel pipe ends to prevent damage to the transition coupling gasket during installation of the coupling. Clean the exterior of the existing pipe end to a sound, smooth finish before installation of the coupling.

01140.48 Maintaining Service:

(a) Service Transfer - Where existing services are to be transferred from old to new mains, plan and coordinate the work with that of the Utility so that service will be resumed with the least possible inconvenience to the public.

(b) Connections by Utility - Allow the Utility to make connections into the new pipe at such locations as the Utility 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 Utility shall not be construed as an acceptance by the Agency of any part of the work required under the Contract.

01140.49 Backfilling - After the pipe is installed and inspected, backfill the trench according to Section 00405.

Field Testing

01140.50 Filling and Flushing - Fill pipes slowly with potable water at a maximum velocity of 1 foot per second while venting all air. Take all required precautions to prevent entrapping air in the pipes.

(a) Flush and Disinfect - Flush sections of pipe to be tested and disinfect to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, provide a tap large enough to develop a velocity of at least 2.5 feet per second in the main.

(b) Taps - Provide taps for temporary or permanent release of air, flushing, or chlorination.

(c) Disposal of Treated Water - Dispose of treated water flushed from mains. Neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel. Dispose of disinfecting solution to the satisfaction of the Engineer and local authorities. If approved by the Engineer and the Utility, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer.

01140.51 Hydrostatic Testing:

(a) General - Test all water mains and appurtenances in sections of convenient length 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. Furnish and operate all pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring equipment necessary for performing the test. Provide certifications of accuracy for gauges used in the test from an approved laboratory.

(1) Backfill - Backfill the pipeline sufficiently to prevent movement of the pipe under pressure. Place all thrust blocks and allow time for the concrete to cure before testing. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.

(2) Filling Pipe - Fill the mains with water and allow to stand under pressure a sufficient length of time to allow the escape of air and to allow the lining of the pipe to absorb water. The Agency will furnish the water necessary to fill the pipelines for testing, at a time of day when sufficient quantities of water are available for normal system operation.

(3) Time Test - 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 ppm.

(4) Measure Quantity - Accurately determine the quantity of water required to maintain and restore the required pressure at the end of the test period by pumping through an approved positive displacement water meter.

(5) Loss Formula - The quantity of water lost from the main shall not exceed the number of gallons per hour determined by the formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

where:

L = allowable leakage in gallons per hour
S = length of pipeline tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in psi

(6) Pressure Loss - There shall be no appreciable or abrupt loss in pressure during the test period.

(7) Leakage - Correct all visible leakage regardless of the allowable leakage specified above. If the actual leakage exceeds the allowable amount, locate and repair the leaks and retest the pipeline.

(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 sections to be tested to 1,500 feet, unless longer test sections are approved. The Engineer may require that the first installed section of pipe installed by each crew, not less than 1,000 feet in length, be tested. Do not continue pipe laying more than an additional 1,000 feet until the first section has been tested successfully.

(10) Test Equipment Readiness - Prior to calling out the Engineer 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 field testing. Whenever it is necessary to replace defective material or correct the workmanship, repeat the hydrostatic test until a satisfactory test is obtained.

(b) Testing Extensions from Existing Mains:

(1) Exceptions - When an existing water main is extended with new pipe to a new valve, and the distance from the existing pipe to the new valve is 18 feet or less, no hydrostatic test will be required if the section of new pipe between the new valve and the end of the existing main is

installed with pretested, prechlorinated pipe. When the required hydrostatic tests are conducted in the new main section beyond the installed new valve in the closed position, the normal pressure of the existing main may be present against the other side of the new valve.

(2) Required Testing - Where the distance between the end of an existing water main pipe extension and the new valve is more than 18 feet, do not connect the new pipe to the existing pipe until after hydrostatic tests have been made to the required pressure in both directions against the new valve. Test after installing a temporary cap or plug on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe. Make the final connection to the existing main with pretested, prechlorinated pipe.

(c) Testing Sections with Hydrants Installed - When hydrants are included with the section of main pipe to be tested, conduct three separate tests as shown in the following table:

	Water Main Gate Valves	Hydrant Auxiliary Gate Valves	Hydrant Operating Stem Valves	Hose Ports
Test No. 1	Closed	Closed	Wide Open	Wide Open
Test No. 2	Closed	Wide Open	Closed	Wide Open
Test No. 3 [1]	–	Closed	Wide Open	Closed

[1] Test each hydrant to the required test pressure. When testing a hydrant singly, pressure in the supply main beyond the hydrant auxiliary gate valve shall be 25 psi.

(d) Testing Hydrants Installed on Existing Mains - For hydrants installed and connected to existing mains, install the hydrant connection, including hydrant tee, connection pipe and auxiliary gate valves, with pretested materials.

Before the hydrant connection is made to the existing main, subject the hydrant installation to hydrostatic Test No. 3 in 01140.51(c).

01140.52 Disinfecting:

(a) General - Before placing new water mains in service, chlorinate new mains and repaired portions of, or extensions to, existing mains and obtain a satisfactory bacteriological report.

The initial chlorine content of the water shall be not less than 25 ppm. A chlorine residual of not less than 10 ppm shall remain in the water after standing 24 hours in the pipe.

(b) Chlorine Application - Apply chlorine by one of the following methods:

(1) Gaseous Chlorine - Apply a chlorine gas-water mixture by means of a solution-feed chlorinating device, or feed the dry gas directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, shall provide means for preventing the backflow of water into the chlorine.

(2) Calcium Hypochlorite - Apply a mixture of water and high-test calcium hypochlorite (65 - 70% Cl). First mix the dry powder as a paste and then thin to a 1% chlorine solution by adding water to give a total quantity of 7.5 gallons per pound (water to dry powder).

(3) Sodium Hypochlorite - Apply sodium hypochlorite, commercial grade (12.5% Cl) or in the form of liquid household bleach (5% - 6% Cl). This liquid chlorine compound may be used full strength or diluted with water.

(c) Point of Application - Apply the chlorinating agent at the beginning of the pipeline extension or any valved section of it, through a corporation stop inserted in the horizontal axis of the pipe. Supply the water injector for delivering the chlorine-bearing water into the pipe from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved.

(d) Rate of Application - Control water from the existing distribution system, or other source of supply, to flow very slowly into the newly laid pipeline during application of the chlorine. The rate of chlorine application shall be in such proportion to the rate of water entering the newly laid pipe that the initial chlorine content of the water will be at least 25 ppm.

(e) Cross Connection Control - Make no connections between the existing distribution system and non-disinfected pipelines constructed under this Contract, unless a State Health Division approved backflow preventer is installed in the connecting line.

(f) Retention Period - Retain chlorinated water in the pipe at least 24 hours. After this period, the residual chlorine at pipe extremities and at other representative points shall be at least 10 ppm.

(g) Chlorinating Connections to Existing Water Mains - Follow the chlorinating procedure specified in AWWA Standard C651. Liberally treat the trench and exterior of existing main with hypochlorites. Swab or spray the interior of all closure fittings with a one percent hypochlorite solution. Disinfect the existing main with a 100 ppm chlorine solution for 3 hours or a 300 ppm chlorine solution for 15 minutes and then thoroughly flush the line.

(h) Flushing and Testing - Following the retention period, flush all chlorinated water from the newly laid pipe until the replacement water throughout its length shows, upon test, an absence of chlorine or a residual no greater than that normally found in the source of supply.

(1) Sampling Tap - Install a sampling tap ahead of the flushing hose for convenient sanitary sampling.

(2) Service Resumption - Do not place the lines into service before a satisfactory report is received from the local or State health department on samples collected from representative points in the new system. Samples will be collected and bacteriological tests obtained by the Engineer.

(i) Repetition of Chlorinating and Testing - If the initial treatment results in a chlorine residual of less than 10 ppm at the end of the retention period or an unsatisfactory bacteriological test, repeat the original chlorination procedure until satisfactory results are obtained.

Measurement

01140.80 Measurement - The quantities of potable water pipe and fittings will be determined as follows:

(a) Pipe, Fittings and Couplings - The quantities of pipe of the various kinds, types, sizes and backfill classes will be measured on the length basis and will be horizontal measurement along the top of the finished trench, with no deduction for fittings, valves, and couplings.

In addition to measurement of the pipe, an allowance of 12 pipe diameters will be made for each factory-fabricated bend, sleeve, reducer or coupling, and an allowance of 18 pipe diameters of the larger diameter pipe will be made for each factory-fabricated tee or cross. The allowance will be added to the quantity for pipe of the same diameter.

(b) Extra Trench Excavation - The quantities of removal and backfill of extra trench excavation will be measured on the volume basis for each backfill class. The backfill classes are defined in Section 00405. The depth will be the actual depth removed for the changed line or grade as directed. The width will be the actual width removed for the changed line or grade, but in no case will the measured width exceed the allowable widths specified in 00405.41(c).

(c) Blowoff Assemblies - The quantities of blowoff assemblies will be measured on the unit basis.

(d) Connections to Existing Mains - The quantities of connections to existing mains will be measured on the unit basis.

Trench resurfacing will be measured according to 00495.80.

Installation under pavement by tunneling, jacking, or boring methods will be measured according to 00406.80.

Valves will be measured according to 01150.80.

Payment

01140.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	___ Inch Potable Water Pipe, Fittings and Couplings with Class ___ Backfill	Foot
(b)	___ Inch Potable Water Pipe, Fittings and Couplings with Restrained Joints and Class ___ Backfill	Foot
(c)	Extra Trench Excavation with Class ___ Backfill	Cubic Yard
(d)	Blowoff Assembly, ___ Inch	Each
(e)	____ Inch Connection to ____ Inch Existing Main	Each

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 shown).

In items (a) and (b), the nominal diameter of pipe, fittings and couplings will be inserted in the first blank. The class of backfill will be inserted in the second blank. The quantities include the pipe plus the allowance for the fittings and couplings.

In item (c), the class of backfill will be inserted in the blank.

In item (d), the nominal diameter of assembly will be inserted in the blank.

In item (e) the nominal diameter of pipe will be inserted in the first blank and the nominal diameter of the main line will be inserted in the second blank.

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

Trench resurfacing will be paid for according to 00495.90.

Installation under pavement by tunneling, jacking or boring methods will be paid for according to 00406.90.

Valves will be paid for according to 01150.90.

No separate or additional payment will be made for:

- trench excavation
- bedding
- pipe zone material
- backfill work
- polyethylene encasement
- concrete thrust blocks
- detectable marking tape and wire
- flushing, hydrostatic testing and disinfection, and water for testing
- exposing and cleaning existing mains, cutting and removing existing pipe, draining existing mains, disinfecting existing mains, and refilling existing mains

Section 01150 - Potable Water Valves

Description

01150.00 Scope - This work consists of furnishing and installing valves in potable water systems at the locations shown or at other locations as directed.

Materials

01150.10 Materials - Furnish materials meeting the following requirements:

Backflow Prevention Devices	02480.70
Ball Valves	02480.23
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 Stem Extensions	02480.26

01150.11 Handling - 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, it may be repaired in a manner satisfactory to the Engineer. Immediately place all damaged valves apart from the undamaged and remove the damaged valves from the site as soon as possible.

01150.12 Connecting Ends - Furnish valves with connecting ends as shown and as required for connection to pipe and fittings furnished.

Construction

01150.40 General - Install valves according to the plans and the manufacturer's recommendations. Join to the pipe according to Section 01140 and AWWA Standards for the type of connecting ends furnished. Thoroughly clean and repair joints prior to installation.

(a) Valve and Valve Box Installation - Set valves and valve boxes plumb. Install valve stem extensions when required. Center the valve box 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. Install the lower casting of the unit first, supported by backfill or by a closed-cell foam collar not less than 2 inches in thickness. Do not allow the casting to rest directly on the body of the valve or on the water main.

(b) Valve Operator Extensions - Install a valve operator extension with rock guard on any valve that has the valve nut operator installed 4 feet or more below finish grade. Hot-dip galvanize extensions after fabrication.

(c) Backfilling - Backfill around valves according to Section 00405. 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. Set the cast iron valve box cover flush with the roadbed or finished paved surface.

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.

01150.50 Field Testing - After installation, operate valves from full open to full closed to make sure valves do not bind during operation. Correct all malfunctions in the operation of the valves. Verify the number of turns from full open to full closed and provide to the Engineer for the Agency's records.

01150.51 Hydrostatic Testing - Subject valves to hydrostatic testing according to 01140.51. Correct all defects in design, materials or workmanship to the satisfaction of the Engineer.

01150.52 Disinfecting - Disinfect valves according to 01140.52.

Measurement

01150.80 Measurement - The quantities of valves will be measured on the unit basis.

Payment

01150.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	____ Inch ____ Valve	Each
(b)	____ Inch ____ Valve With ____ Actuator	Each
(c)	____ Inch ____ Check Valve	Each
(d)	____ Inch ____ Backflow Prevention Assembly	Each
(e)	____ Inch Hydraulically Operated Valve	Each
(f)	____ Inch Combination Air Release/Air Vacuum Valve Assembly	Each
(g)	____ Inch Tapping Sleeve and ____ Inch Valve Assembly	Each

In items (a) through (f), the size of the valve or assembly will be inserted in the first blank.

In items (a) through (d), the type of valve, check valve, or assembly will be inserted in the second blank.

In item (b), the type of actuator will be inserted in the third blank.

In item (g), the size of tapping sleeve will be inserted in the first blank. The size of valve assembly will be inserted in the second blank.

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

No separate or additional payment will be made for earthwork not covered under other pay items, jointing, blocking of valves, protective coatings, valve boxes, valve stem extensions, and hydrostatic testing.

Section 01160 - Hydrants and Appurtenances

Description

01160.00 Scope - This work consists of furnishing and installing dry-barrel fire hydrants and appurtenances in potable water systems at the locations shown or at other locations as directed.

Materials

01160.10 Materials - Furnish materials meeting the following requirements:

Auxiliary Gate Valves	02480.20
Commercial Grade Concrete in Thrust Blocking	00440
End Connections	02485.20
Fire Hydrants	02485.10
Guard Posts	02485.70
Hydrant Dimensions	02485.30
Hydrant Extensions	02485.40
Tie Rods	02485.60
Traffic Flange	02485.50
Valve Boxes	02480.25
Valve Stem Extensions	02480.26

01160.11 Handling of Hydrants:

(a) Loading and Unloading - Handle hydrants 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 a manner satisfactory to the Engineer. Immediately place all damaged hydrants apart from the undamaged and remove the damaged hydrants from the site as soon as possible.

(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 - Inspect all hydrants upon delivery in the field to ensure proper working order. Provide a minimum 5 foot radius unobstructed working area around all hydrants. Set the traffic flange 2 inches above finish grade. Allow the hydrant barrel drain to waste into a pit of porous gravel material situated at the base of the hydrant.

(a) Touchup Painting - After all installation and testing is complete, paint the exposed portion of the hydrant with one coat of the type and color coating designated by the Engineer.

(b) Out-of-Service Hydrants - Identify all hydrants not in service by covering with a burlap or plastic bag properly secured.

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 - Restrain the thrust created in the hydrant lateral as shown. If applicable, clean tie rods after installation and paint with two coats of coal tar epoxy or other approved bituminous coating.

01160.43 Auxiliary Gate Valves and Valve Boxes - Install auxiliary gate valves and valve boxes according to Section 01150, except that the end connections shall be provided with lugs for tie rods, or the bells shall provide sufficient clearance between the body of the valve and the hub to permit the installation of tie rods.

01160.44 Hydrant Guard Posts - Construct hydrant guard posts at the locations shown. Excavate holes 6 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 designated by the Engineer.

01160.45 Resetting Existing Hydrants:

(a) Relocation - Where existing hydrants are shown for adjustments to conform to a new street alignment or grade, or both, relocate the hydrant without disturbing the location of the hydrant lateral tee at the main.

(b) Thrust Restraint - Determine the method for thrust restraint for the hydrant lateral according to the conditions found in the field, and construct as directed.

01160.46 Moving Existing Hydrants - Move existing hydrants where shown. When the existing hydrant lateral tee does not accommodate a new hydrant location, install a new hydrant lateral tee in the main. Remove the existing hydrant lateral tee from the main if the main is to remain active, and insert a new section of pipe into the water main in place of the existing hydrant lateral tee. Where the existing main to which the existing hydrant lateral tee is connected is to be abandoned or temporarily activated after the existing hydrant is moved, plug the open end of the hydrant lateral pipeline. Provide temporary thrust restraint if temporarily reactivated.

01160.47 Reconnecting 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 extends 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.

01160.48 Hydrant Extensions - Install hydrant extensions where required. Set the traffic flanges a minimum of 2 inches and a maximum of 6 inches above finish grade.

Field Testing Installations

01160.50 General - After installation, operate hydrants from full open to full closed to make sure they do not bind during operation. Correct all malfunctions in the operation of the hydrants.

01160.51 Hydrostatic Testing - Subject hydrants to hydrostatic testing according to 01140.51. Correct all defects in design, materials or workmanship to the satisfaction of the Engineer.

01160.52 Disinfecting - Disinfect hydrants according to 01140.52.

Measurement

01160.80 Measurement - The quantities of work performed under this Section will be measured on the unit basis.

New pipe for hydrant connections to existing mains and lateral tees will be measured according to 01140.80.

Payment

01160.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Hydrant Assemblies	Each
(b)	Resetting Existing Hydrants	Each
(c)	Moving Existing Hydrants	Each
(d)	Reconnecting Existing Hydrants	Each
(e)	Hydrant Guard Posts	Each
(f)	Hydrant Extensions	Each

Item (a) includes auxiliary gate valves, tie rods, concrete blocks, gravel, and painting.

Item (b) includes tie rods, painting, and reconnecting to the main.

Item (c) includes new hydrant lateral tee, tie rods, painting, reconnecting to the main, and plugging abandoned laterals if needed.

Item (e) includes excavation, backfill, and painting.

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.

New pipe for hydrant connections to existing mains and lateral tees will be paid for according to 01140.90.

Section 01170 - Potable Water Service Connections, 2 Inch and Smaller

Description

01170.00 Scope - This work consists of furnishing and installing service connections, 2 inch 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 others unless specified otherwise in the Special Provisions or on the plans.

Materials

01170.10 Materials - Furnish materials meeting the following requirements:

Bronze Nipples and Fittings	02490.60
Copper Tubing Service Pipe	02490.40(a)
Corporation Stops	02490.30
Meter Boxes	02490.70
Meter Setters	02490.50
Polyethylene Tubing Service Pipe	02490.40(b)
Saddles	02490.20
Sampling Stations	02490.80
Service Fittings	02490.40(c)

Construction

01170.40 General - Make all service connections to water mains, except to ductile iron pipe, Thickness Class 52 or thicker, using saddles as specified and of the size and type suitable for use with the water main and the pipe being installed. Direct tap ductile iron pipe, Thickness Class 52 or thicker, for corporation stops according to the recommendations of the Ductile Iron Pipe Research Association (DIPRA), unless direct taps are prohibited by the Special Provisions. Install service pipelines perpendicular to the main, unless shown otherwise.

(a) Trench 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. Exercise care to ensure that the main is not damaged by the work undertaken to install the service. Excavate and backfill for service connections according to Section 00405, except install the service pipeline under pavement, curbs and sidewalks by boring methods approved by the agency having jurisdiction over the roadway.

(b) Installation - Make service connections to water mains according to pipe manufacturer's recommendations and appropriate AWWA standard for water main installation. 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.

01170.41 Reconnecting Existing Services - Where shown, reconnect existing service connections to the new mains. Verify the location of existing service connections in the field. Notify affected customers of the service interruption at least 24 hours prior to service interruption. Use insulating couplings at all connections between existing galvanized steel or iron pipe and new copper pipe. All fittings, appurtenances, and other miscellaneous materials on the sections of existing pipe that have been removed become the property of the Contractor.

01170.42 Sampling Stations - Install sampling stations according to the manufacturer's recommendations and at the locations and depths shown or as directed. Perform trenching and backfilling according to 01170.40.

Field Testing Installations

01170.50 Flushing and Disinfecting - For installation of service connections and sampling stations to existing water mains, liberally treat the trench and exterior of existing main with hypochlorites. Swab or spray all service pipe, appurtenances, and sampling stations with a one percent hypochlorite solution. Disinfect service connections and sampling stations with a 100 ppm chlorine solution for 3 hours or a 300 ppm chlorine solution for 15 minutes and then thoroughly flush the service connections and sampling stations. For installation of service connections and sampling stations concurrent with new water mains, flush and disinfect service connections and sampling stations according to Section 01140.

01170.51 Hydrostatic Testing - For installation of service connections and sampling stations to existing water mains, apply system pressure to new installation prior to backfilling and repair any visible leaks. For installation of service connections and sampling stations concurrent with new water mains, perform hydrostatic testing of service connections and sampling stations according to Section 01140. Correct all defects in materials or workmanship and retest until satisfactory results are obtained.

Measurement

01170.80 Measurement - The quantities of service connections, reconnecting existing services, and sampling stations will be measured on the unit basis.

Payment

01170.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	___ Inch Water Service Connections	Each
(b)	Reconnecting Existing Water Services, ___ Inch	Each
(c)	Water Sampling Stations	Each

In items (a) and (b), the size will be inserted in the blank.

Item (a) includes excavating, tapping the main, laying and jointing the pipe and fittings and appurtenances, backfilling, testing, flushing and disinfection of the service connection.

Item (b) includes excavation, tapping the main, laying and jointing the pipe and fittings and appurtenances, backfilling, testing, flushing and disinfection of the reconnected service connection.

Item (c) includes excavating, tapping the main, laying and jointing the pipe and fittings and appurtenances, backfilling, concrete pad, testing, flushing and disinfection of the sampling station.

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

PART 02000 - MATERIALS

Concrete Materials and Additives

Section 02001 - Concrete

Description

02001.00 Scope - This Section includes the requirements for portland cement concrete (concrete) for structural, precast prestressed, or paving applications.

02001.01 General - Produce concrete according to these Specifications and referenced Sections of ASTM C 94, Standard Specification for Ready-Mixed Concrete. Provide quality control according to Section 00165.

02001.02 Abbreviations and Definitions:

ASTV	-	Actual Strength Test Value - average of test cylinder compressive strengths
cm	-	Cementitious Materials
f'_c	-	Minimum Specified Compressive Strength at 28 days
f'_{cr}	-	Average Compressive Strength Over-design. The average strength required to assure that, with normal variations, the concrete will meet f'_c
GGBFS	-	Ground Granulated Blast Furnace Slag
HPC	-	High Performance Concrete
HRWRA	-	High-Range Water-Reducing Admixture (super-plasticizer)
PPCM	-	Precast prestressed concrete member
w	-	Water
WRA	-	Water Reducing Admixture

Cementitious Materials - Included but not limited to portland cement, fly ash, silica fume, ground granulated blast furnace slag, and metakaolin.

High Performance Concrete - Concrete designed for enhanced durability and performance characteristics. High performance concrete is identified on the Plans by the letters "HPC" in front of the concrete class designation (for example, HPC4000 - 3/4).

Moderate Exposure - Elevations below 1,000 feet.

Modifiers - Pozzolans, latex.

Pozzolans - Fly ash.

Severe Exposure - Elevations 1,000 feet and above.

02001.10 Materials - Furnish materials meeting the requirements of the following:

Admixtures 02040
Aggregates 02690
Cement 02010
Modifiers 02030
Water 02020

02001.20 Concrete Properties, Tolerances, and Limits - Provide concrete that is a workable mixture, uniform in composition and consistency, and having the following properties;

(a) Strength - Provide concrete meeting the required Classes shown in the Contract Documents. The class of concrete designates the minimum required compressive strength, f'_c at 28 days, and the nominal maximum size of aggregate to be used in the concrete (for example, Class 3300 - 3/4: f'_c is 3,300 psi with a nominal maximum size aggregate of 3/4 inch).

Table 02001-1

Concrete Strength and Water/Cementitious Material (w/cm) Ratio		
Type of Concrete	**Strength (psi)**	**Maximum w/cm Ratio**
Structural	3300	0.50
	3300 (Seal)	0.45
	4000	0.48
	4000 (Deck)	0.40
	HPC4000	0.40
	5000 and above	0.40 [1]
	HPC5000 and above	0.40
Paving	4000	0.44
[1] PPCM's with cast-in-place decks and no entrained air may have w/cm as follows: 5000 psi - 0.48; 5500 psi - 0.44; 6000 psi and up - 0.42		

(b) Air Entrainment - Provide all concrete, except PPCM with cast-in-place decks, seal concrete, and drilled shaft concrete with entrained air in the amounts shown in Table 02001-2. Field measured entrained air content shall be within ± 1.5% of target air entrainment values.

Table 02001-2

Air Entrainment		
Nominal Maximum Size Aggregate	**Severe Exposure (Percent)**	**Moderate Exposure (Percent)**
3/8"	7.0	6.0
1/2"	6.5	5.5
3/4"	6.0	5.0
1"	5.5	4.5
1 1/2"	5.0	4.5

(c) Slump - Provide concrete at the appropriate slump shown in Table 02001-3. Take corrective action to maintain a consistent slump at the point of discharge from the delivery vehicle.

Table 0201-3

Concrete Slump	
Condition	**Slump**
Concrete without WRA	4" max.
Concrete with WRA	5" max.
Concrete with HRWRA	5 1/2" ± 2 1/2"
Precast Prestressed Concrete with HRWRA	10" max.
Seal Concrete	8" ± 2"
Drilled Shaft Concrete	8 1/2" ± 1 1/2"

(d) Temperature - Provide concrete, at time of placement, at a temperature between a minimum of 50 °F and a maximum of 90 °F, except the maximum bridge deck concrete temperature shall be 80 °F.

Concrete Mix Designs

02001.30 Concrete Mix Design - Submit new or current mix designs, prepared by a CCT, for each required class of structural or paving concrete to the Engineer for review. Allow 14 calendar days for the review. Design mixes by the volumetric method in ACI 211.1 to achieve the properties of 02001.20. Do not proceed with concrete placement until the Engineer has determined that the mix design complies with the Specifications. Review of concrete mix designs does not relieve the Contractor of the responsibility to provide concrete meeting the Specification requirements.

High performance concrete (HPC) mix designs shall either contain cementitious material with 66% portland cement, 30% Fly ash, and 4% Silica fume; or have trial batches performed to demonstrate that the alternate mix design provides a maximum of 1,000 coulombs at 90 days when tested according to AASTHO T 277.

02001.31 Concrete Constituents:

(a) Portland Cement - Use AASHTO M 85 or ASTM C 150, Type I or II cement for structural or paving concrete. Use AASHTO M 85 or ASTM C 150, Type III cement for precast prestressed concrete.

(b) Pozzolans - Except for HPC, pozzolans or GGBFS may be used separately or in combinations up to 30% of the total cementitious materials content.

(c) Modifiers - Modifiers may be used separately or in combinations as approved by the Engineer.

(d) Blended Hydraulic Cement - Blended hydraulic cement may be used subject to the limits of 02001.31(b) and 02010.20.

(e) Chemical Admixtures - Use chemical admixtures according to the manufacturer's recommendations. Use WRA in all seal concrete and in Class 5000 concrete or greater. Use HRWRA in all HPC.

Use a superset extender from the QPL in all concrete for bridge decks. Use an appropriate amount to extend the initial set time of the concrete by 90 minutes.

(f) Aggregate - If the nominal maximum size of the coarse aggregate is not included as a part of the class of concrete shown on the plans, any size from 1 1/2 inch to 3/4 inch nominal maximum size aggregate may be used except:

- Use 3/4 inch nominal maximum size or larger aggregates in bridge deck concrete.
- Use 1 1/2 inch nominal maximum size aggregates in paving concrete.
- Use 3/8 inch nominal maximum size aggregates in drilled shafts unless otherwise indicated.

Proportion all HPC for a minimum coarse aggregate absolute solid volume according to Table 02001-4:

Table 02001-4

Absolute Solid Volume	
Maximum Nominal Aggregate Size	**Cu. Yd. (aggregate) / Cu. Yd. (concrete)**
3/8"	0.36
1/2"	0.38
3/4"	0.40
1"	0.42
1 1/2"	0.46

Two or more aggregate products or sources meeting specifications may be blended to improve concrete properties. Blending non-specification aggregate materials, except for gradation, with specification materials is not allowed.

02001.32 New Mix Designs - Prepare new mix designs for submittal according to the following:

(a) Trial Batch - Make at least one trial batch for each concrete mix design. Prepare and test trial batches using the same materials and having the same plastic properties of concrete that will be used in the Project. Simulate haul time and mixing conditions to ensure proper workability at the jobsite.

(b) Plastic Concrete - For each trial batch, test the temperature, slump, density, and air content and compute the w/cm ratio and yield according to the following test methods:

Test	Test Method
Sampling Fresh Concrete	WAQTC TM 2
Slump	AASHTO T 119
Density	AASHTO T 121
Yield	AASHTO T 121
Air Content	AASHTO T 152
Concrete Temperature	AASHTO T 309
Molding Concrete Specimens	AASHTO T 23 or R 39 [1]
Water-Cement Ratio	[2]

[1] Cast cylinders in single-use plastic molds
[2] Use ODOT's Field Operating Procedure for AASHTO T 121 in the MFTP

(c) Strength Tests - For each trial batch, cast at least three test cylinders in 6 inch x 12 inch or 4 inch x 8 inch single-use plastic molds. Cast and cure all cylinders according to AASHTO T 23 or AASHTO R 39, and test at 28 days according to AASHTO T 22.

Cast three flexural beams for paving concrete trial batches according to AASHTO T 23 or AASHTO R 39. Test flexural beams at 28 days according to AASHTO T 97.

02001.33 Required Over Design Strength (f'_{cr}) for New Mix Designs - Provide test data and calculations demonstrating compliance of the trial batch cylinder's ASTV with the requirements of either (a) or (b) below.

(a) $f'_{cr} = f'_c \times 1.20$ Up to Class 6000 $f'_{cr} = f'_c \times 1.15$ Class 6000 and higher

(b) $f'_{cr} = f'_c + 1.34 \times S$ Up to Class 6000 $f'_{cr} = f'_c + 1.28 \times S$ Class 6000 and higher

Where: S is the standard deviation of 28 day cylinder strengths from a similar class (± 1,000 psi) mix design produced at the same plant. There shall be at least 15 sets of 28 day cylinders from this similar class mix design to use option (b).

(c) Flexural Beams - Flexural beams for paving concrete mix designs shall achieve 600 psi at 28 days.

02001.34 Current Mix Designs - Mix designs that meet the requirements for the specified class of concrete and are currently being used or have been used within the past 12 months on any project, public or private may be submitted for review.

02001.35 Required Submittals for Mix Designs - Submit the following information for each concrete mix design:

(a) Supplier's Unique Mix Design Identification Number

(b) Mix Design Constituent Proportions:

- Weight per cubic yard (pounds per cubic yard) of cementitious material, modifiers, fine and coarse aggregates (SSD), and mix water.
- Absolute volumes of cementitious material, modifiers, fine aggregates and coarse aggregates (SSD), and mix water.
- Dosage rates for chemical admixtures.

(c) Aggregates - Identify the aggregate source by the ODOT source number. Report current values of the following:

- Bulk specific gravities (SSD)
- Fine aggregate absorptions
- Coarse aggregate absorptions
- Dry-rodded density of coarse aggregates
- Fineness modulus of sand used in the mix design calculations

(d) Cementitious Material - For each cementitious material used, identify the following:

- Manufacturer
- Brand name
- Type
- Relevant Specification
- Source or location plant

(e) Modifiers - For each modifier used, identify the following:

- Manufacturer
- Brand name
- Source
- Relevant specification
- Class

(f) Admixtures - For each admixture used, identify the following:

- Manufacturer
- Brand name
- Design dosage rate

(g) Water - Identify the source of water to be used.

(h) Plastic Concrete Tests - Report the temperature, slump, density, air content, yield, and w/cm ratio of the trial batch or the average of these values for the cylinder sets presented for evaluation of a current mix design.

(i) Compressive Strength Test Results - Report the individual test results and the ASTV of cylinders from the trial batch or the average for the cylinder sets presented for evaluation of a current mix design.

(j) Strength Analysis - Provide an analysis, showing all calculations, demonstrating that the mix design meets the requirements of 02001.33.

(k) Quality Control Personnel - Provide the name and certification number of the CCT who prepared the mix design, the QCT who performed the plastic concrete tests and cast the test cylinders, the laboratory where the cylinders were tested, and the CSTT who tested the cylinders.

02001.36 Adjusting Concrete Proportions - After a mix design has been reviewed and accepted, submit any proposed adjustments to concrete proportions for review. Significant changes to the mix design (such as decreases in cementitious material content, increases in pozzolans that replaces cement, or the use of aggregates from a different source) may require verification of compressive strength performance by trial batch, according to 02001.32, or test results from field tests according to 02001.33. Aggregates from new sources shall meet aggregate source quality requirements according to Section 02690.

02001.37 Trial Batch Costs - Furnish all materials, equipment and work required for designing the mixes, testing materials, and making trial batches to verify the design for final use at no additional cost to the Agency.

02001.40 Concrete Production - Produce concrete according to the following sections of ASTM C 94, Standard Specification for Ready-Mixed Concrete:

ASTM Section	ASTM Title
9.	Measuring Materials
10.	Batching Plant
11.	Mixers and Agitators
12.	Mixing and Delivery

02001.50 Quality Control Personnel - Provide the following certified technicians:

(a) Certified Aggregate Technician (CAgT):

- **Duties:**
  - Sample and test aggregates.
  - Sample and test each stockpiled size according to the test procedures and at the frequencies shown in the Field Tested Materials Guide section of the MFTP.
  - Record and evaluate test results according to Section 00165.
  - Provide Stat-Spec results to the Engineer.

(b) Quality Control Technician (QCT):

- **Duties:**
  - Attend pre-placement meetings for bridge deck pours and paving.
  - Be at the concrete placement site when concrete placement is in progress.
  - Have a copy of the mix design on-site and available during concrete placement.
  - Obtain and check each batch ticket upon arrival of the concrete at the jobsite for the correct mix design.
  - Sample the concrete and test for ambient air temperature, plastic concrete temperature, slump, air content, density, w/cm ratio and yield at the frequencies required by and according to the tests listed in the MFTP, after concrete mixture proportions are adjusted in the field, and at such times as requested by the Engineer.
  - Notify the Contractor and the Engineer immediately when the concrete is not in compliance with the Specifications.
  - Be in direct contact with the CCT by telephone, radio or other means to convey information.
  - Notify the CCT of loads rejected and the reason for rejection.
  - Notify the CCT immediately whenever the density of the plastic concrete varies from the mix design target by more than ± 3 pounds per cubic foot.
  - Notify the CCT immediately whenever the w/cm ratio varies from the mix design target by more than ± 0.03.

(c) Concrete Control Technician (CCT):

- **Duties**
  - Prepare new concrete mix designs.
  - Adjust current mix designs.

- Control production of the concrete.
- Test the fine and coarse aggregates for total moisture content according to AASHTO T 255 before batching is started and when there is a significant change in the slump of the concrete. Moisture testing may be by an alternate method if approved by the Engineer. Provide moisture content test results to the Engineer upon request.
- Visually inspect the coarse aggregate for changes in moisture content throughout the day. Perform necessary testing for total moisture, and make mixture adjustments if necessary.
- Monitor concrete properties and compressive strength tests throughout the duration of the Project.
- Make adjustments to maintain a satisfactory over-design f'_{cr}.
- Perform an analysis and make necessary adjustments whenever the unit weight of the plastic concrete varies from the mix design by more than ± 3 pounds per cubic foot. Submit a written analysis along with any recommendations to the Engineer by the middle of the following work shift.
- Submit to the Engineer, in writing, adjustments made to the mix design.
- Perform an analysis and verify the accuracy of coarse and fine aggregate moistures whenever the water-cementitious material ratio varies from the mix design target by more than ± 0.03 and submit to the Engineer by noon of the following workday.

(d) Concrete Strength Testing Technician (CSTT):

- **Duties:**

  - Receive concrete test cylinders
  - Record data
  - Strip cylinders
  - Store cylinders
  - Test Cylinders
  - Record test data
  - Report test data

02001.60 Delivery Tickets - Send a concrete delivery ticket with each load of concrete supplied to the Project. Each delivery ticket shall include the following information:

- Concrete supplier's name, address and telephone number
- Address and telephone number of batch plant if different from above
- Date and time the concrete batch was produced
- ODOT mix design number
- Size of load batched
- Weights or volumes of constituents batched in the load
- Amount of water that can be added at the job site

Record the amount of water added at the job site on the delivery ticket.

Section 02010 - Portland Cement

Description

02010.00 Scope - This Section includes the requirements for portland cement and blended hydraulic cement.

Materials

02010.10 Portland Cement:

(a) Types - Furnish one or another of the following types as elected:

- Type I
- Type II
- Type III

Do not mix or alternately use differing brands or types of cement, or the same brand or type of cement from different mills without prior written approval.

(b) Specifications - Portland cement shall conform to the requirements of AASHTO M 85 for low alkali cement except as follows:

- Cement used west of the summit of the Cascade Mountains shall have a total alkali content (sodium and potassium oxide calculated as $Na_2O + 0.658\ K_2O$) 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) as determined by the air permeability test shall be 430 m^2/kg for any field-sampled check test. Results of field-sampled check tests will not be averaged.

(c) Acceptance - Portland cement shall be from the QPL.

02010.20 Blended Hydraulic Cement - Blended hydraulic cement shall be either Type IP portland-pozzolan cement or Type I (SM) slag-modified portland cement conforming to AASHTO M 240, modified as follows:

- The cement constituent of the blended cement shall conform to 02010.10.
- The pozzolan constituent of the blended cement shall be fly ash conforming to 02030.10 or ground granulated blast furnace slag (GGBFS) slag conforming to 02030.40.

Section 02020 - Water

Description

02020.00 Scope - This Section includes the requirements for water used in mixing concrete, mortar, grout, and other applications when specified or directed.

Materials

02020.10 Water:

(a) General - Water used in mixing or curing concrete, for mortar and grout, and in mixing cement-treated base shall be reasonably clean, and free of oil, sugar, organic matter or other substances injurious to the finished product.

(b) Potable - Potable water may be used without testing if the Contractor provides a quality compliance certificate verifying that the water has met the limits of this Section according to tests made within the last 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 shall be tested at no additional cost to the Agency according to AASHTO T 26 before use in the Project and shall meet the following limits:

	Minimum	Maximum
pH	6.0	8.0
Chloride Ion, %	–	0.15
Sulphate Ion, %	–	0.50
Total Dissolved Solids, ppm	–	6,500
Total Suspended Solids, ppm	–	2,000

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, Table 1, Acceptance Criteria for Questionable Water Supplies, and ASTM C 94, Table 2, Chemical Limitations for Wash Water. In addition the specific gravity maximum limit is 1.03.
- Tested at a weekly interval for at least four weeks prior to use on the Project. The testing frequency may be reduced to monthly thereafter providing no single test exceeds the limits set above. Required tests include the physical tests in Table 1 of ASTM C 94, the chemical tests in Table 2 of ASTM C 94, and testing for specific gravity. The testing shall be at no additional cost to the Agency. The test results shall be provided to the Engineer prior to use on the Project.

- Made up from a dilution process rather than a concentration process. (A dilution process in one in which the reclaimed water is extensively diluted and continuously agitated to keep solids in a state of suspension).
- Free of coloring agents.
- Not used when the ambient temperature is 85 °F or above.
- Not used when the ambient temperature is 40 °F or lower.
- Not used as more than 75% of the water added to the batch.
- Not used in structure decks.

Section 02030 - Modifiers

Description

02030.00 Scope - This Section includes the requirements for fly ash, silica fume, latex, and ground granulated blast furnace slag 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 QPL, 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 QPL 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:

Polymer Type Stabilizers	**Styrene Butadiene**
Latex	Nonionic Surfactants
Portland Cement Composition	Polydimethyl Siloxane
Solids, % by weight, min.	46.0
Volume Density, lb/gal, min.	8.4 at 77 °F
pH	9.0 to 11.0
Color	White

Latex admixtures that have not been stored according to the manufacturer's recommendations will not be accepted.

02030.40 Ground Granulated Blast Furnace Slag (GGBFS) - GGBFS shall meet the requirements of AASHTO M 302.

Section 02040 - Chemical Admixtures

Description

02040.00 Scope - This Section includes the requirements for air-entraining, water-reducing, retarding, and accelerating admixtures.

Materials

02040.10 Materials - Furnish admixtures from the QPL, except as follows:

An admixture that does not appear on the QPL 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 Agency 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:

Admixture	Specification
Air-entraining	AASHTO M 154 (ASTM C 260)
Water-reducing	AASHTO M 194 (ASTM C 494)
Retarding	AASHTO M 194 (ASTM C 494)
Accelerating	AASHTO M 194 (ASTM C 494)

Section 02050 - Curing Materials

Description

02050.00 Scope - This Section includes the requirements for liquid compounds, evaporation reducers, polyethylene films, and curing blankets used to cover concrete and other surfaces to retain moisture and to cure.

Materials

02050.10 Liquid Compounds - Furnish liquid membrane-forming curing compounds from the QPL and meeting the requirements of AASHTO M 148, except that testing will be done according to ODOT TM 721. The specified drying time requirement will be waived. The test application rate shall be 1 gallon per 200 square feet.

All compounds shall be class A. Solvent-based compounds shall be Type 1-D.

02050.20 Polyethylene Films - Furnish clear or white polyethylene films for curing concrete meeting the requirements of AASHTO M 171.

02050.30 Curing Blankets - Furnish curing blankets from the QPL.

02050.40 Liquid Evaporation Reducer Compounds - Furnish evaporation reducer compounds from the QPL.

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 QPL.

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 QPL.

02070.20 Non-Epoxy Bonding Agents - Furnish non-epoxy bonding agents from the QPL.

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 QPL.

02080.20 Non-Epoxy Grout - Furnish non-epoxy grout from the QPL.

02080.30 Keyway Grout - Furnish grout used in the keyways of precast prestressed concrete members that is non-shrink, nonferrous, non-epoxy grout with a minimum design strength of 5,000 psi in 28 calendar days. Furnish keyway grout from the QPL 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 QPL that meets vertical rise requirements.

Section 02090 - Lime

Description

02090.00 Scope - This Section includes the requirements for granular quicklime and hydrated lime.

Materials

02090.10 Granular Quicklime - Furnish granular quicklime (CaO) that has a minimum calcium hydroxide content of 113% and meeting the following grading requirements:

Grading Requirements

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 100	25 maximum

Determine grading and hydroxide content by testing according to AASHTO T 27 and AASHTO T 219.

02090.20 Hydrated Lime - Furnish hydrated lime meeting the requirements of ASTM C 1097.

02090.30 Acceptance - Provide a quality compliance certificate for lime according to 00165.35.

Wood Products

Section 02110 - Posts, Blocks, and Braces

Description

02110.00 Scope - This Section includes the requirements for wood posts and blocks for guardrail, median barrier, signs, fence posts, and braces for fencing.

Materials

02110.10 Guardrail Posts:

(a) General - Furnish posts for guardrail and median barrier of the size shown, manufactured from Douglas fir, Hem-fir, or Southern Yellow Pine. Wood for posts shall have a minimum extreme fiber bending stress (F_b) of 1,200 psi. Only treated posts from approved suppliers that are listed in the "Nonfield-Tested Materials Acceptance Guide" will be allowed.

(b) Grading - Grading of posts shall conform to the following:

- **Douglas Fir** - Conform to the requirements for No. 1 posts and timbers as specified in either paragraph 80.11 of the current WWPA Grading Rules, or paragraph 131-b of the current WCLIB Grading Rules.
- **Hem-fir** - Conform to the requirements for select structural posts and timbers as specified in either paragraph 80.10 of the current WWPA Grading Rules, or paragraph 131-a of the current WCLIB Grading Rules.
- **Southern Yellow Pine** - Conform to the requirements for No. 1 timbers as specified in section 402 of the current Southern Pine Inspection Bureau (SPIB) Grading Rules.

(c) Certificates - Furnish certificates of lumber inspection by a recognized inspection agency.

(d) Fabrication - Before preservative treatment, bore all holes and make all necessary cuts as shown.

(e) Preservative Treatment - Treat posts according to Section 02190.

(f) Seasoning and Checking - Each preservative treated post shall show evidence of reasonable amount of seasoning 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 after final curing of post is achieved. Treat holes for fastenings according to 00570.40.

(g) Inspection, Rejection and Marking at Plant - Posts shall be subject to inspection at the treating plant at any time before, during or after treatment. Normally, inspection of treated posts will be made by the Agency's inspector not later than 10 calendar days after treatment, provided the inspector is notified of the time that treating is to be done.

Inspection of treated posts for compliance with the requirements of 02110.10(e) will be according to applicable AWPA standards, except as follows:

- The inspector will choose the number of treated posts from any one charge of the treating cylinder for determining penetration of treatment.
- Each post selected for testing shall be representative as a basis of acceptance or rejection of a pro rata number of posts in the charge.
- If 20% of the posts randomly selected for testing fail to conform to requirements, all of the posts in the entire charge from which they are selected may be classed as unacceptable.

At the inspector's discretion, each treated post or a representative random selection of treated posts may be inspected for compliance with the requirements of 02110.10(f) "Seasoning and Checking".

Posts which fail to conform to requirements of this subsection will be subject to rejection at the treating plant singly, by partial lots, or by whole lots. (A "lot" comprises the posts in any charge of the treating cylinder.)

Each treated post shall bear a permanent mark or metal tag which identifies the supplier and year of treatment, placed by the supplier either:

- On the top of the post, or
- On the back of the post, 8 inches to 10 inches below the bolt hole.

(h) Field Inspection, Acceptance and Rejection - At the time of installation inspect each post for:

- Width of widest check, shake, or split.
- Damage to treated wood affecting soundness.
- Visible exposure of untreated wood.
- Conformance to the requirements of 02110.10(b) through 02110.10(f).
- Preservative visibly leaching from the post.

Posts that show a check, shake, or split exceeding 1/2 inch in width (surface measurement) on any surface will be rejected.

Posts that show surface damage may be repaired by field treating with preservatives according to AWPA Standard M 4. Repair posts that have splits or checks, or where shakes have opened or deepened sufficiently to expose untreated wood, by treating with a field preservative from the QPL applied to all opened or deepened wood separations and completely filling the separations to the surface of the post.

Remove treated wood posts that have been rejected for any one or more of the above deficiencies or faults and not repaired as stated above.

Acceptance of material will be according to 00165.35, 02110.10(g), and these Specifications.

02110.20 Guardrail Blocks:

(a) General - Furnish wood guardrail blocks of the dimensions shown. Blocks shall be either Douglas fir or Hem-fir meeting the requirements of 02110.10, or pine or Southern Yellow Pine meeting the requirements of 02110.20(b) and 02110.10 except for 02110.10(b). The requirements of marking and branding the treated blocks, according to the last paragraph of 02110.10(g), will be waived provided that the supplier of the treated blocks furnishes certification with each shipment stating that the blocks conform to Specifications and that the preservative treating was done under the inspection and with the approval of the Engineer.

(b) Grading - Pine guardrail blocks shall conform to the requirements of paragraph 80.11 of the current WWPA Grading Rules. Southern Yellow Pine guardrail blocks shall conform to the requirements for No. 1 timber as specified in section 402 of the current SPIB Grading Rules.

(c) Recycled Plastic - Recycled plastic guardrail blocks from the QPL may be used.

(d) Acceptance - Acceptance of material will be according to 00165.35 and this Section.

02110.30 Fence Posts and Braces - Fence posts and brace rails shall be of the sizes and dimensions shown and shall be of sound Douglas fir, western hemlock, or western pine free from decay, end splits, and multiple crooks. Seasoning checks of not more than 5/16 inch width (surface measurement) will be allowed. Allowable crooks may be in one plane only. A line drawn between the centers of the butt and tip of each post and brace rail shall not fall outside of the actual longitudinal centerline of the post or rail by more than 1.67% of its length, with an allowable maximum of 2 inches.

Posts and brace rails may be square, rough, or dressed lumber, or may be peeled round posts, as the Contractor elects. Round members shall be free from bark, protruding knots and irregularities detrimental to a pleasing appearance.

Fabricate posts and brace rails before pressure treatment. Where field boring or field cutting of a treated member is required, field-treat the exposed untreated surface of the member according to 00570.40. The size of holes after treatment shall not exceed the size of the dowels or bolts to be inserted by more than 1/16 inch.

Posts intended to be driven may be machine-pointed on either the small end or the large end, before pressure treatment.

Pressure treat the posts and brace rails according to Section 02190.

Acceptance of material will be according to 00165.35 and these Specifications.

02110.40 Wood Sign Posts - Fabricate wood sign posts from either Douglas fir, surfaced 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:

Species	4" x 4"	4" x 6"	6" x 6" and Larger
Douglas Fir	124-c WCLIB 42.12 WWPA	123-c WCLIB 62.12 WWPA	131-b WCLIB 80.11 WWPA
Hem-Fir	124-b WCLIB 42.11 WWPA	123-b WCLIB 62.11 WWPA	131-a WCLIB 80.10 WWPA

(b) Posts - Construct wood sign posts according to the applicable portions of Section 00570, modified or supplemented as follows:

(1) Length - The length of the posts shall be shown or, where not shown, each post shall be of sufficient length to provide proper sign mounting, a proper mounting height and the required foundation depth.

(2) Framing and Boring - Cut, frame and bore timber before pressure treating, to the extent practical.

(3) Preservative Treatment - Pressure-treat wood sign posts after fabrication according to Section 02190.

(4) Cuts and Abrasions - Treat cuts, abrasions and bolt-holes, prior to shipping, with the same preservative as originally used to treat the post, except that if the post was originally treated with pentachlorophenol - volatile petroleum solvent (LPG) solution, cuts, abrasions and bolt-holes shall be treated with pentachlorophenol - mineral spirits solvent solution according to AWPA Standard M4.

(5) Field Repair - Field treat damaged or drilled pressure-treated posts according to 00570.40.

(c) Acceptance - Acceptance of material will be according to 00165.35 and this Section.

Section 02120 - Poles and Piling

Description

02120.00 Scope - This Section includes the requirements for wood poles for use in illumination and signal installations, and timber piling for structures.

Materials

02120.10 Wood Poles - Furnish all wood poles meeting the current edition of ANSI O5.1, Specifications and Dimensions (for Wood Poles), for Class 4 machine shaved Douglas fir, and treated meeting the requirements of Section 02190. All poles shall be round, sound, well proportioned from butt to tip, and without short kinks or crooks.

02120.20 Timber Piling - Furnish timber piling meeting the requirements of ASTM D 25.

The butt or tip size, or whether the piling are to be friction or bearing piles, will be identified in the Special Provisions. All foundation piles shall be Douglas fir.

Treat timber piling according to Section 02190.

02120.30 Timber Pile Straps - Straps shall be approximately 1 1/4 inch wide and 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 or have a mill certification by an American Lumber Standards certified inspection agency.

02130.20 Acceptance - 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.

Materials

02140.10 General - Furnish all structural glued laminated lumber as shown and specified.

Manufacture of structural glued laminated work shall conform to the manufacturing requirements of the current ANSI/AITC A190.1 American National Standard, Structural Glued Laminated Timber.

Provide quality control according to the AITC 200 "Inspection Manual for Glued Laminated Timber".

Lumber shall be Douglas fir, southern pine, western larch, or other species, as shown or specified. Lumber used shall be of a stress grade to provide glued laminated members with the minimum stress values in bending and tension shown or specified.

Adhesives shall meet the requirements of the glued laminated lumber standards, and be waterproof.

Unless otherwise specified, appearance of members shall be architectural grade as defined in AITC 110 Standard Appearance Grades for Structural Glued Laminated Timber.

Seal surfaces of members with penetrating sealer and apply a coat of end sealer to the ends of all members as soon as practical after end trimming, according to AITC Standard for Preservative Treatment of Structural Glued Laminated Timber. Use a clear sealer compatible with the preservative treatment used according to Section 02210.

Bundle wrap members according to AITC Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection.

Furnish shop details from the fabricator and obtain approval before commencing the work. Details shall conform to the current AITC Typical Construction Details.

02140.20 Acceptance - Glued laminated timber members will be accepted according to 00165.35 and this Section.

Section 02150 - Lumber and Timber Connectors

Description

02150.00 Scope - This Section includes the requirements for connectors, bolts, nuts, nails, and miscellaneous hardware for joining lumber and timber.

Materials

02150.10 Lumber and Timber Connectors:

(a) General - Galvanize connectors for treated structures, except those of malleable iron or lightweight connectors, according to AASHTO M 111 (ASTM A 123).

(b) Split Ring Connectors - Provide 2 5/8 inch and 4 inch inside diameter split rings manufactured from steel conforming to ASTM A 830 (AISI C1010, SAE 1010). Each ring shall form a closed true circle with the principal axis of the cross section of the ring metal parallel to the geometric axis of the ring. Bevel the metal section from the central portion toward the edges to a thickness less than the mid-section. Cut through the ring in one place in its circumference to form a tongue and slot.

Cut connector grooves in timber concentric with the bolt hole and conforming to the cross-sectional shape of the rings, to provide a snug fit. The inside diameter of the groove shall be larger than nominal ring diameter so that the ring can expand slightly during installation.

(c) Shear Pate Connectors:

(1) Pressed Steel Type - Provide 2 5/8 inch diameter pressed steel shear plates manufactured from steel conforming to ASTM A 830 (AISI C1010, SAE 1010). Each plate shall be a true circle with a flange around the edge, extending from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole and two small perforations on opposite sides of the hole and midway between the center and circumference.

(2) Malleable Iron Type - Provide 4 inch diameter malleable iron shear plates manufactured according to ASTM A 47, Grade No. 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge projecting from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole reamed to size with an integral hub concentric with the bolt hole and extending from the same face as the flange.

(d) Bolts, Nuts, Nails, and Miscellaneous Hardware - Provide machine bolts, drift bolts and dowels according to ASTM A 307 or ASTM A 36. Washers may be cast ogee or malleable castings, or they may be cut from steel plate.

Galvanize rough hardware, drive pins, expansion bolts, clamps, washers, anchors, joist hangers, bolts and nuts, lag screws, wood screws, spikes and nails according to AASHTO M 232 (ASTM A 153). Provide these items in standard type and make, or as shown.

(e) Lightweight Metal Connectors - Lightweight metal connectors are mass produced plate or sheet steel connectors with a maximum thickness of 0.25 inches used to connect wood members to wood, concrete or masonry. Provide lightweight metal fasteners as shown with the required minimum capacities as stated in the special provisions. Provide copies of the test reports from the International Code Council (ICC-ES) showing that the supplied fastener meets the minimum capacities listed in the Special Provisions. All lightweight metal connectors shall be galvanized according to ASTM A 653 (coating designation G185), ASTM A 123, or stainless steel.

02150.20 Acceptance - Lumber and timber connectors will be accepted according to 00165.35 and this Section.

Section 02190 - Preservative Treatment of Timber

Description

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 (ACZA)
- Chromated Copper Arsenate (CCA), Type A, B, or C
- Copper Naphthenate
- Ammoniacal Copper Quat, Type B, C, or D

02190.20 Drying Time - When using ACZA, air-dry items 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. The maximum moisture content shall be 19% prior to installation. Collect all spacers and other treated wood waste from the construction site and dispose of them according to 00290.20.

02190.30 Field Treatment - Field-treat damaged or drilled wood surfaces with a preservative listed in the QPL.

Coatings

Section 02210 - Coating Materials for Timber and Concrete

Description

02210.00 Scope - This Section includes the requirements for coating materials used on timber and concrete.

Materials

02210.10 General:

(a) Manufacturing - Furnish coating material meeting the following requirements:

- Be prepared at the factory ready for application or mixing of multi-component coatings. Multi-component coating materials shall be proportioned by the manufacturer with each component in its correct proportion and furnished in separate containers ready for field mixing.
- Be homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Include additives for control of sagging, pigment settling, leveling, drying, dryer absorption, skinning, or other properties that affect application and curing.
- Not require a pretreatment chemical or material prior to application of the prime coat except as specifically stipulated in these specifications.
- Include required tinting and coloring materials at the time of manufacture. When successive coats are specified, each coat shall be tinted to provide contrast between coats. The tinting material shall be compatible with the coating material and not detrimental to performance.
- Not vary in composition without prior notice by the manufacturer and approval of the Engineer. No reformulation will be allowed.

All coats in the coating system shall be from the same manufacturer.

Apply coating materials before expiration of the manufacturer's recommended shelf life.

(b) Packaging - Package the material in containers meeting the following requirements:

- Be new steel or plastic of not more than 6 gallon capacity.
- Have a lug type crimp lid with a ring seal, and shall be equipped with ears and bails.
- Meet U.S. Department of Transportation's Hazardous Material Shipping Regulations.
- Be lined, if necessary, to prevent attack by the coating material. The lining shall not come off the container.
- Be original and unopened.
- Be labeled with a quality compliance certificate according to 00165.35 showing the following:
  - Manufacturer's name
  - Exact title of coating material
  - Agency Specification number, if any
  - Manufacturer's batch number
  - Date of manufacture
  - Shelf life or expiration date
  - Identification of all toxic substances
  - Handling and application precautions

02210.20 Coating Materials for Timber - Furnish coatings for timber from the QPL under the category "Timber Coatings".

02210.21 Sealer for Timber - Furnish clear sealers for timber from the QPL under the category "Timber Sealers".

02210.30 Coating Materials for Concrete - Furnish coatings for concrete from the QPL under the category "Latex Emulsion Paint".

Geosynthetics and Slope Protection

Section 02320 - Geosynthetics

Description

02320.00 Scope - This Section includes the requirements for geosynthetics used in various applications.

02320.01 Definitions - Geosynthetic terms are defined in 00350.01.

Materials

02320.10 Acceptance:

(a) General Requirements - Furnish all geosynthetics meeting the following requirements:

- Free of defects, cuts or tears.
- Resistant to ambient temperatures, acid and alkaline conditions, micro-organisms and insects.
- For the intended purpose and have dimensional stability.

(1) Geotextiles - Furnish woven or nonwoven geotextiles meeting the following requirements:

- Be composed of long chain, synthetic polymeric filaments or yarns formed into a stable network that retains its relative structure during handling, placement and design service life. At least 95%, by weight, of the long chain polymers shall be a polyolefin or polyester.
- Meet or exceed the properties specified in 02320.20, Table 02320-1.
- Be free of any chemical treatment or coating which might significantly reduce permeability.
- Have the selvage finished so the outer fibers are prevented from pulling away from the fabric.

(2) Geogrids - Furnish geogrids meeting the following requirements:

- A regular network of integrally connected, polymer, tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock.
- Dimensionally stable and able to retain their geometry under manufacture, transport and installation.

(b) Acceptance Requirements - The actual minimum average roll values furnished by the manufacturer shall be based on representative test results from the manufacturing plant which produced the geosynthetic, and shall meet or exceed each of the specified minimum values. All geosynthetics shall be clearly labeled as being part of the same production run certified as meeting all applicable requirements.

(c) Manufacturer's Documentation - Furnish a Level A or Level B certification, as indicated in the Special Provisions for the applicable geosynthetics.

(1) Level A - Manufacturer's Test Result Certificate - Furnish a test result certificate according to 00165.35 from the geosynthetic manufacturer. The certificate shall:

- Include the minimum average roll values for each of the specified properties from the same production run as the delivered material.

- Include test results for factory seams.
- Include production run number, production plant name and location.

If the geosynthetic material is modified, remanufactured, relabeled or sewn, furnish an additional certificate from the supplier making the changes that explain the altered properties, seam strength or relabeling.

(2) Level B - Manufacturer's Quality Compliance Certificate - As a basis of acceptance, furnish either a manufacturer's brochure or a quality compliance certificate, according to 00165.35, with geosynthetic properties shown.

If the brochure or certificate lists typical or average roll values instead of minimum average roll values, then increase by 25% the specified minimum values in Table 02320-1 for grab tensile strength, burst strength and puncture strength to determine compliance.

(d) Manufacturer's Sampling/Testing - The manufacturer's reported property values shall be based on the following sampling and testing requirements:

(1) Sampling - Sample all geosynthetics according to ASTM D 4354. The production unit used for sampling shall be a roll or sheet.

(2) Testing - Perform the specified tests to determine geotextile properties for the intended application(s). The tensile strength requirements shall be tested in both machine and cross-machine directions.

(e) Agency Check Tests - The Agency reserves the right to sample and test products for compliance with pertinent requirements, according to 00165.02.

When the Agency performs check tests, the entire production run will be accepted or rejected according to 00150.25, if any of the average roll values of tested rolls are less than the specified minimum values.

02320.11 Seam Testing and Acceptance:

(a) Factory Seams - Where factory seams are made, the sheets of geotextile shall:

- Be sewn together using a lock type stitch Type 301 or 401 as shown.
- Be sewn with polymeric thread that is at least 95%, by weight, polyolefin or polyester, and as resistant to deterioration as the geotextile being sewn.
- Have test results showing that the seams meet or exceed 90% of the specified tensile strength minimum values for the intended application.
- Nylon thread will not be allowed.

(b) Field Seams - Where field sewn seams will be used, furnish:

- The manufacturer's test result certificate, according to 00165.35, that includes wide strip, tensile strength test results and verifies that seam tensile strength and seam grab tensile strength meet or exceed 90% of the minimum specified tensile strength values for the geotextile.
- A field-stitched seam test sample.

02320.20 Geotextile Property Values:

Table 02320-1 Geotextile Property Values

Geotextile Property	Test Method	Units	Filtration							Separation	Reinforcement	
			Drainage[1] Geotextile		Riprap[1] Geotextile		Sediment Fence Geotextile			Subgrade Geotextile	Embankment Geotextile	Pavement Overlay[1] Geotextile
							Supported	Unsupported				
			Type 1	Type 2	Type 1	Type 2	—	Elongation ≥ 50%[2]	Elongation ≤ 50%[2]			
Grab tensile strength (minimum) Machine Direction Cross Machine Direction	ASTM D 4632	lb	 80 80	 180 180	 200 200	 260 260	 90 90	 120 100	 120 100	 180 180	 230 230	 80 80
Grab Elongation (minimum)	ASTM D 4632	%	15		15		—	—		—	—	50
Burst Strength, Diaphragm method (minimum)	ASTM D 3786	psi	130	290	320	435	—	—		290	435	—
Puncture strength (minimum)	ASTM D 4833	lb	35		80		—	—		80	110	—
Apparent opening size (AOS) (maximum), U.S. Standard Sieve	ASTM D 4751 (CW-02215 Corps of Engineers)	in	No. 70		No. 70		No. 30	No. 30	No. 30	No. 30	No. 30	—
Permittivity (minimum)	ASTM D 4491	s^{-1}	0.5		0.5		0.05	0.05	0.05	0.01	0.01	—
Ultraviolet stability (Retained Strength) (minimum)	ASTM D 4355 At 500 hours	%	—		70		70 after 500 hours of exposure			—	—	—
Asphalt retention (minimum)	ODOT TM 817	oz/ft^2	—		—		—	—		—	—	2.8
Melting point (minimum)	ASTM D 276	°F	—		—		—	—		—	—	300

[1] Slit film or slit tape fabrics are not acceptable.
[2] As measured according to ASTM D 4632.

Section 02340 - Rock Gabion Baskets

Description

02340.00 Scope - This Section includes the requirements for rock gabion baskets of twisted or welded wire mesh.

Materials

02340.10 General - Provide wire mesh material free of breaks in the wire, breaks at weld points or other deficiencies. Individual wires of either style mesh shall meet the following minimum requirements:

Galvanizing	0.80 oz. per sq. ft. minimum
Tensile strength [1]	60,000 psi minimum
Wire diameter tolerance limit	± 0.004"

[1] Tensile area includes galvanizing

Welded wire shall also conform to AASHTO M 55 (ASTM A 185) except that the weld shears shall be 600 pounds for 11 gauge, and 800 pounds for 9 gauge wires. All wire sizes are after galvanizing.

Tie wires and internal connecting wires shall be galvanized and no smaller than 13 1/2 gauge. Spiral binders may be used as an alternate to tie wire for basket assembly and basket-to-basket connections. Spiral binders shall be 9 gauge, galvanized, and have a 3 inch pitch. High tensile fasteners of the locking spring steel clip or clamp-on ring type may be used as alternates to tie wire for basket assembly only. High tensile fasteners shall be fabricated from 11 gauge steel wire with a minimum tensile strength of 240,000 psi. Provide a Class 3 zinc coating according to ASTM A 764. High tensile fasteners shall provide a closed position tensile strength of 600 pounds.

All wire shall be galvanized according to ASTM A 641.

02340.12 Twisted Wire Mesh Gabion Baskets - Furnish gabion panels of the twisted mesh style manufactured from 11 gauge with 9 gauge selvage wires. The mesh shall form a uniform hexagonal pattern and shall be formed with a non-raveling twist. The major axis (maximum line dimensions) of any hexagonal opening shall not exceed 4.75 inches. The area of the hexagonal opening, approximately 3.2 inches by 4.5 inches, shall not exceed 9.5 square inches.

02340.20 Welded Wire Mesh Gabion Baskets - Furnish gabion panels of the welded mesh style manufactured from 11 gauge or 9 gauge wire. The mesh shall form a nominal 3 inch by 3 inch grid pattern and conform to AASHTO M 55 (ASTM A 185). The maximum line dimension of any opening shall not exceed 4.75 inches. The 12 inch and 18 inch high mattresses shall be made from 11 gauge panels. Gabions of square cross section (cubical-celled units) may be made with either 9 gauge or 11 gauge panels, except that within the same unit, panels of dissimilar wire sizes may not be mixed.

Galvanized 9 gauge stiffeners, placed diagonally in the baskets at the vertical 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 02340.12 or 02340.20.

The PVC coating for twisted wire mesh gabions shall be extruded onto the wire core before weaving the coated wire into a double twisted hexagonal mesh. The use and minimum diameter of the various wires is as follows:

- Gabion Panel wire core shall be manufactured from galvanized 12 gauge wire core. The overall minimum diameter of the galvanized wire core plus PVC coating shall be 0.136 inch.
- Selvage and reinforcing wire shall be of heavily galvanized 10 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.165 inch.
- Lacing and connecting wire shall be of heavily galvanized 13 1/2 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.120 inch.

02340.40 Fabrication - Fabricate gabions so that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the specified sizes. Dimensions for heights, lengths and widths of gabion baskets shall be as indicated on the plans with a tolerance of plus or minus 3%. Gabions shall be of single unit construction. Either connect the base, lid, ends and sides into a single unit or connect one edge of these members to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

If the length of the gabion exceeds its horizontal width, equally divide the gabion by diaphragms into cells whose length does not exceed the horizontal width. The diaphragm material shall be of the same mesh and size as the body of the gabions. Furnish the gabion with the necessary diaphragms secured in proper position on the base in such manner that no additional tying at this juncture will be necessary.

Assemble the wire mesh panels (base, ends, sides, diaphragms and lid) so strength and flexibility at connections is at least equal to that of a single panel.

02340.50 Acceptance - Provide a quality compliance certificate for gabion baskets according to 00165.35.

Section 02350 - Metal Bin Retaining Walls

Description

02350.00 Scope - This Section includes the requirements for galvanized steel sheets and hardware for the assembly of metal bin retaining walls.

Materials

02350.10 Base Metal, Galvanizing, and Thickness - Design all members, fittings and appurtenances as integral units or parts of the whole assembly. The galvanized sheets used in fabricating the members shall conform to the requirements of AASHTO M 218. Bolts, nuts and miscellaneous hardware shall be galvanized or otherwise protected with approved coatings and shall be of sizes and shapes suitable for use with the members furnished.

Fabricate the members from the specified base metal of the thickness shown. In the absence of given thickness or dimensions for any member, fitting or appurtenance, the thickness of metal or dimensions of the member shall be as required to fully develop the strength of the members whose thickness and dimensions are given, and which are used in structural combination.

02350.20 Fabrication - Fabricate all members so members of the same nominal size are fully interchangeable. Fabricate and punch the members so no drilling, punching or drifting to correct defects in manufacture will be required during field assembly. Any members having improperly punched holes will be rejected. Replace with a member with properly punched holes.

Drainage and Water Distribution Materials

Section 02410 - Concrete and Plastic Pipe

Description

02410.00 Scope - This Section includes the requirements for nonreinforced and reinforced concrete pipe, concrete drain pipe and tile, polyethylene pipe, and polyvinyl chloride (PVC) pipe.

Materials

02410.10 Concrete Pipe - Furnish concrete pipe meeting the following requirements:

(a) End Designs - Where rubber gasket joints are used, modify the design of the ends of the pipe sections according to AASHTO M 198 to accommodate rubber gaskets.

(b) Sloped or Skewed Ends - If the ends of pipe require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish, and protection to otherwise exposed reinforcement where applicable.

(c) Markings - Indent the markings required by AASHTO M 86 (ASTM C 14) in the outside surface of each section of pipe.

(d) Concrete Pipe Field Permeability Tests - The Engineer may require field permeability tests on a maximum of 5% of each lot, class, or size of pipe according to ASTM C 497 on pipe 24 inches in diameter and smaller.

Provide all the necessary labor, equipment, water and materials at the site for performing field permeability tests.

At the option of the pipe supplier, and with the approval of the Engineer, individual field permeability tests may be performed at the point of manufacture.

(e) Concrete Pipe Plant Air Test - The Engineer may require that each length of concrete pipe 12 inches in diameter and smaller be given an individual air test at the point of manufacture. Use test equipment approved by the Engineer and a test pressure of at least of 10 psi. Each length shall show no appreciable loss of air after five seconds.

When individual air testing is performed, no field or shop permeability tests will be required.

(f) Nonreinforced Concrete Pipe - Provide nonreinforced or plain circular concrete pipe and special sections conforming to the requirements of AASHTO M 86 (ASTM C 14) or ASTM C 985 and this Section.

(g) Reinforced Concrete Pipe - Provide reinforced concrete pipe and special sections conforming to the requirements of AASHTO M 170 (ASTM C 76) and this Section, except as follows.

(1) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends and reducers as shown, specified or directed. In the absence of any design or specifications, the special sections shall be of the design recommended by the manufacturer for the intended use. Generally the special sections shall conform to the requirements specified for the pipe with which it is to be used.

Fabricate special sections with components from tested and approved lots. Maintain production dates of components.

(2) Load Strength - Reinforced concrete pipe having the same D-load strengths as those specified to be furnished under AASHTO M 170 (ASTM C 76) may be furnished according to AASHTO M 242 (ASTM C 655).

(3) Acceptance - The basis of acceptance for reinforced concrete pipe manufactured according to AASHTO M 170 (ASTM C 76), and AASHTO M 242 (ASTM C 655) will be Paragraph 5.1.1 of AASHTO M 170.

(h) Concrete Drain Pipe - Use circular, nonreinforced perforated concrete pipe and special sections for subsurface drainage conforming to the requirements of AASHTO M 175 (ASTM C 444), Type 1, all applicable requirements of AASHTO M 86 (ASTM C 14), except indent the markings required by AASHTO M 86 (ASTM C 14) in the outside surface of each section of pipe.

(i) Concrete Drain Tile - Provide concrete drain tile conforming to the requirements of AASHTO M 178 (ASTM C 412).

02410.60 Polyethylene Pipe - Furnish polyethylene pipe meeting the following requirements:

Corrugated polyethylene drain pipe	AASHTO M 252
Corrugated polyethylene culvert pipe	AASHTO M 294, Type S or D
Corrugated polyethylene storm sewer pipe	AASHTO M 294, Type S or D

The allowable nominal inside diameter of polyethylene pipe is as follows:

Corrugated polyethylene drain pipe	Up to 10"
Corrugated polyethylene culvert pipe	12" - 60"
Corrugated polyethylene storm sewer pipe	12" - 60"

Watertight joints for corrugated polyethylene pipe shall meet the requirements of ASTM D 3212 and shall be listed in the QPL.

02410.65 Solid Wall High Density Polyethylene (HDPE) Pipe - Furnish pipe resin that has a hydrostatic design basis of 1,600 psi when tested and analyzed according to ASTM D 2837, and has a material designation code of 3408 as listed by the Plastic Pipe Institute. The resin shall meet the requirements of ASTM D 3350 and have a minimum cell classification of PE345444C (Code D or E may also be used for pipe bursting and lining pipe and for slip lining pipe). The polyethylene composition for code C classification shall contain a minimum of 2% and not more than 3% by weight of well-dispersed and finely divided carbon black when tested according to ASTM D 1603 and ASTM D 4218. 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 pipe. Pipe (excluding black colored pipe) stored outside shall not be recycled. Provide pipe and fittings meeting the requirements of ASTM F 714 and ASTM D 3261 as modified for the specified material.

02410.70 Polyvinyl Chloride (PVC) Pipe - Furnish PVC subsurface drain pipe and fittings meeting the requirements of ASTM D 2729.

Furnish PVC sanitary, storm, culvert, siphon, and irrigation pipe and fittings with 2 feet or more cover that have a minimum pipe stiffness of 46 psi or a minimum SDR of 35 and meet the requirements of sewer pipe ASTM D 3034, ASTM F 679, or ASTM F 794.

Furnish PVC sanitary, storm, culvert, siphon, and irrigation pipe and fittings with less than 2 feet but at least 1 foot cover meeting the requirements of AWWA C 900 or AWWA C 905.

02410.80 Acceptance - Except as provided in 02410.10(g-3), acceptance of nonreinforced concrete pipe, reinforced concrete pipe, concrete drain pipe, concrete drain tile, polyethylene pipe, polyvinyl chloride pipe, and hardware will be according to 00165.35 and this Section.

Section 02420 - Metal Pipe

Description

02420.00 Scope - This Section includes the requirements for corrugated steel pipe, helical rib pipe, arch type pipe, aluminum pipe, ductile iron pipe, and special sections intended for use for storm drainage, underdrains and culverts, and not intended for the conveyance of sanitary or industrial waste.

Materials

02420.10 Corrugated Steel Pipe and Pipe Arches - Furnish corrugated steel pipe, helical rib pipe, pipe arches and special sections meeting the requirements of AASHTO M 36 (ASTM A 760) Types I, IA, and II, except as follows:

(a) Shapes - Provide either full-circle or elliptical pipe, as the Contractor may elect, unless otherwise shown or specified. The shapes of pipe fabricated and furnished may include any of the following:

- **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 AASHTO M 36 (ASTM A 760) the Contractor may repair damaged zinc or aluminum coating by removing all loose or cracked coating, removing all welding flux, wire brushing the damaged area, and applying 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 allowed to furnish pipe with Type D coating.

(1) Riveted Seams - If pipes are not furnished with Type D coating, do the following:

- Place a bead or strip of approved caulking compound, 1/8 inch minimum diameter or thickness, between the laps of all riveted seams.
- Rivet the annular seams of riveted pipe at spacings not greater than 3 inches. Rivet in a single row the longitudinal seams of pipes less than 42 inches in diameter. Place one rivet in each valley and one on each crest of the corrugations.
- Double rivet the longitudinal seams of pipes 42 inches and larger in diameter in each valley of the corrugations and place a single rivet on each crest of the corrugations.
- At the intersection of longitudinal and circumferential seams, close the gap caused by the three-sheet lap by special fabrication. Fabricate a special longitudinal seam at the ends of pipe sections for a sufficient distance to clear the coupling bands.

Spot welding of the seams of corrugated metal pipe used in irrigation pipe installations will not be allowed.

(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 - Furnish ductile iron pipe conforming to the requirements of AWWA C150. Use Pressure Class 150 - 350 or Special Thickness Class 50 - 56, as directed.

02420.20 Protective Coatings - If specified or shown, furnish corrugated metal pipes with protective coatings as follows:

(a) Bituminous Protective Coatings - Provide corrugated metal pipe and connecting bands with bituminous coatings conforming to the requirements of AASHTO M 190 and the following:

- Before immersion, the metal shall be free of grease, dirt, dust, moisture or other contaminants.
- Apply the initial bituminous coating by one of the processes under 02420.20(a-1) or 02420.20(a-2).
- If a second dip is required to meet the coating thickness requirements of AASHTO M 190, the time and temperature requirements of 02420.20(a-1) or 02420.20(a-2) need not be followed for the second dip.

- The paved invert for both Type B and Type C coatings on either circular or arch type pipe shall fill the corrugations for at least 40% of the circumference of the pipe.

(1) Pipe Not Preheated - The temperature of the asphalt at the time of pipe immersion shall be 400 °F ± 5 °F and the duration of the immersion shall conform to the following schedule:

Metal Thickness (Inch)		Minimum Immersion Time
Steel	**Aluminum**	**(Minutes)**
0.064	0.060	2.5
0.079	0.075	3.0
0.109	0.105	5.0
0.138	0.135	6.5
0.168	0.164	8.0

(2) Pipe Preheated - At the time of pipe immersion the asphalt shall have a temperature of 380 °F ± 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 nonuniformity equal to the thickness of the sheet will be allowed. Maintain the thickness of the lining to the ends of the pipe.

(c) Optional Paved Invert - If an asphalt coated pipe with a paved invert (Type C coating) is shown or specified, a centrifugally-applied interior lining conforming to Type D coating may be furnished as an alternate, providing the minimum thickness of bituminous coating over the crests of the corrugations is not less than 1/4 inch.

(d) Polymeric Coatings - If polymeric coating is shown on the pipe data sheet, use a coating from section 02420.20 of the QPL.

02420.30 Corrugated Steel Pipe for Underdrains - Furnish corrugated steel pipe for underdrains conforming to the requirements of AASHTO M 36 (ASTM A 760) Type III - Underdrain Pipes, except as modified in 02420.10(c) and 02420.10(d), and as follows:

(a) Class IV - Semicircular pipe may be used only as an alternate with the 6 inch size of perforated full-circle drain pipe.

(b) Connecting Bands - Connecting bands for underdrain pipe field joints shall conform to the designs shown.

02420.40 Corrugated Aluminum Alloy Pipe - Furnish corrugated aluminum alloy pipe, helical rib pipe, pipe arches and special sections conforming to the requirements of AASHTO M 196 (ASTM B 745), Types I, II and III, except as follows:

(a) Shapes - The shapes of the pipes to be furnished may include any of the shapes described in 02420.10(a).

(b) Connecting Bands - Use connecting bands conforming to the requirements of AASHTO M 196 (ASTM B 745) and the details shown to make field joints for pipes and pipe arches not requiring watertight joints.

(c) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends, reducers and flared inlets as shown or as directed.

Generally, special sections shall conform to the requirements specified for the pipe with which they are used, and shall be connected to the pipe or to each other with connecting bands specified for use with the pipe to which they are connected.

For elbows of 30° 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 allowed 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 AASHTO M 196 (ASTM B 745) and the details shown, and make the field joints watertight for pipe installations used in irrigation.

(e) Siphon Pipe - Fabricate corrugated aluminum alloy pipe used in siphons with watertight seams.

Field joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent separation of pipe sections and provide a watertight joint. Fabricate the connecting bands from aluminum alloy conforming to AASHTO M 196 (ASTM B 745). Attach the connecting bands so they lap a nearly equal portion of each pipe section to be connected.

(f) Sloped or Skewed Ends - If the ends of pipe culverts require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish. Repair bituminous protective coatings and linings when specified.

02420.50 Corrugated Aluminum Alloy Pipe for Underdrains - Furnish corrugated aluminum alloy pipe for underdrains conforming to the requirements of AASHTO M 196 (ASTM B 745) Type III, except as follows:

(a) Special Sections - The provisions of 02420.40(c) apply.

(b) Connecting Bands - Connecting bands for field joints shall conform to the requirements of AASHTO M 196 (ASTM B 745) and the details shown.

02420.60 Acceptance - Acceptance of pipes, underdrains, and protective coatings will be according to 00165.35 and this Section.

Section 02430 - Structural Plate Pipe

Description

02430.00 Scope - This Section includes the requirements for steel and aluminum alloy plates and hardware for structural plate pipe.

Materials

02430.10 Galvanized Steel Plates:

(a) General - Furnish galvanized steel plates for structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A 761).

(b) Plates for Pipe Arches - The top plate(s) shall form an arc between 180 and 155 degrees. The bottom plate(s) shall form an arc between 50 and 10 degrees. 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 degrees.

(c) Forming and Punching Plates - Form plates to provide lap joints. Punch the bolt holes so that all plates with the same dimensions, curvature, thickness, and number of bolts per foot of seam are interchangeable. Curve each plate to the proper radius so that the cross-sectional dimensions of the finished structure will be as shown or as specified.

Unless otherwise specified, fabricate bolt holes as follows:

- Two rows along longitudinal seams.
- Center-to-center spacing not more than 10 inches along circumferential seams.
- Center of hole to edge of the plate at least 1.75 times the diameter of the bolt.
- Longitudinal seam bolt holes shall not exceed the diameter of the bolt by more than 1/8 inch.

The above provisions are for standard punching. Provide additional bolt holes for special conditions of installation when specified or shown.

(d) Sloped and Skewed Ends - Cut plates for forming sloped ends, skewed ends or both, to give the angle of slope or skew shown. Burnt edges shall be free from oxide and burrs. Legibly identify each cut plate to designate its proper position in the finished structure.

02430.20 Aluminum Alloy Plates - Furnish aluminum alloy plates for structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B 746). Fabricate according to 02430.10(b) through 02430.10(d).

02430.90 Bolts, Nuts, and Washers - Furnish bolts, nuts, and washers for use with galvanized steel structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A 761) and galvanized according to AASHTO M 232 (ASTM A 153).

Furnish bolts, nuts, and washers for use with aluminum alloy structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B 746) and galvanized according to AASHTO M 232 (ASTM A 153).

02430.95 Acceptance - Acceptance of structural plate pipe and hardware will be according to 00165.35 and this Section.

Section 02440 - Joint Materials

Description

02440.00 Scope - This Section includes the requirements for joint fillers, seals, gaskets and water stop for concrete pipe joints, manhole section joints, bridge joints, and miscellaneous concrete applications.

Materials

02440.10 Preformed Joint Fillers for Concrete - Furnish preformed joint fillers for concrete from the QPL conforming to the requirements of AASHTO M 153 or AASHTO M 213. Fillers conforming to AASHTO M 213, except the binder, if other than bituminous material, may be used provided they otherwise meet this Specification and they have been demonstrated to be rot and vermin proof for a period of at least five years. Unless otherwise specified or indicated, the Contractor may elect to furnish either type specified in this subsection.

02440.11 Poured Joint Sealant - Furnish a two-component, low modulus, rapid-cure joint sealant from the QPL.

02440.14 Backer Rod - Furnish a closed-cell, non-gassing foam material backer rod from the QPL.

02440.15 Lubricant/Adhesive - Furnish a lubricant/adhesive that is recommended by the seal manufacturer.

02440.19 Steel Bridging Plate - Furnish a hot-dip galvanized, conforming to AASHTO M 111 (ASTM A 123), merchant quality steel bridging plate with a minimum thickness of 1/4 inch and a width of 8 inches, cut in lengths of 4 feet or more. Drill spike holes at 12 inch centers along the centerline of the plate before galvanizing. Repair galvanization according to ASTM A 780.

02440.20 Preformed Joint Seals - Furnish compression joint seals conforming to the requirements of AASHTO M 297. Use strip seals conforming to ASTM D 5973.

02440.21 Elastomeric Concrete - Furnish elastomeric concrete from the QPL.

02440.30 Hot Poured Joint Filler - Furnish hot poured joint filler from the QPL and conforming to the requirements of AASHTO M 324, Type II (ASTM D 6690, Type II).

02440.40 Gaskets for Concrete Pipe and Precast Manhole Section Joints:

(a) Preformed Flexible Joint Sealant - Furnish materials for tongue and groove or key lock manhole joints conforming to the requirements of AASHTO M 198 (ASTM C 990).

(b) Rubber Gaskets - Furnish materials for O-ring manhole and concrete pipe joints conforming to AASHTO M 315 (ASTM C 443).

02440.50 Joint Materials for Concrete Precast Manhole Section Joints:

(a) Mortar - Furnish mortar conforming to the requirements of ASTM C 387, or proportioned one part Type II portland cement to two parts clean, well-graded sand passing a No. 6 screen. Admixtures may be used not exceeding the following percentages by weight of cement:

Hydrated lime	10%
Diatomaceous earth or other inert materials	5%

The consistency of the mortar shall be such that it will readily adhere to the precast concrete if using the standard tongue-and-groove type joint.

(b) Non-Epoxy (Non-Shrink) Grout - Furnish a non-epoxy (non-shrink) grout from the QPL. Place or pack non-shrink grouts only with the use of a non-epoxy bonding agent from the QPL, applied to all cured concrete surfaces being grouted. Use a bonding agent compatible with the grout used.

02440.60 Plastic Compound for Precast Manhole Section Joints - Furnish a plastic compound that is specifically manufactured for the intended use and:

- Has a putty-like, preformed homogeneous blend of hydrocarbon resins and rubber or plasticizing materials with not more than 50% by weight of inert mineral filler.
- Is pliable at temperatures between 32 °F and 135 °F. A specimen at 77 °F and 1/2 inch square in cross section shall stretch at least 1 1/2 inches before rupture when tested with the apparatus described in ASTM D 113.
- Adheres firmly and cohesively to the precast manhole sections when the compound-sealed joint is flexed to its maximum extent.
- Includes a primer solution recommended by the compound manufacturer.
- Conforms with Federal Specification SS-S-00210 (GSA-FSS).

02440.70 Water Stop - Furnish either plastic or rubber water stop, as the Contractor elects, manufactured to the dimensions shown and meeting the following requirements:

(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:

Test	ASTM Test Method	Specification (Minimum)
Tensile Strength, psi	D 412	1,800
Elongation, %	D 412	350
100% Modulus, psi	D 412	760
Low Brittle Temperature	D 746	- 50 °F
Cold Bend Test [1]		No Failures

[1] Samples maintained at -70 °F for two hours, then bent quickly around a 1/4 inch mandrel to 180 degrees.

(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 ± 0.03.

- **Defects** - Minor surface defects such as surface peel covering less than 1 square inch, surface cavities or bumps less than 1/4 inch in longest lateral dimensions and less than 1/16 inch deep will be acceptable.

02440.80 Acceptance - Acceptance of joint materials will be according to 00165.35 and this Section.

Section 02450 - Manhole and Inlet Materials

Descriptions

02450.00 Scope - This Section includes the requirements for precast manhole sump sections, metal frames, covers, grates, and ladders.

Materials

02450.10 Precast Concrete Manhole Sections - Furnish precast risers, cones, and cover slabs for precast concrete manholes conforming to the requirements of AASHTO M 199 (ASTM C 478).

02450.20 Precast Concrete Sump Sections - Furnish precast rings and lids for precast concrete sumps of portland cement concrete conforming to AASHTO M 199 (ASTM C 478).

02450.30 Metal Frames, Covers, Grates, and Ladders - Comply with the following:

Projects on State Highways		
Item	**AASHTO (ASTM) Designation**	**Grade**
Manhole frames and covers	M 306	Class 35 B
Inlet frames and grates	M 306	Class 35 B
Manhole ladder rails	M 270 (A 709) A 36 M 227 (A 663)	36 65

All Other Projects		
Item	**AASHTO (ASTM) Designation**	**Grade**
Manhole frames and covers	M 105	Class 30 B
Inlet frames and grates	M 227 (A 663) M 270 (A 709) A 36 M 103 (A 27)	65 36 65 - 35
Manhole ladder rails	M 270 (A 709) A 36 M 227 (A 663)	36 65

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 AASHTO M 111 (ASTM A 123).

As an alternate, steps for manholes may be steel-reinforced plastic conforming to AASHTO M 199 (ASTM C 478) and AASHTO T 280 (ASTM C 497). The steel shall be deformed reinforcing bar conforming to AASHTO M 31 (ASTM A 615) Grade 60, No. 4 minimum. The plastic material surrounding the reinforcing 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

02470.00 Scope - This Section includes the requirements for ductile iron, steel, and polyvinyl chloride (PVC) pipe 16 inches in diameter and smaller, for potable water systems.

Materials

02470.10 General - Clearly mark all pipe with the type, class, thickness, and manufacturer's name, as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02470.20 Ductile Iron Pipe:

(a) General - Use centrifugally cast ductile iron pipe meeting the requirements of AWWA C151. Ductile iron pipe shall have a cement-mortar lining and seal coating meeting the requirements of AWWA C104. Ductile iron pipe to be joined using bolted flanged joints shall be Standard Thickness Class 53. All other ductile iron pipe shall be Standard Thickness Class 50 or the thickness class specified or indicated.

(b) Nonrestrained Joints - Nonrestrained joints shall be rubber gasket, push-on type, or mechanical type meeting the requirements of AWWA C111. Restrained joints shall conform to 02475.50.

02470.30 Steel Pipe 6 Inches and Larger - Steel pipe 6 inches in diameter and larger shall conform to AWWA C200, and shall have a minimum working pressure rating of 150 psi, or as shown. The type of protective coating and lining and other supplementary information required by AWWA C200 shall be as specified or indicated.

02470.35 Steel Pipe Under 6 Inches - Steel pipe under 6 inches in diameter shall be hot-dip galvanized inside and out and meet the requirements of ASTM A 53. Steel pipe thickness shall be Schedule 40 or the thickness class specified or indicated.

02470.40 Polyvinyl Chloride (PVC) Pipe 4 Inches and Larger:

(a) PVC Pipe Smaller Than 14 inch Diameter - PVC pipe 4 inches in diameter up to but not including 14 inches in diameter shall meet the requirements of AWWA C900, have the same outside dimensions as ductile iron pipe, and have a minimum dimension ratio (DR) of 18 or as specified or indicated.

(b) Large Diameter PCV Pipe - PVC pipe 14 inches in diameter to 16 inches in diameter shall meet the requirements of AWWA C905, have the same outside dimensions as ductile iron pipe, and have a minimum dimension ratio (DR) of 18 or as specified or indicated.

(c) Joints - Joints shall meet the requirements of ASTM D 3139 using a restrained rubber gasket conforming to ASTM F 477. Solvent-welded pipe joints are not allowed.

02470.45 Polyvinyl Chloride (PVC) Pipe Under 4 Inches - Polyvinyl chloride (PVC) under 4 inches in diameter shall meet the requirements of ASTM D 2241. Pipe material shall be PVC 1120, PVC 1220, or PVC 2120, and shall have minimum wall thickness equal to or greater than a standard dimension ratio (SDR) of 21, or as specified or indicated. Joints shall meet the requirements of ASTM D 3139 using a restrained rubber gasket meeting the requirements of ASTM F 477. Solvent welded pipe joints will only be allowed when specified or indicated.

02470.50 Polyethylene Encasement - Polyethylene encasement shall conform to AWWA C105.

02470.60 Marking Tape and Wire:

(a) Marking Tape - 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. The width of the tape shall be as recommended by the manufacturer for the depth of installation. The tape shall be blue and imprinted continuously over its entire length in permanent black ink with the words "Caution - Water".

(b) Detectable Marking Wire - Detectable marking wire shall be No. 12 AWG, minimum, solid copper with blue colored polyethylene insulation. Joints or splices in wire shall be waterproof.

02470.70 Acceptance - Ductile iron pipe, steel pipe and polyvinyl chloride (PVC) pipe will be accepted according to 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 and polyvinyl chloride (PVC) pipe for potable water systems.

Materials

02475.10 General - Bolts, nuts and washers used for securing fittings shall be of similar materials. 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. Galvanize carbon steel bolts, nuts and washers according to 02560.40.

All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02475.20 Ductile Iron Pipe Fittings - 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. Fittings shall be cement mortar lined and seal coated, meeting the requirements of AWWA C104. Gaskets for flat faced or raised faced flanges shall be 1/8 inch thick neoprene having a Durometer reading of 60, $\pm$ 5. The type, material and identification mark for bolts and nuts shall be provided.

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. Field couplings shall be compression type. When flanges are required, they shall meet the requirements of AWWA C207, and gaskets shall conform to 02475.20.

02475.35 Fittings for Steel Pipe Under 6 Inches - Fittings for steel pipe under 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, Grade 22010. Fittings shall be banded and hot-dip galvanized inside and out.

02475.40 Fittings for Polyvinyl Chloride (PVC) Pipe 4 Inches and Larger - Fittings for PVC pipe 4 inches in diameter and larger shall be the same as specified for ductile iron pipe.

02475.45 Fittings for Polyvinyl Chloride (PVC) Pipe Under 4 Inches - Fittings for PVC pipe under 4 inches in diameter shall meet the requirements of ASTM D 2466.

02475.50 Restrained Joints - Restrain pipe, fittings, and valves by using an approved bolted or boltless system. Design the restraint system to operate at a working pressure equal to the hydrostatic test pressure identified in 01140.51(a) or as shown. No device utilizing round point set screws will be allowed. Restraint systems provided for pipe bells shall be certified for use by the pipe manufacturer.

02475.60 Bolted, Sleeve-Type Couplings for Plain-End Pipe - 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.

02475.70 Acceptance - Acceptance of fittings, restrained joints and couplings will be according to 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

02480.10 General - Provide valves with operating nuts, hand wheels or power-actuating devices as specified or indicated. Where operating nuts are called for, furnish a standard 2 inch operating nut. Valves shall be non-rising stem type, open counterclockwise, and be equipped with an O-ring stuffing box. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent. When indicated, coat all interior and exterior ferrous surfaces of valves with a protective epoxy coating meeting the requirements of AWWA C550.

02480.20 Gate Valves:

(a) Minimum Pressure - Gate valves shall meet the requirements of AWWA C500, AWWA C509, or AWWA C515. The minimum design working pressure shall be 200 psi for pipe 2 inches to 12 inches in diameter, and 150 psi for pipe 14 inches to 16 inches in diameter.

(b) Arrangement - For 16 inch diameter pipe, arrange gate valves for operation with gear case in the horizontal position. Equip valves with bypasses and gate valves of the sizes adopted in the AWWA Standards. Equip bypass gate valves with standard 2 inch operating nuts.

02480.22 Butterfly Valves:

(a) Seats and Seals - 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) 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.

02480.23 Ball Valves:

(a) Seats and Seals - 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. Construct valve operators to the standard of the valve manufacturer to withstand all anticipated operating torques and designed to 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.

02480.25 Valve Boxes - Install valve boxes on all buried valves. Boxes shall be of cast iron, two-piece, slip type standard design with a base corresponding to the size of the valve. Boxes shall be coal-tar painted by the manufacturer using its standard. The cover shall have the word "WATER" cast in it.

02480.26 Valve Stem Extensions - Valve stem extensions shall have a 2 inch square operating nut and self-centering rockplate support. Valves with an operating nut more than 4 feet below grade shall have a valve stem extension to raise the operating nut to within 3 feet of the ground surface.

02480.30 Tapping Sleeve and Valve Assemblies:

(a) Valve Assemblies - Furnish tapping valves with flanged inlet end connections. The outlet ends shall conform in dimensions to the AWWA Standards for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine. The seat opening of the valve shall permit a diameter cut no less than 1/2 inch smaller than the valve size. Valves specifically designed for tapping meeting the requirements of AWWA C500, and valves meeting the requirements of AWWA C509, will be allowed. Tapping valves shall be of the same type as other valves on the Project.

(b) Sleeves - Tapping sleeves shall be cast iron, ductile iron, stainless steel, epoxy coated steel or other approved material.

02480.40 Check Valves - Check valves shall conform to the following:

(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 check valves with diameters of 14 inches and 16 inches. Check valves shall be non-assisted, 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 drop-tight 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 - 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.

02480.60 Combination Air Release/Air Vacuum Valves:

(a) Operational Design - Design combination air release/air vacuum valves to 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) Composition - 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, Class 30. Floats shall be stainless steel conforming to ASTM A 240 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.

02480.80 Acceptance - Valves and appurtenances will be accepted according to 00165.35 and this Section.

Section 02485 - Hydrant 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 - Fire hydrants shall be dry-barrel, conforming to AWWA C502, of standard manufacture and of a pattern approved by the Agency. Hydrants shall be designed for a minimum working pressure of 150 psi.

All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02485.20 End Connections - The end connections shall be mechanical joint or flanged, meeting the requirements of AWWA C110 and AWWA C111.

02485.30 Hydrant Dimensions and Nozzle Features:

(a) Hydrant Dimensions - Hydrant connection pipes shall be 6 inches inside diameter with 6 inch auxiliary gate valves. Barrels shall have a 7 inch minimum inside diameter. Hydrant length, measured from the bottom of the hydrant to the sidewalk ring, shall provide proper cover at each installed location. Valve openings shall have a minimum diameter of 5 1/4 inches.

(b) Nozzle Features - Hydrants shall have two 2 1/2 inch diameter hose nozzles and one pumper nozzle to match the Agency's connection requirements.

Fit nozzles with cast iron threaded caps with operating nuts of the same design and proportions as the hydrant stem nuts. Thread caps to fit the corresponding nozzles and fit with suitable neoprene gaskets of positive water tightness under test pressures. The direction of opening shall be counterclockwise and shall be clearly marked on the operating nut or hydrant top. Hydrants shall have O-ring stem seals. Interior and exterior painting of the hydrant shall conform to AWWA C502.

02485.40 Hydrant Extensions - 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.

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.

02485.60 Tie Rods - Tie rods shall be 3/4 inch diameter with threaded ends, galvanized according to 02560.40 and conforming to 02560.30.

02485.70 Guard Posts - Guard posts for hydrants shall be galvanized steel pipe, 6 inches in diameter, meeting the requirements of ASTM A 53, Schedule 40, filled with commercial grade concrete, and with the concrete domed at the top.

02485.80 Acceptance - Acceptance of hydrants and hydrant appurtenances will be according to 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 potable water service connections 2 inches in diameter and smaller, and sampling stations.

Materials

02490.10 General - Service line materials shall conform to AWWA C800 and these specifications. Design service line materials for normal pressure service applications for a working pressure of 100 psi. Where high pressure service materials are specified or shown, they shall be designed for a working pressure of 150 psi. Use high pressure service materials when service line is hydrostatically tested concurrent with the water main.

All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02490.20 Saddles - Saddles shall be ductile iron, bronze or stainless steel. Saddles used for 3/4 inch and 1 inch services shall be single strap saddles and have either AWWA tapered thread or female iron pipe thread outlet. Saddles used for 1 1/2 inch and 2 inch services shall be double strap saddles with female iron pipe thread outlet. Saddles used on asbestos cement or on PVC pipe shall be formed for the pipe and have flat, stainless steel straps.

02490.30 Corporation Stops - Make corporation stops of bronze alloy. Corporation stops for direct tapping shall have AWWA tapered thread inlet and outlet connections compatible with either copper or polyethylene tubing.

(a) Less Than or Equal to 1 Inch - Corporation stops used with 3/4 inch and 1 inch outlet saddles shall have either AWWA tapered thread or male iron pipe thread inlets and outlet connections compatible with either copper or polyethylene tubing. Thread patterns for the saddle outlet and corporation stop inlet shall be the same.

(b) Greater Than 1 Inch - Corporation stops used with 1 1/2 inch and 2 inch outlet saddles shall have male iron pipe thread inlets and outlet connections compatible with connecting service pipes, or have male iron pipe thread outlets.

02490.40 Service Pipe and Fittings:

(a) Copper Tubing Service Pipe - Copper tubing service pipe shall be annealed, seamless tubing conforming to the requirements of ASTM B 88, Type K.

(b) Polyethylene Tubing Service Pipe - Polyethylene tubing service pipe shall meet the requirements of AWWA C901. Tubing shall be high molecular mass with a 200 psi rating. Tubing used for 3/4 inch and 1 inch shall be either SDR 7 (iron pipe size) or SDR 9 (copper tube size). Tubing used for 1 1/2 inch and 2 inch shall be SDR 9 (copper tube size).

(c) Service Fittings - Make fittings used for service connections of bronze alloy. Fittings used for copper tubing shall be either compression or flare type, insulated or noninsulated.

Fittings used for polyethylene tubing shall be either compression or stab type. Stab type fittings shall utilize an internal grip ring and O-ring seal. Use stainless steel liners when utilizing compression fittings on polyethylene tubing.

02490.50 Meter Setters - Meter setters shall be manufactured and tested according to all applicable parts of AWWA C800. Meter setters shall be 12 inches in height and shall have an angle meter stop with drilled padlock wing, an angle check valve, and inlet and outlet threads compatible with fittings connecting to service pipes.

Meter setters for 5/8 inch by 3/4 inch, 3/4 inch, and 1 inch services shall have meter saddle nuts for installation and removal of the meter. Meter setters for 1 1/2 inch and 2 inch services shall be equipped with a locking bypass.

02490.60 Bronze Nipples and Fittings - Bronze threaded nipples and fittings shall meet the requirements of ANSI B16.15, ASA 125 pound class.

02490.70 Meter Boxes:

(a) Nontraffic Areas - Construct meter boxes and covers located in the nontraffic areas of either reinforced concrete or high density polyethylene. High density polyethylene meter boxes and covers shall have a tensile strength conforming to ASTM D 638. Meter box covers shall include a reading lid.

(b) Traffic Areas - Construct meter boxes located in traffic areas of either reinforced concrete, cast iron or ductile iron. Construct traffic covers of aluminum, steel, cast iron or ductile iron. Meter boxes and covers shall be designed for continuous H-20 traffic loading.

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 00165.35 and this Section.

Structures

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 or AASHTO M 31 (ASTM A 615). Unless otherwise specified or shown, all reinforcing bars shall be Grade 420 (Grade 60).

02510.11 Epoxy Coated Reinforcement:

(a) General - Epoxy coated reinforcement shall conform to the requirements of AASHTO M 284 (ASTM A 775) and (b), (c) and (d) below.

(b) Coating Voids - Patch visible voids in the coating, regardless of cause, according to 00530.45.

(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 AASHTO M 284 (ASTM A 775). All testing shall be performed by a qualified private testing laboratory. The Agency's Materials Laboratory will review all test data to determine whether the material meets the pre-qualification 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 AASHTO M 284 (ASTM A 775) and according to (b), (c), and (d) above, and that the coating material used on the project is the same as that pre-qualified.

(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 QPL 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, 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 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.

02510.40 Welded Wire Fabric - Welded wire fabric shall conform to the requirements of AASHTO M 55 (ASTM A 185). Deformed welded wire fabric shall comply with AASHTO M 221 (ASTM A 497).

02510.50 Dowels - Dowels shall conform to the requirements of AASHTO M 31 (ASTM A 615), for Grades 40 and 60, or AASHTO M 227 (ASTM A 663) for Grades 70, 75, and 80.

02510.60 Wire Reinforcement - Wire reinforcement shall conform to the requirements of AASHTO M 32 (ASTM A 82). Deformed wire shall conform to the requirements of AASHTO M 225 (ASTM A 496).

02510.70 Acceptance - Acceptance of reinforcement will be according to 00165.35 and this Section.

Section 02515 - Prestressing Reinforcement

Description

02515.00 Scope - This Section includes the requirements for seven-wire strand, high tensile strength wire, high tensile strength steel alloy bars, tendon duct and couplings.

Materials

02515.10 Seven-Wire Strand - Seven-wire strand (bright wire) shall conform to the requirements of AASHTO M 203 (ASTM A 416), Grade 270, supplement 1 (low relaxation strand), minimum ultimate strength, 270,000 psi.

02515.20 Wire, High Tensile Strength - High tensile strength wire shall conform to the requirements of AASHTO M 204 (ASTM A 421).

02515.30 Bars, High Tensile Strength - High strength steel bars shall conform to the requirements of AASHTO M 275 (ASTM A 722).

02515.40 Seven-Wire Strand Epoxy Coated Reinforcement - Epoxy coated reinforcement shall conform to the requirements of ASTM A 882.

02515.50 Tendon Duct - Provide rigid galvanized steel ducts for post-tensioned structures. Transition couplings connecting rigid ducts in anchoring devices need not be galvanized.

Rigid ducts may be fabricated with either welded or interlocking seams. Galvanizing of the welded seam is not required. Provide ducts with sufficient strength to maintain their correct alignment during placing of concrete and resist denting during construction.

Minimum wall thickness of ducts shall be 26 gauge for 2 5/8 inch diameter and smaller ducts, and 24 gauge for ducts that are larger than 2 5/8 inch diameter.

02515.60 Couplings - Provide couplings that develop at least 95% of the minimum specified ultimate strength of the prestressing steel without exceeding anticipated set. The coupling of tendons shall not reduce the elongation at rupture below the requirements of the tendon itself.

02515.70 Shipping Protection - Package prestressing steel to protect the steel against physical damage and corrosion. Place a corrosion inhibitor that prevents rust or other results of corrosion in the package, or use a corrosion inhibitor type packaging material, or when allowed, apply directly to the steel. Provide a corrosion inhibitor that has no deleterious effect on the steel or concrete or bond strength of steel to concrete. Immediately replace or restore damaged packaging.

Mark the shipping package with the type of corrosion inhibitor used, and the date packaged.

02515.80 Acceptance - Acceptance of pre-stressing 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 pre-stressed 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 specified in AASHTO M 160 (ASTM A 6).

(b) Steel Pipe Piles - Steel pipe piles shall be either spirally welded or longitudinally welded, constant in section and conforming to ASTM A 252, Grade 2. Seal tips with a 1 inch thick steel plate or an approved cast steel point welded in place, when specified. Concrete used to fill steel pipe pile shall be Class 3300 - 1 1/2, 1, or 3/4.

(c) Steel H-Piles - Steel H-piles shall be rolled steel pile sections of the size and weight shown. Steel shall conform to the requirements of ASTM A 36. The manufacturer's name, brand or trademark may be shown by die stamping in the web at intervals not exceeding 20 feet along the length of the pile.

(d) Steel Sheet Piles - Steel sheet piles shall conform to AASHTO M 202 (ASTM A 328).

(e) Reinforced Pile Tips - Steel pile tip reinforcement includes H-pile points, pipe pile shoes or points or any other proprietary steel pile tip reinforcement. Legibly mark or tag each cast steel point or shoe delivered to the project site with the heat or lot number. Submit certified mill test reports showing the physical and chemical properties of each heat or lot number. If the heat or lot number cannot be read on the point or if the mark or tag is missing, the point or shoe will be rejected.

Provide reinforced tips for steel H-piles from the QPL. In addition, all cast steel points or shoes shall conform to the following:

ASTM A 27, Grade 65 - 35
ASTM A 27, Grade 70 - 36
ASTM A 27, Grade 70 - 40
ASTM A 148, all grades

For steel H-piles provide no less than a 5/16 inch fillet weld full width of each flange.

(f) Sampling and Field Testing Pile Tips - The Engineer may randomly sample from each heat or lot number, at least one pile tip or up to 10% of the tips for larger projects, of the pile tips delivered for incorporation into the project.

The selected tip(s) shall be tested as follows:

- Grind five smooth spots on each randomly selected tip. The Engineer will test each smooth spot on each tip with a portable hardness tester or in a laboratory. If three or more of the five spots tested have a reading below 74 on the "B" scale, the tested tip and the entire lot shall be rejected.

- For steel H-piles, determine the weight of the tip(s). Each cast steel H-pile point shall have a weight not less than 30% of the weight of a 1 foot section of the H-pile to which it will be attached. If any of the tested tips fail to pass the minimum weight criteria the entire lot shall be rejected.

Pile tips that are supplied unattached to the pile may be selected for nondestructive testing as described above. Pile tips passing the field test may be incorporated into the project. Pile tips selected for testing that are supplied already attached to the pile will be destructively tested as determined by the Engineer. Provide replacement tips for the tips that are destructively tested at no cost to the Agency. Replace rejected tips with new tips and rejected lots with new lots at no additional cost to the Agency. No time extension or other compensation will be granted for materials or work required in testing pile tips, replacing rejected pile tips or for replacing tips that are destructively tested. New tips and new lots may also be tested according to the requirements above.

02520.20 Prestressed Concrete Piles:

(a) General - Prestressed concrete piles shall be manufactured according to Section 00550 and as shown.

(b) Concrete - Concrete in precast, prestressed piles shall be Class 5000 - 1 or 3/4. Minimum concrete strength at transfer of prestressing force shall be 4,000 psi. Concrete in pile extensions or "build-ups" shall be Class 3300 - 1 1/2, 1, or 3/4.

(c) Prestressing Reinforcement - Prestressing reinforcement steel shall consist of seven-wire, low-relaxation strands conforming to 02515.10.

(d) Mild Steel Reinforcement - Spiral reinforcement shall be plain reinforcing steel meeting the requirements of 02510.10 or cold-drawn wire meeting the requirements of 02510.60. All other mild reinforcing steel shall meet the requirements of AASHTO M 31 (ASTM A 615), Grade 60.

(e) Forms - The use of steel forms on concrete founded casting beds is required. Forms shall enclose all except the top horizontal surface, and shall be mortar-tight. Forms for piles shall not cause the formation of fins at the intersection of surfaces.

(f) Tolerances - The maximum sweep (deviation of straightness measured along 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 per 20 feet.

(g) Finish - The tops of concrete castings shall be given a uniformly smooth finish to match the finish surface of the formed sides.

02520.30 Acceptance - Material for piles will be accepted according to 00165.35 and this Section.

Section 02530 - Structural Steel

Description

02530.00 Scope - This Section includes the requirements for structural steel used in the fabrication of bridges and non-bridge structures.

Materials

02530.10 Structural Steel for Bridges - Structural steel for bridges shall conform to the following, as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)
- AASHTO M 270, Grade 50 (ASTM A 709, Grade 50)
- AASHTO M 270, Grade 50W (ASTM A 709, Grade 50W)
- AASHTO M 270, Grade HPS 70 (ASTM A 709 Grade HPS 70)
- AASHTO M 270, Grade HPS 70W (ASTM A 709 Grade HPS 70W)

Supplementary Requirement S4 (AASHTO M 270 (ASTM A 709)) Fracture-Critical, *F*, Material; Toughness Testing and Marking, is mandatory for all fracture critical steel. Toughness requirements for all areas of Oregon shall be according to Zone 2 requirements.

Supplementary Requirement S6, Limitation on Weld Repair, is mandatory for all fracture critical steel.

Supplementary Requirement S2, Product Analysis, of AASHTO M 160 (ASTM A 6) is mandatory for all steel plate that will be welded. The product analysis shall be on a heat frequency. It shall include all elements listed in Table A of AASHTO M 160 (ASTM A 6), regardless of the material specification, except that nitrogen need not be reported unless specified in the product specification. The product analysis shall be submitted to the Engineer immediately upon receipt of the steel.

02530.20 Structural Steel for Non-Bridge Structures - Structural steel for metal sign structures and other non-bridge structures shall conform to the following, or as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)
- ASTM A 36
- AASHTO M 270, Grade 50 (ASTM A 709, Grade 50)
- ASTM A 572

Notch toughness of all structural steel members and plates greater than 1/2 inch thick in load carrying members of sign bridges and cantilever sign supports shall conform to Zone 2 requirements of AASHTO M 270.

02530.40 Ultrasonic Inspection of Plate - Ultrasonically inspect flanges 2 inches and thicker for welded plate girders before fabrication according to ASTM A 578 except as follows:

- Section 7, Acceptance Standard - Level A, and Section 8, Acceptance Standard - Level B, do not apply. Use Supplementary Requirement S2.1 for acceptance standard.
- Inspection of flanges of rolled shapes with flanges thicker than 1 3/4 inches.

02530.50 Universal Mill Plate - Universal mill plate shall not be used.

02530.60 Rolled Shapes - With the approval of the Engineer, rolled shapes having equal or greater section properties and meeting minimum flange and web thickness requirements may be substituted for members specified on the plans, at no additional cost to the Agency.

02530.70 Galvanizing - Galvanizing shall be by the hot-dip process according to the following, as applicable:

- AASHTO M 111 (ASTM A 123)
- AASHTO M 232 (ASTM A 153)

Steel that will be finished by hot-dip galvanizing for use as sign bridges, illumination poles, traffic signal poles, sign supports, bridge rail and items designated on the plans as "Galvanize - Control Silicon" shall have controlled silicon content. The silicon content shall be in either of the ranges 0 - 0.04% or 0.15% - 0.25%. Before galvanizing, submit mill test certificates verifying silicon content to the Engineer and the galvanizer.

02530.71 Repair of Hot-Dip Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A 780 and ASTM A 123. Minimum zinc content for Method A2 is 94% on the dry film.

02530.80 Acceptance - Acceptance of structural steel will be according to 00165.35 and this Section.

Section 02540 - Forgings, Shafting, Castings, and Nonferrous Materials

Description

02540.00 Scope - This Section includes the requirements for forgings, shafting, castings, and nonferrous materials except those used in potable water systems. For potable water system requirements, see Sections 02470, 02475, 02480, and 02490.

Materials

02540.10 Steel Forgings - Steel forgings shall conform to the following:

Carbon steel forgings ..... AASHTO M 102 (ASTM A 668), Class C
Alloy steel forgings ..... AASHTO M 102 (ASTM A 668), Class G

02540.20 Steel Shafting - Steel shafting shall be cold-finished and shall conform to AASHTO M 169 (ASTM A 108), Grades 1016 - 1030, inclusive.

02540.30 Steel Castings - Steel castings shall conform to the following:

Carbon steel castings.....AASHTO M 103 (ASTM A 27), Grade 70-36
Alloy steel castings.....AASHTO M 163 (ASTM A 743), Grade CA-15

Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Allowance will be made in dimensions for reasonable pattern draft.

Castings shall be boldly filleted at angles and the arises shall be sharp and perfect.

Sandblast castings or otherwise effectively clean of scale and sand to present a smooth, clean and uniform surface.

02540.40 Iron Castings - Iron castings shall conform to the following:

- **Gray Iron Castings** - AASHTO M 105, Class 35 with the test bar size, A, B, C, or S as appropriate to the dimensions of the casting.

- **Ductile Iron Castings** - ASTM A 536, Grade 60-40-18, or as specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing over 1,000 pounds.

- **Malleable Iron Castings** - ASTM A 47, Grade 32510.

Finish iron castings according to 02540.30.

Clean iron castings according to 02540.30.

02540.50 Nonferrous Materials - Nonferrous materials shall conform to the following:

Bronze castings.....AASHTO M 107 (ASTM B 22) Copper Alloy UNS No. C91100
Copper alloy plates.....AASHTO M 108 (ASTM B 100) Copper Alloy UNS No. C51000

02540.60 Acceptance - Acceptance of forgings, shafting, castings, and nonferrous materials will be according to 00165.35 and this Section.

Section 02560 - Fasteners

Description

02560.00 Scope - This Section includes the requirements for fasteners.

Materials

02560.10 Carbon Steel Fasteners:

(a) Bolts - Carbon steel bolts shall conform to ASTM A 307, Grade A or B.

(b) Nuts - Nuts for carbon steel bolts shall conform to the requirements of the following, or equivalent:

Plain (Noncoated) Bolts:

- 1/4" - 1 1/2" - AASHTO M 291 (ASTM A 563), Grade A, hex
- Over 1 1/2" - 4" - AASHTO M 291 (ASTM A 563), Grade A, heavy hex

Galvanized Bolts:

- All - AASHTO M 291 (ASTM A 563), Grade A, C, D, or DH, heavy hex

(c) Washers - Washers for carbon steel bolts shall conform to ASTM F 436.

02560.20 High-Strength Fasteners:

(a) Bolts - High-strength bolts shall conform to AASHTO M 164 (ASTM A 325). High-strength bolts used in noncoated weathering steel connections shall be Type 3.

(b) Nuts - Nuts for high-strength bolts shall conform to the requirements of the following, or equivalent:

Type 1 Plain (Noncoated) Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade C, D, or DH

Type 1 Galvanized Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade DH

Type 3 Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade C3 or DH3

(c) Washers - Washers for high-strength bolts shall conform to ASTM F 436. Use Type 3 washers with Type 3 bolts.

(d) Direct Tension Indicators - Direct tension indicators shall be the compressible-washer type, mechanically galvanized, conforming to ASTM F 959. Adjust bolt lengths to accommodate both direct tension indicators and hardened washers.

(e) Markings - All bolts, nuts, washers and direct tension indicators shall be marked according to the appropriate AASHTO/ASTM specifications and with a symbol identifying the manufacturer.

(f) Lock-Pin and Collar Fasteners - The shank and head of high-strength steel lock-pin and collar fasteners shall meet the requirements of 02560.20(a) and the chemical composition and mechanical property requirements of AASHTO M 164 (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, Grade C.

(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 - Heavy Hex AASHTO M 291 (ASTM A 563), Grade A

Galvanized Carbon Steel Tie Rods and Anchor Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade A, C, D, or DH

Plain Or Galvanized High-Strength Tie Rods or Anchor Bolts:

- All - Heavy Hex AASHTO M 291 (ASTM A 563), Grade DH

(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 AASHTO M 111 (ASTM A 123) or AASHTO M 232 (ASTM A 153) as appropriate to the product.

When specified, mechanically galvanize fasteners according to ASTM B 695, Class 50, Type 1.

Match galvanized bolts, tie rods, and anchor 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 AASHTO M 291 (ASTM A 563).

Measure the zinc thickness on the wrench flats or top of bolt head of galvanized bolts and on the wrench flats of galvanized nuts.

(b) Galvanizing of Direct Tension Indicators - All galvanized compressible washer type direct tension indicators shall be mechanically galvanized according to ASTM B 695, Class 50, Type 1, by the manufacturer.

(c) Repair of Hot-Dip Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A 780. Minimum zinc content for Method A2 is 94% on the dry film.

Testing

02560.60 Testing:

(a) Rotational Capacity Test - Test all high-strength fasteners, except anchor 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:

$$T = 0.25\ PD$$

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, rods, and nuts after galvanizing, overtapping and lubricating. Coated bolts, rods, and nuts may be tested before coating.

Wedge test all bolts according to ASTM F 606, paragraph 3.5, with frequency of testing according to AASHTO M 164 (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 three extra high strength bolt assemblies per size per lot for check testing.

Provide one extra high strength tie rod and 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 shall be "oily" to the touch when installed.

Lubricate galvanized fasteners using commercial wax and coated fasteners using commercial water-soluble wax. Lubricants for galvanized and coated fasteners shall be from the QPL.

Field lubricate galvanized bolts in tapped holes, galvanized anchor rods, and galvanized tie rods with a lubricant from the QPL. 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 relubricate 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 requirements for composite bearings.

Materials

02570.10 Materials - Provide materials meeting the following requirements:

Structural Steel 02530.20
Stainless Steel Sliding Surfaces .....ASTM A 240, Type 304
Flat Brass Rings for Pot Bearings .....ASTM B 36, half hard
Cap Screws ..... ASTM A 574 or ASTM F 835
Bolts and Nuts .....AASHTO M 164 (ASTM A 325) and Section 02560
Galvanized Bolts, Nuts, Washers, Cap screws,
Sole Plates and Base Plates .....02530.70 and 02560.40
Woven Polytetrafluoroethylene (PTFE) ..... section 18 of the current AASHTO LRFD Bridge Construction Specifications

Welded Stainless Steel Overlay - Produce welded stainless steel overlay for the convex rotational surface of spherical bearings using Type 309L electrodes.

Elastomer - Elastomer for elastomeric discs of pot bearings shall be 100% virgin natural polyisoprene (natural rubber) or 100% virgin chloroprene (neoprene) meeting the following requirements:

NATURAL POLYISOPRENE (Natural Rubber):

Physical Properties	ASTM Test Method	Value
Hardness, Durometer D	D 2240	50 ± 5
Tensile strength, minimum, psi	D 412	2,250
Ultimate elongation, minimum, %	D 412	450
Heat Resistance		
Change in durometer hardness, maximum points	D 573 70 hour at 158 °F	+ 10
Change in tensile strength, maximum, %		- 25
Change in ultimate elongation, maximum, %		- 25
Compression Set		
22 hours at 158 °F, maximum, %	D 395, Method B	25
Ozone		
25 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F 48 hours mounting Procedure D518, Procedure A	D 1149	No Cracks

Adhesion		
Bond made during vulcanization, lb/in	D 429 Method B	40
Low Temperature Test		
Brittleness at -40 °F	D 746 Procedure B	No Failure

VIRGIN CHLOROPRENE (Neoprene):

Physical Properties	**ASTM Test Method**	**Value**
Hardness, Durometer D	D 2240	50 ± 5
Tensile strength, minimum, psi	D 412	2,250
Ultimate elongation, minimum, %	D 412	400
Heat Resistance		
Change in durometer hardness, maximum points	D 573 70 hour at 212 °F	+ 15
Change in tensile strength, maximum, %		- 15
Change in ultimate elongation, maximum, %		- 40
Compression Set		
22 hours at 212 °F, maximum, %	D 395, Method B	35
Ozone		
100 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F 100 hours mounting Procedure D518, Procedure A	D 1149	No Cracks
Adhesion		
Bond made during vulcanization, lb/in	D 429 Method B	40
Low Temperature Test		
Brittleness at -40 °F	D 746, Procedure B	No Failure

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:

Property	Test Method	Range of Values
Hardness, Durometer D	ASTM D 2240	62 ± 2
Tensile stress, psi		
at 100% elongation	ASTM D 412	2,300 min.
at 200% elongation		4,000 min.
Tensile strength	ASTM D 412	6,000 min.
Ultimate elongation %	ASTM D 412	220 min.
Compression set, 22 hrs.		
at 158 °F	ASTM D 395	40 max.

Fabric Pads - Make preformed fabric pads for fabric pad bearings of multiple layers of duck, impregnated and bound with high quality oil resistant synthetic rubber compressed into resilient pads of uniform thickness according to the following:

- Cotton duck reinforcement shall be either a two-ply cotton yarn or a single-ply 50-50 blend cotton polyester weighing a minimum of 8 ounces per square yard.
- The fabric shall have a minimum tensile strength of 150 pounds per inch width when tested by the grab method.
- The filling count of the duck shall be 40 ± 2 threads per inch.
- The warp count of the duck shall be 50 ± 1 threads per inch.
- The number of plies shall produce the specified thickness after compression and vulcanizing.
- The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi without any sign of distress after the load is removed. The tested pad shall have a shape factor greater than 2.5. The preformed fabric pad shall have a Shore A hardness of 90 ± 5.

02570.20 Testing - The manufacturer shall have a typical bearing either tested and certified by an independent testing laboratory, or shall test a typical bearing with the test witnessed and attested to by an independent testing laboratory, for compliance with specified performance requirements as listed below. Tests shall have been performed within five years before Award of the Contract. Provide a test results certificate according to 00165.35 with the submittal of shop drawings.

(a) Friction Test - The coefficient of friction between the sliding surfaces shall not be greater than 0.06 when the maximum working stress for the polytetrafluoroethylene (PTFE) surface is 2,000 psi. It shall not be greater than 0.045 when the maximum working stress for the PTFE surface is above 3,000 psi. Determine the coefficient of friction at 68 °F according to the requirements of section 18.3.4.3.2 of the AASHTO LRFD Bridge Construction Specifications.

(b) Proof Load Test:

(1) Vertical Proof Load Test - Apply a vertical load equal to 150% of the vertical design capacity of the tested bearing for a period of one hour. Place the bearing in a rotated position during the test. Rotation shall be 0.015 radians or the design rotation, whichever is greater. The test bearing shall show no indication of failure or other defects such as weld cracking, plate distortion, extrusion of the elastomer or bearing material, or displacement of the elastomer seal while under load or subsequently upon disassembly and inspection.

The bearing tested for vertical proof load shall have a vertical design capacity no more than 50% greater or no less than 50% smaller than the capacity of the required bearing. The successful test of a bearing with a vertical design capacity of 50 tons or less will be accepted as qualification for all bearings of a similar design with a lesser design capacity.

(2) Horizontal Proof Load Test - A horizontal proof load test is required when the design horizontal capacity exceeds 10% of the design vertical capacity and no engineer's calculations are submitted. Apply a horizontal load equal to 100% of the horizontal design capacity while also applying a vertical load equal to 100% of the dead load for a period of 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 requirements for plain and laminated elastomeric bearing pads.

Materials

02571.10 Elastomeric Compound - The elastomer portion of the elastomeric compound shall be 100% virgin chloroprene (neoprene) meeting the requirements of section 18 of the AASHTO LRFD Bridge Construction Specifications including the properties from the following table:

Table 02571-1

Properties	ASTM Test Method	Requirements
Hardness, Durometer D	D 2240	60 ± 5
Tensile strength, min., psi	D 412	2,250
Ultimate elongation, min., %	D 412	350
Heat Resistance:		
Change in durometer hardness max. points after 70 hr. at 212 °F	D 2240	+ 15
Change in tensile strength, max. % after 70 hr. at 212 °F	D 573	- 15
Change in ultimate elongation, max. % after 70 hr. at 212 °F	D 573	- 40
Compressive set, max. % after 22 hr. at 212 °F	D 395 Method B	35
Adhesion: Bond made during vulcanization, lb/in	D 429 Method B	40
Tear Resistance, (psi)	D 624 Die C	180

02571.15 Metal Reinforcement - Metal reinforcement shall be rolled, mild steel sheets 14 gauge thick and conforming to ASTM A 1011, Grade 36 Type 1, or ASTM A 1008, Grade 40.

02571.20 Manufacturing Requirements:

(a) Pads - Pads 1/2 inch thick shall be all elastomer. Pads over 1/2 inch thick shall consist of alternate laminations of elastomer and metal.

In metal reinforced pads, the top and bottom layers shall be elastomer 1/4 inch thick, and interior elastomer layers shall be 1/2 inch thick. The nominal thickness of the bearing shown reflects the thickness of the elastomer only. It does not include the steel laminates.

(b) Laminations - Laminations of elastomer shall be of uniform thickness and in no case shall the thickness of an individual lamination exceed 5/8 inch. Variations in thickness of an individual elastomer lamination shall not exceed 1/8 inch and the variation in thickness of all elastomer laminations within a pad shall be such that each metal lamination shall not vary by more than 1/8 inch from a plane parallel to the top or bottom surface of the pad.

(c) Laminated Pads - Laminated pads shall be molded individually to the sizes required. No shearing to size or drilling of holes will be allowed. Cover all edges of metal laminations with a minimum of 1/8 inch, and a maximum of 1/4 inch, of elastomer except at laminate restraining devices and around holes that will be entirely closed when the pad is in place on the structure.

Clean the exposed edge voids in the pads caused by the steel laminate restraining devices with a solvent. Shop seal with an appropriate caulking material before shipment.

Sandblast and clean the steel laminates of all surface coatings such as grease, oil, rust and mill scale before bonding. Free the laminates of sharp edges and burrs.

Pads 1/2 inch in thickness may be sheared. The shearing shall not heat the material and shall produce a smooth finish to 250 microinches with no tears or jagged areas.

(d) Dimensional Tolerances and Finishes - See section 18 of the AASHTO LRFD Bridge Construction Specifications for fabrication tolerances.

Fabricate pads to meet flash tolerance, finish and appearance requirements given in the current edition of the Rubber Handbook, published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings.

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.

Independently test all completed bearings by compressive visual inspection according to 02571.30(b). Failure of individual bearings to pass the compressive visual inspection will be cause for rejection of those individual bearings.

Independently test five standard test specimens of laminated pads according to 02571.30(c). Failure of any individual specimen to meet the peel strength test requirements will be cause for rejection of the entire bearing production lot. A lot is defined as 50 or less bearings which are manufactured in a reasonably continuous manner from the same batch of elastomer, cured under the dame conditions, and are all the same size and type.

Replace rejected bearings with new acceptable bearings at no additional cost to the Agency. Provide the sample pad and perform all testing at no additional cost to the Agency.

Mark all bearings in indelible ink or flexible paint with the Contract number, lot number, date of manufacturer, and bearing identification number. Place the marking on a side face visible after erection of the bridge.

Clean and free the bearings of any foreign substances such as dust, grit and moisture before testing.

(b) Short-Duration Compression Test - Bring all bearings to a temperature of 73 °F ± 10 °F and proof load for a compressive loaded to 1.5 times the maximum design load. The load shall be held for five minutes, removed, then reapplied for a second period of five minutes. Maintain the load constant while the bearing is inspected for visual faults. The following will be cause for rejection:

- A bulging pattern or patterns implying lack of bond between the elastomer and the laminate or bulging patterns that imply improper laminate placement.
- Three separate surface cracks which are greater than 5/64 inch wide and 5/64 inch deep, or a single crack 3/16 inch deep or wider than 1/4 inch.

(c) Peel Strength Test - Perform a peel strength test according to ASTM D 429 Method B, with the exception that the specimens shall be taken randomly and cut from a production bearing submitted for the Project. The bond between the elastomer and steel laminate in each specimen shall be not less than 40 pounds per inch.

(d) Long Duration Compression Test - Perform long term duration compression tests according to the requirements of AASHTO LRFD Construction Specifications when steel reinforced elastomeric bearings are designed using Method B, or when using Grade 4 elastomer.

02571.31 Acceptance - Provide a quality compliance certification according to 00165.35 that the bearing pads conform to the requirements for materials, fabrication and testing. Provide a test result certificate according to 00165.35 that includes the manufacturer's and independent 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 shall be determined according to AASHTO T 27. The material shall meet the following gradation requirements:

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	54 - 82
No. 10	34 - 56
No. 40	9 - 17
No. 100	0 - 3

(b) Sand Equivalent - Special filter material shall be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

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 shall be determined according to AASHTO T 27. The aggregates shall conform to one of the grading requirements of Table 02630-1 as identified in the Special Provisions or indicated by the pay item(s) in the Contract Schedule of Items.

Table 02630-1

Grading Requirements for Dense-Graded Aggregate

	Separated Sizes				
Sieve Size	**2 1/2" - 0**	**2" - 0**	**1 1/2" - 0**	**1" - 0**	**3/4" - 0**
	Percent Passing (by Weight)				
3"	100				
2 1/2"	95 - 100	100			
2"	–	95 - 100	100		
1 1/2"	–	–	95 - 100	100	
1 1/4"	55 - 75	–	–	–	
1"	–	55 - 75	–	90 - 100	100
3/4"	–	–	55 - 75	–	90 - 100
1/2"	–	–	–	55 - 75	–
3/8"	–	–	–	–	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 10	[1]	[1]	[1]	[1]	[1]

[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 shall 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 Percent of Fractured Particles (by Weight of Material)

Designated Size	**Retained on 1/4 inch Sieve**
1 1/2" - 0 and larger	50
Smaller than 1 1/2" - 0	70

(c) Durability - Dense-graded aggregate shall meet the following durability requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35.0% maximum
Degradation (coarse aggregate)		
Passing No. 20 sieve	ODOT TM 208	30.0% maximum
Sediment Height	ODOT TM 208	3.0" maximum

(d) Sand Equivalent - Dense-graded aggregate shall 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 02630-2

Aggregate Gradation for Open-Graded Aggregate

Sieve Size	Percent Passing (by Weight)
1"	100
3/4"	80 - 98
1/2"	60 - 85
3/8"	30 - 65
No. 10	5 - 20
No. 40	0 - 6
No. 100	0 - 3 (Dry Sieve)

(b) Fracture of Rounded Rock - Fracture of rounded rock shall be determined according to AASHTO TP 61. Open-graded aggregate fracture requirements shall conform to the following:

Percentage of Fracture (by Weight)

Material Retained on 3/4", 1/2", and 1/4" Sieves (two fractured faces) 90
Material Retained on No. 10 Sieve (one fractured face) 75

(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 shall 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 identified in the Special Provisions or indicated by the pay item in the Contract Schedule of Items.

Table 02640-1

Grading Requirements - Shoulder Aggregates

	Separated Sizes	
	1" - 0	3/4" - 0
Sieve Size	Percent Passing (by Weight)	
1 1/2"	100	
1"	90 - 100	100
3/4"	–	90 - 100
1/4"	40 - 55	40 - 60

(b) Fracture of Rounded Rock - Fracture of rounded rock shall 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 Percent of Fractured Particles (by Weight of Material)

Designated Size	Retained on 1/4" Sieve
1 1/2" - 0 and larger	50
Smaller than 1 1/2" - 0	50

(c) Durability - The produced aggregates shall meet the following requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35.0% maximum
Degradation (coarse aggregate) Passing No. 20 sieve	ODOT TM 208	30.0% maximum
Sediment Height	ODOT TM 208	3.0" maximum

(d) Sand Equivalent - Shoulder aggregate shall be tested according to AASHTO T 176, and shall have a sand equivalent of not less than 25.

Section 02690 - PCC Aggregates

Description

02690.00 Scope - This Section includes the requirements for coarse and fine aggregates for portland cement concrete.

Materials

02690.10 Materials - The Contractor may request approval to produce coarse and fine aggregates in sizes other than those stated in 02690.20 and 02690.30. The request shall be in writing, and shall state the proposed target value and specified tolerances for each of the individual sieve sizes of the materials the Contractor proposes to produce.

02690.20 Coarse Aggregate:

(a) General Requirements - Coarse aggregate shall consist of rock, or other approved inert material of similar characteristics having hard, strong, durable pieces free from adherent coatings.

(b) Harmful Substances - Harmful substances shall not exceed the following limits:

Test	Test Method ODOT	Test Method AASHTO	Percent (by Weight)
Lightweight Pieces		T 113	1.0
Material passing No. 200 sieve		T 11	1.0 [1]
Wood Particles	TM 225		0.05

[1] For crushed aggregates, if the material finer than the No. 200 sieve consists of fracture dust, essentially free of clay or shale and is non-plastic, the percentage may be increased to 1.5%.

The materials shall be reasonably free from all other deleterious substances.

(c) Soundness - Coarse aggregates for concrete shall be tested for soundness using sodium sulfate salt, according to AASHTO T104. The weighted percentage loss shall not exceed 12% by weight.

(d) Durability - Coarse aggregates shall meet the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Requirements
Abrasion		T 96	30.0% Max.
Oregon Air Aggregate Degradation:			
Passing No. 20 sieve	TM 208		30.0% Max.
Sediment Height	TM 208		3.0" Max.

(e) PCC Paving Aggregate - In addition to requirements above, comply with the following:

(1) Fracture - Provide aggregate with at least two fractured faces on at least 50% of the particles retained on the 3/8 inch, 1/2 inch, 3/4 inch, 1 inch, and 1 1/2 inch sieves, as determined by AASHTO TP 61.

(2) Elongated Pieces - Provide aggregate with elongated pieces not exceeding 10% by weight of the material retained on the No. 4 sieve when tested according to ODOT TM 229 with the proportional caliper device set at a ratio of 5:1.

(f) Grading and Separation by Sizes for Prestressed Concrete - Sampling shall be according to AASHTO T 2 and sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. PCC coarse aggregate shall conform to grading and separated sizes as follows:

(1) Where indicated in Table 02690-1, the coarse aggregate shall be separated into two sizes and each separated size shall be measured into the batch in the quantity determined by the mix design.

For each of the indicated maximum sizes of coarse aggregates, the separated sizes shall be as indicated in Table 02690-2:

Table 02690-1

Maximum Nominal Size of Aggregates	Separated Sizes
1"	1" - No. 4
3/4"	3/4" - No. 4
3/4"	3/4" - 1/2" and 1/2" - No. 4
3/4"	3/4" - 3/8" and 3/8" - No. 4

(2) The grading of each of the specified separated sizes of coarse aggregate shall conform to the following:

Table 02690-2

	Separated Sizes					
Sieve Size	**1" - No. 4**	**3/4" - No. 4**	**3/4" - 1/2"**	**3/4" - 3/8"**	**1/2" - No. 4**	**3/8" - No. 4**
	Percent Passing (by Weight)					
1 1/2"	100					
1"	90 - 100	100	100	100		
3/4"	50 - 80	90 - 100	85 - 100	85 - 100	100	100
1/2"	–	–	0 - 15	–	85 - 100	–
3/8"	15 - 40	20 - 50	–	0 - 15	35 - 65	85 - 100
No. 4	0 - 10	0 - 10	–	–	0 - 15	0 - 15
No. 200	[1]	[1]	[1]	[1]	[1]	[1]

[1] See 02690.20(b)

(g) Grading and Separation by Sizes for Other Concrete - Sampling shall be according to AASHTO T 2. Sieve analysis shall be according to AASHTO T 27 and AASHTO T 11. Provide aggregates meeting the gradation requirements of Tables 02690-3 and 02690-4 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

Sieve Size	Combined [1] Sizes 1 1/2" - No. 4	Separated Sizes 1 1/2" - 3/4"	Separated Sizes 1" - No. 4	Separated Sizes 3/4" - 1/2"
		Percent Passing (by Weight)		
2"	100	100		
1 1/2"	95 - 100	90 - 100	100	
1"	–	20 - 55	95 - 100	100
3/4"	35 - 70	0 - 15	–	85 - 100
1/2"	–	–	25 - 60	0 - 15
3/8"	10 - 30	0 - 5	–	–
No. 4	0 - 5	–	0 - 10	–
No. 8	–	–	0 - 5	–

[1] For 1 1/2 inch coarse aggregate use two or more separated sizes which when combined shall meet the gradation limits for 1 1/2" - No. 4

Table 02690-4

Gradation of Coarse Aggregates

Sieve Size	Separated Sizes 3/4" - 3/8"	Separated or Combined Sizes 3/4" - No. 4	Separated Sizes 1/2" - No. 4	Separated Sizes 3/8" - No. 8
		Percent Passing (by Weight)		
1"	100	100		
3/4"	90 - 100	90 - 100	100	
1/2"	20 - 55	–	90 - 100	100
3/8"	0 - 15	20 - 55	40 - 70	85 - 100
No. 4	0 - 5	0 - 10	0 - 15	10 - 30
No. 8	–	0 - 5	0 - 5	0 - 10
No. 16	–	–	–	0 - 5

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:

Test	Test Method (AASHTO)	Percent (by Weight)
Lightweight Pieces	T 113	2.0%
Material passing No. 200 Sieve [1]	T 11	4.0% [1]

[1] If this material consists of fracture dust, essentially free of clay and non-plastic, the percentage may be increased to 6.0%.

The material shall also be reasonably free from all other harmful substances, such as shale, alkali, mica, coated grains, and soft and flaky particles.

(d) Soundness - Fine aggregate shall be tested for soundness using sodium sulfate salt, according to AASHTO T 104. The weighted percentage loss shall not exceed 10% by weight.

(e) Organic Impurities - All fine aggregate shall meet the requirements of AASHTO M 6 for organic impurities.

(f) Sand Equivalent - Fine aggregate shall be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 68.

(g) Sand For Mortar - Sand for mortar shall conform to the requirements of this Section.

(h) Grading - Sampling shall be according to AASHTO T 2. Sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. Provide aggregates meeting the gradation requirements of Table 02690-5 for structural concrete on projects with more than 100 cubic yards of concrete, and all prestressed concrete. Provide a CAgT to perform sampling and testing when required.

Table 02690-5

Gradation of Fine Aggregate [1]

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	90 - 100
No. 8	70 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30
No. 100	0 - 10
No. 200	0.0 - 4.0 [2]

[1] Determine the fineness modulus according to AASHTO T 27 and AASHTO T 11. Maintain the fine aggregate fineness modulus within plus or minus 0.20 from the fineness modulus used in the Contractor's mix design. Fine aggregates in which the fineness modulus varies by more than 0.20 from the mix design target shall be rejected unless an adjustment in the aggregate proportions is performed by a CCT according to the provisions of ACI 211.

[2] For manufactured sand, where the material passing No. 200 is non-plastic rock dust crusher fines, the specification limits may be increased to 6%.

Section 02695 - Reclaimed Glass (Mixed Waste Cullet)

Description

02695.00 Scope - This Section includes the requirements for reclaimed glass (mixed waste cullet) as a substitute for aggregates.

Materials

02695.10 Mixed Waste Cullet - Cullet shall be 1/2" - 0. It shall be clean, hard, and durable. Not more than 5% by weight shall pass a No. 200 sieve.

The maximum debris level shall be 10% except as noted below. Debris is defined as any deleterious material that impacts the performance of the backfill. Percent of debris shall be estimated.

02695.20 Cullet Applications:

Use	Maximum Cullet Content (%)	Maximum Debris Level (%)	Minimum Compaction Level (%)
Nonstructural Fill	100	10	90

02695.41 Hauling and Placing - Transport the cullet to the Project Site, add water to obtain the proper moisture content, and place in the trench by means acceptable to the Engineer, in loose lifts of 8 inches or less.

02695.43 Compacting and Shaping - Compact each layer of material by steel wheel vibratory rollers or as directed.

02695.50 Testing - The Engineer will check gradation and density by laboratory or field testing as deemed appropriate. Impurities will be checked visually by sampling a specimen of processed cullet with a weight of approximately 1/2 pound.

Railing and Guidance Devices

Section 02810 - Bridge Rail

Description

02810.00 Scope - This Section includes the requirements for the steel in railings for bridges.

Materials

02810.10 Shapes, Plates, and Bars - Shapes, plates and bars shall comply with ASTM A 36.

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be according to 02530.70.

02810.20 Structural Steel Tubing - Structural steel rail members shall comply with ASTM A 500, Grade B, or ASTM A 501. Steel conforming to ASTM A 513 or ASTM A 618 may be substituted for ASTM A 500 tubing subject to the following limitations:

- Provide chemical and tensile properties test results.
- Silicon content shall be according to 02530.70.
- Strength and elongation requirements of ASTM A 513 tubing shall meet the requirements of ASTM A 500 tubing.

02810.30 Steel Pipe - Metal parapet rail members shall be standard steel pipe complying with ASTM A 53, Grade B or ASTM A 500, Grade B.

02810.40 Cast Steel Posts - Cast steel posts shall be carbon steel castings complying with AASHTO M 103 (ASTM A 27), Grade 65-35.

02810.50 Metal Thrie Beam Rail - Galvanize steel thrie beam rail according to AASHTO M 180, Class A rail, Type II coating after fabrication and subject to the single spot test. Backup plates will be accepted with ungalvanized edges and bolt holes, provided these areas are field-coated with an approved galvanizing substitute according to 02530.71. Metal posts and hardware shall meet the requirements of 02820.20 and 02820.30.

02810.60 Incidentals - Plates, caps and miscellaneous pieces necessary to complete the rail shall be as shown or specified.

02810.70 Acceptance - Bridge rail materials will be accepted according to 00165.35 and this Section.

Section 02820 - Metal Guardrail

Description

02820.00 Scope - This Section includes the requirements for forming galvanized steel sheets into metal beam rail, and the manufacture of guardrail hardware.

Materials

02820.10 Metal Beam Rail - Form metal beam rail from galvanized steel. Galvanized steel beam rail shall conform to the requirements of AASHTO M 180, Class A. The zinc coating shall conform to the requirements of AASHTO M 180, Type II, applied after fabrication and subject to the single spot test. Backup plates will be accepted with ungalvanized 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 and galvanized according to AASHTO M 111 (ASTM A 123).

02820.30 Guardrail Hardware - All bolts, nuts, washers and other fittings for beam type guardrail shall be galvanized steel meeting the requirements of AASHTO M 180.

All bolts, nuts, and washers shall be as detailed, with nuts tapped oversize not to exceed 1/32 inch.

02820.40 Guardrail Anchor Hardware - Provide cable and fittings for guardrail anchors that conform to the requirements of AASHTO M 30, Class C, for Type II cable. Galvanize all fittings according to AASHTO M 111 (ASTM A 123).

For steel anchors, the steel tubing shall meet the requirements of ASTM A 500, Grade B, ASTM A 501 or ASTM A 618. The soil plate shall meet the requirements of ASTM A 36. After fabrication galvanize tubing and plate according to AASHTO M 111 (ASTM A 123).

02820.50 Acceptance of Materials - Manufacturing plants may be inspected periodically for compliance with specified manufacturing methods, and material samples obtained for laboratory testing for compliance with materials quality requirements. This may be the basis for acceptance of manufacturing lots as to quality.

Acceptance of metal guardrail materials will be according to Section 00165.35 and this Section.

Section 02830 - Handrail

Description

02830.00 Scope - This Section includes the requirements for the steel in handrail for bridges and stairways.

Materials

02830.10 Shapes, Plates, and Bars - Shapes, plates and bars shall comply with ASTM A 36.

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be according to 02530.70.

02830.20 Steel Pipe - Steel pipe used for handrail members shall comply with ASTM A 53 or ASTM A 500.

02830.30 Incidentals - Plates, caps and miscellaneous pieces necessary to complete the rail shall be as shown.

02830.40 Acceptance - Acceptance of handrail materials will be according to 00165.35 and this Section.

Illumination and Traffic Control Materials

Section 02910 - **Sign Materials**

02910.00 Scope - This Section includes the requirements for backing, sheeting, legend, reflectors, and hardware for sign installations.

02910.02 Types of Signs - Traffic signs are classified by sign type as follows:

"B" Blue Type III or Type IV sheeting background with silver-white Type III or Type IV permanent or removable legend, or silver-white Type III or Type IV sheeting overlaid with blue transparent paste background with retroreflective silver-white screened legend.

"B1" Blue Type I sheeting background with silver-white Type III or Type IV permanent or removable legend, with retroreflective silver-white screened legend.

"B2" Blue Type III or Type IV sheeting background with white Type VII or Type IX permanent removable legend.

"B3" Blue Type IX sheeting background with white Type VII or Type IX permanent or removable legend or white Type IX sheeting overlaid with blue transparent paste background, with retroreflective silver-white screened legend.

"C" Brown Type III or Type IV sheeting background with silver-white Type III or Type IV permanent or removable legend, or silver-white Type III or Type IV sheeting overlaid with brown transparent paste background with retroreflective silver-white screened legend.

"C1" Brown Type III or Type IV sheeting background with white Type VII or Type IX permanent or removable legend.

"C2" Brown Type IX sheeting background with white Type VII or Type IX permanent or removable legend or white Type IX sheeting overlaid with brown transparent paste background, with retroreflective silver-white screened legend.

"F" Silver-white Type III or Type IV sheeting background overlaid with red and blue transparent paste background with retroreflective silver-white screened legend or silver-white Type III or Type IV permanent legend.

"F1" White Type IX sheeting background overlaid with red and blue transparent paste background with white Type VII or Type IX permanent legend.

"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.

"G1" Green Type III or Type IV sheeting background with white Type VII or Type IX removable legend.

"G2" Green Type III or Type IV sheeting background with white Type VII or Type IX permanent legend.

"G3" Green Type IX sheeting background with white Type VII or Type IX permanent legend, or white Type IX sheeting background overlaid with green transparent paste background with retroreflective silver-white screened legend.

"G4" Green Type IX sheeting background with white Type VII or Type IX removable legend.

"O" Orange Type I sheeting background with black nonreflective permanent or removable legend.

"OO" Orange Type III or Type IV sheeting background with black nonreflective permanent or removable legend.

"O3" Fluorescent orange Type VII, Type VIII, Type IX, or Type X sheeting background with black nonreflective permanent legend and red retroreflective symbol (Stop or Yield Ahead Symbol Sign).

"O4" Fluorescent orange Type VII, Type VIII, Type IX, or Type X sheeting background with black nonreflective permanent legend.

"O5" Fluorescent orange Type VII, Type VIII, Type IX or Type X sheeting background with black nonreflective removable legend.

"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. (Stop Sign, Wrong-Way, Do Not Enter.)

"R1" White Type IX sheeting background overlaid with red transparent paste background with white Type VII or Type IX permanent legend.

"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. (Yield Sign)

"R3" White Type IX sheeting background overlaid with screened red transparent paste triangle and permanent legend.

"R4" Rubber STOP flap made of natural rubber with a red background and white lettering.

"W1" Silver-white Type III or Type IV sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"W2" Silver-white Type III or Type IV sheeting background with a screened black nonreflective legend overlaid with a screened red transparent paste circle and continuous diagonal bar. (Prohibition)

"W3" Silver-white Type III or Type IV sheeting background with transparent brown screened legend or brown Type III or Type IV cut-out permanent legend.

"W4" Silver-white Type III or Type IV sheeting background with transparent red screened legend or red Type III or Type IV cut-out permanent legend.

"W5" Silver-white Type III or Type IV sheeting background with transparent green screened legend or green Type III or Type IV cut-out permanent legend.

"W6" White Type IX sheeting background with a screened or cut-out black nonreflective legend overlaid with a screened red transparent paste circle and continuous diagonal bar. (Prohibition sign overhead)

"W7" White Type IX sheeting background with black nonreflective screened or cut-out permanent legend.

"W8" Silver-white Type III or Type IV sheeting background with blue transparent screened legend or blue Type III or Type IV cut-out permanent legend.

"W9" Silver-white Type III or Type IV sheeting background with 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.

"W11" Silver-white Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend with red Type III or Type IV symbol. (Bicycle Stop or Bicycle Yield symbol signs)

"Y1" Yellow Type III or Type IV sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"Y2" Yellow Type III or Type IV sheeting background with a screened or cut-out black nonreflective legend and red and green Type III or Type IV circles. The center yellow circle part shall be part of the background sheeting. (Signal Ahead Symbol Sign)

"Y3" Yellow Type IX sheeting background with black nonreflective screened, cut-out permanent or removable legend.

"Y4" Yellow Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend and red Type III or Type IV symbol. (Stop or Yield Ahead Symbol Sign)

"Y5" Fluorescent yellow Type IX sheeting background with black nonreflective screened cut-out permanent legend, or removable legend.

"Y6" Fluorescent yellow Type IX sheeting background with black nonreflective screened or cut-out permanent legend and red and green Type IX circles. The center yellow circle shall be part of the background sheeting. (Signal Ahead Symbol Sign overhead)

"Y7" Fluorescent yellow Type IX sheeting background with black nonreflective screened or cut-out permanent legend and red Type VII or Type IX symbol. (Stop or Yield Ahead Symbol Sign)

"Y8" Yellow Type III or Type IV sheeting background with black nonreflective screened or cut-out permanent legend and silver-white Type III or Type IV symbol. (Speed Reduction Symbol Sign)

"YG" Fluorescent yellow-green Type IX sheeting background with black non-reflective legend or cut-out permanent legend.

"**YGW"** Fluorescent yellow-green Type IX sheeting background with black nonreflective screened or cut-out permanent legend and silver-white Type III or Type IV symbol with black nonreflective screened or cut-out permanent legend and red Type III or Type IV symbol. (In-Street Pedestrian Crossing Symbol Sign)

02910.10 Aluminum - The aluminum materials shall be new and conform to the following requirements:

Aluminum Bars or Rods	ASTM B 211
Aluminum Sand Castings	ASTM B 26
Aluminum Sheet	ASTM B 209
Extruded Aluminum Shapes	ASTM B 221
Rolled or Extruded Structural Shapes	ASTM B 308

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 Agency. Signs shall be of the thickness shown on Table 02910-1 unless otherwise indicated.

Table 02910-1

Sign Width (Horizontal Measure)	Sheet Aluminum Thickness
Less than 20"	0.063"
20" through 30"	0.080"
31" through 48"	0.100"
Over 48"	0.125"

02910.11 Plywood:

(a) General - Construct all plywood signs for permanent signing from 3/4 inch high-density overlay plywood. Construct plywood signs for temporary signs from either 3/4 inch high-density overlay plywood or 3/4 inch 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 all 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.

02910.20 Reflective and Retroreflective Sheeting:

(a) General - Use reflective sheeting Type I and retroreflective sheeting Type III, Type IV, Type VII, Type VIII, Type IX, and Type X from the QPL and the following:

(1) Perforation - If required for application, the sheeting may be pre-perforated with holes not greater than 0.02 inch in diameter. The perforations shall be approximately 0.4 inch apart in rows approximately 1.5 inches apart.

(2) Surface - The sheeting and adhesive shall be compatible with non-reflective permanent cut-out legend.

(b) Acceptance - Furnish a quality compliance certification according to 00165.35, certifying that the reflective sheeting furnished meets the above requirements.

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 00940.02. Submit for testing a 4 inch by 4 inch sample of the background color for each color of nonreflective sheeting shown.

(c) Adhesive - Adhere the nonreflective sheeting by a mildew and vandal resistant precoated adhesive that has no staining effect on the sheeting.

(d) Film:

(1) General - The nonreflective sheeting shall be flexible and easily cut to shape. The minimum tensile strength of the sheeting shall be 5 pounds per inch width.

(2) Surface - The sheeting surface shall be smooth and flat, to facilitate cleaning and wet performance. The sheeting surface shall be readily processed and compatible with recommended transparent and opaque process inks.

The sheeting shall permit cutting and color processing at minimum temperatures of 60 °F. The sheeting shall be heat resistant and shall permit force curing of applied sheeting at temperatures up to 150 °F. The sheeting surface shall be solvent resistant. Clean according to the manufacturer's recommendations.

(e) Durability - Process and apply according to the manufacturer’s recommendations. The material shall be weather resistant, and following cleaning shall show no discoloration, cracking, crazing, blistering or dimensional change.

The sheeting surface shall be capable of being readily refurbished when cleaned and clear over-coated according to the manufacturer’s recommendations.

(f) Acceptance - Furnish a quality compliance certificate according to 00165.35, certifying that the nonreflective sheeting furnished meets all the above requirements.

02910.32 Retroreflective Removable Legend:

(a) General - The letters and numerals for all removable legend shall conform to the design of the FHWA "Standard Rounded Capital Letter Alphabets". The letters and numerals for removable legend for all freeway and expressway signs shall conform to the design of Series "E" modified from the FHWA "Standard Rounded Capitol Letter Alphabets".

Provide mounting holes within the frames to permit the use of the mounting hardware specified in these Specifications. Provide a sufficient number of mounting holes to ensure a firm attachment of the frames to the sign and meet the requirements of 00940.45(b). This requires a minimum of four mounting holes at each joint in the border.

(b) Retroreflective Sheeting Legend - The silver-white or white letters, numerals, symbols and borders shall be of adhesive-coated retroreflective sheeting permanently adhered to a flat aluminum frame. The white retroreflective sheeting shall consist of Type VII or Type IX 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, alloy 3003-H14. Degrease and etch the aluminum, or treat with a light, tight amorphous chromate type coating.

Apply the reflective sheeting to the prepared aluminum according to the sheeting manufacturer's recommendations.

The finished letters, numerals, symbols and borders shall be clean-cut and sharp, and shall have a nearly plane surface.

(c) Acceptance - Acceptance of retroreflective removable legend shall be a mill test certificate from the aluminum manufacturer attesting to the correct alloy, temper, and material thickness of the metal supplied. The Engineer may reject damaged or non-specification materials regardless of the test certification furnished.

02910.33 Permanent Legends:

(a) General - Permanent legends consist of silver-white retroreflective screened, red retroreflective screened, black screened or cut-out silver-white retroreflective sheeting. The letters and numerals of all permanent legends shall conform to the design of the FHWA "Standard Rounded Capital Letter Alphabets".

(b) Retroreflective White Screened Legend - The transparent paste materials used for the reverse screening of retroreflective white legends and for the screening of retroreflective red legends shall conform to the recommendations of the manufacturer of the reflective sheeting.

(c) Retroreflective Cut-out Legend - The material used for retroreflective cut-out legend shall conform to the requirements of 02910.20.

(d) Nonreflective Black Screened Legend - The screen process ink for nonreflective legends shall be Naz-Dar 811 Black Screen Process Ink (Naz-Dar Company), Sherwin Williams Kem Screen Process, color D22-B2 (Sherwin Williams Company), or approved equal.

(e) Nonreflective Black Cut-out Legend - The material used for nonreflective cut-out legend shall conform to 02910.21.

02910.40 Hardware - The bolts, nuts, and washers used to fabricate and erect signs shall be aluminum alloy, stainless steel, or galvanized steel. Aluminum for bolts and nuts shall conform to ASTM B 211, alloys 2024-T4 or 6061-T6 as the Contractor elects. Aluminum washers shall conform to ASTM B 209, alloy Alclad 2024-T4. Stainless steel shall be Type 316. Galvanized steel bolts, nuts, and washers shall be medium carbon steel. Galvanize steel hardware according to AASHTO M 232 (ASTM A 153).

Use nylon washers supplied by the sheeting manufacturer as shown or directed.

All mounting hardware shall be of the design and type shown, or if not shown shall be of such sizes and kinds as approved by the Engineer.

Blind rivets shall be 1/8 inch diameter, 1/4 inch head diameter, domed head, aluminum alloy conforming to ASTM B 316. Aluminum alloys 5052 and 5056 are acceptable alloys. Blind rivets used to attach sign panels to closure strips or wind beams shall be anodized the same color as the sign background.

02910.60 Electronically Cuttable Films for Use on Retroreflective 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 electronically cuttable films from the QPL.

(b) Acceptance - If requested, furnish with each lot or shipment a quality compliance certificate according to 00165.35, certifying that the material supplied is an acceptable product on the QPL.

02910.75 Manufacturer's Warranty - Furnish a Warranty, for Warranty periods stated below, from the Manufacturer and signed by a Manufacturer's Representative, conforming to the following requirements:

For retroreflective Type III, Type IV, and Type VII sheeting used for permanent signs, provide a Warranty, for a Warranty period of 10 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For retroreflective Type IX sheeting used for permanent signs, provide a Warranty, for a Warranty period of 12 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For retroreflective sheeting used for temporary signs, provide a Warranty, for a period of 3 years, for restoring sign panels and replacing sheeting if the sheeting has failed as defined below.

For purposes of the Warranty, the retroreflective sheeting will be deemed to have failed if it has deteriorated due to conditions inherent to the sheeting (including inks, overlay film, and electronic cuttable film) to the extent that:

- The sign shows discoloration, cracking, delamination, loss of adhesion, or
- The coefficient of retroreflection is less than the following:
  - 80% of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D 4956 for the first 7 years of the Warranty period.
  - 70% of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D 4956 for the remaining 3 years of the Warranty period for Type III, Type IV, and Type VII sheeting and remaining 5 years of the Warranty period for Type IX sheeting.

All coefficient of retroreflection measurements will be made after signs are cleaned according to the Manufacturer’s recommendation.

The Warranty shall recite that, upon written notification by the Agency 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 a condition that meets the remaining warranty conditions at no cost to the Agency (100% full replacement covering all material and labor costs).
- For the remaining three years, (five years for Type IX sheeting) the Manufacturer shall furnish replacement sheeting required to restore the sign panel to a condition that meets the remaining warranty conditions at no cost to the Agency (100% sheeting replacement).

When the Agency makes written notification to the Manufacturer of sheeting failure, the Warranty period will stop for the effected signs until required repairs or replacements are made and accepted.

All repaired or replaced signs and sheeting shall meet current sheeting specifications and be warranted for the remaining Warranty period.

The Agency will date all approved signs at the time of inspection at the Agency's material laboratory. That date is the start of the Warranty period.

Applicable warranties for sign sheeting shall be turned over to the Agency. The Agency shall be named oblige on all manufacturer's warranties. The warranty document shall have an identifying document number assigned to it that is unique to the project that it is submitted for, such that warranty claims can be processed under a specific document number. The warranty document shall be dated to reflect the date that the document is submitted to the Agency for approval.

Section 02920 - Common Electrical Materials

Description

02920.00 Scope - This Section includes the requirements for common electrical systems.

Materials

02920.01 Materials - Where shown or specified, furnish and install hardware that is hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts, and washers.

02920.02 Powder Coating - Powder coat materials according to Section 00593.

02920.10 Metal Conduit - Furnish metal conduit meeting the following requirements:

- **Rigid Metal Conduit** - Galvanized rigid metal manufactured of mild steel conforming to UL 6, Rigid Metal Electrical Conduit.
- **Liquid-Tight Flexible Metal Conduit** - Liquid-tight, nonmetallic, sunlight resistant outer jacket over an inner flexible metal core. Conduit shall conform to UL 360 Liquid-Tight Flexible Steel Electrical Conduit.

02920.11 Nonmetallic Conduit - Furnish nonmetallic conduit meeting the following requirements:

- **Rigid Nonmetallic Conduit** - Heavy wall, extruded, rigid polyvinyl chloride (PVC) conforming to UL 651, Schedule 40 or 80 Rigid PVC Conduit as shown.
- **Liquid-Tight Flexible Nonmetallic Conduit** - Meet the requirements of Article 351 of the NEC and shall be UL listed.
- **High Density Polyethylene Conduit (HDPE)** - SDR15 (Schedule 40) equivalent minimum conforming to UL651B. The conduit shall lay flat when unwound.
- **Rigid Nonmetallic Fiberglass Conduit** - Schedule 40 or Schedule 80 reinforced thermosetting resin conforming to UL1684.

02920.12 Conduit Fittings - Furnish conduit fittings meeting the following requirements:

- **Expansion Fittings** - Weatherproof, hot dip galvanized malleable iron expansion head and body. Where the plans do not specify an equipment grounding wire in the conduit run, furnish fittings with external bonding jumpers. The expansion fitting shall permit a 4 inch conduit movement minimum.
- **Condulets** - Hot-dip galvanized malleable iron conduit body with corrosion resistant cover and moisture proof gasket.
- **Metallic Bushings** - Galvanized steel or die cast zinc with insulated throat. Include a bonding lug if required.
- **Nonmetallic Bushings** - PVC push on end bell style.

02920.13 Underground Marking Tape - Provide underground marking tape that is red polyethylene film, 6 inches wide, 4 mils thick minimum, and imprinted with the following or similar legend:

"CAUTION CAUTION CAUTION BURIED ELECTRIC LINE"

02920.14 Junction Boxes:

(a) General - Junction box covers in vehicle traffic areas shall be rated for AASHTO H-20 highway loading. Surface-mounted boxes shall have overlapping covers.

Junction box covers shall have the legend "SIGNALS", "STREET LIGHTING", etc stamped or embossed on the cover as appropriate. Letter size shall be no smaller than 1/16 of the box width.

(b) Metal Junction Boxes - Construct boxes of cast iron or 1/8 inch nominal welded sheet steel. Make covers from reinforced non-slip steel plate. Hot-dip galvanize boxes and covers after fabrication according to AASHTO M 232 (ASTM A 153). Each box shall have a cover gasket that will, with cover in place, form a NEMA 4 watertight fit. Provide covers with stainless steel hex-head cap screws. Recess screw heads in the cover.

Recessed covers shall fit the box so that when the cover is set in the box, the top of the cover shall be even with the top of the box, with not more than a 1/8 inch gap between any part of the top edge of the cover and the inside lip edge of the box.

Flush-mounted boxes shall be outside-flanged with recessed, checkered steel covers.

(c) Concrete Junction Boxes - Concrete junction boxes shall be precast concrete, water meter type. Covers shall be capable of withstanding a load of 15,000 pounds over a 10 inch by 10 inch square surface. Covers shall have a skid-resistant surface, and bolt to the junction box with recessed stainless steel hex-head bolts. All covers shall be recessed and 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.

(d) Polymer Concrete Junction Boxes - Polymer concrete junction boxes shall be precast water meter type. Material shall consist of aggregate bonded with a polyester resin and reinforced with fiberglass strands. The box and cover shall be gray in color. 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, and bolt to the junction box with a recessed stainless steel hex-head bolts. All covers shall be recessed and 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.

(e) Hybrid Junction Boxes - Hybrid junction boxes shall be constructed of polymer, fiberglass, or polymer concrete. Materials shall be resistant to temperature extremes and ultraviolet light exposure. Cover and boxes shall be capable of withstanding loads of 15,000 pounds over a 10 inch by 10 inch square surface. Covers shall have a skid-resistant surface and bolt to the junction box with recessed stainless steel hex-head bolts. All covers shall be recessed and 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.

02920.20 Cable and Wire - Unless otherwise noted, all electrical conductors shall be stranded copper conforming to ASTM B 3 and ASTM B 8, Class B or C. Insulation shall be 600 V plasticized polyvinyl chloride, polyethylene, or chemically cross-linked polyethylene, conforming to ASTM D 2220, ASTM D 1351, ASTM D 2655, and ASTM D 2656. Do not use polyethylene compounds where exposed to sunlight. Tape the ends of unused and spare conductors with insulating vinyl plastic tape.

02920.21 Wire and Cable Color Coding:

(a) General - Apply wire color coding mechanically, with striping clearly visible the entire length. Colored tape may be used where striping is worn from handling.

(b) Illumination Circuits - Color coding of illumination circuits will be required for three-phase systems only. Color coding of each phase conductor shall remain consistent throughout the entire electrical system.

(c) Traffic Signal Circuits - Color coding of traffic signal circuits shall conform to the wiring color code shown or specified.

02920.22 Cable - Furnish cable meeting the following requirements:

- **Direct Burial Cable** - All cable shown or specified as direct burial cable shall be:
  - **Underground Service Entrance Cable** - Comprised of a heat and moisture resistant cross-linked polyethylene insulated wire rated for 167 °F operation in wet or dry locations and be UL labeled as type USE cable according to the NEC.
  - **Underground Feeder and Branch Circuit Cable** - Comprised of moisture resistant thermoplastic insulated wires and a moisture and sunlight resistant thermoplastic outer covering rated for 140 °F operation in wet or dry locations and be UL labeled as type UF cable according to the NEC.
- **Messenger Cable** - Galvanized steel seven-strand conforming to ASTM A 475 utility grade with Class A coating.
- **Tether and Stabilizer Cable** - Galvanized steel seven-strand conforming to ASTM A 475 common grade with Class A coating.
- **Loop Feeder Cable** - Two-conductor No. 14 AWG twisted pair shielded cable with drain wire conforming to IMSA 50-2.
- **Interconnect Cable** - REA PE-38 or PE-39 cable consisting of No. 19 AWG stranded or solid individual conductors. The cable shall contain the number of wire pairs shown.
- **Control Cable** - Comply with IMSA 20-1. Outside jacket insulation shall be black in color.
- **Cable Ties** - Heavy-duty UV resistant black plastic self-locking straps approximately 5/16 inch in width, serrated gripping surfaces through a binding buckle, and a minimum tensile strength of 45 pounds.
- **TC Cable** - XHHW conductors with PVC jacket.
- **Polyethylene Pull Line** - An electrical polyethylene pull rope with a 1,200 pound minimum break strength.

02920.23 Wire - Furnish wire meeting the following requirements:

- **THWN Wire** - Insulated stranded copper wire rated for 167 °F operation in wet or dry locations and be UL listed as THWN.
- **XHHW Wire** - Insulated stranded copper wire rated for 194 °F dry and 167 °F wet locations and be UL listed as XHHW.
- **Grounding and Bonding Wire** - Stranded copper wire. Minimum size shall be No. 6 AWG or as shown. When installed in conduit use type THWN that is green in color.
- **Loop Wire** - Insulated stranded copper No. 14 AWG type XHHW conductor inside a polyethylene tube conforming to IMSA Specification No. 51-7.

02920.24 Eyebolts - Furnish eyebolts meeting the requirements to ASTM A 307.

02920.25 Electrical Splice Materials - Furnish electrical splice material meeting the following requirements:

- **Split Bolt** - Made of silicon bronze to securely join the wires both mechanically and electrically.
- **Heat-Shrink Tubing** - Surface-irradiated tube complying with UL 486, rated at 194 °F, with 600 V inner melting wall or liner to provide void-free encapsulated insulation.
- **Insulating Rubber Tape** - Electrical grade, nondrying, rubber based, elastic type conforming to ASTM D 4388.
- **Insulating Vinyl Plastic Tape** - Comply with ASTM D 3005, Type II and UL 510.

02920.26 In-Line Fuse Holder - The in-line fuse holder rated for 30 A at 600 V shall be designed to hold a 13/32 inch by 1 1/2 inch 10 A 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 rated for copper wire.

02920.27 Ground Rod and Clamp - Furnish 5/8 inch x 8 foot copper covered steel ground rods with bronze grounding wire clamps.

02920.28 Conduit Plug - Furnish conduit plug material used to seal the ends of conduit composed of closed cell polyethylene foam or duct seal meeting the following requirements:

- **Closed Cell Polyethylene Foam** - Consisting of precut sections with a plug length of 3 inch and a plug diameter 1/2 inch larger than the conduit diameter being plugged. Approximately one third of the plug length shall be exposed after installation.
- **Duct Seal** - UL listed clay putty material designed to seal electrical conduit.

Section 02925 - Traffic Signal Materials

Description

02925.00 Scope - In addition to Section 02920, this Section includes the requirements for traffic signal installations:

Materials

02925.01 Materials - Where shown or specified, hardware shall be furnished and installed with hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts and washers. Bolts and screws shall have square or hex heads. Allen head fasteners will not be allowed.

02925.33 Frangible Bases:

(a) General - Bolts, nuts and washers shall conform to 02560.20 and shall be galvanized according to 02560.40.

(b) Vehicle Signal Pedestals - 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, cast iron or steel plate and include a removable access plate. Hot-dip galvanize cast iron and steel plate bases after fabrication.

(c) Pedestrian Signal Pedestals - Pedestrian signal pedestal bases shall be a frangible type and constructed of either galvanized cast iron or cast aluminum. Include a removable access plate and a threaded connection to accept a 4 inch nominal steel pipe.

02925.34 Anchor Bolts - Anchor bolts shall conform to 02560.30 and to the types and sizes shown.

Cabinets and Control Devices

02925.40 Cabinets - Construct all cabinets, except signal controller cabinets, from 12 gauge Type 304 stainless steel, or 10 gauge sheet steel and hot-dip galvanize after fabrication according to 02530.70, or 8 gauge 5052 - H32 powder-coated aluminum. Cabinets shall be weatherproof, NEMA type 3R rated, and constructed as shown. Pole-mounted controller cabinets shall be provided with solid bottoms or equipped with a bottom cover plate.

The internal wiring of cabinets shall be done by a UL listed facility. Cabinets shall conform to one or more of the following standards where appropriate:

- UL 50, Cabinets and Boxes
- UL 67, Panel Boards
- UL 869A, Service Equipment

Use a welded conduit hub or screw-on hub to make conduit entrances into cabinets. Welded hubs shall be securely welded to the cabinet before galvanizing.

Power service cabinets with live parts exposed shall have a dead-front panel installed with cutouts for operating handles. Dead-front panels up to and including 120 square inches in size shall have a minimum of three holding studs. Install panels larger than 120 square inches in size using an adequate number of studs to maintain rigidity of the panel.

Construct the dead-front panels of stainless steel or galvanized steel and treat all cut galvanized steel edges with zinc-rich paint. Prime galvanized steel dead-front panels with vinyl wash primer and finish with exterior polyurethane enamel. The finish color of galvanized steel shall be grey.

Mounting pans or false backs are required for circuit breakers, contactors, relays, switches, transformers or other types of electrical equipment. They shall be securely mounted inside the cabinet.

Label circuit breakers and equipment with an engraved permanent label on the dead-front panel to indicate the circuit controlled.

Provide each cabinet with a latching device for a standard Agency padlock.

02925.41 Circuit Control Devices:

(a) General - Install circuit breakers**,** the copper neutral block, and contactors as shown.

(b) Circuit Breakers - Provide UL489 listed circuit breakers of the rating shown or specified. Circuit breakers shall be of the unenclosed, molded case bolt-on type with end conductor terminals, suitable for surface mounting in the cabinet on a false back or bracket.

(c) Terminal Blocks - Provide sectional channel mount 600 V terminal blocks of sufficient size to accommodate the wiring shown.

02925.42 Traffic Signal Control Devices - The traffic signal controllers and related equipment shall conform to requirements of the current edition of the ODOT Standard Specification for Microcomputer Signal Controller, except as supplemented and modified by the Special Provisions.

02925.51 Traffic Signal Lamps - Vehicle signal and pedestrian signals shall be illuminated by incandescent bulbs or LED modules as indicated in the Special Provisions.

(a) Incandescent Lamps - Incandescent lamps shall be rated for 130 V AC operation with a rated life of at least 8,000 hours. Lamps shall be designed to withstand vibration and intended for use in traffic signal heads.

(b) Light Emitting Diode (LED) Modules - Use only prequalified LED modules that are listed in the Traffic Signal Materials "Blue Sheets".

Signal Indication Material

02925.60 Signal Indication Material - The housings, including doors and hoods, shall have a smooth homogeneous finish. All parts shall be clean, smooth, and free from flaws, cracks, blow holes, and other imperfections. All fasteners not specifically noted as hot-dip galvanized shall be Type 304 or 316 stainless steel installed with anti-seize compound.

02925.62 Signal and Sign Mounting Hardware:

(a) General - All fasteners not specifically noted as hot-dip galvanized shall be Type 304 or 316 stainless steel. All fasteners shall have either square or hex heads.

(b) Plumbizer - Provide plumbizers that are constructed of cast bronze. Paint the mounting hardware with two coats of zinc-rich aluminum paint.

(c) Span Wire Hanger - Provide span wire hangers that are constructed of cast bronze. Paint the mounting hardware with two coats of zinc-rich aluminum paint.

(d) Adjustable Bracket - Attach adjustable brackets to the pole with cables. A safety cable shall be supplied to capture the appurtenance in the event of a failure of the mounting bracket.

(e) Tri-stud Adapters - Furnish tri-stud adapters with two backing washers and omit the neoprene washer/gasket. Use silicon caulking to seal between the tri-stud adapter and the signal head.

02925.64 Vehicle Signal - Each housing shall be of the one-section expandable type. Each section shall be of one-piece construction. The design shall be such that at any time and without the use of other than simple tools, it shall be possible to convert any housing into a one-, two-, three-, four- or five-section housing by the addition or subtraction of housing sections. The entire housing shall be made dust and water resistant. Vehicle signal heads not utilizing the bottom opening for mounting shall have a screw hole plug installed and shall have a 1/4 inch drain hole drilled in the bottom of the plug. Construct vehicle signal housings and doors of die-cast aluminum alloy. If LED modules are used omit the requirements of (a) and (c) below for that housing section.

(a) Lenses - Vehicular signal lenses shall conform to ITE Specifications and meet the following requirements:

- Glass.
- Circular with a nominal diameter as shown or specified.
- 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.

(b) Doors - Gasket each door to provide moisture resistant construction.

(c) Reflectors and Lamp Sockets - Illuminate each lens independently of any other lens and provide with a parabolic 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 allowed without removing the reflector. 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. The lamp socket mounting shall incorporate the ability to orient the lamp filament after the lamp has been securely seated into the socket.

(d) Visors - Construct visors of sheet aluminum alloy 3003-H16 (ASTM B 209), nominal thickness 16 gauge. Visors shall be of one-piece construction and attach to the signal housing doors with Type 304 or 316 stainless steel screws. Provide 8 inch lenses with a 7 inch visor and 12 inch lenses with a 9 1/2 inch visor. Signal housing doors, with visors attached, shall be capable of being opened a minimum of 90 degrees. Use tunnel visors on all vehicular signal indications with the bottom portion open, so the sections light output is visible directly in front of and below the signal head.

(e) Backboards - Construct backboards of sheet aluminum alloy 3003-H14 (ASTM B 209), 14 gauge nominal thickness. All backboards shall be louvered. Provide all vehicular signal heads with backboards and include all of the necessary mounting hardware for completing the installation. Backboard dimensions shall fit the signal head housings used, with no gap between backboard and housing. Backboards shall have a border width of 5 inches. Attach backboards with stainless steel screws and washers. Use washers at least 3/8 inch in diameter.

02925.65 Pedestrian Signal Heads - Provide single-section pedestrian signal heads meeting the following requirements:

(a) Light Source:

(1) Standard - The standard light source shall:

- Be LED filled hand/man style.
- Meet ITE standards for color and luminous intensity.
- Compatible with all other controller equipment.

(2) Count Down - The count down, if shown, shall:

- Be 16 inch by 18 inch module.
- Be 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 interval.
- Compatible with all other controller equipment.

(b) Housing and Door - The housing and door shall:

- Use a one-piece housing and sealed door constructed of die-cast aluminum alloy that provides a dustproof and weatherproof enclosure.
- Allow easy access for maintenance of the interior components with the door open.

(c) Visors - The visor shall:

- Use a one-piece z-crate or egg crate type polycarbonate plastic visor.
- Include vertical (or angled) and horizontal members spaced to provide the required shielding and strength.
- Be held securely to the door assembly.

(d) Mounting - The mounting shall be designed to use either a bracket assembly or a clamshell mounting as shown.

02925.66 Pedestrian Push Buttons and Mount:

(a) General - Push buttons shall be:

- Direct contact type.
- Free of levers, handles, or toggle switches externally or internally.

(b) Contacts - Push button contacts shall be:

- Entirely insulated from the housings and operating buttons.
- Normally open.
- Closed only when push buttons are operated by pressure.
- Restored immediately to the normal open position when pressure is released.

(c) Housing - The housing containing the pedestrian push button shall be made with:

- A one-piece H frame construction assembly of extruded aluminum containing the push button, with the signs placed directly on both sides of the extrusion.
- A sign background of two coats of white enamel with black silk-screened legend conforming to Standard Sign R10-4b.
- An outlet in the back of the housing for rigid conduit.
- A 1/4 inch diameter drain hole in the bottom.

(d) External Button - The external operating button shall:

- Be constructed of durable materials able to withstand the typical abuse inflicted by the general public.
- Be removable from the housing with simple tools.
- Be at least 2 inches in diameter.
- Operate a momentary contact switch by direct contact.
- Contain a guard completely encircling the push button, and extending far enough to prevent prying under the push button. It shall be resistant to damage associated to striking it with an object other than the hand.

02925.67 Coatings:

(a) Signal Heads - Pedestrian signal heads, vehicle signal heads, beacon heads, visors and backboards shall be powder coated inside and outside to meet Federal Standard 595b-37038 (dull black).

(b) Signal Controller Cabinets - Provide signal controller cabinets that are constructed of anodize aluminum.

(c) Brackets and Hangers - Apply two coats of aluminum paint to cast bronze type brackets and hangers after they have been primed.

Section 02926 - Highway Illumination Materials

Description

02926.00 Scope - In addition to Section 02920 and all applicable portions of AASHTO "Roadway Lighting Design Guide" (2005) and "American Standard Practice for Roadway Lighting" (IES, RP-8, 2000), this Section includes the requirements for highway illumination installations.

Materials

02926.01 Materials - Where shown or specified, hardware shall be furnished and installed with hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts and washers. Bolts and screws shall have square or hex heads. Allen head fasteners will not be allowed.

Cabinets and Control Devices

02926.40 Cabinets - Construct all cabinets from 12 gauge Type 304 stainless steel, or 10 gauge sheet steel and hot-dip galvanize after fabrication according to 2530.70. Post mount cabinets shall be weatherproof, rated as NEMA type 3R, and constructed as shown.

With 3 phase electrical system and/or main circuit breaker of 200 amp or higher, pad-mount cabinet shall be installed as shown. It shall be NEMA type 3R, with hinged double door, 3 point lockable vault handles and stainless steel hardware. Cabinet size is 48 inches x 63 inches x 18 inches deep, or as shown.

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
- 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.

Power service cabinets with live parts exposed shall have a dead-front panel installed with cutouts for operating handles. Each dead-front panel shall have a minimum of two holding latches to maintain rigidity of the panel.

Construct the dead-front panels of stainless steel or code-gauge galvanized steel and treat all cut galvanized steel edges with zinc-rich paint. Prime galvanized steel dead-front panels with vinyl wash primer and finish with exterior polyurethane enamel. The finish color of galvanized steel shall be aluminum.

In all outdoor locations, mounting pans are required when circuit breakers, contactors, relays, switches, transformers or other types of electrical equipment are to be mounted inside the cabinet.

Label circuit breakers and equipment with an engraved permanent label on the dead-front panel to indicate the circuit controlled.

Provide each cabinet with a latching device for a standard Agency padlock.

Meter base shall be made from 16 gauge galvanized sheet steel (G90), and powder coated inside and out after fabrication, or from 16 gauge Type 304 stainless steel sheet.

02926.41 Circuit Control Devices:

(a) General - Install circuit breakers**,** the copper neutral block, and contactors as shown.

(b) Circuit Breakers - Circuit breakers shall have voltage rating and number of poles shown or specified. Circuit breaker's interrupting rating shall meet or exceed short circuit rating of the specified electrical system.

Circuit breakers shall be UL 489 conformed, thermal magnetic molded case circuit breakers and bolt-on type with individually insulated and protected terminals, suitable for surface mounting in the cabinet on a false back or bracket.

All 100 A frame breakers shall be Class 13a for single pole breakers, Class 18a for multiple pole breakers, and 225 A frame breakers shall be Class 20a in Federal Specification W-C-375B, table "Classification of ratings".

Install overcurrent protection and relay equipment, as shown or specified, with materials and installation conforming to the NEC.

(c) Multiple Light Contactors - Contactors shall be lighting type specifically rated for high-intensity discharge type lamp loads, electrically held. The contactors shall have a 600 V rating. All multiple light contactors shall be unenclosed single-phase, two- or three-pole, open type lighting contactors of the rating shown or specified. Construct contactors for surface mounting on a false back or bracket within a weatherproof cabinet. The contactor coil shall operate on 120 V for 240 V circuits and 240 V, 208 V, and 277 V for 480 V circuits.

(d) Test Switch - Furnish and install a 277 V AC rated test switch in the control cabinets if shown. The test switch shall be a heavy-duty single-pole switch or circuit breaker rated at 15 A and shall be installed in the control cabinet as a roadway lighting test switch. The switch shall be wired to shunt the photoelectric relay power contactor and energize the lighting circuit contactors.

(e) Photoelectric Relay - The photoelectric relay shall attach to a three-pole locking receptacle by a twisting motion.

The unit shall have a built-in surge protective device for protection from induced high voltage and follow-through currents. The relay shall meet or exceed the requirements of ANSI C136.10. Factory set turn-on lights shall be 1.4 footcandle $\pm$ 0.2 footcandle at 120 V AC. When operated at 240 V AC, turn-on shall not change more than plus or minus 0.3 footcandle from the 120 V value. Maximum off-to-on ratio shall be 1.5:1.

The photoelectric replay 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 relay shall be capable of controlling a minimum mercury vapor, fluorescent or incandescent lamp load of 1000 W. Minimum operating temperature range shall be from -40 °F to 150 °F.

A time-delay control circuit shall prevent false turn-offs by transient light conditions. Provide a fail-safe circuit for the lighting load to remain on or become energized if any functional failure of the photoelectric control circuit occurs.

Lamps, Ballasts, and Luminaires

02926.50 Illumination Lamps - All high-pressure sodium lamps shall conform to ANSI Standards for dual-arc tubes. 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:

Lamp Watts	ANSI Code	Minimum Initial Lumens Vertical	Lamp Lumens Horizontal	Minimum Average Lamp Life
		High-Pressure Sodium - Clear		
70	S62ME-70	6,300	6,300	24,000
100	S54SB-100	9,500	9,500	24,000
250	S50VA-250/S	29,000	29,000	24,000
400	S51WA-400	50,000	50,000	24,000
1,000	S52XB-1000	140,000	140,000	24,000
		High-Pressure Sodium - Dual Arc-Tube (Standby)		
70	S62	6,050	6,050	40,000
100	S54	9,500	9,500	40,000
250	S50	27,500	27,500	40,000
400	S51	47,500	47,500	40,000
1,000	S52	127,000	127,000	40,000

02926.52 Ballasts - High-pressure sodium ballasts shall be magnetic regulator (lag type regulator) with primary and secondary windings electrically isolated from each other.

Unless otherwise shown or specified, the ballast shall be an integral part of the luminaire unit. It shall be of the prewired, built-in type mounted 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 the allowable range shown in the table below over the line voltage variation shown.
- 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 minimum efficiency of the ballast (nominal lamp watts/line watts) shall not be less than shown below.
- The ballast shall not allow the lamp arc to extinguish when a line voltage dip as shown below occurs for several seconds.
- The power factor shall not drop below 90% for the line voltage variation shown below.
- The line starting current shall not exceed normal line operating current.

- 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.
- The ballast shall have capacity to operate dual-arc tube lamps as well as standard lamps without modification of the luminaire.

Submit for review ballast electrical data and lamp operating volt-watt traces for nominal and ± 10% rated line voltage for each type of high-pressure sodium lamp ballast.

Lamp Type	Lamp Wattage Range	Line Voltage Variation	Allowable Lamp Watt Variation	Minimum Efficiency	Allowable Line Voltage Dip
HPS	70 - 100	± 10%	± 10%	70%	40 - 50%
HPS	150 - 400	± 10%	± 10%	78%	40 - 50%
HPS	1,000	± 10%	± 10%	92%	40 - 50%

Unless otherwise shown or specified, operate ballasts on 240 V or 480 V. When 120 V operation is specified, the ballast shall be a multi-voltage type with taps to allow the ballast to be connected to 120 V, 208 V, 240 V, or 277 V.

02926.53 High-Intensity Discharge Luminaires:

(a) General - Furnish conventional roadway luminaires for horizontal slip fitter end mounting.

Luminaires shall have a cast-aluminum housing and shall attach to 2 inch pipe tenons on mast arms. The luminaire attachment fitting shall provide for a minimum of plus or minus 3 degree adjustment of the luminaire in the vertical direction. The reflector of all luminaires shall be of a snap-on or easily removed design manufactured of polished aluminum or molded from prismatically formed borosilicate glass. The refractor shall be mounted in a door frame assembly hinged to the luminaire and secured in the closed position by means of an automatic latch or a draw latch. The refractor and doorframe assembly, when closed, shall exert pressure against a gasket. Gaskets shall be composed of material capable of withstanding the temperatures encountered and shall be securely held in place. Glassware shall be of the refractor type with prisms.

Reflectors and refractors provided with the luminaire shall be stamped or labeled with a part number. The luminaire photometric submittal (isocandela diagrams) shall indicate the reflector and refractor part number used.

All luminaires shall have their components secured to the luminaire frame with corrosion-resistant mounting hardware. The housing, complete with integral ballast, shall be weather tight.

If sand-cast, the aluminum housing shall be left in its natural finish. If die-cast, the housing shall be given a coat of aluminum paint.

Refractors shall be formed from heat-resistant, high-impact, molded borosilicate glass.

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 shall not deflect more than 1/16 inch.

(b) Classification of Luminaire Light Distribution - Furnish the following distribution types as shown or specified. The classifications listed shall conform to ANSI definitions.

(1) Vertical Light Distributions - Divide vertical light distributions into three groups: short (S), medium (M), and long (L). Classification of the three groups depends on the maximum candle power point within a grid area according to the ANSI/IES RP-8 (2000) 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
Semi cutoff
Noncutoff

The classifications listed above shall conform to ANSI definitions.

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PART 03000 - MATERIALS

Section 03010 - Fencing Materials

Description

03010.00 Scope - This Section includes the requirements for barbed wire, woven wire and chain link fabric, metal posts, braces, hardware, and gates.

Materials

03010.10 Barbed Wire - The barbed wire shall be two-strand and either 12 1/2 gauge or 15 1/2 gauge with four-point barbs spaced at 5 inch intervals conforming to the requirements of AASHTO M 280 (ASTM A 121). Galvanizing shall be Class 3.

All barbed wire installed on the Project shall be new or like new, and the same diameter unless otherwise approved.

03010.20 Woven Wire Fabric - The woven wire fabric shall be 12 1/2 gauge galvanized steel wire conforming to the requirements of AASHTO M 279 (ASTM A 116), Class 3 coating or 11 gauge or 12 1/2 gauge aluminum coated steel wire conforming to the applicable requirements of ASTM A 116. The 12 1/2 gauge aluminum coated steel wire shall have the same coating thickness required for 11 gauge steel wire in Table 2 of ASTM A 116.

03010.30 Chain Link Fabric, Ties, and Tension Wire - Chain link fabric, ties, and tension wire shall conform to the requirements of AASHTO M 181 supplemented and modified as follows:

- Fabric may be zinc-coated steel meeting Type I, Class D coating requirement, aluminum-coated steel, or aluminum alloy. Use only one type on the Project.
- Wire fabric ties, wire ties, and hog rings may be zinc-coated steel wire, aluminum-coated steel, or aluminum alloy as elected, regardless of the type of wire fabric used.
- Use ductile, zinc-coated steel meeting the coating requirements of ASTM A 641, Class 1 for wire fabric ties, wire ties, and hog rings. Aluminum-coated steel wire fabric ties, wire ties and hog rings shall be coated with at least 0.30 ounce per square foot.
- Tension wire shall have a Class 2 coating.
- Fabric for the fence to be installed with pickets shall be 9 gauge wire woven in 3 1/2 inch by 5 1/2 inch diamond mesh. Top and bottom selvage shall be knuckled finish.

03010.31 Pickets - Pickets shall be either standard Grade A redwood or cedar pickets, 3/8 inch x 2 1/2 inch x 6 feet, or industry standard metal, or plastic pickets as shown or approved.

03010.40 Vinyl Clad Fabric - Vinyl clad chain link fabric shall conform to AASHTO M 181, Type IV. The color of the PVC coating shall be either medium or dark green.

03010.50 Metal Fence Posts, Braces, and Appurtenances - Metal fence posts, braces and appurtenances shall conform to the requirements indicated on the plans and the following:

(a) Painted Metal Posts - All painted metal posts shall be of the same kind and color.

(b) Posts, Braces, and Appurtenances for Chain Link Fence - Posts, braces, and appurtenances for chain link fence shall conform to the requirements of AASHTO M 181.

Posts for bridge protective fence shall be galvanized and conform to the requirements of ASTM A 53, Grade B. Braces and appurtenances for bridge protective fence shall conform to the requirements of AASHTO M 181.

(c) Posts, Braces, and Appurtenances for Barbed Wire and Woven Wire Fence:

(1) Tubular Steel Posts - Tubular steel posts, braces and appurtenances shall conform to the requirements of AASHTO M 181. Tubular posts shall be fitted with a snug-fitting, galvanized metal cap.

(2) Other Shapes - Metal posts and braces, other than tubular shape, for barbed wire and woven wire fences, shall conform to AASHTO M 281 (ASTM A 702), except that galvanizing may conform to the requirements of AASHTO M 111 (ASTM A 123). The posts and braces may be either galvanized or painted, as elected. Wire fasteners shall meet the coating requirements of ASTM A 641, Class 1.

(3) Fence Stays, Brace Guys, and Wire Loops - Metal fence stays, brace guy wires, wire loops for gateways and other miscellaneous wire used in barbed and woven wire fences shall be furnished with Class 1 coating as required by ASTM A 641. Either 9 1/2 gauge or 10 gauge wire is acceptable for fence stays.

(d) Concrete In Footings - Concrete for footings shall conform to Section 00440.

(e) Grounding Rod - 5/8 inch by 8 feet, nonrusting, copper covered steel rod with a bronze grounding wire clamp.

(f) Grounding Wire - AWG 4/0 Solid Copper or No. 6 bare aluminum wire with clamps.

03010.60 Fence Gates:

(a) General - Tubular steel gate frames shall conform to AASHTO M 181. Fabric in gates used with chain link fence shall be chain link of the same gauge and conforming to applicable requirements of 03010.30. Fabric in gates used with woven wire fence shall be woven wire fabric conforming to 03010.20 or chain link fabric conforming to the applicable requirements of 03010.30, except that the zinc coating may be either Class C or Class D.

(b) Hardware - All fence and gate hardware shall conform to the requirements of AASHTO M 181, except that the thickness of galvanizing shall be according to AASHTO M 232 (ASTM A 153).

03010.75 Protective Fence Materials, On and Off Structures - 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 QPL 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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