

PART III

**TECHNICAL
REQUIREMENTS**

CATEGORY 100

SECTION 101 — CLEARING AND GRUBBING

101.01 DESCRIPTION. Clear and grub within the specified limits.

101.01.01 Definitions.

- (a) **Clearing.** The removal and disposal of trees, fallen timber and rotten wood, brush, shrubs, vegetation, rubbish, fences, and structures not specified in the Contract Documents for removal and disposal. Unless otherwise specified, clearing outside the LOD includes the removal of rubbish only.
- (b) **Grubbing.** An earth-disturbing activity, which includes the removing from the ground and disposing of all stumps, roots and stubs, brush, and debris.
- (c) **Limits of Disturbance (LOD).** The maximum allowable limit of earth disturbance as delineated in the Contract Documents. When not delineated in the Contract Documents, the LOD will be the top of cut, toe of slope, or limit of ditch excavation. Do not perform earth-disturbing activities beyond the LOD without authorization.
- (d) **Limits.** Clearing and grubbing is confined to the LOD and authorized modifications to the LOD. When indicated in the Contract Documents, the limit of clearing may include the area between the LOD and the right-of-way or easement lines.
- (e) **Grading Unit.** The area of erodible material exposed at one time, not to exceed 20 acres.
- (f) **Disturbed Area.** An area where erodible material is exposed by construction activities.
- (g) **Stabilization Measures.** Activities that provide vegetation or otherwise prevent erosion. These activities include the placement of temporary or permanent seeding or mulching, soil stabilization matting, riprap, stone aggregate, and asphalt or concrete paving. The placement of one or more of these temporary or permanent stabilization measures to the satisfaction of the Engineer will meet the requirements for proceeding to the next grading unit or operation.

101.02 MATERIALS. Not applicable.

101.03 CONSTRUCTION.

101.03.01 Erosion and Sediment Control. Unless otherwise specified or approved, the clearing and grubbing area shall be limited to a single 20-acre grading unit per grading operation. Once this first unit is half graded and stabilization measures are in place and approved, the work may proceed to a second 20 acre grading unit. When approved by the Engineer, the clearing and grubbing area may exceed the one grading unit requirement when necessary to balance earthwork or when grading interchanges. Maintain erosion and sediment controls as specified.

The grading operation will be limited to the Contractor's ability to provide adequate resources to perform the grading in a timely manner and to provide and maintain the proper erosion and sediment control measures. The Engineer is the final authority in this determination. A grading unit need not be 20 contiguous acres. When wet soil conditions are encountered, the clearing, grubbing, and grading of another unit will be allowed, once stabilization of the initial unit is approved. No more than two grading units may be active at any time.

101.03.02 Vegetation. The Engineer will designate and mark trees, shrubbery, and plants that are to remain in place. Protect them from any damage, as specified in GP-7.11. Cut and properly trim the branches of trees overhanging the roadway to maintain a vertical clearance of 16 ft. Employ a tree expert licensed by the State of Maryland to supervise all trimming operations. Perform all trimming and repair of cuts and scars as specified in Section 712.

101.03.03 Fences. Remove and dispose of all fences within the right of way, unless otherwise specified.

101.03.04 Mailboxes. Remove and reset mailboxes as directed.

101.03.05 Grubbing.

- (a) **Excavation Areas.** Remove all embedded stumps and roots to a depth of at least 3 ft below the subgrade or slope surface. Refill all depressions made below the subgrade or slope surfaces with materials suitable for embankment and compact as specified in Section 204.
- (b) **Low Embankments.** Grub areas where the total depth of the embankment is less than 3 ft.
- (c) **High Embankments.** In areas where the embankment is 3 ft or more in depth, cut off trees and stumps as close to the ground as

practical but not greater than 1 ft above the ground surface. Near the toe of embankment slopes, remove trees and stumps that are within 1 ft of the slope surface.

101.03.06 Stream and Channel Changes. When an LOD is not specified, clear and grub 5 ft beyond the top of the cut slopes or as directed.

101.03.07 Disposal.

- (a) **Burning.** Perform burning under the constant care of a watchperson and in accordance with applicable laws and ordinances of respective jurisdictions.
- (b) **Disposal Locations.** Remove from the right-of-way and dispose of all unburned material and debris. Make all necessary arrangements to obtain suitable disposal locations. Furnish the Engineer with a copy of resulting agreements.
- (c) **Wood Disposal.** If disposal of wood to the public is proposed, submit the disposal plan to the District Engineer for review, and obtain approval prior to beginning the clearing and grubbing operation. Perform this method of disposal from a location that is off the job site.

101.03.08 Damage to Trees and Other Protected Resources. Ensure that the LOD and all protected resources are demarcated as specified in Section 107.

Perform damage repair and damage compensation as specified in Section 712 for damage beyond the LOD due to work operations. Refer to Occupying Wetlands provisions in the Contract Documents for unauthorized impacts to wetlands, wetland buffers, Waters of the United States (WUS), and floodplains.

101.04 MEASUREMENT AND PAYMENT. Clearing and Grubbing will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for the removal and disposal of fences, removal and resetting of mailboxes, selective tree trimming and scar repair, repair or replacement of damaged trees, restoration measures for damaged or destroyed protected resources, repair to other damaged properties, removal and disposal of existing buildings when not covered as a specific pay item in the Contract Documents, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 102 — REMOVAL AND DISPOSAL OF EXISTING BUILDINGS

102.01 DESCRIPTION. Remove and dispose of existing buildings, including foundations, footings, or any part thereof, and backfill as specified. Locations of buildings included in the work will be designated in the Contract Documents by the circled numbers ①, ②, ③ etc.

102.02 MATERIALS. Not applicable.

102.03 CONSTRUCTION. Schedule the removal, razing, or occupation of buildings and appurtenances as one of the first items of work. Post and protect the buildings from vandalism and theft.

Remove and dispose of buildings scheduled for temporary use immediately when vacated.

Buildings and appurtenances may be disposed of by burning if they are not located close to habitable dwellings and if not prohibited by local or State laws, regulations, ordinances, or by the fire marshal.

Salvaged materials shall become the property of the Contractor. Selling of merchantable material and removal by the purchaser shall be done only during daylight working hours and accompanied by a Contractor's representative.

102.04 MEASUREMENT AND PAYMENT. Removal and Disposal of Existing Buildings will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Buildings not designated for removal and disposal in the Contract Documents will not be measured but the cost will be incidental to Section 101. The Administration reserves the right to eliminate from this item any or all buildings or structures. For each building eliminated from this item, the item will be credited to the extent of the cost eliminated, which will be determined from a breakdown submitted by the Contractor showing the tabulation of individual unit costs used in arriving at the Contract price for this item. Submit a breakdown of the Contract lump sum price for Removal and Disposal of Existing Buildings to the Engineer prior to beginning work.

SECTION 103 — ENGINEERS OFFICE

103.01 DESCRIPTION. Furnish, clean, and maintain in good condition an Engineers office at an approved location within the immediate vicinity of the project. The office shall be separate from any offices used by the Contractor, and it and all items therein shall be for the exclusive use of the Administration's Engineers and Inspectors. Rented properties that conform to the type of office specified in the Contract Documents will be acceptable.

103.02 MATERIALS. Not applicable.

103.03 CONSTRUCTION. Set up, equip, and make the office ready for use at least five days prior to commencement of other work on the project. Leave the office and appurtenances in place until all field records are complete. Upon removal of the office, restore the location to a condition acceptable to the Engineer.

Unless otherwise specified, the office and all furnished equipment and accessories shall become the property of the Contractor at the completion of the project.

103.03.01 Mobile Housing Unit. Provide a mobile housing unit having floor space of at least 100 ft² and window area of at least 10 ft². Ensure it is entirely enclosed and waterproofed and has a door that locks. Provide a table 36 x 48 x 40 in. high and one closet equipped with a lock. Furnish two keys for each lock. Provide satisfactory heating and cooling. Relocate the unit as directed.

103.03.02 Handicap Accessibility. When handicap accessibility is necessary, comply with the Federal Register-Volume 56 No. 144-Americans with Disability Act (ADA) Accessibility Guidelines for Buildings and Facilities.

103.03.03 Mobile Office Trailers. Anchor in accordance with the manufacturer's recommendations. Office trailers, as defined under the Industrial Building and Mobile Act of Maryland, shall be approved by the Maryland Department of Housing and Community Development and bear the Maryland Certification Insignia in the interior of the office.

103.03.04 Quality Control Laboratory. Section 915.

103.03.05 Requirements for all Offices.

- (a) Entirely enclosed, waterproofed, and completely insulated to at least an R11 rating.
- (b) Double thick floor with building paper placed in between the floor layers.
- (c) Finished inside and outside as approved.
- (d) A ceiling height of at least 7 ft, a pitched roof, and a ventilating louver in each gable.
- (e) A 4 x 1 ft sign with the message "ENGINEERS OFFICE - STATE HIGHWAY ADMINISTRATION" attached to or mounted in front of the office. The sign shall have a black background and have white lettering at least 3 in. high.
- (f) A 5 x 7 in. no smoking sign posted on the outside of each entrance to the office, plant laboratory, and mobile housing unit.
- (g) Interior and exterior doors equipped with different key locks. Interior doors keyed alike. Exterior doors keyed alike. An additional dead bolt lock for each exterior door. Four keys for each interior and exterior lock.
- (h) Windows capable of being opened and closed. Equip with latches, screens, and venetian blinds or shades.
- (i) Electrified in accordance with national and State electrical codes with satisfactory artificial lighting and lighting services. Ensure an illumination level of at least 75 ft-c.
- (j) Equipment capable of heating the office to at least 70 F and cooling to at least 78 F.
- (k) A restroom facility in accordance with the State Department of Health and Mental Hygiene or other authorities having jurisdiction. Connect to water and sewage or a well and septic system. Provide a pressurized water system capable of maintaining at least 20 psi. Furnish a wash basin, water closet, soap holder, paper towel holder, and mirror.
- (l) Maintain the facilities in a clean and sanitary condition. Sweep the floor and remove the trash daily. Damp mop and wax the floor biweekly. Clean the interior and exterior of all windows monthly. Perform all work on an as needed basis and when requested.

- (m) Protect the Administration and Administration employees from any loss or damage to their property stored in the Engineers Office. Provide protection in the amount of twenty thousand dollars (\$20 000), nondeductible, per each occurrence, for any loss or damage due to fire, theft, vandalism, storms, or floods. Complete the reimbursement, replacement, or repair within 30 days from the date the Engineer reports the loss.
- (n) A parking area for the exclusive use of Administration employees. Provide the specified number of spaces. Post signs to designate the assigned parking areas. Stabilize the parking area as directed.
- (o) Fire extinguishers of a dry chemical or multi-purpose ABC type (at least 10 lb), equipped with a visual air pressure gauge, and maintained in accordance with OSHA standards.
- (p) A 24 unit first aid kit furnished and maintained as described in the Code of Federal Regulations, Title 29 Subpart D, Section 1926.50(d)2.
- (q) A 4 x 8 ft waterproof bulletin board. Place in an easily accessible area within the project limits and conspicuously displayed to all employees. Post and maintain all pertinent and required notices for the duration of the project.
- (r) Touch-tone telephones equipped with an answering device capable of answering, recording, storing, and playing back incoming messages at least 30 minutes in length and recording outgoing messages up to 15 seconds in length. The device shall be voice activated, beeperless, record as long as the speaker speaks, and play back recorded messages without dial tone or pauses.

Replace stolen equipment and equipment that becomes defective or for any other reason does not function as intended. Provide an equal or better unit within eight hours after notification. Replacement shall be at no additional cost to the Administration. Post emergency telephone numbers at a conspicuous location.

- (s) One 12 ft³ electric refrigerator.
- (t) An approved cassette player/recorder with cassettes or digital recording device.
- (u) One paper copier machine, with automatic document feed capable of printing at least 15 copies per minute and documents of up to 11 x 17 in. Supply paper and provide service as needed.

- (v) One sanitary electric water cooler, including bottled water and disposable cups.

103.03.06 Microcomputer System for all Offices. As specified in the Contract Documents.

103.03.07 Facsimile (FAX) Transceiver for all Offices.

Provide a FAX machine that:

- (a) Is connected to a dedicated phone jack with a separate independent telephone line and phone number.
- (b) Is in accordance and compatible with CCITT Group Transmission Standards (see specific line items for compatibility requirements).
- (c) Uses public switched telephone networks and standard two wire leased line through RJ11C jacks or similar devices.
- (d) Transmits at least 9600 BPS with automatic stepdown to compensate for phone line conditions.
- (e) Is capable of transmitting a standard 8-1/2 x 11 in. page within 20 seconds through a clear phone line, based on CCITT #1 test chart.
- (f) Is capable of two levels of resolution with contrast control:
 - (1) Standard 200/96 lines
 - (2) Fine 200/196 lines
- (g) Is capable of self-test and providing activity reports with page headers, time, and date.
- (h) Uses standard copy paper for receiving transmissions.
- (i) Has an automatic document feeder tray (see specific requirements for each transceiver class).
- (j) Has handsets.
- (k) Has automatic answer, receive, and disconnect features.
- (l) Provide the FCC registration number, ringer equivalence, and connection circuitry for each transceiver.

103.03.08 Specific Field Office Requirements.

Type A Engineers Office – Standard office trailer with at least 200 ft² of floor area under one roof.

Type B Engineers Office – Standard office trailer with at least 400 ft² of floor area under one roof.

Type C Engineers Office – Standard office trailer with at least 700 ft² of floor area under one roof.

Type D Engineers Office – One-story structure containing at least 1300 ft² of floor area under one roof. Modular construction is acceptable. Office trailers are not acceptable.

Table 103 Specific Requirements

ENGINEERS OFFICE				ITEM
A	B	C	D	
–	1	2	–	Inner Offices–100 ft ² each
–	1	1	–	General office area
–	–	–	4	Inner Offices–120 ft ² each
–	–	–	1	Conference room–240 ft ²
–	–	–	1	Storeroom with shelves–120 ft ²
1	1	1	2	Restroom, 30 ft ²
–	1	1	1	Inner office ingress and egress to the other rooms
3	4	4	5	32 x 60 in. Executive type desks with center drawers
3	4	4	5	Swivel chairs, padded with arm rests
1	1	1	1	30 x 72 in. slant top drafting table and stool, approximately 40 in. high at the front edge
1	2	3	6	30 x 72 in. folding utility table, 30 in. high
–	–	–	1	12-person conference table with padded chairs
2	6	10	12	Additional padded chairs
1	2	2	3	Plan racks
1	1	1	2	Coat racks
1	1	1	1	3 x 6 ft blackboard or whiteboard
1	2	3	3	Electronic desk calculators with memory and tape readout (including manuals, and tapes as needed)
1	1	2	6	Legal size steel filing cabinets, 4 drawer fire resistant (D label) with locks
–	2	2	2	Standard size steel filing cabinets, 4 drawer with locks
1	1	1	5	Bookcases having four shelves 36 x 12 in.
1	2	2	2	Closets, full height, measuring at least 24 x 30 in., equipped with locks, and at least two shelves in each
1	1	1	–	Utility cabinet with 3 adjustable shelves
1	1	1	–	Overhead cabinet at least 8 ft long, 15 in. deep, and 18 in. high
1	1	1	2	Fire extinguisher as specified in 103.03.05
1	2	2	4	Telephones with separate lines, as specified in 103.03.05
2	2	2	2	Battery-operated smoke detectors
4	8	10	15	Designated parking spaces

103.03.09 Recyclable Materials (Paper, Bottles, Cans, Etc.). Recycling of suitable material is encouraged at all Engineers Offices and Contractor's facilities. However, when the project includes a Type D

Engineer's Office, recycling will be required at both the Engineers Office and the Contractor's facilities for the project. Provide the necessary containers and arrange for the removal of the recycled material from the site.

103.04 MEASUREMENT AND PAYMENT. Engineer's office will not be measured but will be paid for at the Contract lump sum price for the pertinent Engineers Office specified.

Payment of 50 percent of the Contract lump sum price will be payable on the first estimate subsequent to complete installation of the Engineers office. The remaining 50 percent will be prorated and paid in equal amounts on each subsequent monthly estimate. The number of months used for prorating will be the number estimated to complete the work. The final month's prorata amount will not be paid until the office is removed and the area is restored. The payment will be full compensation for site preparation, utility costs, all specified furnishings, to provide, equip, clean, maintain, insure, remove and dispose of the office, restore the site, recycling, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

The only exception to the all-inclusive Contract lump sum price is the stabilization of the parking area, which will be measured and paid for using the pertinent items as directed.

SECTION 104 — MAINTENANCE OF TRAFFIC

104.00 GENERAL. This Section sets forth the traffic control requirements necessary for the safe and continuous maintenance of traffic throughout the area affected by the work, and is intended to minimize inconveniences to the traveling public, while providing for the safety of motorists, pedestrians, and workers. Maintain vehicular and pedestrian traffic on or along any transportation facility as specified in the Contract Documents.

When speed of traffic is noted, this means the posted speed or prevailing travel speed, whichever is higher, unless otherwise specified.

All applicable Maintenance of Traffic equipment shall conform to NCHRP Report 350 criteria for test Level 3.

When no longer needed, remove items used for temporary maintenance of traffic from the project site. All removed items shall become the property of the Contractor, unless otherwise specified.

Ensure that at least 90 percent of all reflective barrier markers, warning lights, and raised pavement markers are operational at any given time. Correct deficiencies within 24 hours after notification.

Upon initial installation, temporary traffic control signs shall have at least 70 percent of the reflectivity specified in 950.03 over 90 percent of the reflectorized surface. Channelizing devices shall have at least 80 percent of the reflectivity specified in 950.03 over 90 percent of the reflectorized surface.

Replace damaged traffic control signs within four hours of notification. Take necessary corrective action, as approved, to adequately warn and protect the public until the signs are replaced.

The Contract Documents will specify one or more of the items listed in the following sections. When work is specified to be accomplished under the Maintenance of Traffic item, the work will be incidental to the Contract price for Maintenance of Traffic.

104.01 TRAFFIC CONTROL PLAN (TCP).

104.01.01 DESCRIPTION. Develop and implement a TCP. The TCP will include the design and placement of items such as signing, pavement markings, delineation, channelization, barriers, crash cushions, and other items as required.

TCPs may be implemented within a single project or jointly between two or more projects. In situations where TCPs are jointly implemented, ensure that correct and nonconflicting guidance is presented to the traveling public.

Prior to commencement of Contract work, the successful bidder shall complete a Traffic Control Plan Certification. Indicate whether the Administration's TCP will be implemented (Option 1), the Administration's TCP will be modified (Option 2), or a TCP will be developed (Option 3). Submit the TCP in writing to the Engineer at least 20 days prior to starting any work. Submit changes to the approved TCP in writing at least five days prior to implementing the change. For emergencies, the approval process will be completed within four hours. All changes to the TCP shall be approved in writing by the Engineer prior to implementation. Submit for approval supporting documentation containing an assessment of safety and mobility impacts of the modified or proposed TCP. Contact the Engineer to determine what level of detail and types of analysis are required for the assessment. No work shall begin until the required traffic control patterns and devices are in place.

Refer to the Contract Documents for Work Restrictions.

When TCP Option 2 or Option 3 is selected, the following shall apply:

- (a) Plans and revisions to plans shall be drawn to the same degree, likeness, and sophistication as that of the Contract Plans.
- (b) Submittals shall be on sheets measuring 22 x 34 in. with a standard margin and a standard title block at the lower right corner approximately 4 x 8 in., or on 8-1/2 x 11 in. paper with a 1 in. margin and a title block.

Include the following information in the title block and in the order listed.

- (1) Name of Contractor (and subcontractor, if applicable).
 - (2) Address of Contractor (and subcontractor, if applicable).
 - (3) Sheet Title.
 - (4) Administration Contract Numbers and complete Federal Aid Number.
 - (5) "Prepared for Maryland State Highway Administration".
 - (6) Signature block for approval by Contractor's Traffic Manager and date of approval.
- (c) All lines shall be clean, sharp, solid, and heavy enough for adequate reproduction. The scale of phase details on the TCP shall be 1 in. equals 100 ft. Additional plans that revise the design plans shall be at the same scale as the Contract Plans.
 - (d) Do not use white pigment to cover lines.
 - (e) Plans shall indicate the proposed traffic movements throughout the area affected by the work for each phase of construction. Label all routes, and show north arrow and any other information that would clarify the TCP.

Any monetary savings from changes to the TCP made by the Contractor and approved by the Engineer will be divided equally between the Contractor and the Administration.

104.01.02 MATERIALS. Not applicable.

104.01.03 CONSTRUCTION. Not applicable.

104.01.04 MEASUREMENT AND PAYMENT. Any traffic control plan developed by the Contractor will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

104.02 MAINTENANCE OF TRAFFIC (MOT).

104.02.01 DESCRIPTION. Maintain traffic safely and efficiently through and around the area affected by the work.

104.02.02 MATERIALS.

Traffic Materials

950

104.02.03 CONSTRUCTION.

- (a) Maintenance of Existing Roadway.** Maintain the existing roadway surface and shoulders, including crossroads, ramps, approaches, crossovers, medians, detour roads, entrances, and pavement markings within the limits of the project, throughout the duration of the Contract.

Repair potholes, shoulder defects, and hazardous conditions that exist or develop throughout the duration of the Contract.

- (b) Existing Regulatory Signs, Warning Signs, Guide Signs, and Pavement Markings.** Relocate, turn, completely cover with opaque material, or remove with the approval of the Engineer, signs that are not applicable due to temporary traffic conditions. Properly redisplay signs to traffic as soon as conditions warrant. Replace any signs misplaced or damaged by the Contractor's operations.

Prior to construction and in the company of the Engineer, inventory and note the location, type, size, and color of all existing pavement markings, legends, and symbols. Submit the results on a marked up set of the Contract Plans or on Contractor prepared sketches or drawings.

(c) Storage and Movement of Equipment, Material, and Vehicles.

All equipment, material, storage, and parking areas shall have advance written approval from the Engineer. Employee vehicles shall not be parked within the right-of-way of the through highway, without a written exception. Equipment and material shall not be stored or permitted to stand in unprotected areas or open areas within 30 ft of traffic except as follows:

- (1) Approved temporary traffic barrier is in place prior to storage of any equipment or materials.
- (2) Equipment and material is at least 4 ft behind the face of the traffic barrier.
- (3) Equipment or material is stored in conformance with the AASHTO Roadside Design Guide.

Restore areas used for storage of equipment and material to original condition immediately upon completion of use, at no additional cost to the Administration.

Vehicles and equipment shall enter and leave the work area in the direction of traffic flow.

Work on or adjacent to the traveled way shall be performed in the direction of traffic flow, unless written approval is obtained prior to beginning the work.

The Contractor's vehicles and equipment shall enter on and exit from the roadway at interchanges or legally allowed public use crossovers. Do not make U-turns across medians and crossovers signed FOR USE OF AUTHORIZED AND EMERGENCY VEHICLES ONLY, without written approval.

- (d) Warning Lights and Devices.** Use warning lights and flags on warning signs as specified in the TCP, the Contract Documents, or as directed. During hours of darkness, attach one Type A low intensity flashing warning light to the traffic side of channelizing devices used to warn of a spot hazard. Attach two Type A low intensity flashing warning lights to the top of each Type III barricade.

- (e) General Requirements for Temporary Pavement Markings (TPMs).** For pavement marking dimensions refer to Pavement Marking Dimension Table following (f)(10) below.

- (1) Temporary pavement markings are those markings placed upon the roadway to serve an area of work activity or a work phase for a period of time after which they are to be removed.

When approved, a less than full complement of pavement markings and reduced dimension markings for dashed center lines and lane lines may be used, but for a period of not more than two weeks.

- (2) TPMs may be either full dimension or reduced dimension as specified in the Contract Documents or as directed.
- (3) Full dimension TPMs shall be in accordance with the MdMUTCD and the Pavement Marking Dimension Table following (f)(10).
- (4) Reduced dimension TPMs shall be in accordance with the MdMUTCD and the Pavement Marking Dimension Table following (f)(10), except that the dashed center lines and lane lines may consist of 4 ft segments and 36 ft gaps.

(f) Specific Requirements for TPMs.

- (1) As a minimum, place all center and lane lines at the close of each day.
- (2) During the work day, while work activities are underway, clearly define all vehicle paths by center and lane lines, channelizing devices, signs, or other traffic control devices.
- (3) Along two-lane, two-way roadways, place a center line consisting of a continuous double solid yellow center line, a single dashed yellow center line at full dimension, or a single dashed yellow center line at reduced dimension as directed.
- (4) Mark and sign 'no passing zones' as specified or as directed. A no passing zone may be identified by signing for a period not to exceed seven days.
- (5) Along multilane undivided roadways, identify the center line using a continuous double solid yellow line.

If a two-way left turn is present, see (6) below.

If the roadway is three lanes, the center line may be either a continuous double solid yellow center line or, where passing is permitted in the single lane direction, a continuous single solid

yellow and single dashed yellow combination center line. For the placement of no passing zones, see (f)(4) above.

- (6) Along multilane undivided roadways having a two-way left turn lane, the left-turn lane need not be marked provided that the lane is continuously delineated using channelizing devices spaced at no more than 200ft. The devices shall separate the opposing flows of traffic and provide areas where left-turning vehicles may store while awaiting the opportunity to turn.
- (7) Along multilane roadways having reversible lanes, mark the lanes with the full complement of pavement markings as described in the MdmUTCD.
- (8) Where edge lines are not in place, delineate the edge of the roadway by using appropriate channelizing devices or other delineation.
- (9) Specific pavement marking and complementary signing details are shown on the Temporary Traffic Control (TTC) Typical Applications.
- (10) Contact the Office of Materials Technology (OMT) for the latest approved TPM materials.

PAVEMENT MARKING DIMENSION TABLE			
LINE TYPE	MATERIAL	REQUIRED MINIMUM EFFECTIVE WIDTH, in.	
		EXPRESSWAYS AND FREEWAYS	OTHER ROADWAYS
Lane Lines	Paint	5	5
	Preformed Tape	5	5
Lane Shifts, Lane Divides and Severe Alignment Changes	Paint	5	5
	Preformed Tape	5	5
Center Lines * See Note	Paint	5	5
	Preformed Tape	5	5
Edge Lines	Paint	5	5
	Preformed Tape		
Ramp Edge Lines	Paint	5	5
	Preformed Tape	5	5
Gore Marking	Paint	10	10
	Preformed Tape	10	10
Auxiliary	Paint	Same as particular line being extended	Same as particular line being extended
	Preformed Tape		

Note: Provide a discernible space of 4 to 5 in. between double lines.

(g) Channelizing Devices. Install traffic channelizing in accordance with the MdMUTCD, the Contract Documents, and the following:

- (1) Spacing in feet for channelizing devices in a taper shall be no more than the posted speed limit in mph.
- (2) Spacing in feet for channelizing devices in a tangent shall be no more than twice the posted speed limit in mph.
- (3) To define interchange gore areas or other unusual alignments, space channelizing devices at 25 ft intervals, unless the Engineer directs a closer spacing.
- (4) Space channelizing devices at approximately 6ft intervals at driveways and intersections, so that sight distance at these locations is not restricted.

- (5) The Contractor's name or identification mark may be placed in an inconspicuous location on the channelizing device, facing away from traffic. No advertising is permitted.

104.02.04 MEASUREMENT AND PAYMENT. Unless otherwise specified, Maintenance of Traffic will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for relocating, turning, completely covering and uncovering or removing and resetting, maintaining in like new condition, and cleaning existing and temporary traffic signs and other traffic control devices. Included is the inventory of all existing pavement markings and the treatment of any other traffic control device not included in these Specifications but necessary for the fulfillment of the Contract requirements and implementation of the approved Traffic Control Plan, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment of the Contract lump sum price will be prorated and paid in equal amounts on each monthly estimate. The number of months used for prorating will be the number estimated to complete the work.

- (a) When additional Contract pay items for Maintenance of Traffic are specified in the Contract Documents, measurement and payment will conform to the pertinent pay items.
- (b) Cones, reflective collars, anchoring devices, STOP/SLOW paddles, sign flags, and warning lights will not be measured but the cost will be incidental to the Contract price for Maintenance of Traffic unless otherwise specified.
- (c) Temporary traffic control devices that need replacement shall be replaced immediately, as directed. The cost of replacement, including all material, labor, equipment and tools, will not be measured but will be incidental to the Contract price for Maintenance of Traffic except when specifically set up in the Contract Documents as a separate Contract pay item.
- (d) Material, equipment, and labor necessary for the construction and removal of temporary or detour roads will be measured and paid for at the Contract unit price for the pertinent items used.

104.02.04.01 When specified in the Contract Documents, Maintenance of Traffic will be measured and paid for at the Contract price per unit day.

104.02.04.02 When there is no item in the Contract Documents, maintenance of traffic will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

104.03 TEMPORARY RAISED PAVEMENT MARKERS (RPMs).

104.03.01 DESCRIPTION. Furnish, install, and remove as necessary, temporary RPMs.

104.03.02 MATERIALS.

Temporary RPMs

QPL

104.03.03 CONSTRUCTION. Install temporary RPMs, as specified in the Contract Documents and in accordance with the manufacturer's recommendations.

104.03.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Increases or decreases in quantities will not be a basis for renegotiation of the Contract unit price.

- (a) Temporary Raised Pavement Markers will be measured and paid for at the Contract unit price per each.
- (b) Removal of Temporary Raised Pavement Markers will be measured and paid for at the Contract unit price per each.
- (c) Reimbursement will be made at the Contract unit price for each marker damaged by snowplow operations.

104.04 TEMPORARY CONCRETE TRAFFIC BARRIER (TCB) FOR MAINTENANCE OF TRAFFIC.

104.04.01 DESCRIPTION. Furnish, place, reset, and remove TCB.

104.04.02 MATERIALS.

Precast Concrete Traffic Barrier
Vertical Panels and Reflective.
Barrier Markers

950.01

QPL

104.04.03 CONSTRUCTION. Maintain TCB in alignment and in a like new condition.

Remove and relocate TCBs as directed.

Install reflective barrier markers and vertical panels (object markers) on the TCB as specified.

Connections. In addition to the pin and loop connection shown on the Standards, the channel splice, vertical I beam, and lapped joint connections specified in the AASHTO Roadside Design Guide, and the proprietary T-Lok and J-J Hook Systems will be allowed provided only one type of joint connection is used for the length of the barrier.

104.04.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing, placing, maintaining and removal from the project site as directed, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

- (a) Temporary Concrete Traffic Barrier for Maintenance of Traffic and Reset Temporary Concrete Traffic Barrier for Maintenance of Traffic will be measured and paid for at the Contract unit price per linear foot measured along the center line of the top of the barrier.

The payment for Reset Temporary Concrete Traffic Barrier for Maintenance of Traffic will include removal from its original placement, transporting, and resetting it in its new temporary location.

- (b) Reflective Barrier Markers and Vertical Panels will be measured and paid for at the Contract unit price per each.

104.05 TRAFFIC BARRIER W BEAM (TBWB) FOR MAINTENANCE OF TRAFFIC.

104.05.01 DESCRIPTION. Furnish, install, maintain, reset, and remove temporary TBWB.

104.05.02 MATERIALS.

Traffic Barrier W Beam	918.01
Traffic Barrier Posts	918.02
Hardware for Traffic Barriers	918.03
Wood Offset Blocks	918.04
Composite Offset Blocks	605

104.05.03 CONSTRUCTION.

TBWB. Use construction methods in accordance with the applicable portions of Section 605.

TBWB Replacement. Immediately replace damaged portions of the TBWB. Install the TBWB to the correct horizontal and vertical alignment using offset blocks in kind.

TBWB Reset. When work is sufficiently completed through a traffic control area and TBWB is no longer required, remove and reset the TBWB and all components to a new work area as specified. Restore the previous location to original condition.

TBWB End Treatments. 104.09 and 104.10.

Place an approved end treatment at all ends of TBWB prior to opening to traffic.

104.05.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing and installing all cables, posts, brackets, traffic barrier W beam, hardware, galvanizing, excavation, backfilling, connections to rigid structures, removal, restoration of the area, and for all material, labor, equipment, tools, and incidentals necessary to complete the work as directed.

- (a) Traffic Barrier W Beam for Maintenance of Traffic will be measured and paid for at the Contract unit price per linear foot.
- (b) Replacing sections of the traffic barrier that have been damaged by vehicular traffic while in place will be measured and paid for at the Contract unit price per linear foot for the Traffic Barrier W Beam Replacement for Maintenance of Traffic item.
- (c) Reset Traffic Barrier W Beam for Maintenance of Traffic will be measured and paid for at the Contract unit price per linear foot.
- (d) Temporary Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each.

104.06 TUBULAR MARKERS.

104.06.01 DESCRIPTION. Furnish, install, and remove tubular markers for maintenance of traffic.

104.06.02 MATERIALS.

Tubular Markers	QPL
Reflectorization	950.03

104.06.03 CONSTRUCTION. Install tubular markers as recommended by the manufacturer and as approved by the Engineer.

104.06.04 MEASUREMENT AND PAYMENT. Tubular Markers will be measured and paid for at the Contract unit price per each. The payment will be full compensation for removal and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Tubular markers damaged due to traffic operations will be measured and paid for at the Contract unit price per each for Replacement of Tubular Marker Mast. If the base detaches from the pavement, replace the entire tubular marker assembly at no additional cost to the Administration, unless damaged by Administration snow removal operations.

104.07 ARROW PANEL (AP).

104.07.01 DESCRIPTION. Furnish and place APs for temporary use.

Furnish APs that are self-contained, vehicle mounted or portable, and approved by the Engineer. Use self-contained trailer units unless otherwise specified.

APs shall have both manual and automatic dimmer devices capable of reducing the light intensity by 50 percent. Periodically clean the photocells in order to prevent malfunctioning of the brightness control. Dimmer devices are mandatory during night operation. The devices shall include a fail safe system ensuring that maximum brightness is displayed during sunlight and 50 percent brightness is displayed during darkness, regardless of which dimmer device is operational.

104.07.02 MATERIALS.

Arrow Panel	QPL
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104.07.03 CONSTRUCTION. Furnish and test the APs as directed 24 hours in advance of actual use. The AP unit shall conform to the Arrow Panel table and be arranged with double pointed arrow configuration capable of displaying a left arrow, right arrow, double arrow, and a four corner caution mode.

A sequential chevron shall not be displayed.

ARROW PANEL				
AP UNIT	MdmMUTCD TYPE	LAMP OPTIONS*		
		No. 4412 A-Par 46	No. 4415A	1295 GE
Portable	A, D	—	X	X
Vehicle Mounted	B	X	—	—
Self-Contained Trailer	C	X	—	—

*Or as approved.

Use an AP to close any lane of a multilane highway. Place APs as specified. Maintain APs in good operating order.

- (a) The AP shall conform to the applicable requirements of the MdmMUTCD and only be used to supplement other required traffic control devices. Use the "Arrow" mode when closing a through travel lane on a multilane roadway. Place only one AP in the "Arrow" mode for each stationary lane closure. Moving work operations may utilize one or more APs for a single lane closure. Ensure that placement does not cause driver confusion near ramps, median crossovers, and side road intersections.
- (b) Aim the AP at approaching traffic in conformance with the minimum legibility distance specified in the MdmMUTCD. Ensure that the display is level.
- (c) For stationary lane closures, place the AP on the shoulder at the beginning of the taper (nearest to oncoming traffic). Where there are narrow or no existing shoulders in the closed lane behind the channelizing devices, place the AP as near to the beginning of the taper as possible.
- (d) For a lane closure on a two-lane, two-way roadway, or for a shoulder closure on any roadway, use the "Caution" mode. In "Caution" mode, one light is displayed in each corner.
- (e) For moving operations, refer to 104.23.

104.07.04 MEASUREMENT AND PAYMENT. Arrow Panels will be measured and paid for at the Contract price per unit day. A unit day shall consist of any approved usage within a 24 hour calendar day

period. Each Arrow Panel will be paid for only once per unit day, regardless of how many times it is relocated. When an arrow panel is used for part of a day, it will be measured and paid for as a unit day.

The payment will be full compensation for all material, labor, equipment, tools, incidentals required to set up and operate at the site as required, and at any relocated site as required by the Traffic Control Plan or as directed.

104.08 TEMPORARY TRAFFIC SIGNS (TTS).

104.08.01 DESCRIPTION. Furnish, install, and maintain TTS on or along all transportation facilities.

104.08.02 MATERIALS.

Wood Sign Supports	921.05 and 921.06
Square Perforated Tubular Steel Sign Supports	As Approved by the Office of Traffic and Safety
Reflectorization	950.03.04
Signs	950.08
Portable Sign Supports, Composite Aluminum Signs, Plastic Signs, and Flexible Roll Up Signs	QPL

104.08.03 CONSTRUCTION. Place signing in accordance with the MdMUTCD, the Administration’s Standard Highway Sign Book (SHSB), and the Contract Documents. All work area warning signs shall be 48 x 48 in. unless otherwise specified. The SHSB may be obtained from the Office of Traffic and Safety, Traffic Engineering Design Division. Designs of signs not included in the SHSB may be prepared by the Contractor in sketch form, to scale, and for approval. Sign designs may be obtained upon a seven-day request to the Office of Traffic and Safety. Make requests in written form directed to the Engineer.

Mount signs that will be in place for more than three working days on two 4 x 4 in. wood posts or on two 2 x 2 in. square perforated tubular steel posts, unless otherwise specified. Mount the sign at a height of at least 7 ft or as specified. Do not place any additional bracing on wood posts unless the sign is behind the protective barrier. The tops of the wood posts shall not protrude more than 3 in. beyond the nearest edge of the sign. Place 4 x 4 in. wood posts at least 4 ft into the ground. Place 4 x 6 in. wood posts at least 5 ft into the ground.

Signs on portable supports shall be mounted so that the bottom of the sign is at least 1 ft above the roadway pavement elevation. Portable sign supports shall be self-erecting, able to withstand a wind velocity of 70 mph, and able to maintain themselves within five degrees rotation around their vertical axis.

Use the following minimum thickness for fabricated aluminum signs mounted on wood or steel tubular posts.

LONGEST DIMENSION OF SIGN in.	MINIMUM THICKNESS in.
≤ 12	0.040
12+ to 24	0.063
24+ to 36	0.080
36+ to 48	0.10
> 48	0.125

When composite aluminum, plastic, or flexible roll up signs are used on portable supports, the support shall be approved by the Office of Traffic and Safety to hold that sign material. When supported on portable sign supports, composite aluminum signs shall be at least 0.08 in. thick.

TTS shall not be installed until inspected and approved. Do not display signs to traffic until directed. Properly maintain the TTS, leave in place while applicable, and remove immediately when no longer required. When operations are performed in phases or stages, only signs that apply to the present conditions shall be displayed to traffic.

Properly space the signs along the highway to provide adequate sight distance to work zone signs and existing signs. When a sign is not indicative of actual conditions, such as during periods of temporary shutdown or extended periods of no work being performed (including lunchtimes and overnight periods), either remove the entire work zone setup and remove the sign, turn it away from all traffic (turning parallel to traffic is prohibited), or completely cover it with an approved opaque material. This will not be required for nonwork periods up to one hour.

Ensure that signs are not obscured or obstructed, and that they meet all specified sight distance requirements.

Use reflectorized TTS for both daytime and nighttime use.

Maintain sign faces free of tape, tape residue, or any other foreign matter. Remove all advertisements from signs and supports. Ensure that supplemental signs do not cover any part of the face of the primary sign.

Sign Replacement. Maintain signs in a new or like new condition. When directed, replace signs that become faded, illegible, or damaged. Signs that are not new may be used only if the reflective intensity at a divergence angle of 0.2 degrees and incidence angle of minus 4 degrees conforms to at least 70 percent of the values specified in 950.03 over 90 percent of their reflectorized surface. At other times throughout the duration of the Contract, the sign reflectivity intensity shall be at least 60 percent. The acceptability of the signs shall be determined by 1 ft square test plates calibrated in accordance with these requirements.

104.08.04 MEASUREMENT AND PAYMENT. Temporary traffic signs will be measured and paid for at the Contract unit price per square foot for the pertinent Temporary Traffic Sign item. The payment will be full compensation for furnishing the signs and supports, installation, relocation, maintenance, cleaning, replacement due to non-traffic damage and normal wear, removal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Where signs have been set and damaged by traffic and the Engineer determines that they are not repairable, replacement will be measured and paid for at the Contract unit price.

When no longer needed, temporary traffic signs and all associated materials and incidentals shall be removed from the project site and become the property of the Contractor.

104.09 TEMPORARY TRAFFIC BARRIER END TREATMENTS.

104.09.01 DESCRIPTION. Furnish, install, maintain, reset, and remove temporary traffic barrier end treatments in conformance with the manufacturer's recommendations or as directed.

104.09.02 MATERIALS.

Temporary Traffic Barrier End Treatments

Refer to the Contract Documents or QPL

Temporary Crash Cushion Sand
Filled Plastic Barrels (SFPB)

104.10.02

104.09.03 CONSTRUCTION.

Temporary End Treatments.

- (a) Install Temporary Type E and J Traffic Barrier End Treatments in conformance with the manufacturer's recommendations and as approved.

The nose section shall be reflectorized as approved by the Office of Traffic & Safety.

- (b) Install SFPB as specified in 104.10.03.

Inspection of End Treatments.

- (a) Perform a daily visual inspection of the devices to ensure that no damage has occurred, and that the end treatment is capable of functioning as intended.
- (b) Following an impact, an approved reflectorized drum will suffice temporarily as reflectorization for the end treatment. Repair or replace the damaged end treatment within four hours after notification.

104.09.04 MEASUREMENT AND PAYMENT. Temporary Traffic Barrier End Treatments, Remove and Reset Temporary Traffic Barrier End Treatments, and Repairing Temporary Traffic Barrier End Treatments will be measured and paid for at the Contract unit price for one or more of the items listed below unless otherwise specified.

- (a) Temporary Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each for the type specified. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to provide a complete temporary traffic barrier end treatment.
- (b) Temporary crash cushion sand filled plastic barrels will be measured and paid for as specified in 104.10.04.

- (c) Remove and Reset Temporary Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each for the type specified. The conditions specified for the initial installation and removal of the end treatment shall be applicable to removing and resetting the end treatment.
- (d) Temporary Traffic Barrier End Treatment Spare Parts Package furnished and installed will be measured and paid for at the Contract unit price per each for the type specified. The payment will be full compensation for the complete clearing and removal of debris and damaged unsalvageable parts, and for all material, labor, equipment, tools, and incidentals necessary to construct the temporary end treatment to the configuration specified.

When spare parts packages are furnished by the Administration, Repairing Temporary Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each for the type specified. The payment will be full compensation for pickup and all transportation, installation, reconnection to fixed objects where necessary, complete clearing and removal of debris and damaged unsalvageable parts, and for all material, labor, equipment, tools, and incidentals necessary to construct the temporary end treatment to the configuration specified.

Payment will not be made for spare parts packages used for end treatments damaged due to the Contractor’s operations.

- (e) Removal of the temporary traffic barrier end treatments will not be measured but the cost will be incidental to the initial Contract unit price per each. Removal shall include patching of any holes made to anchor or stabilize the end treatment, and cleaning and clearing the area of all debris.

104.10 TEMPORARY CRASH CUSHION SAND FILLED PLASTIC BARRELS (SFPB).

104.10.01 DESCRIPTION. Furnish and install SFPB.

104.10.02 MATERIALS.

Sand	901.01
Plastic Barrels (Yellow)	QPL

104.10.03 CONSTRUCTION. Prior to installing the SFPB, level the ground supporting the system utilizing material comparable to the existing ground or as approved.

The components, assembly, placing configuration, and filling of the individual plastic barrels with varying weights of sand shall be in accordance with the manufacturer's recommendations or as specified in the Contract Documents. Barrels shall be watertight. SFPB may stand on pallets up to 4 in. high.

Reflectorize the first barrel of the SFPB configuration as specified. Following an impact, an approved reflectorized drum will suffice temporarily as reflectorization for the SFPB. Replace damaged barrels within four hours after notification.

Use dry and loose sand in the barrels. Do not use bags of sand. Add an antifreeze agent to the sand in accordance with the manufacturer's recommendations. Have sufficient replacement materials available.

Immediately after the SFPB have served the intended purpose, remove the installation and restore the site as directed.

104.10.04 MEASUREMENT AND PAYMENT. Temporary Crash Cushion Sand Filled Plastic Barrels will be measured and paid for at the Contract unit price per barrel for one or more of the items listed below and specified in the Contract Documents.

- (a) Temporary Crash Cushion Sand Filled Plastic Barrels for Maintenance of Traffic.
- (b) Replace Temporary Crash Cushion Sand Filled Plastic Barrels for Maintenance of Traffic.
- (c) Remove and Reset Temporary Crash Cushion Sand Filled Plastic Barrels for Maintenance of Traffic.

The payment will be full compensation for excavation, regrading, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

104.11 TEMPORARY PAVEMENT MARKINGS.

104.11.01 DESCRIPTION. Furnish, install, and remove temporary pavement markings. These markings include lines (striping), legends (letters and numbers) and symbols. The requirements of Section 549 apply to this specification.

104.11.02 MATERIALS.

Pavement Marking Paint	Refer to Contract Documents
Removable Pavement	
Marking Tape	Refer to Contract Documents
Black Out Tape	QPL

104.11.03 CONSTRUCTION.

104.11.03.01 Quality Control/Quality Assurance. Perform Quality Control testing in conformance with MSMT 729. Technicians will be certified by the Administration. The Engineer will complete the Quality Assurance checks by performing the Nighttime Visibility Evaluations.

Retroreflectance. The initial retroreflectance readings for temporary pavement markings shall be at least 250 millicandelas per lux per square meter for white and 150 for yellow. The Engineer will monitor the pavement markings in conformance with MSMT 729 during the service life of the material.

104.11.03.02 Service Life. Maintain the pavement markings for the applicable service life of the materials. The service life shall be at least 180 days for tape and 60 days for paint. Replace the materials if the retroreflectance falls below 150 millicandelas per lux per square meter for white and 100 for yellow.

Replace or repair the pavement markings as necessary within this period and within four hours or as directed at no additional cost to the Administration. Refer to GP-5.11.

104.11.03.03 Application. Apply pavement markings in accordance with the manufacturer's recommendations and the Contract Documents. Apply markings prior to allowing traffic on the pavement and in the same direction as the flow of traffic.

Surface Condition. The pavement surface shall be clean, dry, and free of all contaminants, including curing compound, dirt, and loose particles. Remove all residual, loose, and poorly constructed pavement markings.

104.11.03.04 Pavement Marking Removal. Completely remove all removable pavement markings prior to application of the permanent markings. On stage construction or final surfaces of portland cement concrete pavements, remove any objectionable adhesive residue by water blasting or other approved methods. Do not use open flame to remove adhesive residue, or any pavement markings. Completely remove or obscure pavement markings within the travel way or adjacent to the travel way that are not applicable.

Ensure that neither the existing nor the final surface is damaged by the operations.

Refer to the Contract Documents for the removal of existing permanent paving markings.

Completely remove or obscure all nonapplicable pavement markings within the travel way or adjacent to the travel way with removable pavement marking tape, as specified in 104.11.02.

104.11.04 MEASUREMENT AND PAYMENT. Pavement Marking Paint and Removable Pavement Marking Tape will be measured and paid for using one or more of the items listed below and as specified.

The payment will be full compensation for furnishing, installing, and removal of lines, letters, numbers, arrows, symbols, and the removal of all residue. In addition, payment will cover maintenance and replacement during the service life, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

- (a) Replacement of Pavement Markings required beyond the service life per linear foot for the specified pavement marking item.
- (b) Replacement of Removable Markings during the service life as a result of plowing (as determined by the Engineer) per linear foot for the specified removable marking item.
- (c) Pavement Marking Paint Lines - in width specified - per linear foot.
- (d) Pavement Marking Paint Legends (letters and numbers) and Symbols per square foot. The square foot quantity for Legends (letters and numbers) and Symbols will be as specified in the Administrations Standard Details.
- (e) Removal of Removable Pavement Marking Tape Lines - in width specified - per linear foot.
- (f) Removal of Removable Pavement Marking Tape Legends (letters and numbers) and Symbols per square foot. The square foot quantity for Legends (letters and numbers) and Symbols will be as specified in the Administrations Standard Details.
- (g) Placement of Removable Pavement Marking Tape Lines – any type, any width – per linear foot.
- (h) Placement of Removable Pavement Marking Tape Legends (letters

and numbers) and Symbols per square foot. The square foot quantity for Legends (letters and numbers) and Symbols will be as specified in the Administrations Standard Details.

- (i) Black Out Tape Lines – any type, any width – per linear foot.

104.12 DRUMS FOR MAINTENANCE OF TRAFFIC.

104.12.01 DESCRIPTION. Furnish, set, reset, maintain, and remove drums for maintenance of traffic.

104.12.02 MATERIALS.

Reflectorization	950.03
Plastic Drums	QPL

Drums shall be manufactured of low density polyethylene (PE), 36 in. in height, and have a diameter of at least 18 in. The drum shall have four, 6 in. wide horizontal, circumferential, alternating orange and white stripes, with the top stripe being orange. Drums may have one or more flat sides as long as the minimum 18 in. diameter is satisfied.

Use high performance wide angle white and fluorescent orange sheeting on all drums.

104.12.03 CONSTRUCTION. Use sand-filled bases or bags of sand to keep the drums from moving. Install sandbags on the base of the drum only. Rubber or plastic bases or recycled tires, weighing between 20 and 40 lbs., may be used as a substitute for sand bags.

The Contractor’s name or identification mark may be neatly stenciled at the bottom of the nonreflective portion of the drum in letters no more than 2 in. high. No other markings or wording may be on the vertical side of the drum.

Maintain drums in a new or like new condition. Replace drums damaged by traffic within four hours after notification.

104.12.04 MEASUREMENT AND PAYMENT. Drums for Maintenance of Traffic will be measured and paid for once at the Contract unit price per each. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Where drums have been set and damaged by traffic and the Engineer determines that they are not repairable, replacement will be measured and paid for at the Contract unit price.

104.13 BARRICADES FOR MAINTENANCE OF TRAFFIC.

104.13.01 DESCRIPTION. Furnish, set, reset, maintain, and remove barricades for maintenance of traffic.

104.13.02 MATERIALS.

Reflectorization	950.03
Barricades	QPL

104.13.03 CONSTRUCTION. Use barricade rails conforming to the MdMUTCD, with a minimum rail length of 5 ft. Use approved reflective sheeting and installation procedures.

Replace barricades damaged by traffic within four hours after notification.

Mount signs so that no more than half of the top two rails or one third of the barricade is covered. Mount signs on the barricade so that the bottom of the sign is at least 12 in. above the ground or surface. The bottom of rectangular signs shall not be mounted higher than the bottom of the top rail. Do not use aluminum signs.

104.13.04 MEASUREMENT AND PAYMENT. Barricades will be measured and paid for once at the Contract unit price per each for the pertinent barricade item specified in the contract documents. The payment will be full compensation for warning lights (when required), the maintenance and removal of any required warning lights, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Where barricades have been set and damaged by traffic, and the Engineer determines that they are not repairable, replacement will be measured and paid for at the Contract unit price.

104.14 CONES FOR MAINTENANCE OF TRAFFIC.

104.14.01 DESCRIPTION. Furnish, set, reset, maintain, and remove cones for maintenance of traffic.

104.14.02 MATERIALS.

Reflectorization	950.03
Cones	QPL

Cones shall be new or like new condition. Cones shall be at least 28 in. high, at least 10 in. diameter at the inside of the base, reflectorized, and equipped with approved anchor collars as needed to maintain an upright position.

104.14.03 CONSTRUCTION. The Contractor's name or identification mark may be neatly stenciled at the bottom of the cone in maximum 2 in. high letters. Place no other markings or writings on the vertical area of the cone. Turn the cone so that Contractor's name or identification mark faces away from traffic.

Replace cones damaged by traffic within four hours or as directed after being notified.

104.14.04 MEASUREMENT AND PAYMENT. Cones for maintenance of traffic and cones that have to be replaced will not be measured but the cost will be incidental to the Contract price for Maintenance of Traffic.

104.15 FLAGGER.

104.15.01 DESCRIPTION. Furnish flaggers when specified or directed. Flaggers shall have completed an Administration approved flagger training course within the last four years. The failure of any flagger to perform the required duties will be grounds for replacement.

Flaggers shall utilize two-way radios, field telephones, or pilot vehicles when not within sight distance of each other, or when directed.

104.15.02 MATERIALS.

Reflective sheeting on the STOP/SLOW paddle 950.03

Paddles shall be 24 x 24 in. with letters at least 8 in. high and mounted at least 5 ft above the ground.

104.15.03 CONSTRUCTION. Flagging shall conform to MdMUTCD. All outfits and equipment (STOP/SLOW paddles, pilot cars or other vehicles, air horns or bullhorns, field telephones, two-way radios, site illumination, etc.) will be subject to approval. Use STOP/SLOW paddles unless otherwise permitted.

104.15.04 MEASUREMENT AND PAYMENT. Flagger will not be measured but the cost will be incidental to the Contract price for Maintenance of Traffic.

When an item for Flagger is included in the Contract Documents, Flagger will be measured and paid for at the Contract unit price per hour. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

104.16 MODIFICATION OF EXISTING SIGNS.

104.16.01 DESCRIPTION. Relocate, remove, cover, modify copy, reinstall, or change existing highway signs relating to the construction activity. This work is in addition to the temporary traffic signs specified in 104.08.

104.16.02 MATERIAL.

Sign Panel Supports and Hardware	909.07, 921.05, 921.06, 950.04 A 123, A 153 and A 709
Reflective and Non-reflective Sheeting	950.03
Sign Materials	950.08

Use an approved opaque sign covering material.

104.16.03 CONSTRUCTION. Modify existing signs as specified.

104.16.04 MEASUREMENT AND PAYMENT. Modification of existing signs will be measured and paid for using one or more of the items listed below and specified in the contract documents. The payment will be full compensation for all excavation, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

- (a) Relocate Wood Sign Supports per each support.
- (b) Sign Modifications to Overhead Sign Structures per square foot.
- (c) Relocate Sign per square foot.
- (d) Remove Sign per square foot.
- (e) Modify Copy per each character.
- (f) Install or Remove Shield per each.
- (g) Cover Sign per square foot.
- (h) Relocate Sign Luminaire per each.

104.17 TEMPORARY MOVABLE TYPE CONCRETE TRAFFIC BARRIER (MCTB).

104.17.01 DESCRIPTION. Furnish, place, assemble, maintain, move, and remove and dispose of movable interlocking type concrete traffic barrier. Movable barrier systems shall consist of individual units that remain connected for the total length when being moved in one continuous operation.

104.17.02 MATERIAL.

Precast Movable Concrete	
Barrier and Transfer Device	QPL
Reflective Barrier Markers	QPL

104.17.03 CONSTRUCTION. Perform all transfer shifts using the transfer device. The transfer device shall be capable of moving and transferring the barrier as required, and of operating on the curve and grades specified. Ensure that the device does not extend into traffic.

The Engineer will inspect the movable barrier upon delivery and throughout the life of the project. Replace any damaged or defective units as directed. Install reflective barrier markers as specified. Maintain the barrier and reflective barrier markers in a like new condition.

Perform all maintenance operations for the transfer device. Have sufficient spare parts and personnel available to ensure that the required lane configurations are in place at the required times. Failure to move the MCTB at the proper time will be cause for penalty under TC-4.02.

104.17.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

- (a) The initial installation of the Temporary Movable Type Concrete Traffic Barrier will be measured and paid for at the Contract unit price per linear foot measured in place from end to end.
- (b) Transfer shifts of the barrier will be measured and paid for at the Contract unit price per linear foot for the Transfer Shift of Movable Type Concrete Barrier item. The measurement will be end to end of the barrier actually shifted. The Contract unit price will apply to each shift.
- (c) Replacing sections of the barrier that have been damaged by vehicular traffic while in place will be measured and paid for at the

Contract unit price per each for the Replacement Sections for Movable Type Concrete Barrier item. Replacement of sections damaged by the Contractor's operations shall be at no additional cost to the Administration.

- (d) Resetting the barrier will be measured and paid for at the Contract unit price per linear foot for the Reset Movable Type Concrete Barrier item. The payment will also include removal from its original placement and transporting and resetting it in its new temporary location.
- (e) Reflective barrier markers will be measured and paid for as specified in 104.04.04(b).
- (f) End treatments will be measured and paid for under the pertinent item specified in the Contract Documents.

104.18 TRAFFIC MANAGER (TM).

104.18.01 DESCRIPTION. Provide a Traffic Manager (TM).

104.18.02 MATERIALS. Not applicable.

104.18.03 CONSTRUCTION. Submit the TM's name for approval at least 10 days prior to commencing any work on the project. Provide proof that the TM has completed an Administration approved Temporary Traffic Control training course within the last four years. A change in the appointment of any TM throughout the duration of the Contract will require a written submittal for approval. Any failure of the TM to perform the required duties will be grounds for replacement. The TM shall be available at all times and be on site within 1/2 hour during periods of active work in the work zone.

The TM shall do the following:

- (a) Implement the Traffic Control Plan (TCP), maintain an up-to-date TCP, and provide a copy to the Engineer following any changes.
- (b) Closely coordinate the operations with the Engineer and supervise the maintenance of traffic on the project, including those involving subcontractors.
- (c) Make on-site inspections of the area affected by the work on a regular basis including Saturdays, Sundays, and holidays, and be available for consultation at all times. When the TCP is in place,

make daily inspections during hours of operations and at least one night inspection per week. Perform additional inspections as directed.

- (d) During holiday periods, in addition to the monitoring of the maintenance of traffic, conduct a surveillance of any area affected by the Contract work.
- (e) Maintain a daily log of the inspections and include the date, time, hours worked, condition of maintenance of traffic, and any corrective action taken. Furnish a copy of the daily log to the Engineer by the following day.
- (f) Provide coordination between adjacent work zone operations to ensure that inappropriate or conflicting messages or devices are not displayed to traffic.
- (g) Immediately, notify the Engineer of any accident or incident within the area affected by the Contract.
- (h) Make inspections during and immediately after adverse weather conditions to ensure that the traffic control devices are clean, undamaged, and in the correct position.

104.18.04 MEASUREMENT AND PAYMENT. The Traffic Manager will not be measured but the cost will be incidental to the Contract price for Maintenance of Traffic.

104.19 PORTABLE VARIABLE MESSAGE SIGNS (PVMS)

104.19.01 DESCRIPTION. Furnish, install and relocate portable, self-contained, trailer mounted variable message signs.

104.19.02 MATERIALS.

PVMS

QPL

All materials shall be like new, corrosion resistant, and unaffected by water spray, salt, oil, gasoline, and all other contaminants in the quantities normally found along the edge of the traveled roadway. Construction, materials, and operation shall meet NFPA, UL, and NEC. Ensure that sign messages are visible and legible for a distance of 900 ft from any point along the traveled approach roadway at all times. The PVMS shall be equipped with a sighting device to provide alignment for maximum visibility.

104.19.03 CONSTRUCTION.**104.19.03.01 Equipment.**

Trailer. In accordance with Maryland Motor Vehicle Law.

Structural Support. The structural support framework shall allow the system to be assembled into a unit and be mounted on the trailer, and shall provide the support mechanism between the sign panel assembly, the power supply, and the controller.

The framework shall provide sufficient support to prevent damage to any unit component when the sign is in down and locked position during normal highway travel.

The deployed structure shall supply adequate support to allow complete sign operation, including raising and lowering of the sign panel, during sustained wind speeds of 85 mph.

The display windows shall be made of impact-resistant clear Lexan or as approved.

Sign Panel. Not to exceed 144 in. length, 90 in. height, 12 in. depth.

Display.

- (a) Capable of displaying three lines of text.
- (b) Each line of text shall be constructed using either a discrete matrix or a full matrix display.
- (c) Capable of displaying eight characters per line.
- (d) The character height shall be at least 18 in.
- (e) If discrete matrix display is used, each character shall be displayed using a 5 x 7 array with at least eight array modules per line.

A 4-1/4 to 7 in. space shall exist between each display line with no glare reflection.

- (f) If full matrix display is used, the sign shall have at least 25 rows and 45 columns of disks. Each display line shall have at least 7 rows and 45 columns of disks and a 4-1/4 to 7 in. space between each display line with no glare reflection.

Flip Disk Mechanism.

- (a) Be electromagnetically activated, with a service life of at least 200 million operations.
- (b) Have a reflective surface that will maintain color intensity for at least three years.
- (c) Be circular or rectangular, with a visible surface area between 3-3/4 and 4-1/4 in².

LED Illumination. LED illumination for each matrix element shall:

- (a) Meet ITE specification for amber color.
- (b) Utilize AlInGaP substrate.
- (c) Each LED shall produce at least a 1 candela output on center at 25 mA drive current.
- (d) Each matrix element shall have at least two LED's located within the perimeter of the flipping disk.
- (e) Provide full illumination within at least a 24 degree cone perpendicular to the sign face.
- (f) Have an operating temperature range of -40 to 160 F.

PVMS UNIT.**Lift Mechanism.**

- (a) Electric or electrically assisted hydraulic mechanism capable of raising and lowering the sign panel.
- (b) Capable of being raised or lowered manually.
- (c) Furnished with a stainless steel safety bolt to prevent the sign panel from lowering once in the raised position. A self-locking mechanism shall be incorporated into the safety bolt to prevent it from being inadvertently dislodged.
- (d) Designed to allow the raised sign panel to rotate 360 degrees about the vertical axis.
 - (1) Allow rotation clockwise and counter-clockwise.

- (2) A mechanism shall be provided to lock the sign panel in place, at any position.

Electrical Connections and Gauges.

- (a) All wiring from power sources to PVMS equipment shall use locking cable connectors.
- (b) Volt and amp gauges shall be provided for both AC and DC.
- (c) Standard negative ground system shall be tied to the sign chassis.
- (c) Lightning protection shall be supplied to the load side of the sign system's distributed power lines to withstand multiple surges in excess of 600 volts.

Power Supply. Either a solar powered electrical system, or existing commercial electrical service.

Solar Powered Electrical System. Battery power system and solar array panels capable of displaying a two page message for 21 consecutive days without auxiliary charge.

Sign Controller.

- (a) Capable of driving the matrix display panel operating over a -50 to 150 F range and in a 20 to 100 percent noncondensing humidity range.
 - (b) Accommodate 100 preprogrammed, user-defined messages.
 - (c) Capable of displaying three sequenced messages. On/Off time for each message in a sequence shall be user adjustable within a range of 0 to 5 seconds.
 - (d) Designed for fail-safe prevention of improper information display in the case of a system malfunction.
 - (e) Cause a user defined default message to be displayed in case of failure of the PVMS unit when flip disk mechanism is used.
 - (f) Have the capability of retrieving all messages stored in temporary memory.
- (1) Temporary memory shall be nonvolatile.

- (2) All messages and programs shall remain resident in the controller's memory in the event of a power failure.
- (3) Have an RS-232 port to facilitate connection of an external communication device.
- (g) Capable of automatic system recovery after power outages to the central controller without operator intervention, including the ability to maintain an up-to-date status on a remote unit if sign is operated from a remote location.
- (h) Monitor and display the battery output voltage and solar array activities (charging/discharging), and blank the sign when the battery output voltage drops below the manufacturer's recommended output level.
- (i) Capable of monitoring and displaying the status of the photocell and adjusting the sign illumination to match the ambient light conditions. The controller shall have at least nine levels of dimming from 10 to 100 percent brightness.
- (j) Contained in a weatherproof cabinet located on the controller housing and insulated to protect against excessive vibration and temperature.
 - (1) Equipped with a lockable door latch and interior cabinet dome light.
 - (2) Provided with a keyboard storage location inside the cabinet.

Character Set Software.

- (a) Have all of the standard ASCII characters and symbols.
- (b) Provide left and right arrows.
- (c) Have all alphanumeric entries performed with a keyboard or keypad that causes the same character to be displayed on the matrix. Arrow symbols shall be generated via a cursor pad on the keyboard or keypad.
- (d) Have messages default to self-centering display with the ability to left or right justify a display when full matrix is used.

104.19.03.02 Set up and operate the PVMS on the project site 24 hours in advance of actual use. Ensure that each unit is functioning properly and approved. Locate the PVMS as specified.

Aim the PVMS at approaching traffic in accordance with the 900 ft minimum visibility and legibility requirement. Ensure that the PVMS is level and that the sign face is not obscured by highway alignment or glare from either sunlight or vehicle headlights.

104.19.04 MEASUREMENT AND PAYMENT. The Portable Variable Message Sign will be measured and paid for at the Contract price per unit day. A unit day shall consist of any approved usage within a 24hour calendar day period. Each unit will be paid for only once per unit day, regardless of how many times it is relocated. When a unit is used for part of a day, it will be measured as a unit day. This unit price will be the same regardless of the type of unit used.

The payment will be full compensation for the electrical power and hook up, setup and maintenance of computer programs, changing messages, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

104.20 TEMPORARY ORANGE CONSTRUCTION FENCE.

104.20.01 DESCRIPTION. Furnish, install, and maintain new or like new temporary orange mesh construction fence. This fence is not to be used as a safety barrier.

104.20.02 MATERIALS.

Precast Concrete Blocks	903.05
Tie Wire, Tension Wires, Tension Wire Clips and Hardware	914.02
Orange Mesh Fencing	As approved

Fence posts shall be 4 ft high, 1.90 in. diameter round posts; or 5-1/2 ft high, 2 in. steel U channel posts, as specified herein.

Submit samples of the fence fabric, fence posts, movable precast concrete blocks, tie wire, tension wires, and other miscellaneous hardware for approval.

104.20.03 CONSTRUCTION. Temporary orange construction fence shall be at least 4 ft high and with a maximum post spacing of 8 ft. When installed on a paved surface, support the fence by inserting the round post into a precast concrete block having a round hole through the center of the block. When installed in unpaved areas, use steel U channel fence posts driven 1-1/2 ft into the ground. Installation of the fence in any other manner will require approval.

Secure the fabric to the posts by wrapping a tie wire around the horizontal fence strands and the posts. Install a top tension wire to prevent sagging. When installed on paved surfaces, the Engineer will determine if a bottom tension wire is required.

Remove the fence when the Engineer determines that the fence is no longer required. The removed fence is the property of the Contractor.

Damaged Construction Fence. Repair or replace damaged construction fence within four hours after notification.

104.20.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Temporary Orange Construction Fence will be measured and paid for at the Contract unit price per linear foot for the actual number of linear feet measured to the centers of end posts.

Remove and Reset Temporary Orange Construction Fence will be measured and paid for at the Contract unit price per linear foot.

104.23 PROTECTION VEHICLE (PV).

104.23.01 DESCRIPTION. Furnish a PV as required.

The PV shall consist of a work vehicle with approved flashing lights as required by the standard TCP's and either:

- (a) A truck-mounted attenuator (TMA) with support structure designed for mounting the system to the work vehicle, or
- (b) A trailer truck-mounted attenuator (TTMA) designed for attaching the system to the work vehicle by a pintle hook.

Provide an arrow panel (arrow mode for multilane roadways and caution mode on two-lane, two-way roadways) in accordance with 104.07.03. The arrow panel shall be integral to either the work vehicle or the TMA/TTMA.

The size of the work vehicle and the method of attachment shall be as specified in the TMA/TTMA manufacturer's specifications, and as tested per NCHRP Report 350 at Test Level 3.

No part of the TMA/TTMA shall be designed to intrude under the support vehicle during impact or require a safety clearance under the support vehicle that extends forward of the rear axle.

General. The ballast of the work vehicle shall meet the manufacturer's specification for the TMA/TTMA and be firmly secured to prevent movement during an impact.

All exposed steel on the attenuator shall be primed and painted yellow. The undercarriage and support frame may be primed and painted black. All welding shall be performed by or under the direct supervision of a certified welder.

The rear facing surface of the TMA/TTMA shall have an inverted "V" chevron pattern formed by alternating 4 in. wide black and yellow stripes as shown in Standard No. MD 104.01-21. The sides of the TMA/TTMA shall have a border of 4 in. red and white reflective tape as shown on Standard No. MD 104.01-18.

The TMA/TTMA shall have a standard lighting system including brake lights, tail lights, turn signals, and ICC bar lights. All wiring shall be protected and adequately supported. The TTMA trailer shall conform to Maryland Motor Vehicle Law governing trailers.

Impact Performance. TMA/TTMAs manufactured prior to January 1, 2005 shall have passed NCHRP Report 350 Tests 50 and 51 Level 3. TMA/TTMAs manufactured after January 1, 2005 shall have passed NCHRP Report 350 Tests 50, 51, 52, and 53 Level 3.

Dimensions.

- (a) Road clearance for the TMA/TTMA shall be 12 ± 1 in. or as specified by the manufacturer.
- (b) Total weight of the TMA, exclusive of the work vehicle, shall not exceed 2100 lb unless it is trailer-mounted.

Durability. The manufacturer shall ensure that travel vibration, in either a vertical (for TMA) or horizontal position, will not affect the performance of the work vehicle or the TMA/TTMA.

Certifications. Provide certification that the TMA/TTMA is in good working order, has not been damaged, conforms to the requirements of the manufacturer's specifications (model number, roll ahead distance, truck weight, etc.), and includes the date of manufacture.

The manufacturer shall certify that moisture penetration will not impede the energy impact absorption properties or add significantly to the weight of the TMA/TTMA.

Tilting. An electrically powered tilt system shall be incorporated to facilitate the tilting of the TMA cartridge to a 90 degree position from horizontal. The unit shall have a locking device to secure the TMA system in the vertical position. The completed tilt system shall be factory assembled.

104.23.02 MATERIAL. Not applicable.

104.23.03 CONSTRUCTION. Not applicable.

104.23.04 MEASUREMENT AND PAYMENT. Protection Vehicles will be measured and paid for at the Contract price per unit day. A unit day shall consist of any approved usage within a 24 hour calendar day period. If a protection vehicle is used for part of a day, it will be measured as a unit day, regardless of how many times it is relocated. The payment will be full compensation for the complete protection vehicle, including the truck mounted attenuator/trailer truck mounted attenuator and arrow panel, licensed work vehicle operator, relocating the protection vehicle, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

104.26 REMOVABLE RUMBLE STRIPS.

104.26.01 DESCRIPTION. Furnish, install, maintain, and remove removable rumble strips.

104.26.02 MATERIALS.

Removable Rumble Strips

QPL

Rumble strips shall be white in color, 4 in. wide, and 0.250 in. thick.

104.26.03 CONSTRUCTION.

104.26.03.01 Quality Assurance/Quality Control. Perform quality control testing using technicians certified by the Administration.

104.26.03.02 Warranty Period. Maintain the rumble strips and repair defects for a period of 180 days from the date of application. Replace as necessary within this period as directed at no additional cost to the Administration. Refer to GP-5.11.

At least 90 percent of the total number of rumble strips in any lane shall be free from signs of failure due to blistering, excessive cracking, discoloration, smearing or spreading under heat, chipping, spalling, or poor adhesion to the pavement. Replace rumble strips showing wear or a thickness less than 0.20 in.

104.26.03.03 Application and Removal. The pavement surfaces shall be completely dry and free of oil, grease, sand, dirt, dust, loose aggregate, soil, salt, and other contaminants. Apply the rumble strips in accordance with the manufacturer's recommendations and the Contract Documents. Place perpendicular to the flow of traffic and located as specified.

Space the strips between 4 and 10 ft on center, with a pattern of at least 10 but not more than 12 strips per set. Decrease the spacing within each set as motorists approach the work zone. The spacing between the sets shall be as specified.

Do not place on sharp horizontal or vertical curves. Use in conjunction with other traffic control devices or visual cues that will assist drivers in identifying the appropriate action to take.

For installations where the roadway is wider than one lane in each direction, install in one-lane width segments utilizing butt joints. Do not overlap. Continue at least 1 ft onto each shoulder. Do not install over pavement seams, joints, or deteriorating markings and substrates.

When no longer required, remove rumble strips and residue. Return the pavement surface to its original condition.

104.26.04 MEASUREMENT AND PAYMENT. Removable Rumble Strips will be measured and paid for at the Contract unit price per linear foot. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Removal and replacement required beyond the 180 day period will be measured and paid for at the Contract unit price for the Removable Rumble Strip item.

Replacements made during the service life due to plowing will be paid for at the Contract unit price for the Removable Rumble Strip item.

104.26.04.01 Removal, Replacement, and Corrective Actions. Any additional cost, including maintenance of traffic, for the removal of rumble strips that are installed inaccurately or incorrectly shall be at no additional cost to the Administration. In addition, the current road user fee will be applied when traffic disruption occurs during corrective actions.

104.28 SPEED DISPLAY TRAILER (SDT)

104.28.01 DESCRIPTION. Furnish, install and relocate a portable, self-contained, trailer mounted, dynamic speed display with static speed limit sign.

104.28.02 MATERIALS.

Speed Display Trailer

QPL

Each unit shall include the trailer, structural support system, sign panel assembly, lift mechanism, power supplies, sign mounted controller, non-invasive speed detection device, and ancillary equipment.

All materials for the SDT shall be like new, corrosion resistant, and unaffected by water spray, salt, oil, gasoline, and all other contaminants in the quantities normally found along the edge of the traveled roadway. Construction, materials, and operation shall be in accordance with NFPA, ULI, and NEC. Sign messages shall be visible and legible for a distance of 900 ft from any point along the traveled approach roadway at all times.

104.28.02.01 Equipment.

Trailer. In accordance with Maryland Motor Vehicle Law governing trailers.

Structural Support. Refer to 104.19

Sign Panel. Sign panel dimensions shall not exceed 48 in. wide by 60 in. high.

Display.

- (a) Each line of text shall be constructed using either a full or discrete matrix display.
- (b) The character height shall be at least 16 in.
- (c) If discrete matrix display is used, each character shall be displayed using a 5 x 7 array with at least two array modules per line.
- (d) If a full matrix display is used, the sign shall have a pixel arrangement of at least 5 rows by 7 columns with 3 LEDs per pixel.
- (e) Attach one R2-1 (48 x 60 in.) Speed Limit sign to the trailer. The sign shall be easily removed and replaced.

LED Illumination. LED illumination for each matrix element shall have the following characteristics:

- (a) LED shall conform to the ITE specification for amber color for warning applications.
- (b) The pixels shall be white on a black background.
- (c) LED shall utilize AlInGap substrate.
- (d) Each LED shall produce at least 1 candela output on center at 25 mA drive current.
- (e) LED shall provide full illumination within at least a 24 degree cone perpendicular to the sign face.
- (f) Operating temperature range of the LED shall be -30 to 125°F.

SDT Unit. Submit a catalog cut and character set for any SDT approval to the Office of Traffic and Safety, Chief of Traffic Operations.

Lift Mechanism.

- (a) The lift mechanism shall be installed such that the sign panel can be raised and lowered manually.
- (b) A stainless steel safety bolt shall be provided to prevent the sign panel from lowering once in the raised position. A self-locking mechanism shall be incorporated into the safety bolt to prevent it from being inadvertently dislodged.

Electrical Connections and Gauges.

- (a) All wiring from power sources to SDT equipment shall use locking cable connectors.
- (b) Volt and amp gauges shall be provided for both AC and DC.
- (c) Standard negative ground system shall be tied to the sign chassis.

Power Supply. The SDT shall operate from a solar powered electrical system. This system shall consist of battery power system and solar array panels, and be capable of displaying and storing vehicle speeds for 21 consecutive days without an auxiliary charge.

Sign Controller. The controller shall:

- (a) Be capable of driving the matrix display panel operating over a -30 to 125°F range and in a 20 to 95 percent noncondensing humidity range.
- (b) Be designed for fail-safe prevention of improper information display in the case of a system malfunction.
- (c) Monitor and display the battery output voltage and solar array activities (charging and discharging). The controller shall blank the sign when the battery output voltage drops below the manufacturer's recommended output level.
- (d) Be capable of monitoring and displaying the status of the photocell and adjusting the sign illumination to match the ambient light conditions. The controller shall have at least nine levels of dimming from 10 to 100 percent brightness.
- (e) Be contained in a sheet metal, weatherproof cabinet located on the controller housing, and insulated to protect against excessive vibration and temperature.

The cabinet shall have a lockable door latch and interior cabinet dome light.

- (f) Be capable of storing vehicle speed readings with a time and date stamp and have sufficient memory to store 100 000 readings.
- (g) Be capable of having remote access to modify sign messages, speed thresholds, and download vehicle speed readings.

Speed Display Software.

- (a) The SDT shall be supplied with a non-invasive speed detection unit. The unit shall be able to be rotated on a separate vertical axis from the SDT to allow for better aiming and detection. The unit shall detect and display the speed of only approaching traffic.
- (b) The speed display software shall be able to display vehicle speeds that are traveling over a set threshold. The SDT shall also be capable of not displaying a vehicle speed over a separate set threshold.

The speed display software shall have the capability of modifying speed thresholds.

104.28.03. CONSTRUCTION. Set up and operate the SDT on the project site 24 hours in advance of actual use to ensure that each unit is functioning properly and approved.

Aim the STD at approaching traffic that is at least 900 ft in advance of the STD and in accordance with the 900 ft minimum visibility and legibility requirement. Ensure that the STD is level and that the sign face is not obscured by highway alignment or glare from either sunlight or vehicle headlights.

104.28.04 MEASUREMENT AND PAYMENT. The Speed Display Trailer will be measured and paid for at the Contract price per unit day. A unit day shall consist of any approved usage within a 24hour calendar day period. Each Speed Display Trailer will be paid for only once per unit day, regardless of how many times it is relocated. When a unit is used for part of a day, it will be measured as a unit day.

The payment will be full compensation for the setup and maintenance of computer programs, changing messages, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

104.29 TRUCK MOUNTED VARIABLE MESSAGE SIGN (TVMS).

104.29.01 DESCRIPTION. Furnish, install and relocate a portable, self-contained, truck mounted, variable message sign.

104.29.02 MATERIALS. Each unit shall contain the work vehicle structural support system, sign panel assembly, lift mechanism, power supplies, sign mounted controller, and ancillary equipment.

All materials for TVMS shall be like new, corrosion resistant, and unaffected by water spray, salt, oil, gasoline, and all other contaminants in the quantities normally found along the edge of the traveled roadway. The TVMS construction, materials, and operation shall meet NFPA, ULI, and NEC. Ensure that sign messages are visible and legible for a distance of 900 ft from any point along the traveled approach roadway at all times.

The TVMS shall not block the driver's rear view vision when either in the transport or the deployed position.

104.29.03 CONSTRUCTION.

104.29.03.01 Equipment.

Truck. The work vehicle size and the method of attachment shall be as specified in the manufacturer's specifications. All vehicles shall be in accordance with Maryland Motor Vehicle Law.

Structural Support. The structural support framework shall allow the system to be assembled into a unit and be mounted on the truck, and shall provide the support mechanism between the sign panel assembly, the power supply, and the controller.

The framework shall provide sufficient support to prevent damage to any TVMS components when the sign is in the down and locked position during normal highway travel.

The sign panel shall be mounted as a permanent fixture of the truck and provide a minimum height of 7 ft from the bottom of the sign to the surface of the roadway when in its operating position. Affixing a trailer mounted unit to a truck is prohibited.

The deployed structure shall supply adequate support to allow complete sign operation including raising and lowering of the sign panel during sustained wind speeds of 85 mph.

The display windows shall be made of impact-resistant clear Lexan or as approved.

Sign Panel. Sign panel dimensions shall not exceed 92 in. wide by 54 in. high unless approved. The TVMS shall be capable of displaying three lines of text with the following requirements:

- (a) Each line of text shall be constructed using a full matrix display.
- (b) The sign shall be capable of displaying six characters per line.
- (c) The character height shall be at least 12 in.
- (d) The sign shall have a pixel arrangement of at least 20 rows by 40 columns, with at least 3 LEDs per pixel.

LED Illumination. LED illumination for each matrix element shall have the following characteristics:

- (a) LED shall meet to the ITE specification for amber color.
- (b) LED shall utilize AlInGap substrate.
- (c) Each LED shall produce at least one candela output on center at 25 mA drive current.

- (d) LED shall provide full illumination within at least a 24 degree cone perpendicular to the sign face.
- (e) Operating temperature range of the LED shall be -30 to 125°F.

TVMS Unit. Submit a catalog cut and character set for any TVMS approval to the Office of Traffic and Safety, Chief of Traffic Operations. Furnish examples of standard messages to be used on the sign.

Lift Mechanism.

- (a) The lift mechanism shall be capable of being raised and lowered manually.
- (b) A self-locking mechanism shall be provided to prevent the sign panel from lowering once in the raised position.

Electrical Connections and Gauges.

- (a) All wiring from power sources to TVMS equipment shall use locking cable connectors.
- (b) Each sign shall be equipped with an automatic lamp intensity regulator that maintains a constant output with a varying battery voltage.
- (c) Standard negative ground system shall be tied to the vehicle chassis.

Power Supply. The TVMS shall operate from a solar powered electrical system.

Sign Controller. The controller shall:

- (a) Be capable of driving the matrix display panel operating over a -30 to 125°F range and in a 20 to 95 percent noncondensing humidity range.
- (b) Accommodate 50 preprogrammed, user-defined messages.
- (c) Be capable of displaying three sequenced messages. On/Off time for each message in a sequence shall be user adjustable at one-tenth of a second increments within a range of 0 to 5 seconds.
- (d) Be designed for fail-safe prevention of improper information display in the case of a system malfunction. In the event of a system malfunction, the sign shall display a blank message.

- (e) Have the capability of retrieving all messages stored in temporary memory.
 - (1) Temporary memory shall be nonvolatile.
 - (2) All messages and programs shall remain resident in the controller's memory in the event of a power failure.
 - (3) Have an RS-232 port to facilitate connection of an external communication device.
- (f) Monitor and display the battery output voltage and solar array activities (charging and discharging) and blank the sign when the battery output voltage drops below the manufacturer's recommended output level.
- (g) Be capable of monitoring and displaying the status of the photocell, adjust the sign illumination to match the ambient light conditions, and have at least nine levels of dimming from 10 to 100 percent brightness.
- (h) Be contained in a sheet metal or high density polyethylene (HDPE), weatherproof cabinet located on the controller housing, and insulated to protect against excessive vibration and temperature.
 - (1) The cabinet shall have a lockable door latch.
 - (2) The keyboard/input device storage location shall be provided inside the cabinet.

Character Set Software. The character set software shall:

- (a) Have all the standard ASCII characters and symbols.
- (b) Provide left and right arrows.
- (c) Have all alphanumeric entries performed with a keyboard or keypad that causes the same character to be displayed on the matrix. Arrow symbols shall be generated via a cursor pad on the keyboard or keypad.
- (d) Have messages default to self-centering display with the ability to left or right justify.

104.29.03.02 Operation. Set up and operate the TVMS 24hours in advance of actual use to ensure that each unit is functioning properly and approved.

Variable Message Sign Mode. Use the TVMS in variable message sign mode on roadways where the posted speed limit is less than or equal to 40 mph. The TVMS is intended for mobile operations. If used for stationary construction or maintenance operations, do not leave the TVMS in place for more than eight consecutive hours.

Arrow Panel Mode. The TVMS may be used in lieu of a Type C arrow panel on any roadway as long as the TVMS is capable of displaying a left arrow, right arrow, double arrow, and a four-corner caution mode.

Use the TVMS only as a supplement to other required traffic control devices. When closing a through travel lane on a multilane roadway, use the “Arrow” mode only. Only one TVMS in the “Arrow” mode shall be used for each stationary lane closure. Moving work operations may utilize one or more TVMS for a single lane closure.

- (a) Ensure that the placement does not cause driver confusion near ramps, median crossovers, and side road intersections.
- (b) For stationary lane closures, place the TVMS on the shoulder at the beginning of the taper (nearest to oncoming traffic). Where there are narrow or no existing shoulders in the closed lane behind the channelizing devices, place the TVMS as near to the beginning of the taper as possible.
- (c) For moving maintenance type activities along multilane highways where a lane is closed, place the TVMS at the rear of the activity in the closed lane on a vehicle separate from the maintenance vehicle itself. For paint striping activities, additional vehicles with TVMS or arrow panels in the arrow mode may be required to supplement the work operation. TVMS shall always remain upstream of the maintenance vehicles where adequate recognition distance is available. The vehicle carrying the TVMS shall be equipped with signing and lighting as required by the standard TCPs.
- (d) TVMS shall only display the “Caution” mode for a lane closure on a two-lane, two-way roadway, or for a shoulder closure on any roadway. The “Caution” mode on a TVMS shall show displays of circular appearance in each of the four corners of the TVMS. The circle diameters shall range from 9.5 to 11 in. and utilize approximately 30 pixels. The circles shall be offset from the left and right edge between 3 and 6 in. and from the top and bottom edge between 1.5 and 3 in. The vertical spacing between the centers of the circles shall range from 2.5 to 3 times the diameter of the circles. The horizontal spacing between the centers of the circles shall range from 1.75 to 2 times the vertical spacing.

Install the TVMS as specified.

The TVMS shall be designed so that it supplies a minimum visibility and legibility distance of 900 ft. Ensure that the TVMS is level and that the sign face is not obscured by highway alignment or glare from either sunlight or vehicle headlights.

104.29.04 MEASUREMENT AND PAYMENT. The Truck Mounted Variable Message Sign will be measured and paid for at the Contract price per unit day. A unit day shall consist of any approved usage within a 24 hour calendar day period. Each Truck Mounted Variable Message Sign will be paid for only once per unit day, regardless of how many times it is relocated. When a unit is used for part of a day, it will be measured as a unit day.

The payment will be full compensation for the vehicle, setup and maintenance of computer programs, changing messages, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 105 — AGGREGATE FOR MAINTENANCE OF TRAFFIC

105.01 DESCRIPTION. Place aggregate material for the maintenance of traffic.

105.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
Bank Run Gravel Subbase	901.01
Graded Aggregate Base	901.01

105.03 CONSTRUCTION. Refer to 501.03.

105.04 MEASUREMENT AND PAYMENT. Crusher Run Aggregate CR-6 for Maintenance of Traffic, Bank Run Gravel Subbase for Maintenance of Traffic, and Graded Aggregate Base for Maintenance of Traffic will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for all aggregate, hauling, placing, compacting, removal, rehandling, reworking, disposal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

When aggregate is part of any base or pavement course used for the construction and maintenance of temporary detours, approaches, crossings, and widenings, the item of work will be measured and paid for

106 HOT MIX ASPHALT FOR MAINTENANCE OF TRAFFIC

as specified in 501. Refer to 501.04.03, which states that the materials manipulation or addition of chemical additives will not be measured but the cost will be incidental to the Contract unit price for Bank Run Gravel Base Course item.

Aggregate for maintenance of traffic when used for temporary and permanent patching at pipe culverts and utilities will not be measured but the cost will be incidental to the Contact unit price for Pipe Culvert or Utility item.

SECTION 106 — HOT MIX ASPHALT (HMA) FOR MAINTENANCE OF TRAFFIC

106.01 DESCRIPTION. Place HMA for maintenance of traffic.

106.02 MATERIALS.

Tack Coat (Rapid Setting)	904.03
HMA	904.04
Crack Filler	911.01& 911.01.01
Production Plant	915

106.03 CONSTRUCTION. Refer to 504.03.

106.04 MEASUREMENT AND PAYMENT. Hot Mix Asphalt for Maintenance of Traffic will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for all tack coat, crack filler, hauling, placing, compacting, maintaining, removal, rehandling, reworking, disposal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

When hot mix asphalt is part of any base or pavement course used for the construction and maintenance of temporary detours, approaches, crossings, and widenings, the item of work will be measured and paid for as specified in Section 504. For payment of temporary tie-ins, refer to 504.04.

Hot mix asphalt for maintenance of traffic when used for temporary and permanent patching at pipe culverts and utilities will not be measured but the cost will be incidental to the Contract unit price for Pipe Culvert or Utility item.

SECTION 107 — CONSTRUCTION STAKEOUT

107.01 DESCRIPTION. Furnish, place, and maintain construction layout stakes. Demarcate (flag) the Limit of Disturbance (LOD), and protected resources including, wetlands, wetland buffers, waters of the United States, floodplains, and tree preservation areas.

The LOD is defined as the maximum allowable limit of earth disturbance as delineated in the Contract Documents. When not delineated in the Contract Documents, the LOD will be the top of cut, toe of slope, or limit of ditch excavation.

No clearing or earth disturbance activity may begin until the LOD and all protected resources are demarcated as specified.

107.02 MATERIALS. Refer to 107.03.09.

107.03 CONSTRUCTION.

107.03.01 Line and Grade. The Engineer will provide the following:

(a) Roadway Stakeout.

- (1) A staked center line of the roadway with stations not over 100 ft apart.
- (2) Appropriately spaced bench marks and necessary references, including all points of curvature (P.C.) and points of tangency (P.T.), for the preservation and control of the center line.
- (3) Two sets of prints of the cross sections. Use the cross sections as a guide only. Dimensions or elevations scaled from the cross sections are not sufficiently precise for use in construction.

(b) Structure Stakeout.

- (1) A staked center line or working line, whichever applies, with stations not over 100 ft apart and extending at least 100 ft beyond each end of the structure.
- (2) When the structure is on a curve, a staked center line or working line, whichever applies, consisting of stations not over 100 ft apart and including the P.C., P.T., and at least one point on the tangents beyond each end of the curve.

- (3) At least two bench marks, one on each end of the structure.

107.03.02 Equipment and Personnel. Use competent personnel and state of the art equipment for all engineering work required to set and maintain the specified elevations and dimensions.

107.03.03 Control Markers. Preserve the center line and bench marks set by the Engineer. Replace any disturbed or destroyed controls at no additional cost to the Administration.

107.03.04 Control Stakes. For roadways as specified in 107.03.01(a), furnish, set, and preserve stakes at each station along each side of the project on the right-of-way or easement line, whichever is farther from the center line of construction. Where only part of an ultimate dual highway is to be constructed, set the stakes on the side of the future improvement 10 ft beyond the construction limits. On each of these stakes, mark the offset distance from the center line and its top elevation or the cut or fill to the profile grade line. Place additional stakes as necessary or as directed to ensure the correct layout of the work.

107.03.05 Layout. For structures, proceed with the layout work as specified in 107.03.01(b). Before any actual construction begins, rerun and check the Engineer's lines and grades. Then establish all center line or working line intersections with the center line or center of bearing of all piers, bents, and abutments. From these field layouts, check the proposed span lengths by either electronic distance measurement or chaining from the field layouts. When chaining, compensate for temperature, sag, and horizontal alignment. Check the location of the structure to affirm its correct location with relation to existing structures, roads, and existing conditions that are to remain. If any discrepancies are found, notify the Engineer at once in writing. Ensure that all lines established on the ground are preserved or referenced, marked, and kept available at all times.

Ensure that the field elevations of all bridge seats are correct and that they are finished to proper grade. When steel beams or girders are incorporated in the project, determine the deflection of each member by running elevations over the tops of the beams or girders after they are in place and before attaching any forms. Apply this information to the deflection diagram to determine the corrected elevation of bottom slab forms and screed supports. The Engineer will check the assembled information. Make necessary adjustments prior to placing concrete.

107.03.06 Utilities. Promptly upon request, furnish references to control points, alignment, and grade data to the utility companies or agencies working within the limits of the project, so that they may properly locate and coordinate their work and improvements.

Intersection Utility Stakeout. Notify the appropriate agencies at least 72 hours (excluding weekends and holidays) prior to the anticipated time for beginning any underground work.

- (a) Request a MISS UTILITY stakeout and possess a valid MISS UTILITY clearance ticket number for any underground work.
- (b) Contact all utilities within the limits of the project who are not a member of MISS UTILITY, and obtain a stakeout of their respective facilities.
- (c) Request the Office of Traffic & Safety's Signal Operations Section to stakeout Administration maintained traffic signal facilities.
- (d) Request the District Engineer to stakeout their lighting facilities.

Stakeout the proposed construction as indicated in the Contract Documents. Allow the Engineer to verify the location of the proposed facilities.

107.03.07 Right-of-Way and Easement Lines. Promptly upon request, define the project right-of-way and easement lines for adjacent property owners.

107.03.08 Subgrade, Subbase and Base Controls. When placing subgrade, subbase, and base courses, furnish a string line and grade with fixed controls having longitudinal and transverse spacing of no more than 25 ft. Along each form line for cement concrete pavement, provide the line and grade with fixed controls not to exceed 25 ft.

- (a) **Automated Machine Control.** When approved by the Engineer, construction equipment guided by Global Positioning System (GPS) or Robotic Total Station (RTS) equipment may be utilized in the placement of subgrade, subbase, base courses, and other roadway materials. Preserve the stakeout established by the Engineer and set additional controls as directed.
- (1) If utilizing GPS and RTS equipment, develop and submit a Digital Terrain Model (DTM) for review. If using the Contract Documents and any Administration furnished DTM data, a DTM shall be developed independently. In order to use any Administration furnished DTM data, the Administration and its designers shall be released from all liability for the accuracy of the data and its conformance to the Contract Documents.

- (2) Establish primary control points at appropriate intervals along the length of the project. Where project work is performed beyond the project limits, establish control points at intervals not to exceed 1000 ft. Determine the horizontal position of these points by static GPS sessions or by traverse connection from the original base line control points. Establish the elevation of these control points using differential leveling from the project benchmarks, forming closed loops where practical. Prior to construction activities, provide a copy of all new control point information to the Engineer. Correct all deficiencies at no additional cost to the Administration.
 - (3) Provide control points and conventional grade stakes at critical points such as PCs and PTs, super elevation points such as begin full super and half-level plane inclined, and other critical points required for construction of structures and utility relocation or coordination. The Engineer will determine whether additional stakeout and control points are necessary.
 - (4) Provide adequate control points, stationing, and stakes for coordination activities involving environmental agencies, utility companies, and Contractors on adjacent projects.
- (b) **Real-Time Kinematic (RTK) GPS.** May be utilized to control equipment where the grade tolerance is ± 0.1 ft or greater.
 - (c) **RTS Positioning.** RTS shall be utilized where grade tolerances are less than ± 0.1 ft. Check the index error of the vertical circle of the RTS and adjust as necessary prior to each day's operations. Begin and end each work session by checking between adjacent control points.
 - (d) **Grade Busts.** Grade busts and all associated quantity adjustments or errors resulting from the Contractor's activities shall be corrected and at no additional cost to the Administration.
 - (e) **Utilizing Automated Controlled Equipment.** When automated controlled equipment is used, furnish a GPS Rover instrument for Administration use during the project, along with 8 hours of formal training on GPS/RTS and the utilized systems. Provide a surveyor to perform verification when discrepancies arise.
 - (f) **Test Sections.** Perform test sections for GPS and RTS systems to demonstrate the capability, knowledge, equipment, and experience to properly operate the systems and achieve acceptable tolerances.

If this ability is not demonstrated, conventional stakeout procedures will be required.

107.03.09 Demarcation. Perform all demarcation as specified or directed. Demarcate wetlands using the Administration's standard 1-1/2 in. pink and white striped vinyl flagging with "SHA WETLAND" printed in blue letters. Demarcate the LOD and other applicable protected resources using a minimum 2-mil vinyl that is 1-1/2 inch wide with 7/8 in. letters, and locate as directed.

Establish tree preservation areas as specified in Section 120.

When directed, reflag areas where flagging has been destroyed. If the destroyed flagging is not replaced within 48 hours, the Engineer may proceed to reflag the area. The cost of the reflagging by the Engineer will be deducted from any monies due under the Contract.

Remove all flagging at the completion of construction.

107.04 MEASUREMENT AND PAYMENT. Construction Stakeout will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment of the Contract lump sum price will be prorated and paid in equal amounts on each monthly estimate. The number of months used for prorating will be the number estimated to complete the work.

SECTION 108 — MOBILIZATION

108.01 DESCRIPTION. Construction preparatory operations that include the movement of personnel and equipment to the project site and the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work.

108.02 MATERIALS. Not applicable.

108.03 CONSTRUCTION. Not applicable.

108.04 MEASUREMENT AND PAYMENT. Mobilization will not be measured but will be paid for at the Contract lump sum price. The cost of all required insurance and bonds will be incidental to the Mobilization item.

Payment of 50 percent of the Mobilization item will be made in the first monthly estimate after the Contractor has established the necessary

facilities. The remaining 50 percent will be prorated and paid in equal amounts on each of the next five monthly estimates. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Payment of the Mobilization item will not be made more than once, regardless of the fact that the Contractor may have, for any reason, shut the work down on the project or moved their equipment away from the project and then back again.

If an item for mobilization is not provided, the cost of mobilization, including the required insurance and bonds, will be incidental to the other items specified in the Contract Documents.

SECTION 109 — CRITICAL PATH METHOD PROJECT SCHEDULE

109.01 DESCRIPTION. Plan, schedule, and construct the project by using a Critical Path Method Project Schedule (CPM). Use the CPM for coordinating and monitoring the work specified in the Contract Documents including all activities of subcontractors, vendors, suppliers, utilities, railroads, the Administration, and all other parties associated with the construction of the Contract. All work including but not limited to submittals, major procurement, delivery, and construction activities shall be included. All activities, including bid items, quantified in the Contract Documents shall be included. Base the CPM upon the entirety of the Contract Documents. Utilize CPM software that generates files compatible with Primavera Project Planner.

Float. The CPM utilizes float. Float is defined as the amount of time between when an activity “can start or finish” and when an activity “must start or finish”. Float is a shared commodity for the use of the Administration and the Contractor and is not for the exclusive use or benefit of either party. Both parties have the full use of the float until depleted.

Scheduling Representative. Designate a scheduling representative prior to submission of the Initial Critical Path Method Project Schedule (ICPM). The scheduling representative is the person primarily responsible for development and maintenance of the CPM schedule, the contractor’s representative in all matters regarding the schedule, and the designated attendee for all schedule related meetings. Replacement of the scheduling representative will require written approval from the Administration.

Submit the qualifications of the scheduling representative to the Administration for approval. This approval is required before the ICPM will be accepted. The scheduling representative shall have at least three years of verifiable experience for preparing and maintaining CPM project schedules on Contracts of similar size and complexity.

Initial Critical Path Method Project Schedule (ICPM). The ICPM shall consist of:

- (a) A time scaled diagram of acceptable scale and format that is acceptable to the Engineer. Clearly label and identify each activity. Show all relationships between activities.
- (b) Tabular reports with activities sorted as follows:
 - (1) Activity ID. Provide predecessors and successors for each activity with leads and lags shown.
 - (2) Activity ID. Provide and clearly define the resources assigned to each activity.
 - (3) Early Start, Total Float.
 - (4) Total Float, Early Start.
 - (5) Project Area (if applicable).
 - (6) Project Phase (if applicable).
 - (7) Responsibility, e.g., Contractor, specific subcontractor, specific supplier, the Administration, etc.

Provide in the header of each tabular report: the project name, Contract number, data date, run date and number, and report type.

Provide in the body of each report: the activity identification, activity description, original and remaining duration, early/late start and finish dates, percent complete, actual start/finish dates, total float, and calendar designation for every activity.

- (c) Written Narrative (WN). Comply with the requirements described hereinafter.
- (d) Printed Calendars. Include a listing, description, and calendar form tabulation of all calendars used. Include the total number of anticipated work days required to complete the Contract work.

Delineate holidays and anticipated nonwork days or periods. Explain in the WN the basis for determining each nonwork day or period.

- (e) A data disc containing all of the information contained in the ICPM and in a format compatible with Primavera Project Planner software. All construction activities shall have durations not exceeding 10 working days, unless otherwise approved. Provide a duration of at least 30 calendar days for activities required for review and approval of working drawings and materials by the Administration. A short list of highly critical approval activities may be submitted. The Engineer will make every effort to expedite the approval of these submittals; however, this will not alter the requirement to include 30 calendar days for all approvals. Schedule the duration for activities such as curing and pre-load in calendar days. Durations for procurement activities will be evaluated on a case-by-case basis.

The latest calculated early finish date in the ICPM shall equal the calendar date for completion specified in the Contract Documents. If an earlier completion date is submitted, the Administration, upon approval of the ICPM, will issue a change order to adjust the Contract time to the completion date shown on the ICPM.

Resource load all construction activities in the schedule with the material, equipment, and manpower planned to be utilized in accomplishing each activity. Provide a full explanation of the resource loading in the WN.

The Engineer reserves the right to specify the number of activities and to require an additional breakdown of the activities at any time.

Utilize activity codes to categorize activities by at least the following: project area; project phase; and responsibility, e.g. Contractor or specific subcontractors.

Provide a WN as part of the ICPM. Explain the sequence of work, the critical path, interim completion dates, project phasing, nonwork days or periods, maintenance of traffic, and labor and equipment resources. Explain how the ICPM provides for permit requirements, environmental requirements, coordination with other public Contractors, milestone dates (for the Contract or other related contracts), coordination with other entities, coordination with all utility companies, special nonwork days or periods, and weather. Explain the specific scope of each activity and the basis used to determine the original duration of each activity, i.e.

production rates and anticipated quantities. Address all activities quantified in the Contract Documents. Explain the following in the WN.

- (a) Relationships between activities not obviously identified.
- (b) Equipment usage and limitations.
- (c) Manpower usage and limitations.
- (d) Use of additional shifts and overtime.
- (e) Activity codes, abbreviations, and activity identification system.
- (f) All calendars utilized in the CPM.
- (g) Date or time constraints.
- (h) All abbreviations.
- (i) Use of calendars.
- (j) Scheduling of weather and temperature sensitive activities.

Complete and submit the proposed ICPM within 30 calendar days after receiving the Notice of Award. Submit five sets of all required information for review and acceptance. Do not start any work until the ICPM is accepted. Upon issuance of the Notice to Proceed, the start date utilized in the ICPM will be adjusted to comply with the Notice to Proceed.

The Engineer will complete the review of the ICPM within 30 calendar days after submittal. If required, a Joint Review Conference will be convened at which time the Engineer and Contractor may make corrections and adjustments to the proposed ICPM. If a revision is necessary due to the Engineer's review or the Joint Review Conference, submit the proposed revision within seven calendar days after receiving the Engineer's review comments or within seven calendar days after the date of the Joint Review Conference, whichever is the latest. Make revisions in accordance with the requirements for the ICPM. The Engineer will respond to the revised ICPM within seven calendar days after receipt.

Any delay in starting work caused by the acceptance of the ICPM by the Engineer will not be considered as a basis for any adjustment in the Contract amount or time.

Upon notification that the ICPM has been accepted, that document will

become the CPM of record. The CPM of record shall be the Contractor's work plan for completing the entire Contract as specified in the Contract Documents.

Failure to adhere to the CPM of record will be cause for the Administration to deny requests for additional compensation or extensions of the Contract duration and may result in the withholding of pay estimates.

CPM Updates. Provide monthly updates of the CPM of record. Update submissions shall include the activity data as specified in (a) through (e) of the ICPM. Use the update to describe the progress to date. The WN shall include a description of the work performed during the update periods, current critical path, the amount of float on the critical path, any delays or disruptions experienced during the period of the update, any change in manpower or equipment, and any potential delays or disruptions.

The scheduling representative and the Engineer will meet to review, mutually agree to, and sign-off on the information required to update the schedule (actual start and finish dates, remaining durations, and percentages complete). Use an acceptable update form. The data date for each update shall be seven days prior to the cut-off date of the pay estimate for that month. Submit the update within seven calendar days from the data date. Failure to submit the update on a timely basis may result in the withholding of pay estimates. Upon acceptance by the Engineer, the update shall become the CPM of record for the period between its data date and the data date of the next approved update or revision.

Do not include any revisions to the CPM without prior approval.

Revisions to the Schedule of Record. Revisions are defined as one or more of the following:

- (a) A change in the original duration of an activity.
- (b) A change in the logic of the schedule.
- (c) A change in the calendars or to the calendar to which an activity is assigned.
- (d) A change to resources.
- (e) A change to any actual date, previously established.
- (f) The deletion or addition of an activity.

- (g) A change to, addition of, or deletion of a date or time constraint.
- (h) A change to, addition of, or deletion of an activity code.
- (i) A change to an activity description.
- (j) Any change other than updating an activity.

Discuss any proposed revision to the CPM verbally with the Engineer. If the revision is minor in nature, the Engineer may allow the revision to be included on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, submit the proposed revision for review and approval prior to deviating from the approved CPM.

When a revision to the CPM is required due to changes in the Contract initiated by the Engineer, immediately contact the Engineer to discuss the changes. If the revision is minor in nature, the Engineer may allow the revision to be included on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, submit the proposed revision for review and approval prior to deviating from the approved CPM.

The Engineer may allow a deviation from the approved CPM for specific mitigating activities.

Submit the proposed revision in the same format and with the same requirements used for the ICPM. The proposed revision shall be made to the CPM of record at the time the revision is made, i.e. the revision shall include all update information and revisions previously approved and the additional progress to the date of the revision. The WN accompanying the proposed revision shall describe the reason for the revision, the resulting critical path, and all particulars of the revision. These shall include but not be limited to changes in the method or manner of the work, changes in specifications, changes in resources, addition or deletion of work, increased or decreased quantities, defective work, and acceleration of the work.

The Engineer will review and respond to the proposed revision within 14 calendar days after receipt. Resubmit, if required, within seven calendar days after receipt of the Engineer's review comments. The Administration reserves the right to reject any proposed revision that adversely impacts the Administration, utilities, or other concerned parties.

Extensions of Contract Time or Incentive/Disincentive Date. Make requests for extension of Contract time in writing and subject to the notice and timeliness of submission provisions as provided for elsewhere in the

Contract. Requests for an extension of Contract time or change in an incentive/disincentive date will be evaluated by the Engineer's analysis of the CPM of record and any proposed revision submitted. The request shall include a WN of the events, which would require an extension of the Contract time or incentive/disincentive date.

Only delays to activities that affect the Contract completion date or incentive/disincentive date will be considered for an extension of Contract time. The extension of the specified Contract completion date or incentive/disincentive date will be based upon the number of calendar days the Contract completion date or incentive/disincentive date is impacted as determined by the Engineer's analysis.

When an acceptable Update or Revision is not submitted within the time limits prescribed above, pay estimates may be withheld until an acceptable Update or Revision is submitted.

109.02 MATERIALS. Not Applicable.

109.03 CONSTRUCTION. Not Applicable.

109.04 MEASUREMENT AND PAYMENT. The accepted Initial Critical Path Method Project Schedule, Critical Path Method Project Schedule Revisions, and all accepted Critical Path Method Project Schedule Updates will be paid for at the Contract lump sum price for the CPM Project Schedule item. Fifty percent of the lump sum price will be paid upon acceptance of the Initial Critical Path Method Project Schedule (except when the price bid exceeds half of one percent of the total Contract price bid). The balance will be paid as a monthly prorated sum based upon the specified Contract duration. This monthly payment will be made on the next progress payment following the Administration's acceptance of the required monthly Critical Path Method Project Schedule updates.

When the price bid for the CPM Project Schedule exceeds half of one percent of the total Contract price, the total progress payments for the Critical Path Method Project Schedule will be limited to half of one percent of the total Contract price. Any remaining balance (over half of one percent of the total Contract price bid) will be paid upon final Contract payment.

SECTION 110 — ACTIVITIES CHART PROJECT SCHEDULE

110.01 DESCRIPTION. Plan, schedule, and construct the project using an Activities Chart (AC). The AC shall break down into detail the Contract time required to perform the work activities for the duration of the project. Use the AC for coordinating and monitoring the work specified in the Contract Documents including activities of subcontractors, vendors, suppliers, utilities, railroads, and other parties associated with the construction of the Contract.

Initial Activities Chart Project Schedule (IAC). The IAC shall consist of:

- (a) A chronologically sequenced bar chart in which work activity durations shall be represented by working days, days, or completion date as specified in the Invitation for Bids (IFB).
- (b) A Written Narrative (WN) describing the original sequence of work, number of shifts per day, number of hours per shift, number and composition of crews, and the equipment to be utilized on each work activity. List subcontracting activities.

Expend the entire Contract time specified in the IFB.

The Engineer reserves the right to specify the number of activities and require additional breakdown of the activities at any time.

Complete the proposed IAC within 14 days after receiving the Notice of Award. Submit five sets for review and approval. The Engineer will review the IAC within 30 days after receipt. If required, a Joint Review Conference will be convened at which time the Engineer and Contractor may make corrections and adjustments to the IAC. Submit revisions to the IAC due to the Engineer's review or the Joint Review Conference within seven days from the date of the review for another review. Submit the revisions in the format used in the IAC. The Engineer will respond to the revised IAC within seven days after receipt.

No construction work shall begin until the IAC is accepted.

Time charges shall begin no later than the on or before date of the Notice to Proceed. Any delay in starting work caused by the acceptance of the IAC by the Engineer will not be a basis for any monetary claim. The Administration may consider a noncompensable Contract time extension, if warranted.

Upon notification that the IAC is accepted, that document will become the AC of Record (ACR). The ACR shall be the work plan for completing the entire Contract as specified in the Contract Documents.

Failure to adhere to the latest approved ACR will be cause for the Administration to deny requests for additional compensation or extensions of the Contract duration.

Revisions to the ACR. Revisions shall consist of one or a combination of the following:

- (a) A change in the duration of an activity.
- (b) A change in the logic of the schedule.
- (c) The deletion or addition of one or more activities.

Proposed revisions to the ACR may be submitted at any time during the life of the Contract.

Submit a proposed revision whenever the activities differ from the accepted ACR. Submit the revision in the same format used for the IAC and within 30 days from the date on which activities deviated from the accepted ACR. Include data from all ACR Updates that have been accepted by the Administration. The WN accompanying the revisions shall describe the reason for the revision, the interdependence of the work activities, and all duration modifications to the ACR. These shall include, but not be limited to, changes in the method or manner of the work, changes in Specifications, addition or deletion of work, increased or decreased quantities, defective work, and acceleration of the work.

The Engineer will review the ACR and respond to the proposed revision within 30 days after receipt. The Administration reserves the right to deny any proposed revision that adversely impacts the Administration, utilities, or other interested parties.

ACR Updates. Submit monthly updates of the ACR. Submit updates in the same format as the IAC. Describe the progress of the project to date. Include a description of the current work, any delays or disruptions experienced during the period of the update, any change in manpower or equipment, the inclusion of any schedule revisions, and any potential delays or disruptions.

When a delay or disruption to the work identified in the ACR Update is believed to be the responsibility of the Administration, submit a revision to the ACR within 30 days after the submittal of the update.

Monthly Job Site Progress Meetings. The Administration and the Contractor shall hold monthly job site progress meetings to discuss the progress of the project and update the ACR. Arrange to have a representative of each subcontractor currently working on the project in attendance. Submit the ACR updates within 14 days from the date of the monthly meeting. The Engineer will review the update and advise the Contractor of its acceptability prior to the next monthly meeting.

Extensions Of Contract Time. Any written request for an extension of time shall be accompanied by a revised ACR documenting the actual delay to the Contract completion date. Include a WN of the events necessitating the extension of the Contract time. Only delays to activities that affect the Contract completion date will be considered for a time extension.

110.02 MATERIALS. Not applicable.

110.03 CONSTRUCTION. Not applicable.

110.04 MEASUREMENT AND PAYMENT. Activities chart project schedule will not be measured but the cost to develop, prepare, write, record, meetings, revise, update and all incidentals necessary to complete the work will be included in the other pay items specified in the Contract Documents.

SECTION 111 — SAMPLING DEVICES AND TESTING EQUIPMENT

111.01 DESCRIPTION. Furnish and maintain Sampling Devices and Testing Equipment with accessories that are required to sample and test materials used on the project. The sampling and testing equipment will be used by Administration employees as directed by the Engineer. All equipment shall be as approved by the Office of Materials Technology. Furnish the sampling devices and testing equipment to the Engineer at least five days prior to commencement of work on the project. All equipment shall remain in the Engineers' possession until completion of all sampling and testing on the project. Unless otherwise specified, all testing equipment, accessories, and unused sampling devices will be returned to the Contractor at the completion of the project.

111.02 MATERIALS. Furnish all applicable sampling devices and containers required by the Administrations' Materials Manual, including all inserts, Sample Testing and Frequency Guide, and this Specification. Quantities will be designated by the Engineer at the preconstruction meeting.

111.03 CONSTRUCTION.

Testing Equipment Requirements. Maintain the equipment in good working condition and submit a written certification to the Administration stating when the testing equipment was last calibrated or inspected by an Administration approved testing agency. Ensure that the equipment is calibrated at the frequency required for that type of equipment as specified in the test method and AASHTO R18.

If any testing equipment or accessories are stolen, become defective, or for any other reason do not function as intended, replace with an equal or better unit at no additional cost to the Administration within eight hours after notification.

111.03.01 Sampling Devices and Testing Equipment with Accessories. The following is a general list for sampling devices and testing equipment to be furnished by the Contractor for the specified testing. Contact the Office of Materials Technology, Materials Management Division with any questions concerning the requirements for Sampling Devices, Testing Equipment, and Accessories. The devices, testing equipment, and accessories will be randomly inspected during Independent Assurance Audits.

(a) Sampling Devices from the Administration's Materials Manual.

- (1) Soil bags (able to hold at least 35 lb).
- (2) Screw top cans - 1 qt.
- (3) Friction top cans - 1 qt and 1 gal.
- (4) Plastic jar - 1 gal.
- (5) Flow panels for joint sealer.

(b) Testing Equipment and Accessories from the Administration's Materials Manual - Determination of Moisture Content of Aggregates (MSMT 251).

- (1) Electric hot plate or a gas burner, including bottle and fuel.
- (2) Scale or balance conforming to M 231, Class G2.
- (3) Metal container, such as large frying pan or equivalent.
- (4) Pointing trowel or large spoon.

- (c) Field Determination of the Amount of Stabilization Agent in Bases and Subbases (MSMT 254).
 - (1) Scale or balancing conforming to M 231, Class G 100 having a capacity of at least 100 lb/sample containers.
 - (2) Bench brush.
 - (3) Large spoon or scoop.
 - (4) Sampling mat consisting of a sheet of plywood or canvas with a surface of at least 1 yd².
 - (5) Tape measure.
- (d) Field Determination of Moisture Density Relations of Soils (MSMT 351). Refer to MSMT 350.
- (e) Hot Applied Joint Materials Sealer and Crack Filler (MSMT 404). Flow panels (brass panel may be used in lieu of a tin panel).
- (f) In-Place Density of Embankment, Subbase, Base, Surface and Shoulder Material (T 99, T 180, T 191, and MSMT 350).
 - (1) Cylindrical compaction molds, 1/30 and 1/13.33 ft³.
 - (2) Compaction rammers, 5.5 and 10 lb.
 - (3) 12 in. straightedge.
 - (4) Scale or balance conforming to M 231, Class G 100, having a capacity of at least 100 lb.
 - (5) Two 10 in. pie pans.
 - (6) 12 in. frying pan.
 - (7) 12 in. rocker set complete with pan.
 - (8) One each of the following sieves conforming to M 92:

SIZE (in.)	SHAPE	SIZE OPENINGS
12	Square	2 in.
12	Square	3/4 in.
12	Square	No. 4
12	Square	No. 10
*8	Round	No. 10

* For density sand.

- (9) Field density plate with recess to accommodate sand cone apparatus.
 - (10) Steel pan, 12 x 30 in.
 - (11) Electric plate or gas burner, including bottle an fuel.
 - (12) Soil density pick.
 - (13) Precalibrated sand cone density apparatus.
 - (14) Spatula, 3 in.
 - (15) Two water pails.
 - (16) Bag of density sand.
 - (17) Stencil brush, bench brush, sprinkling can, large spoon, and sample shovel.
- (g) Sampling Hot Mix Asphalt prior to Compaction (MSMT 457) - Performed by the paving contractor).
- (1) A 25 ft measuring tape.
 - (2) Random selection cards numbered from 0 to width of the paving lane in 1 ft increments.
 - (3) Sample boxes.
 - (4) Spatula.
 - (5) Spray paint or other suitable marking material.
 - (6) GPS equipment.
 - (7) Masonry nails or equivalent.

- (8) Thermometers (50 to 550°F).
- (9) Square end shovel, fire shovel, or grain shovel.
- (10) Scoop.
- (11) 24 ft of 18 gauge mechanical wire or equivalent to tie through each hole of the plate template.

(h) Concrete Tests.

TEST	METHOD
Slump	T 119
Air Content - Pressure Method	T 152
Air Content - Volumetric Method	T 196
Sampling	T 141
Temperature	T 309

- (1) Air meter, pressure type for conventional concrete and Roll-a-Meter for lightweight Concrete.
- (2) Air Bulb.
- (3) Air pump.
- (4) Rubber mallet.
- (5) Slump cone with rod.
- (6) Steel straight edge.
- (7) Large scoop.
- (8) Trowel.
- (9) 3/8 in. rod for latex cylinder.
- (10) Unit weight bucket for light weight concrete.
- (11) Sprinkle can or bucket for water.
- (12) Postal scale (only for lightweight concrete).
- (13) Thermometer (0 to 220° F).
- (14) 6 x 12 cylinder molds.

(15) 3 x 6 in. cylinder molds for latex concrete.

111.04 MEASUREMENT AND PAYMENT. Sampling devices and testing equipment will not be measured but the cost will be incidental to items of work for which they are required.

SECTION 112 THRU 119 — RESERVED

SECTION 120 — TREE PRESERVATION AREA

120.01 DESCRIPTION. Establish and maintain a Tree Preservation Area (TPA).

120.02 MATERIALS.

Temporary Orange Construction Fence	104.20.02
Fertilizer	920.03.01

120.02.01 Tree Preservation Program (TPP). The Administration will develop a TPP to establish the goals and specify the procedures for tree branch pruning, brush removal, tree felling, tree root pruning, tree fertilizing, and other tree preservation operations to protect trees and vegetation within the TPA.

120.03 CONSTRUCTION.

120.03.01 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the operations specified in the Contract Documents and the TPP in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

120.03.02 Delineation. Delineate the perimeter of the TPA as specified in the Contract Documents.

120.03.03 Temporary Orange Construction Fence (TOCF). Ensure that the delineated TPA is approved prior to installing the TOCF. Perform installation and maintenance as specified in 104.20.03. Complete installation of the TOCF before:

- (a) Beginning clearing and grubbing operations.
- (b) Installing erosion and sediment controls.
- (c) Conducting the Tree Preservation Meeting.

- (d) Performing tree preservation operations.

120.03.04 Tree Preservation Meeting. Prior to beginning work, meet at the TPA with the Engineer, the Landscape Operations Division, and the LTE to review the TPP

120.03.05 Tree Preservation Operations. Maintain the TPA as specified in the TPP and the Contract Documents. Perform the following operations, as specified in the TPP.

- (a) **Tree Branch Pruning.** Section 712.
- (b) **Brush Removal.** Section 713.
- (c) **Tree Felling.** Section 714.
- (d) **Tree Root Pruning.** Section 715.
- (e) **Tree Fertilizing.** Section 716.

120.03.06 Prohibited Activities within the TPA.

PROHIBITED ACTIVITES	
a	Felling, removing, or harming any tree or plant designated for preservation.
b	Removing wood, soil, stones, and other natural materials.
c	Any kind of foot or vehicular traffic.
d	Driving, storing, washing, or maintaining trucks or construction equipment.
e	Placing backfill, stacking or storing supplies.
f	Grading, trenching, draining, dewatering, and burning activities.
g	Dumping waste or storing toxic or hazardous materials.

120.03.07 Restricted Activities. The following activities are restricted in the area near the TPA unless authorized by the Engineer.

RESTRICTED ACTIVITES	
a	Felling trees.
b	Grading that will disrupt drainage patterns.
c	Draining and dewatering activities.
d	Storing construction equipment.
e	Truck washing and maintenance activities.
f	Dumping waste and storing toxic or hazardous materials.
g	Burning and trenching activities.

120.03.08 Cleanup and Restoration. When construction activities are complete, remove the TOCF, construction materials, and debris without damaging trees in the TPA and adjacent areas. Grade the perimeter of the TPA to blend with nearby areas. Seed as specified in Section 705.

120.03.09 Damage Repair. Refer to 712.03.11.

120.03.10 Damage Compensation. Refer to 712.03.12.

120.04 MEASUREMENT AND PAYMENT. Work performed as specified in the Tree Preservation Program or Contract Documents will be measured and paid for one or more of the items listed below. Payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

120.04.01 Temporary Orange Construction Fence. Refer to 104.20.04.

120.04.02 Tree Branch Pruning. Refer to 712.04.

120.04.03 Brush Removal. Refer to 713.04.

120.04.04 Tree Felling. Refer to 714.04.

120.04.05 Tree Root Pruning. Refer to 715.04.

120.04.06 Tree Fertilizing. Refer to 716.04.

120.04.07 The licensed tree expert services will not be measured but the cost will be incidental to the Contract unit price for the Clearing and Grubbing item.

CATEGORY 200 GRADING

SECTION 201—ROADWAY EXCAVATION (CLASS 1, CLASS 1-A, CLASS 2)

201.01 DESCRIPTION. Excavate and grade for roadways and appurtenances to the lines and grades specified.

201.01.01 Classification.

CLASS 1 — All excavation where the width of the bottom of the cut is 15 ft or more.

CLASS 1-A — All excavation of unsuitable material below the lowest excavation limits established.

CLASS 2 — All excavation where the width of the bottom of the cut is less than 15 ft. Excavation for flumes, ditches outside cut or fill slopes, and stream and channel changes are included in this classification unless otherwise specified.

201.01.02 Excavation. Excavation includes the following:

- (a) Cut areas within the boundary faces of the typical cross sections specified, including ditches within the cut sections, entrances, approach roads, streets, intersections, gutters, ditches, berm ditches, and flumes.
- (b) Topsoil salvaged within the specified limits of excavation or as directed.
- (c) The removal and disposal of existing pavement, sidewalks, curb, and combination curb and gutter, when within the limits of Class 1 or Class 2 excavation. Perform this work as specified in Section 206.
- (d) The removal and disposal of below grade structures other than as specified in Sections 102 and 207.

201.02 MATERIALS. Not applicable.

201.03 CONSTRUCTION.

201.03.01 Grading Units. Each unit is the surface area of erodible earth that can be exposed to construction operations without undue erosion or sedimentation. Refer to 101.03.01 for the size and number of units that can be opened at one time.

201.03.02 Use of Excavated Materials. Refer to TC-3.03 and Section 203. Do not waste excavated material without prior approval. Do not use borrow unless provisions have been made for utilizing all available suitable excavated material in embankments.

201.03.03 Broken Pavement Material. Existing pavement, sidewalks, gutter, curb, and combination curb and gutter within the excavation may be broken and used in embankments provided that the materials conform to 204.02.01. If the Engineer determines that the material is unsuitable, dispose of it as excess or unsuitable material.

201.03.04 Rock Excavation.

- (a) **Boulders and Rock.** Boulders and rock from the excavation may be broken and used in embankment if the materials conform to 204.02.01.
- (b) **Blasting.** Refer to TC-6.07. Where rock encountered in cuts requires drilling and blasting, finished slopes shall remain reasonably straight and clean.
- (c) **Presplitting.** When presplitting of rock slopes is specified, perform the presplitting operation prior to the primary blasting. Apply the knowledge gained from excavation of the presplit face to subsequent presplitting operations. Do not drill any portion of any primary blast hole closer to the proposed finished slope than half the spacing of the drilling pattern.

Submit a plan for the proposed presplitting operations for approval. Include the drill size, lift height, explosive and detonator specifications, loading pattern, stemming materials, stemming depth, charge size, and charge timing.

Limit the initial presplit shot to a length of 100 ft. Drill 2 to 3 in. diameter holes on the same plane along the slope line and at the slope angle specified in the Contract Documents. Unless otherwise directed, drill holes on maximum 3 ft centers and to a maximum depth of 20 ft. If the vertical depth of cut to be presplit is greater than the maximum permissible depth of holes as determined by the Engineer, perform the blasting in two or more

lifts. In this case, set back the first line of drill holes a sufficient distance from the slope line to allow for a 1 ft offset for each succeeding line of drill holes.

Before proceeding, excavate the initial presplit shot for inspection by the Engineer. If the results are found to be satisfactory, continue the presplitting using the approved drilling and loading pattern. Whenever the presplitting is found to be unsatisfactory, make adjustments in the operations and repeat the inspection procedure used for the initial presplit shot.

Ensure that the presplit face is within 6 in. from the front of the line of drill holes and 1 ft from the back of the line of drill holes, except where the character of the material (badly broken rock, vertical seams, etc.) will result in irregularities.

Extend the line of presplit holes at least 30 ft beyond the limits of the primary blast holes or to the end of the cut.

Use cartridge explosives that are manufactured for presplitting and that are no more than half the diameter of the presplit hole. Do not use bulk explosives.

The Engineer may stop the presplitting operations wherever the rock is of a character that no apparent advantage is gained.

201.03.05 Frozen Material. Do not place frozen material in embankments. Stockpile the material outside the construction limits and reserve it for future use. Replace any material that is wasted. Rehandling of excavated material and replacement of wasted material shall be at no additional cost to the Administration.

201.03.06 Serrated Slopes. Serrated cut slopes have continuously benched faces. Construct serrated slopes as specified or as directed. Construct the benches as the excavation progresses, parallel to each other, level, and not graded to drain.

201.03.07 Drainage. Construct all drainage as specified in Section 308. Maintain the roadbed in a well-drained condition at all times. Do not place excavated material within 3 ft of the edge of the ditch or channel. Do not allow material to obstruct normal surface drainage into the ditch or channel. Construct ditches draining from cuts to embankments or otherwise to avoid damage to embankments by erosion. Prior to placing any surface material, install all drainage necessary to provide free and uninterrupted flow of surface and underground water. When stabilized side and outlet ditches provide the principal means for drainage, cut and stabilize ditches as the first order of work in the grading operation.

201.03.08 Excavation Beyond Specified Limits. Except by written authorization, do not widen cut or excavation sections beyond the limits of the typical cross section specified. When authorized, the procurement of additional material for embankments, unless otherwise specified under Borrow Excavation, will be as follows:

- (a) **Finished Excavation.** Finish the widening of cut sections so that the completed flat and slope areas are uniform in appearance. Do not cut slopes steeper than specified or as directed.
- (b) **Roadway Excavation Limits.**
 - (1) If the Engineer directs the Contractor to excavate beyond the limits of the typical cross section originally proposed, prior to starting roadway excavation in a cut section, all material within the limits will be classified as Class 1 Excavation.
 - (2) If the Contractor, with approval of the Engineer, elects to obtain additional material by widening cuts beyond the limits of the typical cross section originally proposed and within the right-of-way or easement, the excavation of the materials will be classified as Class 1 Excavation.
- (c) **Borrow Excavation Beyond Specified Limits.** If the Engineer directs the Contractor to excavate beyond the limits of the typical cross section originally proposed, after the Contractor has substantially completed the roadway excavation in a cut section, all material removed beyond the limits of the typical cross section will be classified as Borrow Excavation.

201.03.09 Unsuitable Material. Remove unstable or other unsuitable material encountered at or below the specified typical section to the extent directed by the Engineer as Class 1-A Excavation. In rock areas, the limit of measurement for excavation will be the bottom of the typical section. Except when rock is encountered at subgrade, backfill all voids created by the removal of unsuitable material using the material specified. Furnish material that conforms to Section 916.

201.03.10 Coal Deposits. Notify the Bureau of Mines when coal is encountered. Send the notice to the Director, Bureau of Mines, Maryland Department of Natural Resources. Dispose of any coal encountered on the project as directed by the Engineer.

201.03.11 Widening for Staged Roadway Construction. Limit the area to be excavated for widening to the extent that the excavated area can be backfilled within the same working day using the excavated material or common borrow to form a temporary wedge. Refer to Standard No.

MD 104.01-28 for the area to be backfilled. Maintain the 4:1 or flatter fill slope. Compact the material as directed and leave it in place until placement of the graded aggregate base course.

201.04 MEASUREMENT AND PAYMENT. Roadway excavation will be measured and paid for at the Contract unit price per cubic yard for the pertinent Class of Excavation. The payment will be full compensation for all excavation and hauling, blasting, formation and compaction of embankments and backfills, disposing of excess and unsuitable materials, preparation and completion of subgrade and shoulders except as otherwise specified, serrated slopes, rounded and transition slopes, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment will not be made for excavation of any material used for purposes other than those designated.

When only one bid item for either Class 1 or Class 2 Excavation is established in the Contract Documents, all roadway excavation (except Class 1-A Excavations) shall be included in the unit bid price, regardless of the width of the excavation.

201.04.01 Limits of Measurement.

- (a) **Roadway Excavation.** The lower limit of measurement will be the surface upon which roadway materials, including base course, surfacing, or selected capping material is to be placed in either pavement or shoulder areas.
- (b) **Concrete Pavements.** Measurement will be taken to 1 ft outside of the outer edge of the pavement on each side. Where concrete curb or combination concrete curb and gutter is built contiguous to the pavement, measurement for excavation will be the outer limits of the concrete curb or combination curb and gutter.
- (c) **Rocks and Boulders.** If ledge rock, scattered rock, or boulders of 1/2 cy or larger volume are removed, any resulting undercutting approved by the Engineer will be measured for payment.
- (d) **Slides or Breakages.** Slides or breakages not attributable to the Contractor's negligence, as determined by the Engineer, will be measured and included in the final quantities for Class 1 Excavation.
- (e) **Topsoil and Root Mat.** Measurement will be made for the removal of topsoil and root mat when it is required to be removed from fill areas. In the case of removal of root mat, Class 1 Excavation shall only apply when the strata underlying the root mat are suitable for supporting embankment. If material is

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unsuitable for supporting embankment, then removal of root mat and unsuitable material will be measured as Class 1-A Excavation.

Excavation will always be measured in its original position. No liquids will be included in any measurement.

No measurement will be made for any additional excavation required to construct new curb, curb and gutter, paved ditch, paved gutter, paved flume, or sidewalk paving.

201.04.02 Template Method of Measurement. Unless otherwise specified, excavation will be computed using the template from preliminary cross sections of the original ground surface combined with templates of the typical cross sections. If this method is used, the following volumes will be excluded.

- (a) Undercutting for cushion over rock.
- (b) Entrances and intersections for which details are not specified in the Contract Documents and for which no quantity was allowed in the Contract Documents.
- (c) Salvaged topsoil from under embankments.
- (d) Removal of root mat from under embankments.

The template method will not be used:

- (a) Where there are approved changes in design and typical section.
- (b) Where there are approved deviations from planned slope faces in rock cuts.
- (c) Where the original ground conditions upon which preliminary cross sections were taken have been changed before the Contractor begins work.
- (d) For Class 1-A Excavation.
- (e) When the work of the Contractor does not conform to the line, grade, or cross section specified in the Contract Documents or as changed by subsequent written authorization by the Engineer. Unless corrective action is required, payment will be based on the changed quantities as determined by the cross section method in 201.04.03.

201.04.03 Cross Section Method of Measurement. When specified, quantities for payment of Excavation will be computed by average end areas from the cross sections of the original ground combined with cross sections of the completed work. Class 1 Excavation will be allowed in median areas of cut sections only where 4 in. or greater of topsoil is to be placed. This method will also apply to Class 1-A and Class 2 Excavation unless otherwise specified.

201.04.04 Presplitting will not be measured but the cost will be incidental to the Contract unit price per cubic yard for the pertinent Class of Excavation in which it occurs.

201.04.05 Removal of existing pavement, sidewalk, paved ditches, curb, or combination curb and gutter outside the limits of construction will be measured and paid for as specified in 206.04.

201.04.06 Removal of existing pavement, sidewalk, paved ditches, curb, and combination curb and gutter within the limits of any Class of Excavation will not be measured but the cost will be incidental to the Contract unit price per cubic yard for the pertinent Class of Excavation in which it occurs.

201.04.07 The Contractor or the Administration may elect to recompute quantities in any section where it is believed the planned quantities are incorrect. When recomputation reveals an error, the corrected quantity will be used.

201.04.08 The excavated material or common borrow required to fill the temporary wedge area as specified in 201.03.11, maintaining the 4:1 or flatter slope, compaction, and removal of the material will not be measured but the cost will be incidental to the Contract unit price for the pertinent Class of Excavation. Refer to 104.12.04 for measurement and payment of Drums.

201.04.09 Backfill for unsuitable material will be measured and paid for at the Contract unit price for the pertinent item specified in the Contract Documents.

SECTION 202 — CHANNEL OR STREAM CHANGE EXCAVATION (CLASS 5)

202.01 DESCRIPTION. Excavate for changes in channels or streams when specified. Use all suitable material for the construction of the project. Dispose of unsuitable material as directed.

202.02 MATERIALS. Not applicable.

202.03 CONSTRUCTION. Section 201.

202.04 MEASUREMENT AND PAYMENT. Class 5 Excavation will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for all excavation and hauling, formation and compaction of embankments and backfill, backfilling old stream beds or otherwise disposing of excess and unsuitable materials, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Material will be measured in its original position and the volume computed by the Method of Average End Area. The cross sectional area measured will not include liquids. Measurement for Class 5 Excavation excludes any material removed outside the limits of payment as specified in the Contract Documents.

SECTION 203 — BORROW EXCAVATION

203.01 DESCRIPTION. Furnish, excavate, haul, and place approved materials for embankments and backfills when sufficient quantities of suitable materials are not available from other excavations specified in the Contract Documents. This includes all work prescribed for backfills, embankments, subgrade, and earth shoulders, all necessary clearing and grubbing, the removal and disposal of overburden or other unsuitable spoil material, and the trimming, shaping, dressing, draining, and reclamation of the pit or location from which borrow material is secured. Refer to 201.03.02 before securing borrow.

203.01.01 Contractor's Options. As a duly authorized agent of the Administration, select one of the following three methods to obtain borrow material for use on public highway contracts:

OPTION 1 — Acquire material from a licensed commercial operating supplier.

OPTION 2 — Make application to the Maryland Department of the Environment under the Annotated Code of Maryland, Environment, Subtitle 8, entitled "Surface Mining".

OPTION 3 — Make application to the Administration to operate under the standard adopted in conformance with the Annotated Code of Maryland, Environment, Subtitle 8, Surface Mining, Subsection 15-834 entitled

"Exemptions". If this option is selected submit an application to the Administration fulfilling all the requirements of the cited subtitle.

Provide notification of the option selected to the Administration.

203.01.02 Notice to Contractor—Borrow Pits. If proposed, a borrow pit may be established on privately owned property. The Administration may grant an "Exemption for a Surface Mining Permit" normally issued by the Maryland Department of the Environment, Water Management Administration (WMA). Before a permit can be granted, submit written proof to the Administration that all local permits or approvals have been secured for the borrow pits.

An exemption under Option 3 will require approval of an excavation and reclamation plan along with the drainage patterns and methods of attaining satisfactory drainage and soil conservation as the work progresses. The plan shall provide for surface restoration suitable for the proposed subsequent land use after reclamation is completed and the proposed method of accomplishment.

203.01.03 Borrow Pits Within Jurisdictional Resources. Borrow pits located within tidal or nontidal wetlands, waterways, and 100 year floodplains require approval by the appropriate Federal and State Authorities. Obtain and provide all required permits.

If the pit is in operation and the Administration discovers that the work does not meet these regulations, the Administration will notify the contractor to make the necessary corrections and all other operations shall cease until the work is in compliance.

203.02 MATERIALS. Section 916.

203.03 CONSTRUCTION.

203.03.01 Clearing and Grubbing. Section 101.

203.03.02 Borrow Pit Material. Notify the Engineer at least 30 days in advance of the opening of any borrow pit so that soil analysis, elevations, and measurements of the ground may be made. After the pit is opened, use the excavated material only for the project intended. Do not excavate additional material for other purposes until a final survey is made of the pit.

203.03.03 Borrow Pit After Excavation. Meet the requirements of the Reclamation (Permit) Plan after the necessary quantity of materials has been removed. Avoid steep slopes and sheer faces. Seed and mulch all

disturbed areas as specified in Section 705, at no additional cost to the Administration. Shaping and seeding requirements do not apply to commercial borrow pits.

203.03.04 Borrow Excavation Beyond Specified Limits. Refer to 201.03.08.

203.03.05 Compaction. Refer to 204.03.04.

203.04 MEASUREMENT AND PAYMENT. Borrow excavation will be measured and paid for at the Contract unit price per cubic yard for the pertinent Borrow item. The payment will be full compensation for clearing and grubbing, furnishing, excavating and hauling, sloping, draining and reclamation of pits (if Option 2 or 3 is selected), the formation and compaction of embankments, backfills, subgrade, manipulation and additives for select borrow, all work and materials for earth shoulders except as otherwise specified, disposing of all unsuitable spoil material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

When requested by the Contractor in writing, the Engineer may approve an alternate method of measurement for the computation of borrow excavation quantities. This alternate method will not be considered for approval unless the Contractor can show that the cross section method computed by average end area is not a feasible method of measurement. When approved in writing, this alternate method will consist of measuring the borrow excavation in approved hauling vehicles. Refer to TC-7.01 and the following:

- (a) Prior to the start of hauling operations, provide the identification number of each vehicle to be used. The Engineer will determine the water level capacity of each vehicle. The measured capacity will be multiplied by a factor of 0.85 to determine the pay volume.
- (b) Furnish a delivery ticket to the Engineer for each load of borrow material delivered to the project with the information listed below. Only tickets signed by the Engineer will be used in the computation of the borrow quantity.
 - (1) The supplier's name.
 - (2) The Administration's Contract number.
 - (3) The date and ticket number.
 - (4) Vehicle identification number.

- (5) Type of material delivered.
- (6) Pay volume computed as specified in (a).

SECTION 204 — EMBANKMENT AND SUBGRADE

204.01 DESCRIPTION. Construct embankment and subgrade using suitable material obtained from roadway, structure, borrow, and other excavation included in the Contract. Place, process, and compact material to the specified line and grade.

204.02 MATERIALS. Unless otherwise specified, use soils and soil aggregate mixtures that meet the common borrow requirements specified in Section 916.

204.02.01 Rock. Rock may be used in embankments, if individual pieces do not exceed 24 in. in any dimension. Larger size rocks may be wasted with the approval of the Engineer.

204.02.02 Frozen Material. Refer to 201.03.05. In addition, do not cover any material that freezes after being placed in the embankment until it has thawed.

204.02.03 Embankment Adjacent to Structures. The Engineer may require the use of specially selected material adjacent to structures to protect the structure from damage. Do not use rock. At locations of pile supported foundations, use embankment material that will allow piles to be easily driven.

204.03 CONSTRUCTION.

204.03.01 Embankment Foundation.

- (a) **Foundation Material.** The Engineer will inspect and approve the area prior to construction of the embankment. Remove topsoil, root mat, and unsuitable material to the depth directed.
- (b) **Embankment Over Existing Pavement.** Thoroughly break up, scarify, or remove the pavement as specified or as directed.
- (c) **Test Rolling.** When specified or directed, test the foundation by rolling with a 35 ton pneumatic tired roller, or as approved.

204.03.02 Placing and Spreading. Place the material in horizontal layers across the full width of the embankment. Maintain an adequate

crown to provide drainage at all times. Maintain side slopes at the specified slope throughout the progress of the work.

- (a) **Embankment on Unstable Ground.** When embankment is to be constructed on ground that will not support the weight of the construction equipment, the first layer of the fill may be constructed by depositing material in a layer no thicker than that required to support the equipment. Place subsequent layers as specified in (b).
- (b) **Earth Embankment.** Except when specified, do not place layers exceeding 8 in. compacted depth.
- (c) **Rock Embankment.**
 - (1) Determine the thickness of layers by the size of the rock or a 24 in. maximum depth, whichever is less. Where the embankment is less than 6 ft below the subgrade at the profile grade line, place the material in layers not exceeding 8 in. compacted depth. Solidly fill and choke these layers with spalls, rock dust, or earth. Fill and compact each layer before placing the next layer.
 - (2) Place the rock material to a uniform top surface, determined by connecting with straight lines the points on the typical cross section that are 9 in. below any median ditch invert and 9 in. below the bottom of the pavement structure and then sloping downward and outward under the shoulders at the rate of $\frac{3}{4}$ in. per ft to the outer slope of the embankment.
 - (3) Unless otherwise specified, construct the remaining upper portion of the embankment, using suitable earth that is free from stones retained on a 3 in. sieve.

204.03.03 Benching. When placing and compacting embankment on hillsides or against existing embankments, continuously bench the slopes where the slope is steeper than 4:1 when measured at right angles to the roadway. Perform the benching operation as the embankment is constructed in layers. Maintain a bench width of at least 5 ft. Begin each horizontal cut at the intersection of the original ground and the vertical sides of the previous cut. If the material cut from the benches meets embankment requirements, compact this material along with the new embankment material.

204.03.04 Compaction. Immediately after spreading each layer of fill, compact the material with approved equipment. Perform all rolling in a longitudinal direction along the embankment. Begin at the outer edges

and progress towards the center. Vary the travel paths of traffic and equipment over the width of the embankment to aid in obtaining uniform compaction.

Compact the material that is 1 ft below the top of subgrade to at least 92 percent of the maximum dry density per T 180. Compact the top 1 ft to at least 97 percent of the maximum dry density. Determine in-place density per MSMT 350 or 352. When necessary, add water or dry the layer in order to compact to the required density. When finally compacted to the required density, the resultant moisture content of embankment material shall be within two percentage points of optimum.

Provide a portland cement concrete compaction block having dimensions 18 x 18 x 9 in., weighing at least 200 lb, and with one 18 x 18 in. level and broomed working surface.

204.03.05 Stability of Embankments. Remove and replace with acceptable material any embankment or portion thereof that has been constructed with unsuitable material. Remove and replace unstable material and remove and replace portions of the embankment that become unstable or displaced as the result of the construction operations.

204.03.06 Protection of Structures and Utilities During Construction. Protect all structures and utilities from any damage in the handling, processing, or compacting of embankment or backfill material. Exercise caution near arches, retaining walls, culverts, and utility trenches to prevent undue strain or movement. In areas where rollers cannot be used, refer to Section 210.

204.03.07 Subgrade. After all cuts, embankment, and backfilling have been substantially completed, construct and shape the subgrade to the specified cross section. Test roll the subgrade as specified in 204.03.01(c).

204.03.08 Maintenance. Maintain the embankment and subgrade until final acceptance. Use acceptable material from excavation or borrow to replace embankment and subgrade material that may be lost or displaced as a result of natural causes such as storms and cloudbursts, or as a result of unavoidable movement or settlement of the ground or foundation upon which the embankment and subgrade is constructed. Maintain ditches and drains at all times. Keep all traffic on the embankment and subgrade to a minimum. Remove ruts that are 2 in. or more in depth by reshaping and recompacting.

204.04 MEASUREMENT AND PAYMENT. Embankment, subgrade, and all necessary work will not be measured but the cost will be incidental to the Contract unit price per cubic yard for the pertinent Class of Excavation. The payment will be full compensation for the formation, sprinkling, compacting, test rolling, shaping, scarifying, breaking or removing of the existing pavement, sloping, trimming, finishing, maintaining embankments and subgrade, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Replacement of material lost as a result of natural causes will be measured and paid for at the Contract unit price per cubic yard for the pertinent Class of Excavation item or as directed by the Engineer.

Compaction by means of mechanical tampers or vibratory compactors will not be measured but the cost will be incidental to the pertinent Class of Excavation item.

SECTION 205 — TEST PIT EXCAVATION

205.01 DESCRIPTION. Excavate and backfill test pits to determine the location of underground structures and utilities.

205.02 MATERIALS. Not applicable.

205.03 CONSTRUCTION. Determine the location of underground structures and utilities by test pit excavation prior to excavation operations.

Excavate test pits at the location and to the size and depth authorized. Backfill test pits as specified in Section 210.

205.04 MEASUREMENT AND PAYMENT. Test Pit Excavation will be measured and paid for at the Contract unit price per cubic yard for the material actually removed from within the limits specified. The payment will be full compensation for all excavation, tamped backfill, and all material, labor, equipment, tools, and incidentals necessary to complete the work. Any pavement to be replaced will be measured and paid for as specified in Section 106.

SECTION 206 — REMOVAL OF EXISTING PAVEMENT, SIDEWALK, PAVED DITCHES, CURB, OR COMBINATION CURB AND GUTTER

206.01 DESCRIPTION. Remove to full depth and dispose of existing pavement, sidewalk, paved ditches, curb, or combination curb and gutter.

206.02 MATERIALS. Not applicable.

206.03 CONSTRUCTION.

206.03.01 Full Depth Saw Cut. Saw cut to full depth the existing pavement, sidewalk, paved ditches, curb, or combination curb and gutter along the lines specified or as directed.

206.03.02 Use of Removed Pavement, Sidewalk, Paved Ditches, Curb, or Combination Curb and Gutter. When approved, removed materials may be broken and used in the work. Refer to 204.02.01.

206.03.03 Protection of Retained Pavement, Sidewalk, Paved Ditches, Curb, or Combination Curb and Gutter. Protect all sections designated to remain from being damaged. Repair or replace damaged areas.

206.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

206.04.01 Removal of existing pavement, sidewalk, paved ditches, curb or combination curb and gutter, and full depth saw cuts within the limits of any class of excavation will not be measured but the cost will be incidental to the Contract unit price for the Class of Excavation in which it occurs.

206.04.02 Saw cuts, removal of existing pavement, sidewalk (except as specified in 603.04), paved ditches, and curb or combination curb and gutter (except as specified in 602.04) outside the limits of any class of excavation will be measured in the original position and paid for as follows:

- (a) Saw Cuts per linear foot when an item is included in the Contract Documents.
- (b) Removal of Existing Pavement, Sidewalk, and Paved Ditches per cubic yard.

- (c) Removal of Existing Curb or Combination Curb and Gutter per linear foot.

When any material included in (b) or (c) is removed but not replaced, backfilling and landscaping as directed by the Engineer will not be included in Contract Unit Price. Payment for this work will be made using the applicable items included in the Contract Documents.

SECTION 207 — REMOVAL OF EXISTING MASONRY

207.01 DESCRIPTION. Remove all or part of existing concrete, concrete block, brick, or stone structures (headwalls, toe walls, etc.), including concrete piles. Refer to Section 405 for removal of existing bridge structures, box culverts., retaining walls , and noise barriers.

207.02 MATERIALS. Not applicable.

207.03 CONSTRUCTION.

207.03.01 Removal. Unless otherwise specified, remove material to at least 1 ft below subgrade or existing ground. Except with written approval, do not use blasting. Piles, grillages, and cribbing under removed masonry shall be cut off to the above limit.

207.03.02 Use of Removed Masonry. Masonry material may be broken and used in accordance with 204.02.01. Material determined to be unsuitable shall be disposed of as excess or unsuitable material.

207.03.03 Protection of Retained Masonry. Repair or replace retained sections that are damaged due to the construction operations. Cut connecting edges and surfaces to the line and grade specified or as directed.

207.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, backfill, disposal of excess or unsuitable material, blasting, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

207.04.01 Removal of Existing Masonry will be paid for at the Contract lump sum price.

207.04.02 When specified in the Contract Documents, Removal of Existing Masonry will be measured and paid for at the Contract unit price per cubic yard.

207.04.03 When a new structure is placed in the location of an existing structure, the removal of the existing structure will be incidental to the new structure, unless otherwise specified.

SECTION 208 — SUBGRADE PREPARATION

208.01 DESCRIPTION. Prepare, protect, and maintain the subgrade prior to the construction of succeeding courses.

208.02 MATERIALS. Section 916.

208.03 CONSTRUCTION. After roadway excavation and embankments are completed in conformance with Section 204, fine grade and compact the subgrade to at least 97 percent of the maximum dry density per T 180.

208.03.01 Removal and Replacement of Unsuitable Material. Remove and dispose of all soft and unstable material and any other portions of the subgrade that will not properly compact. Replace with suitable material and compact.

208.03.02 Subgrade Control. Bring the subgrade surface to line and grade and shape it to the specified cross section. Set grade for subgrade control both longitudinally and transversely with fixed controls not exceeding 25 ft spacing. Limit the finish subgrade deviation to 1/2 in. from the established grade. Compact and smooth the subgrade over its full width by the use of an approved smooth faced, steel-wheeled roller approved by the Engineer. Use mechanical tampers and vibratory compactors if rolling is not feasible.

208.03.03 Bleeder Ditches. Maintain adequate open bleeder ditches along the subgrade at all times to keep it thoroughly drained. Maintain erosion and sediment control practices as specified in Section 308.

208.03.04 Subgrade Maintenance. Prevent damage by heavy loads or equipment. Repair or replace any defects or damage.

208.03.05 Subgrade Approval. Do not place subsequent cover material upon a frozen subgrade or any subgrade until it has been checked and approved.

208.04 MEASUREMENT AND PAYMENT. Subgrade preparation, including bleeder ditches and any mechanical tamping will not be measured but the cost will be incidental to the pertinent items specified in the Contract Documents.

SECTION 209 — TRIMMING EXISTING DITCHES

209.01 DESCRIPTION. Trim, slope, and shape existing ditches within the limits and to the lines and grades specified. Clearing and grubbing and the removal and disposal of surplus or unsuitable materials are included in the work.

209.02 MATERIALS. Not applicable.

209.03 CONSTRUCTION. Clear and grub as specified in Section 101. Trim, slope, and shape existing ditches to a uniform grade and cross section. Maintain a constant side slope having a maximum slope of 1:1 unless otherwise specified. Dispose of excess and unsuitable materials as specified in Section 201.

209.04 MEASUREMENT AND PAYMENT. Trimming Existing Ditches will be measured and paid for at the Contract unit price per linear foot of trimmed ditch. Measurement will be along the center line of the ditch.

The payment will be full compensation for all clearing, grubbing, excavation, disposal of surplus and unsuitable materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 210 — TAMPED FILL

210.01 DESCRIPTION. Compact the embankment and backfill materials by means of mechanical tampers or vibratory compactors. Use this method of compaction wherever materials cannot be adequately compacted by other approved methods.

210.02 MATERIALS. Section 916.

210.03 CONSTRUCTION. After approval has been given by the Engineer, place approved material in horizontal layers not exceeding 6 in. loose depth over the entire area. Tamp and uniformly compact the material using mechanical tampers or vibratory compactors. Refer to 204.03.04 for moisture and compaction.

When backfilling around abutments, retaining walls, culverts, utilities, or other structures, prevent any wedging action against the structure. When placing backfill against existing slopes, excavate benches or steps. Place the backfill in horizontal layers as described above and wide

enough that there is a horizontal berm of thoroughly compacted material behind the structure at all times for a distance at least equal to the height of the structure remaining to be backfilled, except insofar as undisturbed material protrudes into this space. Tamping may be required over additional widths when the material cannot be adequately compacted by other methods. When installing structures below subgrade in embankments, place the tamped fill to a depth of 1 ft over the top of the structure. In excavation sections, extend the tamped fill to the surface of the finished earthwork.

210.04 MEASUREMENT AND PAYMENT. Compacting embankments and backfills by mechanical tampers or vibratory compactors will not be measured but the cost will be incidental to the pertinent items specified in the Contract Documents.

SECTION 211 — GEOSYNTHETIC STABILIZED SUBGRADE USING GRADED AGGREGATE BASE

211.01 DESCRIPTION. Furnish and place a layer of geotextile and 12 in. of graded aggregate base to bridge unstable material and minimize the use of undercutting. Use this item only when specified or directed. In extremely unstable areas, the Engineer may increase the thickness of the graded aggregate base material.

211.02 MATERIALS.

Graded Aggregate Base	901.01
Geotextile for Subgrade Stabilization-Class ST	921.09
Securing Pins or Staples	921.09

211.03 CONSTRUCTION.

211.03.01 Test Strip. In extremely unstable areas, the Engineer may direct that a test strip be constructed to determine the thickness of aggregate layer required to stabilize the area. The Engineer will determine the depth of aggregate to be used in the test strip. Construct the test strip a least 100 ft in length and at least one lane wide. The results of the test strip will be used to determine the thickness of aggregate required for subsequent construction.

211.03.02 Grade Preparation. Cut the area where the geotextile is to be placed to the depth shown or as directed. Bring the area to the specified line, grade, and cross section. Provide a grade that is smooth as practical and free of debris. Minimize construction traffic on the grade. Remove ruts by reshaping, but do not overwork the grade. Have the grade

approved prior to placement of the geotextile. Maintain adequate surface drainage as specified in 208.03.03.

The Engineer may waive compaction and moisture requirements for the underlying soil.

211.03.03 Geotextile Placement. Place geotextile on the prepared surface for the full width of the area to be treated. In areas where longitudinal underdrain is to be placed, place the geotextile up to the edge of the proposed longitudinal underdrain trench, but not where the trench is to be excavated.

Unroll the geotextile parallel to the base line. Do not drag the geotextile across the grade. Remove wrinkles and folds by stretching and pinning.

Overlap the geotextile at least 30 in. at roll edges and ends. Overlap the end of the roll in the direction of aggregate placement, with the roll being covered by aggregate on top of the next roll. Pin all roll ends and roll end overlaps a maximum of 5 ft on center. Pin roll edges and roll edge overlaps a maximum of 50 ft on center.

For curves, fold or cut the geotextile and overlap in the direction of the turn. Pin folds in the geotextile a maximum of 5 ft on center. Immediately repair or replace damaged geotextile as directed. Overlap geotextile patches at least 3 ft into undamaged geotextile.

Do not allow traffic, including construction equipment, on the bare geotextile.

211.03.04 Aggregate Placement. Place the graded aggregate base as specified in Section 501, with the following exceptions:

- (a) **Placement and Spreading.** Place the graded aggregate base within three working days of geotextile placement. Use the end dumping and spreading method. Place a single lift parallel to the baseline and at the thickness required to provide the specified compacted depth. Keep the turning of construction equipment on the graded aggregate base to a minimum.
- (b) **Density Requirements.** Immediately after placement, compact the graded aggregate base material to the required density. Unless otherwise directed, compact the top 6 in. to at least 95 percent of maximum dry density within 2 percent optimum moisture. Use T 180 to determine the optimum moisture content and maximum dry density. Use MSMT 350 or 352 to measure the in-place density. Compaction requirements will be waived for the graded aggregate base material below the top 6 in.

- (c) **Vibration.** Unless otherwise specified or directed, do not vibrate graded aggregate base.

211.04 MEASUREMENT AND PAYMENT. Geosynthetic Stabilized Subgrade Using Graded Aggregate Base will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for the test strip, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

CATEGORY 300 DRAINAGE

SECTION 301 — CLASS 3 EXCAVATION FOR INCIDENTAL CONSTRUCTION

301.01 DESCRIPTION. Excavate below the planned elevation as directed.

301.02 MATERIALS. Not applicable.

301.03 CONSTRUCTION. Excavate the area to the size, depth, and location as authorized. Backfill as specified in Section 302. For excavated material, refer to 402.03.01.

301.04 MEASUREMENT AND PAYMENT. Class 3 Excavation for Incidental Construction will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Backfill. Backfill will be measured and paid for as specified in 302.04.

SECTION 302 — SELECTED BACKFILL

302.01 DESCRIPTION. Place selected backfill material as directed.

302.02 MATERIALS.

No. 57 Aggregate	901.01
Crusher Run Aggregate CR-6	901.01

302.03 CONSTRUCTION. Replace unsuitable foundation material as directed. Refer to Section 210 for compaction.

302.04 MEASUREMENT AND PAYMENT. Selected Backfill using No. 57 Aggregate or Selected Backfill using Crusher Run Aggregate CR-6 will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for compaction and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 303 — PIPE CULVERTS

303.01 DESCRIPTION. Place the specified size and type of pipe on a firm bed to the specified line and grade; make connections to existing pipes, inlets, end walls, or manholes; and clean the existing pipes.

303.02 MATERIALS.

Selected Backfill	302.02
Flowable Backfill	314.02
Concrete Mix No. 2	902.10
Brick	903.03
Mortar	903.06
Pipe	905
Select Borrow	916.01

303.03 CONSTRUCTION. Verify pipe lengths and gradients and obtain approval before installation.

When endwalls are visible from the roadway, construct them parallel to the roadway with the askew pipe protruding through the end wall. If not visible, construct them normal to the center line of the pipe.

Clean existing pipes and dispose of the material.

303.03.01 Excavation. When a pipe is to be laid on existing ground, on or under fill, construct embankment to a height of at least 9 in., but not more than 3 ft above the proposed top of the pipe. Then excavate to a width of twice the outside diameter of the pipe or the outside diameter plus 18 in. on each side, whichever is less. For excavated material, refer to 402.03.01.

Where soil does not meet the classification specified as suitable backfill, remove to a depth of 4 inches below the bottom of the pipe elevation. Remove rock, boulders, or other hard, lumpy, or unyielding material to a depth of 12 inches below the bottom of the pipe elevation. Remove muck or other soft material to a depth necessary to establish a firm foundation. Where the soils permit, ensure that the trench sides are vertical up to at least the midpoint of the pipe.

When rock is encountered, remove and replaced it with at least 8 in. of selected backfill.

When unsuitable foundation material is encountered, remove and replace it with selected backfill for the full width of the trench.

303.03.02 Bedding. Place earth for bedding meeting the requirements of M 145, A-1, A-2-4, A-2-5 or A-3. The maximum particle size is 1.25 in. Do not use organic material, stones larger than 1.5 in., or frozen lumps. Ensure that moisture content is in the range of optimum content to permit thorough compaction. Selected Backfill may be used.

Place bedding for culverts 48 in. or more in nominal horizontal diameter in an approved foundation, shaped using a template that supports the pipe for at least 10 percent of its overall height.

303.03.03 Installation. Lay pipes with hubs upgrade. A single lay hole through the shell of concrete pipe is permitted with an approved lifting device. Cast the lay hole in the pipe during fabrication or core it without damaging or exposing any reinforcement. After installation, permanently seal the lay hole by filling with mortar, rubber plug, or other approved means. Wood plugs are unacceptable. Lay holes that expose any reinforcement may not be used. Do not lay pipe in standing water or when weather conditions are deemed unsuitable by the Engineer.

303.03.04 Joints. Seal pipe joints in a manner appropriate for the applicable pipe material.

Reinforced Concrete Pipe. Seal joints with rubber type gaskets (circular pipe) or resilient type material (elliptical pipe) meeting M 198. Mortar joints are unacceptable.

Metal Pipe. Use Bell and spigot joints with integral rubber gaskets or butt pipes and seal using rubber gaskets with an approved coupling band meeting 905.01.

Plastic Pipe. Use integral bell and spigot joints with rubber or neoprene gaskets meeting F 477.

303.03.05 Pipe Connections. Pipe connections may be either prefabricated or constructed in the field. A field pipe connection includes cutting a hole in one pipe, inserting and trimming the connecting pipe, and placing a concrete collar using Concrete Mix No. 2 at the connection. Finish the connection to provide a smooth surface. In the case of corrugated pipes, a welded connection may be substituted for the concrete collar. Coat the weld with a zinc-rich paint coating per M 36. For connections to drainage structures, refer to 305.03.05.

303.03.06 Pipe Encasement. When specified, encase pipes using Concrete Mix No. 2.

303.03.07 Backfill. When specified or directed, use material meeting the requirements for Select Borrow, Selected Backfill or Flowable Backfill. Large lumps, clods, frozen material or rocks are not acceptable. For plastic pipe installations, use backfill materials meeting the requirements of M 145, A-1, A-2-4, A-2-5 or A-3. Place backfill along the side of the pipe for the full width of the trench in layers not exceeding an uncompacted depth of 6 in. Compact each layer simultaneously on both sides of the pipe using an approved mechanical tamper. Refer to Section 210. Compact thoroughly under the haunches of the pipe. Continue this method of filling and compaction until the backfill is completed to at least 9 in., 12 in. for plastic pipe, above the top of pipe. Protect all pipes from damage due to construction equipment or other vehicular traffic.

Backfill may be placed immediately after laying the pipe, provided that all joints have been sealed.

Place magnetically-detectable plastic tape in the trench immediately above the structural backfill. The minimum thickness of the tape is 5.5 mils and the minimum tensile strength is 5000 psi. Demark the tape as to its purpose (i.e., "STORM DRAIN").

303.03.08 Removal of Existing Pipe Culverts. When specified, remove and dispose of existing pipe culverts. Backfill as specified herein.

303.03.09 Relaying Existing Pipe. When specified, remove, salvage, and relay culverts according to these Specifications relating to new pipe.

303.03.10 Abandoned Pipes. When specified, plug abandoned pipes using Concrete Mix No. 2 or brick masonry. When specified, fill pipes with Flowable Backfill. Refer to Section 314 and 463.

303.03.11 Clean Existing Pipes. When specified, clean existing pipes of all sediment and debris without damaging to the pipe and drainage structures. Remove and dispose of sediment and debris as specified in Section 308.

303.03.12 Inspection and Acceptance. No sooner than 30 days after installation visually inspect all new pipe in the presence of the Engineer. Any cracks, differential movement, efflorescence, rust stains, spalls, exposed reinforcement, slabbing, dents, buckling, holes, damaged coating, obstructions, improperly engaged joints, improper gasket placement, excessive joint gaps, misaligned joints, excessive deflection, or undue horizontal or vertical misalignment will be cause for repair or replacement at no cost to the Administration. Video inspect pipe which cannot be physically accessed for inspection. Ensure that thermoplastic pipe deflection does not exceed 5 percent

303.04 MEASUREMENT AND PAYMENT. The payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, rehandling of material, removal and disposal of excess and unsuitable material, tamped fill, forming bed or foundation, bedding, backfill, compaction, inspection, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

303.04.01 New pipe culverts will be measured complete in place and paid for at the Contract unit price per linear foot. When a new pipe is to be installed at the same location as an existing pipe, the cost of removal and disposal of the existing pipe, including end walls and end sections, will not be measured but the cost will be incidental to the Contract price of new pipe.

303.04.02 Pipe Connections and Elbows will be measured and paid for at the Contract unit price per each. No deduction from the pipe measurement will be made for pipe connections. Connections to drainage structures containing prefabricated holes in which the pipe will be connected with grout or mortar will not be measured, but the cost will be incidental to the pertinent Pipe item.

303.04.03 Excavation required below the planned elevation will be measured and paid for as specified in 301.04.

303.04.04 Removal of Existing Pipe will be measured and paid for per the total number of linear feet removed, regardless of the condition. When a multiple pipe installation is removed, each pipe will be measured and paid for. End walls, end sections, etc. removed with the pipe will not be measured but the cost will be incidental to the Contract price.

303.04.05 Selected backfill will be measured and paid for as specified in Section 302.

303.04.06 Flowable Backfill will be measured and paid for as specified in Section 314.

303.04.07 Select Borrow will be measured and paid for as specified in Section 203.

303.04.08 Relaid Existing Pipe Culverts-Any Size will be measured and paid for as specified in 303.04.01 unless otherwise specified in the Contract Documents.

303.04.09 New end walls, end sections, etc., will be measured and paid for as specified in Section 305.

303.04.10 Removal of existing headwalls, end sections, etc., that are not incidental to the Contract price for the respective pipe items will be measured and paid for as specified in Section 207.

303.04.11 Encasement concrete, and concrete or brick masonry to plug existing pipes will be measured and paid for at the Contract price for the pertinent Concrete Mix No. 2 for Miscellaneous Structures, or Brick Masonry for Miscellaneous Structures item.

303.04.12 Clean Existing Pipe Any Size will be measured and paid for at the Contract unit price per linear foot. Removal of construction debris and sediment will not be measured for payment.

SECTION 304 — STRUCTURAL PLATE PIPE AND STRUCTURAL PLATE PIPE ARCH CULVERTS

304.01 DESCRIPTION. Furnish and install structural plate pipe and structural plate pipe arch culverts.

304.02 MATERIALS.

Selected Backfill	302.02
Concrete Mix No. 2	902.10
Structural Plate for Pipe and Pipe Arches	905

304.03 CONSTRUCTION.

304.03.01 Fabrication. Submit working drawings, including erection diagrams and strutting tables for approval. Include proposed lengths and lifting locations of preassembled sections in the erection diagrams. Upon approval, shop fabricate the plates, including required holes, to the required dimensions. Ship the plates complete, with proper markings and all necessary connection devices.

The plate configurations shall have radii and curvature according to AASHTO Standard Specifications for Highway Bridges. When bottom plates of circular pipes are specified to be thicker than top and side plates, cover at least 25 percent of the periphery of the circle with the thicker plate. For pipe arches, the thicker plates shall include corner plates as well as bottom plates. Lay these culverts on a firm bed, true to the specified line and grade.

Along those edges of the plates that will form longitudinal seams in the finished structure, stagger bolt holes in rows 2 in. apart, with one row in the valley and one in the crest of the corrugations, unless otherwise

specified. Along those edges of the plates that will form circumferential seams in the finished structure, provide a bolt spacing of not more than 12 in. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than 1/8 in.

Shop cut all edges to line and grade, and keep them free from oxide and burrs. Stagger connections so that no more than three plates come together at any one point. Form plates to provide lap joints.

304.03.02 Excavation. When a structural plate pipe or structural plate pipe arch is to be laid on existing ground, on or under fill, construct embankment to a height of at least 18 in., but not more than 3 ft above the proposed top of the pipe. Then excavate the trench to a width of twice the outside diameter of the pipe or the outside diameter plus 18 in. on each side, whichever is less. For excavated material, refer to 402.03.01.

304.03.03 Foundation Preparation. Provide bedding as specified in 303.03.02. Set rails and then screed the foundation to the exact shape of the bottom plates, immediately prior to erection.

304.03.04 Erection. When strutting is required, it shall be uniform from end to end. Keep struts in place until backfills are completed. Tighten nuts and bolts to between 100 and 200 ft·lb of torque.

When washers are specified, place them under the turned element. Distribute bolts over the section being assembled. Align holes by shifting the plates. For bottom plates, place the nuts inside the structure. Do not draw the nuts tight until the section is assembled. Before backfilling, tighten all nuts and test to ensure compliance with torque requirements.

304.03.05 Backfill. Earth for backfill shall be free from large lumps, clods, frozen material and rocks. Place it along the side of the pipe for the full width of the trench in layers not exceeding an uncompacted depth of 6 in. Compact each layer simultaneously on both sides of the pipe using an approved mechanical tamper. Refer to Section 210. Compact the backfill thoroughly under the haunches of the pipe.

Elevate the backfill uniformly along each side of the structure to a height of at least 18 in. above the top of the structure. For structures without headwalls, start backfill in the center of the structure. If the structure includes headwalls or spandrel walls, start backfilling operations at one wall and work toward the opposite side. When batteries or multicell installations are specified, elevate backfill between cells equally on each side of each cell.

Do not run trucks and construction equipment over any part of a structural plate pipe structure until the backfill has been completed and tamped up to a height of at least 18 in. above the structure.

304.03.06 Concrete Invert. When specified, pave the invert using Concrete Mix No. 2. Place and cure the concrete as specified in Section 420.

304.03.07 End Treatment. Shop fabricate the ends of structural plate pipes and structural plate pipe arches on a bevel to fit and be flush with the slope and alignment of the surface through which they protrude, except that where an end wall or masonry slope protection is specified, shop fabricate the ends to fit that construction. The ends of all structural plate pipes and structural plate pipe arches that require an end treatment (end wall or slope protection) shall contain hook bolts for anchorage into the concrete.

Headwalls for structural plate pipes and pipe arches shall meet Section 305. Unless otherwise specified, constructed them parallel to the proposed outer edge of the roadway shoulder.

304.04 MEASUREMENT AND PAYMENT. The payment for the items specified in the Contract Documents will be full compensation for all applicable fabrication, assembly, excavation, sheeting, shoring, strutting, dewatering, hauling, invert paving, storing, rehandling of material, removal and disposal of excess and unsuitable material, tamped fill, foundation preparation, backfill, compaction and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

304.04.01 Structural Plate Pipe and Structural Plate Pipe Arch Culverts will be measured and paid for at the Contract unit price per linear foot. Measurement will be as follows: measure the top length and the bottom length and average. The average length will be the pay length for each pipe in the structure. For multiple pipes, the length will be totaled to obtain the total pay length.

304.04.02 Excavation required below the planned elevation will be measured and paid for as specified in 301.04.

304.04.03 Selected backfill will be measured and paid for as specified in Section 302.

304.04.04 Headwalls will be measured and paid for as specified in Section 305.

SECTION 305 — MISCELLANEOUS STRUCTURES

305.01 DESCRIPTION. Construct miscellaneous cast-in-place concrete or masonry structures, install precast concrete structures, and clean existing inlets.

305.02 MATERIALS.

Mortar Sand	901.01
Curing Materials	902.07
Concrete Mix No. 2, No. 3 or No. 6	902.10
Grout	902.11
Brick	903.02
Pipe	905
Reinforcement Steel	908
Steel	909.02
Castings for Frames, Covers, Gratings and Steps	909.04
Zinc Coating	A 153
Stone	M 43 Size No. 57
Precast Concrete End walls, Inlets, and Manholes	M 199

305.03 CONSTRUCTION. Refer to Section 420 for portland cement concrete, Section 463 for brick masonry, and 402.03.01 for excavated material.

305.03.01 Construction Sequence. Complete the underground drainage structures before placing the roadway surfacing. Manholes, catch basins, and inlets shall not be completed to final grade until the grading has been finished and all necessary arrangements have been made to ensure suitable connections and tie-ins at proper grade and alignment with pavements, gutters, and curbs.

305.03.02 Castings. Set frames for grates and covers for inlets and manholes, in full beds of mortar and rigidly secure them in place to the specified grade and alignment.

305.03.03 Pipe Connections. Set or cut inlet and outlet pipes flush with the inside face of the structure. Extend them a sufficient distance beyond the outside face of these walls to provide for making proper connections. Completely and neatly close the joint around the pipe in the structure wall with mortar or other specified materials.

305.03.04 Inverts. When drainage structures contain two or more pipes, construct channeled inverts conforming to the Contract Documents.

305.03.05 Drainage Structures. Provide two blockouts, each at least 8 in. diameter, in inlets and manholes for underdrains. Backfill with No. 57 aggregate for a width of 1.5 ft outside of the structure and extended from the bottom of the structure to the subgrade.

305.03.06 Precast Drainage Structures. For structures not detailed in the Contract Documents, submit working drawings for approval.

Certification. Certification from the manufacturer is required for each shipment of precast units. Provide a copy of the certification to the Engineer, the Laboratory, and the Contractor with each shipment. One copy shall remain at the plant. Include the name and address of the manufacturer, the type of structure, the identification number, the date of manufacture, the date of shipment, a statement indicating conformance with the Specifications, and the signature of the quality control manager. Mark the unit with the station number and designation, the identification number, the name or trademark of the manufacturer, the date manufactured, and stamp indicating conformance with the Specifications.

Do not ship any untested precast unit.

Place and consolidate at least 6 in. of No. 57 aggregate bedding under the unit.

305.03.07 Clean Existing Inlets. Clean existing inlets and dispose of the material. Reset and anchor existing grates as directed.

305.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, concrete, masonry, special or precast units, reinforcement, ladder rungs, drip stones, No. 57 aggregate, underdrain stubs, frames, grates and covers, grade and slope adjustments, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

305.04.01 Standard Inlets and Manholes will be measured and paid for at the Contract unit price per each. When a structure exceeds the standard minimum depth an additional payment will be made for the excess depth at the Contract unit price per linear foot for the pertinent Vertical Depth item.

305.04.02 Standard End Walls, Headwalls, End Sections, and Special Structures will be measured and paid for at the Contract unit price per each.

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305.04.03 Nonstandard End Walls and other miscellaneous structures such as steps, spring boxes, and junction boxes, constructed using brick masonry or concrete will be measured and paid for at the Contract unit price per cubic yard, unless otherwise specified.

305.04.04 Stormwater Management Risers will be measured and paid for at the Contract unit price per cubic yard of Concrete Mix 3 which includes gasket, watertight seals, trash racks, orifice plates, low flow and dewatering pipe stubs and safety rails.

305.04.05 No separate or additional measurement will be made for any precast concrete units, metal, or castings used in the construction of any of the items noted above.

305.04.06 Cleaning Existing Inlets will be measured and paid for at the Contract unit price per each, regardless of type, size, or depth of the inlet.

305.04.07 When an existing drainage structure is to be removed and replaced with a new drainage structure in the same location, the cost to remove the existing drainage structure and a section of the existing pipe will be incidental to the cost of the new drainage structure.

SECTION 306 — UNDERDRAINS, SUBGRADE DRAINS, AND SPRING CONTROL

306.01 DESCRIPTION. Construct underdrains, subgrade drains, underdrain for spring control, underdrain pipe outlets, and blind drains using pipe, geotextile, and granular material. Clean existing underdrain outlets.

306.02 MATERIALS.

No 57 Aggregate	901.01
Concrete Mix No.2	902.10
Pipe	905
Geotextile, Class as specified	921.09
Securing Pins or Staples	921.09
Flexible Delineator Post and Rodent Screens	As approved by the Office of Materials Technology

306.03 CONSTRUCTION. Coordinate the field installation of traffic barrier, signs, lighting, and landscaping with the Engineer to avoid any damage to the underdrains, subgrade drains, or outlet pipes. Correct any damage to the underdrains, subgrade drains, or outlet pipes.

306.03.01 Excavation. Excavate trenches to the specified dimensions and grade. Ensure that the sides and bottom of trenches are smooth and uniform to prevent tearing of the geotextile when backfilling. For excavated material, refer to 402.03.01.

306.03.02 Geotextile. Place geotextile when specified. Place it with the machine direction parallel to the longitudinal direction of the trench. Ensure that it is of sufficient width to completely enclose the underdrain trench, including specified overlaps.

Place the geotextile tightly against the underdrain trench to eliminate voids beneath the geotextile. Avoid wrinkles and folds. Maintain at least a 24 in. overlap at joint ends or breaks. Pin joints and overlaps to securely hold the geotextile in place until placement of the cover material. Pin longitudinal joints, overlaps, and edges no more than 50 ft on center.

Replace or repair damaged geotextile.

306.03.03 Pipe Placement. Slope the underdrain pipe to maintain positive drainage toward the outlet. Place perforated pipes with the perforations down and arranged symmetrically about the vertical axis. Plug the ends of trunk lines, wyes, tees, or ells as directed. Make joints and connections in accordance with the manufacturer's recommendations.

306.03.04 Outlets. Outlet the underdrains into drainage structures whenever possible. Outlets that empty into a drainage structure shall be at least 9 in. above the normal flow line in the structure and be constructed of normal underdrain outlet pipe. Maintain at least 18 in. of cover over the pipe. Rodent screens are not required when an underdrain outfalls into a drainage structure.

When outfalled into a slope or ditch, slope the outlet pipe at least three percent. Use Type 'S' (smooth interior wall) polyethylene (PE), or smooth-wall polyvinyl chloride (PVC) as specified in Section 905. Construct a sloped concrete headwall with a removable rodent screen at the end of the outlet pipe. Place a flexible delineator post on the slope headwall.

Space outlets for longitudinal underdrains at intervals no more than 250 ft and at the lowest elevation on all vertical curves. When changing the direction of the longitudinal underdrain or outlet pipe, all bends shall have a radius of at least 3 ft.

306.03.05 Backfill. Backfill trenches to the specified dimensions and grades. Backfill underdrain and outlet trenches as the work progresses.

(a) **Underdrain.** Lightly tamp aggregate backfill, and screed or rake to provide proper thickness and grade.

(b) **Outlets.** Backfill per Section 210.

Replace geotextile, underdrain pipe, and outlet pipe damaged by excessive tamping.

Cover longitudinal underdrain with the next pavement layer within 72 hours. Cover all other underdrain within 48 hours. Protect underdrain, including the geotextile, from contamination by soil fines. Replace or repair clogged geotextile and any underdrain trench that becomes contaminated.

306.03.06 Video Inspection and Acceptance. Perform a video inspection of all new longitudinal underdrain and outlets in the presence of the Engineer, as part of final acceptance. Correct all damage as directed.

306.03.07 Cleaning Existing Outlets. Clean existing underdrain pipe outlets and dispose of the material. Remove and replace existing rodent screens. Where there are no screens, install them as directed.

306.03.08 Permanent Subgrade Drains. Construct permanent subgrade drains when specified. Subgrade drains consist of trenches excavated through the shoulder and roadside grading from the edges of the road pavement to a side ditch, embankment slope, or other approved outlet and filled with aggregate. Locate subgrade drains at low points, and space them at 25 ft intervals for a distance of 125 ft on each side of the low point, then at intervals of 100 ft to within 125 ft of the high point. Before placing the road pavement and before completion of the shoulder paving or final roadside grading areas, cut and shape trenches to a width of 24 in. Place No. 57 aggregate to the underside of the shoulder material and to the underside of the specified topsoil thickness in the roadside grading area. The portion of the trench within the roadside grading area shall be completely wrapped in geotextile. The bottom of the trench at the end adjacent to the road pavement shall be at least 2 in. below the subgrade.

306.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, pipe, coupling bands, aggregate, backfill, geotextile, video inspection, and all material, labor, equipment, tools, and incidentals necessary to complete the work.

306.04.01 Underdrains, Underdrain Pipe Outlets, Subgrade Drains, and Underdrain Pipe for Spring Control will be measured and paid for at the Contract unit price per linear foot.

Slope headwalls, rodent screens, and marker posts will not be measured but will be incidental to the cost of the Underdrain Outlet.

306.04.02 When an underdrain pipe is not used for spring control, all excavation and backfill for spring control will be measured and paid for at the Contract unit price per cubic yard for Class 3 Excavation for Incidental Construction and Aggregate Backfill for Underdrain.

306.04.03 When directed by the Engineer, excavation for underdrains, subgrade drains, and underdrain for spring control required to lower the trench to an elevation deeper than specified in the Contract Documents will be measured and paid for at the Contract unit price per cubic yard for Class 3 Excavation for Incidental Construction and Aggregate Backfill for Underdrain.

306.04.04 When measuring the length of a manufactured connection (tee, elbows, etc.) other than coupling bands, each actual linear foot will be doubled and payment made at the Contract unit price per linear foot for the appropriate underdrain pipe item specified in the Contract Documents.

306.04.05 Cleaning Existing Underdrain Outlets will be measured and paid for at the Contract unit price per each. The payment will be full compensation for locating outlets, removing and replacing the existing rodent screens, removal and disposal of material removed from the pipe, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 307 — PREFABRICATED EDGE DRAINS

307.01 DESCRIPTION. Construct prefabricated edge drain systems and underdrain pipe outlets.

307.02 MATERIALS.

Outlet Pipe	905
Select Borrow	916
Prefabricated Edge Drain and Fittings	922

307.03 CONSTRUCTION. Install prefabricated edge drains according to the manufacturer's recommendations. For drains with support on only one side, place the support side away from the pavement edge. For excavated material, refer to 402.03.01.

307.03.01 Trenches for Prefabricated Edge Drains. Excavate using a trencher. Make the trenches as narrow as possible, but no more than 10 in. Ensure that the drain is in direct contact with the pavement. Perform the excavation of the trench, placement of the edge drain, and placement of the first lift of backfill in a single continuous operation.

307.03.02 Splices. Make splices prior to placement in the trench; in accordance with the manufacturer's recommendations and as approved by the Engineer.

Solid Central Cores (unconnected two sided flow). Use crossover couplings at all splices and at 200 ft intervals.

307.03.03 Connections to Outlets. Use fittings recommended by the manufacturer.

Space outlets at 200 ft intervals and at the lowest elevation on all vertical curves. Construct outlets in accordance with 306.03.04.

307.03.04 Backfilling of Trenches. Unless otherwise specified, use approved material generated from the trenching operation. Use Select Borrow whenever additional backfill material is needed.

Backfill in two layers, with the first layer being placed simultaneously with the drain, holding the drain flush against the side of the pavement. Use a vibratory shoe compactor.

307.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for excavation, backfill, compaction, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

307.04.01 Prefabricated Edge Drains and Outlet Pipe will be measured and paid for at the Contract unit price per linear foot.

307.04.02 Additional backfill material authorized by the Engineer will be measured and paid for at the Contract unit price per cubic yard for Select Borrow Excavation.

SECTION 308 — EROSION AND SEDIMENT CONTROL

308.01 DESCRIPTION. Apply erosion and sediment control measures to all disturbed areas throughout the life of the project to control erosion and to minimize sedimentation in rivers, streams, lakes, reservoirs, bays, and coastal waters.

Implement the approved Erosion and Sediment Control Plan and any approved modifications to the plan.

Identify staging and stockpile areas, and apply erosion and sediment control measures as approved by the Engineer and the Maryland Department of the Environment (MDE).

308.01.01 Erosion and Sediment Control Manager. Prior to beginning any work, assign an employee as Erosion and Sediment Control Manager (ESCM). The ESCM and the superintendent shall have successfully completed the MDE “Responsible Personnel Training for Erosion and Sediment Control” and the Administration’s “Erosion and Sediment Control Certification Training for Contractors and Inspectors”. The certifications shall be current at all times. If the certification expires or is revoked for either person, immediately replace the person with an appropriately certified person acceptable to the Administration. No work may proceed without the appropriate certified personnel in place.

308.01.02 Standards and Specifications. Construct and maintain the erosion and sediment control measures and devices in accordance with the latest Maryland Department of the Environment (MDE) Erosion and Sediment Control and Stormwater Management regulations, “Maryland Standards and Specifications for Soil Erosion and Sediment Control”, “Maryland Stormwater Design Manual, Volumes I and II”, “SHA Field Guide for Erosion and Sediment Control”, and as specified in the Contract Documents. Keep a copy of the latest “Maryland Standards and Specifications for Soil Erosion and Sediment Control” on the site at all times. Where details differ from the MDE Standards and Specifications and the SHA Field Guide, use the details from then Field Guide.

308.01.03 Quality Assurance Ratings. A Quality Assurance Inspector will inspect each project every 2 weeks to ensure compliance with the approved Erosion and Sediment Control Plan. The scores will be reported on Form No. OOC61, Erosion and Sediment Control Field Investigation Report. The Quality Assurance Inspector will use the scores to determine the following ratings:

SCORE	RATING
≥ 90	A
80 - 89.9	B
70 - 79.9	C
60 - 69.9	D
< 60	F

Rating A. The project is in compliance. Minor corrective action may be necessary.

Rating B. The project is in compliance; however, corrective action is necessary.

Rating C. The project is in compliance; however, deficiencies noted require corrections. Shutdown conditions described elsewhere herein could arise quickly. Project will be reinspected within 72 hours.

Rating D. The project is in non-compliance. The Administration will shut down all earthwork operations. All work efforts shall focus on correcting erosion and sediment control deficiencies. The project will be reinspected within 72 hours. All required corrective actions shall be completed within the 72 hour period for the project to be upgraded to a 'B' rating. Failure to upgrade the project from a 'D' rating to a 'B' or better rating will result in the project being rated an 'F'. Liquidated damages will be imposed for each day the project has a 'D' rating. Refer to Shutdown elsewhere in this Specification for additional requirements.

Rating F. The project is in non-compliance. An 'F' rating indicates a score less than 60 or the appropriate permits and approvals have not been obtained; or that the limit of disturbance has been exceeded, or that wetlands, wetland buffers, Waters of the United States (WUS), floodplains, and tree preservation areas as specified in Section 107 have been encroached upon; or that work is not proceeding according to the approved Erosion and Sediment Control Plan and schedules. The Administration will shut down the entire project until the project receives a 'B' or better rating. All work efforts shall focus on correcting erosion and sediment control deficiencies. Liquidated damages will be imposed for each day the project has an 'F' rating.

Shutdowns. If a project is rated 'C', correct all deficiencies within 72 hours. The project will be reinspected at the end of this period. If the deficiencies have not been satisfactorily corrected, the project will be rated 'D' and all earthwork operations will be shut down until the project is rated 'B' or better.

If consecutive 'C' ratings are received, the Contractor will be alerted that their overall effort is marginal and a shut down of all earthwork operations is imminent if erosion and sediment control efforts do not substantially improve within the next 72 hours. The project will be reinspected at the end of this period. If the deficiencies are not satisfactorily corrected or other deficiencies are identified that result in a score of less than 80 and not below 60 on Form No. OOC61, a 'D' rating will be given and all earthwork operations will be shut down.

If disregard for correcting these deficiencies is evident, an 'F' rating will be given, and the entire project will be shut down until the project receives a 'B' or better rating. When degradation to a resource could occur, or if the Contractor is unresponsive, the Administration may elect to have these corrective actions performed by another contractor or by Administration maintenance staff. All costs associated with this work will be billed to the original Contractor in addition to liquidated damages.

Incentive Payments. When specified in the Contract Documents, the Administration may include incentive payments to the Contractor. Starting at the Notice to Proceed, an Incentive Payment will be made for a rating quarter consisting of 3 months when; at least four inspections were performed by the Quality Assurance Inspector and an average score equal to or greater than 85 for the entire rating quarter is received. The quarterly incentive payment will be made within 60 days after the end of the rating quarter. No incentive will be paid for partial quarters or for quarters with less than four inspections. No incentives will be paid for any quarter in which a 'D' or 'F' rating is received. When a project receives no 'D' or 'F' ratings and the overall average score is equal to or greater than 85, the final incentive payment will be made at final project closeout. If a time extension is granted, additional quarterly incentive payments will be drawn from the final incentive payment.

Liquidated Damages. Whenever a project is rated 'D' or 'F', the Administration will assess Liquidated Damages. Liquidated Damages shall be paid within 30 days from the date of notification to the Contractor. Payments will not be allowed to accrue for consideration at final project closeout.

The second time that a project is rated 'F', the Erosion and Sediment Control Training Certificate issued by the Administration will be immediately revoked from the project superintendent and the Erosion and Sediment Control Manager for at least a six month period and until successful completion of the Administration's Erosion and Sediment Control Certification Program. Neither the project superintendent nor the Erosion and Sediment Control Manager will be allowed to oversee the installation and maintenance of erosion and sediment controls during the

period the certification is revoked on any project of the Administration. Replace the project superintendent and the Erosion and Sediment Control Manager with certified personnel. Work may not commence until the certified personnel are in place.

308.01.04 Incentive Payments and Liquidated Damages. The Contract Documents will specify the amounts of incentive payments and liquidated damages that apply.

308.02 MATERIALS.

Riprap	901.03
4 to 7 in. Stone	901.05
Hot Mix Asphalt	904
Pipe	905
Gabion Wire	906
Steel Plate	909.02
Welding Material	909.03
Fence Fabric for Super Silt Fence	914.01.01
Seed, Mulch, Fertilizer, Soil Conditioner, Soil Stabilization Matting, and Other Materials for seeding and soil stabilization	920
Straw Bales	921.08
Geotextile, Class as specified	921.09
2 to 3 in. Stone	M 43, No. 2
3/4 to 1-1/2 in. Stone	M 43, No. 4
No. 57 Stone	M 43, No. 57

Soil Stabilization Matting replaces Erosion Control Matting, and Geotextile Class SE replaces Filter Cloth and Geotextile Class C where they appear in the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control.

308.03 CONSTRUCTION.

308.03.01 Contractor Responsibilities. Prior to beginning any earth disturbing activity, complete the following:

- (a) Demarcate all wetlands, wetland buffers, floodplains, waters of the United States, tree protection areas, and the Limit of Disturbance (LOD) as specified Section 107.
- (b) Have all demarcated wetlands, wetland buffers, floodplains, water of the United States, tree protection areas, and LOD inspected and approved by the Engineer.

- (c) Construct all erosion and sediment control measures in conformance with 308.01.02.
- (d) Have all control measures inspected and approved by the Engineer.

Ensure that all runoff is directed from disturbed areas to the sediment control measures.

Do not remove any erosion or sediment control measure without the approval of the Engineer and MDE. Refer to GP-7.12 for unforeseen conditions.

Ensure that dewatering practices do not cause any visible change to stream clarity.

308.03.02 Erosion and Sediment Control Plan (E & S Plan) and Sequence of Construction. Implement the Administration's E & S Plan and Sequence of Construction as approved by MDE. Minor adjustments to the sediment control locations may be made in the field with the approval of the Engineer and MDE. Major revisions, deletions, or substitutions to the E & S Plan require a formal review and approval by the Administration and MDE. Submit changes to the approved E & S Plan to the Administration in writing at least 14 days prior to implementing the change. Obtain Administration and MDE approval for changes to the E & S Plan or Sequence of Construction prior to implementing the change.

308.03.03 Erosion and Sediment Control Manager (ESCM). At least 10 days prior to beginning any work, submit the name and credentials of the ESCM for approval. Any substitutes for the ESCM will be subject to approval. Time the substitution to ensure that an ESCM is assigned to the project at all times. The Administration reserves the right to request a reassignment of the ESCM duties to another individual for any reason.

Ensure that the ESCM is thoroughly experienced in all aspects of construction and has the required certifications. The ESCM is primarily responsible for and has the authority to implement the approved erosion and sediment control plans, schedules and methods of operation for both on-site and off-site activities. The ESCM's duties include:

- (a) Inspect the erosion and sediment controls on a daily basis to ensure that all controls are in place at all times and to develop a list of activities and schedules to ensure compliance with the Contract Documents.

- (b) Maintain a daily log of these inspections, including actions taken, and submit a written report at the end of the work day.
- (c) Conduct after storm inspections with the Engineer both during and beyond normal working hours and submit a written report.
- (d) Have the authority to mobilize crews to make immediate repairs to the controls during working and nonworking hours.
- (e) When requested, accompany the Engineer on Quality Assurance Inspections and inspections made by the regulating agencies.
- (f) Coordinate with the Engineer to ensure that all corrections are made immediately and that the project is in compliance with the approved plan at all times.

308.03.04 Schedule. Within 14 days after the Notice of Award, submit an Erosion and Sediment Control Schedule to implement the E & S Plan to the Administration and the MDE. Ensure that the schedule indicates the sequence of construction, implementation and maintenance controls, temporary and permanent stabilization, and the various stages of earth disturbance. Any changes to the MDE approved Plan require concurrence from MDE in addition to the Administration's approval. Include the following:

- (a) Demarcation of all wetlands, wetland buffers, jurisdictional waters, floodplains, tree protection areas, and the LOD prior to any earth disturbing activity.
- (b) Clearing and grubbing of areas necessary for installation of perimeter controls specified in the Contract Documents.
- (c) Construction of perimeter controls specified in the Contract Documents.
- (d) Remaining clearing and grubbing.
- (e) Roadway grading (including off-site work).
- (f) If applicable, utility installation and whether storm drains will be used or blocked after construction.
- (g) Final grading, landscaping, and stabilization.
- (h) Removal of perimeter controls.

Work is prohibited on-site and off-site until the Erosion and Sediment Control schedules and methods of operation have been accepted by the Administration and MDE.

308.03.05 Preconstruction Conference. Present a general overview at the Preconstruction Conference of how erosion and sediment control measures will be implemented on the project.

308.03.06 Meetings. At least seven working days prior to the start of work, the Engineer will initiate and conduct an Erosion and Sediment Control Field Meeting which will include the ESCM, the Administration and MDE.

In addition to the initial Erosion and Sediment Control Field Meeting, periodic in-field Erosion and Sediment Control Meetings will be held to review and evaluate the effectiveness of measures already installed, and to plan for the implementation of necessary controls proposed for succeeding areas of soil disturbance.

308.03.07 Initial Controls. Install all perimeter controls such as silt fence, earth dikes/swales, check dams, traps, and basins, prior to the grubbing operation. Typically, no controls are required during the clearing operation.

If the Engineer determines that the clearing area has been disturbed and a potential for sediment runoff or erosion exists, install the controls at that time as directed.

308.03.08 Stabilization Requirements. Permanently or temporarily stabilize areas flatter than 3:1 and stockpile areas as soon as possible, but not later than fourteen days after grubbing and grading activities have ceased in the area. Permanently or temporarily stabilize trap embankments and slopes, earth dikes, temporary swales, perimeter dike/swales, ditches, and slopes 3:1 or steeper as soon as possible, but not later than seven days after grubbing and grading activities have ceased in the area. The seven and fourteen day requirements mean that the stabilization operation is complete within the applicable seven or fourteen day time frame.

When the excavation or embankment reaches the bottom of the subgrade, those areas in which paving will be placed are exempt from the stabilization requirements. Areas between temporary berms, except median areas, need not be stabilized during incremental stabilization. When permanently stabilized areas are disturbed by grading operations or other activities not specifically approved, restabilization will be at no additional cost to the Administration.

Stabilization requirements may be reduced to less than seven days for sensitive areas. Perform maintenance as necessary to ensure continued stabilization.

Track all slopes within five days of establishment with cleated type equipment operating perpendicular to the slope.

308.03.09 Dewatering. Dewatering is considered an elective practice. Ensure that dewatering activities do not cause any visible change to stream clarity. If a sediment plume is visible, immediately cease the dewatering activity.

308.03.10 Maintenance. Maintain all erosion and sediment control devices during the construction season, the winter months, and other times when the project is inactive. Maintain access to all erosion and sediment controls until the controls are removed. Lack of this maintenance will be considered as noncompliance with the E & S Plan and grounds for a shutdown of the project.

Inspect controls immediately following storm events. Clean out as necessary and repair all damage as the first order of business after the storm event.

Direct any pumping activity, including dewatering sediment traps and basins, through a dewatering device approved by MDE.

308.03.11 Waste Areas. Off-site waste areas on State or Federal property require MDE approval. All other off-site waste areas shall be approved by the appropriate Soil Conservation District for each county or the Baltimore City Department of Public Works. All waste areas and stockpile areas shall be protected by erosion and sediment control measures and stabilized within the seven or fourteen day stabilization requirement.

308.03.12 MDE Inspections. MDE will conduct frequent field inspections. If they find noncompliance with erosion and sediment control provisions, their representative will immediately notify the Engineer relative to corrective action. This corrective action may require a shutdown of construction activities until the noncompliance is satisfactorily corrected. No claims against the Administration will be considered due to a shutdown of the grading operations or the entire project.

308.03.13 Side or Berm Ditches and Culverts. As a first order of work, construct the side ditches in fill areas and berm ditches in cuts, including lining. Protect these linings from sediment deposits. Place silt fence

along the banks of existing streams as shown in the Contract Documents prior to placing any culverts. To avoid sedimentation during construction, divert the streams around the location of the culvert until the proposed culvert and channel are stabilized.

308.03.14 Removal of Controls. Do not remove erosion and sediment control measures until all previously disturbed areas are vegetated with at least a 3 in. growth of grass, and the removal has been approved by the Engineer and MDE. Backfill, grade, and stabilize the sediment controls.

Remove all control devices except as directed.

308.03.15 Erosion and Sediment Control Original Excavation. Excavate, construct embankments, grade, and backfill for sediment traps, sediment basins, and other sediment controls.

Ensure that excavation and embankments meet the dimensions for each sediment control as specified. Stockpile excavated material and use for backfill when the sediment controls are removed.

308.03.16 Erosion and Sediment Control Cleanout Excavation. Remove accumulated sediment from sediment controls or other areas during routine maintenance of sediment controls, or as directed.

Clean out sediment traps as necessary to ensure that at least 50 percent of the wet storage capacity is available at all times. Ensure that riprap outlet sediment traps have at least 75 percent of the wet storage capacity available at all times. Remove sediment from silt fence, super silt fence, stone outlet structures, stone check dams, and straw bales when it reaches 50 percent of the height of the device.

Place removed sediment in an approved waste site either on or off the project. Material stored on-site may be reused once it is dried and it meets embankment requirements.

308.03.17 Earth Dike. Do not use sod as stabilization unless specifically approved.

308.03.18 Temporary Swale. Do not use sod as stabilization, unless specifically approved.

308.03.19 Perimeter Dike Swale. Do not use sod as stabilization unless specifically approved.

308.03.20 Pipe Slope Drain. When slope drains are placed on grade, construct interceptor berms to direct flow into the flared end section.

308.03.21 Riprap Inflow Protection. Gabions shall not be used.

308.03.22 Gabion Inflow Protection. Construct as specified in Section 313.

308.03.23 Stone Check Dam. Space as specified.

308.03.24 Sediment Traps. Locate and excavate sediment traps to the specified length, width, and depth. In areas of limited right-of-way, cut side slopes as steep as soil conditions will allow.

At sites where infiltration devices are used for the control of storm water, prevent runoff from unstabilized areas from entering the infiltration devices. Ensure that bottom elevations of sediment control devices placed in infiltration areas are at least 2 ft higher than the finish grade bottom elevation of the infiltration device. When converting a sediment trap to an infiltration device, remove and dispose of all accumulated sediment prior to final grading of the device.

When grading and paving operations have been completed and vegetation has been established on the slopes and channels to the satisfaction of the Engineer, refill the sediment traps with suitable materials, and shape and treat them as specified.

308.03.25 Stone Outlet Structure. Stabilize the area immediately after removal of the structure.

308.03.26 Removable Pumping Station. Furnish the standpipe, pump, hoses, and connections required to perform dewatering activities. Excavate a pit to the dimensions required.

308.03.27 Sump Pit. Furnish the standpipe, pump, hoses, and connections required to perform dewatering activities. Excavate a pit to the dimensions required.

308.03.28 Portable Sediment Tank. Furnish the standpipe, pump, hoses, and connections required to perform dewatering activities. Determine the dimensions necessary to provide the required storage volume.

308.03.29 Silt Fence. Trench the geotextile at least 8 in. vertically into the ground and extend to at least 22 in. above ground. Drive fence posts at least 16 in. into the ground and extend at least 26 in. above the ground.

Remove and reset silt fence when and as directed, per the requirements for the original placement.

308.03.30 Inlet Protection. Install standard inlet protection, at grade inlet protection, curb inlet protection, or median inlet protection.

308.03.31 Stabilized Construction Entrance. Construct stabilized construction entrances at the specified locations.

Rehabilitate stabilized construction entrance consists of periodic top dressing with additional aggregate, replacement of pipe, or other repairs to the entrance and sediment trapping devices.

308.03.32 Super Silt Fence. Construct the chain link fence as specified in Section 607.03 with the following exceptions:

- (a) Use drive anchors when and as directed.
- (b) Do not use the lower tension wire, brace and truss rods, post caps, 1 in. ground clearance, and concrete footings.
- (c) Use line posts only.
- (d) Run a 7 gage top tension wire continuously between posts.
- (e) Embed at least 8 in. into the ground and extend at least 33 in. above ground.

Remove and reset super silt fence when and as directed, per the requirements for the original placement.

308.03.33 Temporary Asphalt Berm. When a storm drain system outfall is directed to a sediment trap, or sediment basin, and the system is to be used for temporarily conveying sediment laden water, construct temporary asphalt berms at all storm drain inlets in nonsump areas as directed by the Engineer at the time of base paving to direct gutter flow into the inlets to avoid surcharging and overflow of inlets in sump areas.

308.03.34 Straw Bales for Sediment Control. Use straw bales for temporary control of erosion and sedimentation in side ditches and where the placement of a stone outlet structure is not practical. Do not use straw bales in median ditches.

Use straw bales consisting of undecayed firmly packed straw, approximate size 14 x 18 x 36 in. as prepared by a standard baling machine, and firmly bound by at least two separate circuits of rope or band material that will withstand weathering for the length of time the bale is functioning as a sediment control device. Ensure that the binding tension on the baling machine is sufficient to produce a bale with voids no greater than the nominal thickness of the straw. Embed the bales to a

depth of at least 4 in., and anchor in place with two No. 4 reinforcement bars, steel pickets, or 2 x 2 in. wood stakes, 36 in. length. Locate the anchoring devices at approximate third points along the longitudinal center line of each bale, driven through the bale and into the ground to a depth of 12 to 18 in.

308.03.35 Stone for Sediment Control. Place No. 57 stone, 3/4 to 1-1/2 in. stone, 2 to 3 in. stone, 4 to 7 in. stone, and riprap for sediment control as specified.

308.03.36 Maintenance of Stream Flow. Maintain the continuous flow of waterways during all operations for the locations indicated.

Upon completion of construction and after temporary drainage devices have served their purpose, remove and dispose of the devices in an acceptable manner.

When included in the Contract Documents, stream diversions details will show a system and a location that is approved by the Maryland Department of the Environment.

The stream diversion system as shown may not be capable of blocking the flow of water through the soil beneath the system. Design and provide an effective means of diverting the water away from the designated areas, even though a more elaborate system may be required. Ensure that all excavation performed within the diverted stream is performed in a dewatered condition, which may require additional pumps, sheeting, shoring, cofferdams, etc. If the proposed system does not perform satisfactorily or additional material and equipment are required to dewater the site and excavated areas, adjust the stream diversion system and obtain approvals at no additional cost to the Administration.

Securely anchor the stream diversion system in place to prevent movement during high water events. Submit the proposed method of anchoring to the Engineer and the MDE field inspector for approval. Anchors shall not go beyond the limits of disturbance shown on the Plans or infringe on the channel area available for stream flow. Do not install the diversion system in the stream without the approval of both the Engineer and the MDE inspector. All costs associated with the anchoring of the stream diversion system are incidental to the Maintenance of Stream Flow item.

When the Contract Documents include details for the continuous maintenance of stream flow during construction, a Temporary Stream Crossing Permit is not required if the details in the Contract Documents are used and there is no other work in the waterways. A different plan for maintenance of stream flow may be submitted, but approval from the

Engineer and a Temporary Stream Crossing Permit will be required. Temporary Stream Crossing Permits may be obtained from the Maryland Department of the Environment - Water Management Administration, Permits Services Center.

308.03.37 Diversion Fence. Trench double 6 mil polyethylene sheeting at least 6 in. into the ground, cover at least 4 ft. from the trench line to the fence posts, extend at least 20 in. above the ground, and wrap over the fence posts to grade.

308.03.38 Temporary Gabion Outlet Structure. As specified in Section 313. Grade and stabilize the area beneath the structure, immediately upon removal.

308.03.39 Dewatering Bag. Furnish the required bags, straw bales, stone, pump, hoses, and connections to perform dewatering activities. Determine the dimensions necessary to provide the required storage volume.

308.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. The maintenance, repair, resetting, and final removal of all erosion and sediment control devices will not be measured, but the cost will be incidental to the Contract price to construct the device unless otherwise specified in the Contract Documents.

308.04.01 Erosion and sediment control manager will not be measured but the cost will be incidental to Erosion and Sediment Control items specified in the Contract Documents.

308.04.02 Implementation of the Erosion and Sediment Control Plan by the Contractor will not be measured but the cost will be incidental to the Erosion and Sediment Control items specified in the Contract Documents.

308.04.03 Erosion and Sediment Control Original Excavation will be measured and paid for at the Contract unit price per cubic yard. The payment will also include excavation, backfill, and grading.

308.04.04 Erosion and Sediment Control Cleanout Excavation will be measured and paid for at the Contract unit price per cubic yard. The payment will also include excavation and disposal.

308.04.05 Earth Dikes will be measured and paid for at the Contract unit price per linear foot. When 4 to 7 in. stone, temporary seeding, and soil stabilization matting are required, they will be measured and paid for as specified in 308.04.25, 704.04, and 709.04, respectively.

308.04.06 Temporary Swales will be measured and paid for at the Contract unit price per linear foot. When 4 to 7 in. stone, temporary seeding, and soil stabilization matting are required, they will be measured and paid for as specified in 308.04.25, 704.04, and 709.04, respectively.

308.04.07 Perimeter Dike/Swales will be measured and paid for at the Contract unit price per linear foot. When temporary seeding and soil stabilization matting are required, they will be measured and paid for as specified in 704.04 and 709.04, respectively.

308.04.08 Pipe Slope Drain will be measured and paid for at the Contract unit price per linear foot. The payment will also include excavation, backfill, flared end section, geotextile, anchors, coupling bands, and pipe elbows.

Outlet protection will be measured and paid for as specified in 308.04.25.

308.04.09 Riprap inflow protection will be measured and paid for as specified in 308.04.25.

308.04.10 Gabion inflow protection will be measured and paid for as specified in 313.04.

308.04.11 Stone check dam will be measured and paid for as specified in 308.04.25.

308.04.12 Sediment traps will be measured and paid for at the Contract unit price for one or more of the items listed below:

- (a) Erosion and Sediment Control Original Excavation as specified in 308.04.03.
- (b) Pipe per linear foot.
- (c) Stone as specified in 308.04.25.
- (d) Inflow protection as specified in 308.04.09 and 308.04.10.
- (e) Baffle board and stakes will not be measured but the cost will be incidental to the other items.

308.04.13 Stone outlet structure will be measured and paid for as specified in 308.04.25. The baffle board and stakes will not be measured but the cost will be incidental to the Contract price.

308.04.14 Removable Pumping Station will be measured and paid for at the Contract unit price per each. The payment will also include excavation, pipe, geotextile, wire mesh, steel plate, hose, pump, and connections.

No. 57 stone will be measured and paid for as specified in 308.04.25.

308.04.15 Sump Pit will be measured and paid for at the Contract unit price per each. The payment will also include excavation, pipe, geotextile, wire mesh, steel plate, hose, pump, and connections.

No. 57 stone will be measured and paid for as specified in 308.04.25.

308.04.16 Portable Sediment Tank will be measured and paid for at the Contract unit price per each. The payment will also include pipe, geotextile, wire mesh, steel plate, hose, pump, and connections. No adjustments will be made for resizing or relocating portable sediment tanks to meet stream clarity discharge requirements.

308.04.17 Silt Fence will be measured and paid for at the Contract unit price per linear foot.

308.04.18 Remove and Reset Silt Fence will be measured and paid for at the Contract unit price per linear foot.

308.04.19 Inlet Protection will be measured and paid for at the Contract unit price per each.

308.04.20 Stabilized Construction Entrance and Rehabilitate Stabilized Construction Entrance will be measured and paid for at the Contract unit price per ton. When pipe is required, it will not be measured but the cost will be incidental to the Contract price.

308.04.21 Super Silt Fence will be measured and paid for at the Contract unit price per linear foot.

308.04.22 Remove and Reset Super Silt Fence will be measured and paid for at the Contract unit price per linear foot.

308.04.23 Temporary Asphalt Berm will be measured and paid for at the Contract unit price per ton of Hot Mix Asphalt. The removal of the temporary asphalt berm will not be measured but the cost will be incidental to the Contract price.

308.04.24 Straw Bales will be measured and paid for at the Contract unit price per linear foot measured along the approximate center line of

the row of bales. Excavation and anchoring the straw bales will not be measured but the cost will be incidental to the Contract price.

308.04.25 Stone for sediment control will be measured and paid for at the Contract unit price per ton for the pertinent Stone for Sediment Control item. Geotextile, excavation, and backfill will not be measured but the cost will be incidental to the Contract price.

308.04.26 Maintenance of Stream Flow will not be measured but will be paid for at the Contract lump sum price. The payment will also include designing and providing diversion structures regardless of the type required to satisfactorily divert the stream flow, excavation, backfill, dewater the site and excavated areas within the stream diversion area, maintenance of the diversion system, sandbags, polyethylene sheeting, diversion pipes, pumps, hoses, connections, and portable sediment tanks. This price will not be adjusted when consideration is given to an alternative stream diversion system regardless of any changes in quantities from that shown in the Contract Documents. The provisions of GP-4.05 will not apply to this work.

308.04.27 Temporary Mulch will be measured and paid for as specified in 704.04.02.

308.04.28 Temporary Seed will be measured and paid for as specified in 704.04.01.

308.04.29 Temporary Wood Cellulose Fiber will be incidental to Temporary Seed.

308.04.30 Soil Stabilization Matting will be measured and paid for as specified in 709.04.

308.04.31 Turfgrass Sod will be measured and paid for as specified in 708.04.01.

308.04.32 Temporary earth berms and interceptor berms for incremental stabilization will not be measured, but the cost will be incidental to the excavation items specified in the Contract Documents.

308.04.33 Diversion Fence will be measured and paid for at the Contract unit price per linear foot.

308.04.34 Temporary Gabion Outlet Structures will be measured and paid for at the Contract unit price per each.

308.04.35 Dewatering Bags will be measured and paid for at the Contract unit price per each and will include pump, hose, connections,

straw bales locating, relocating, disposal and any other incidentals necessary. No adjustments will be made for resizing or relocating bags to meet stream clarity discharge requirements.

SECTION 309 — CONCRETE DITCHES

309.01 DESCRIPTION. Construct concrete ditches and incidental toe walls.

309.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
No. 57 Aggregate	901.01
Curing Materials	902.07
Form Release Compounds	902.08
Concrete Mix No. 2	902.10
Joint Sealer	911.01
Preformed Joint Filler	911.02
Borrow	916
Soil Stabilization Matting	920.06

309.03 CONSTRUCTION.

309.03.01 Excavation. Excavate and prepare the subgrade per Section 602. For excavated material, refer to 402.03.01.

309.03.02 Forms. Use steel or wooden forms meeting Section 603.

309.03.03 Concrete. Mix and place according to Section 603.

309.03.04 Joints. Place joints no more than 15 ft apart. Use either bulkhead or weakened plane construction joints. Either tool or saw weakened plane joints to a depth of at least 3/4 in. Place expansion joints no more than 90 ft apart and seal.

309.03.05 Cold Weather Construction and Curing. Refer to 520.03.02 for cold weather construction and to 520.03.12 for concrete curing.

309.03.06 Backfill. After the forms have been removed, place and compact the backfill.

309.03.07 When the existing concrete ditch is removed but not replaced, regrade and stabilize the area as directed.

309.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all concrete, excavation, forms, backfill, curing, disposal of excess or unsuitable material, toe walls, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

309.04.01 Concrete Ditches will be measured and paid for at the Contract unit price per square yard.

309.04.02 The removal and disposal of unsuitable material below the subgrade will be measured and paid for at the Contract unit price per cubic yard for Class 2 Excavation.

309.04.03 When Borrow or Selected Backfill using No. 57 Aggregate or Selected Backfill using Crusher Run Aggregate CR-6 is approved by the Engineer as replacement material for the Class 2 Excavation, it will be measured and paid for at the Contract unit price per cubic yard for the pertinent items as specified in the Contract Documents.

309.04.04 Concrete Ditches removed but not replaced will be paid for at the Contract unit price per square yard. The payment will include the cost to dispose of the material, regrading, topsoil, and soil stabilization matting.

SECTION 310 — CONCRETE SLOPE AND CHANNEL PROTECTION

310.01 DESCRIPTION. Protect slopes and channels with cast-in-place concrete and cutoff walls.

310.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
No. 57 Aggregate	901.01
Curing Materials	902.07
Form Release Compound	902.08
Concrete Mix No. 2	902.10
Welded Steel Wire Fabric	908.05
Joint Sealer	911.01
Preformed Joint Fillers	911.02
Roofing Paper	911.07
Borrow	916

310.03 CONSTRUCTION.

310.03.01 Excavation. Excavate, including excavation for cutoff walls, according to Section 602. Refer to 402.03.01 for excavated material.

310.03.02 Cast-In-Place Concrete. Construct cast-in-place concrete slope protection in alternate strips so that construction joints are all in one direction and that tooled joints run perpendicular to the construction joints. The result shall be a checkerboard pattern having squares of at least 3 ft but not more than 5 ft. The Engineer will determine the size of the squares and the size of squares around curved surfaces. Construct joints and cutoff walls as specified.

310.03.03 Forms. As specified in Section 603.

310.03.04 Concreting. Mix concrete as specified in 915.03.04. Volumetric batching and continuous mixing will be permitted. Prior to placing the concrete, use acceptable methods to dewater areas that are subject to the infiltration of water. Spread and tamp, or otherwise consolidate the concrete. Strike it off with an approved screed, and give the surface a broomed finish. Do not plaster the surface. Use a 1/4 in. edging tool on all edges and joints.

310.03.05 Cold Weather Construction and Curing. Refer to 520.03.02 and .12 respectively.

310.03.06 Backfill. After removing the forms, place and compact the backfill.

310.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all concrete, forms, excavation, curing, joint sealer and filler, backfill, compaction, disposal of excess or unsuitable material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

310.04.01 Concrete Slope and Channel Protection and Concrete Slope Protection for Streams will be measured and paid for at the Contract unit price per square yard of finished surface.

310.04.02 Cutoff Walls will be measured and paid for at the Contract unit price per linear foot.

310.04.03 The removal and disposal of unsuitable material below the subgrade will be measured and paid for at the Contract unit price per cubic yard for Class 2 Excavation.

310.04.04 When Borrow or Selected Backfill using No. 57 Aggregate or Selected Backfill using Crusher Run Aggregate CR-6 is approved by the Engineer as replacement material for the Class 2 Excavation, it will be measured and paid for at the Contract unit price per cubic yard for the pertinent item specified in the Contract Documents.

SECTION 311 — RIPRAP DITCHES

311.01 DESCRIPTION. Construct riprap ditches and riprap ditches with capping.

311.02 MATERIALS.

Riprap	901.02 and .03
Geotextile, Class as specified	921.09
2 to 4 in. Stone	M43, No.1

311.03 CONSTRUCTION.

311.03.01 Excavation. Excavate to the specified line and grade. Ensure that ditch sides and bottom are smooth and firm, free from protruding objects that would damage the geotextile, and constructed in an acceptable manner. For excavated material, refer to 402.03.01.

311.03.02 Geotextile Placement. Place the geotextile on the prepared subgrade with the adjacent edges overlapped at least 2 ft. Replace or repair damaged geotextile as directed.

311.03.03 Riprap Placement. Place stones by mechanical or other acceptable methods to produce a reasonably graded mass of stone. Methods that cause extensive segregation are unacceptable. Place the riprap to the specified depth.

311.03.04 Backfill. Backfill any excavation voids existing along the edges and ends of the placed riprap. Use suitable material to blend in with contiguous slopes, ditch lines, and existing ground. Cap riprap placed in the clear recovery area with a layer of 2 to 4 in. stone.

311.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, geotextile, stone, backfill, disposal of excess material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

311.04.01 Riprap Ditches and Riprap Ditches with Capping will be measured and paid for at the Contract unit price per square yard of finished surface.

311.04.02 Bottom Cutoff Walls and Side Cutoff Walls will be measured and paid for at the Contract unit price per linear foot.

SECTION 312 — RIPRAP SLOPE AND CHANNEL PROTECTION

312.01 DESCRIPTION. Protect slopes and channels with a covering of geotextile and stone or an aggregate filter blanket.

312.02 MATERIALS.

Aggregate Filter Blanket	
Crusher Run Aggregate CR-6	901.01
Stone	901.02
Geotextile, Class as specified	921.09

312.03 CONSTRUCTION.

312.03.01 Excavation. Excavate for riprap and cutoff walls to the specified lines and grades. Ensure that the subgrade is smooth and firm, free from protruding objects that would damage the geotextile, and constructed in an acceptable manner. For excavated material, refer to 402.03.01.

312.03.02 Geotextile. Place the geotextile on the prepared subgrade with the adjacent edges overlapping at least 2 ft. Replace or repair damaged geotextile as directed.

312.03.03 Aggregate Filter Blanket. When an aggregate filter blanket is specified, construct it to the specified lines and grades and compact it in an acceptable manner.

312.03.04 Riprap Placement. Ensure that the underlying surface is free of brush, trees, and stumps, and is acceptable to the Engineer.

Place the first section of riprap consisting of at least 5 tons, which will be inspected by the Engineer for conformance to gradation and placement requirements. If approved, this section will be used to evaluate quality control for the remainder of the project. If the material is rejected, remove it from the project and place additional sections, each at least 5 tons.

Begin the placement of the riprap with the bottom cutoff walls or toe sections. Place the larger stones in the cutoff walls and along the outside edges of the limits of slope and channel protection. Place the riprap with equipment that produces a uniformly graded mass of stones.

Ensure that the surface elevation of completed riprap installations is flush with adjacent channel bed or bank slope elevations, and does not create an obstacle to the flow. Ensure that the outer riprap surfaces are even and present a generally neat appearance. The plus or minus tolerance of the surface of the finished riprap installation is 3 in. for Class I Riprap and 6 in. for Class II and III Riprap from the lines and grades shown on the Contract Documents when measured perpendicular to the exterior surface of the stonework.

Place and distribute the stone so the resulting layer will contain a minimum of voids and there will be no pockets of same size material. Place the stone to its full course thickness in one operation in a manner that the underlying material is not be displaced or worked into the course of riprap being placed. When an aggregate filter blanket is used, proceed with the placement of the riprap in a controlled manner to avoid disruption or damage to the layer of bedding material.

312.03.05 Backfill. Backfill any excavation voids existing along the edges of the completed slope and channel protection, and compact it in an acceptable manner.

312.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, geotextile, stone, backfill, compaction, disposal of excess material, prewashing when required, preparation of quality control section, and for all material, labor, equipment, tools and incidentals necessary to complete the work.

312.04.01 Riprap Slope and Channel Protection will be measured and paid for at the Contract unit price per square yard. Area measurements will be actual surface measurements.

312.04.02 Cutoff Walls will be measured and paid for at the Contract unit price per linear foot.

312.04.03 Riprap for Scour Protection will be measured and paid for at the Contract unit price per ton for the item Class II Riprap For Scour Protection.

312.04.04 Aggregate Filter Blanket will be measured and paid for at the Contract unit price per square yard for the depth specified.

SECTION 313 — GABIONS

313.01 DESCRIPTION. Protect slopes and channels by placing stone filled wire baskets.

313.02 MATERIALS.

Stone	901.05
Wire for Gabions	906.01
Geotextile, Class as specified	921.09

313.03 CONSTRUCTION.

313.03.01 Excavation. Excavate, including excavation for cutoff walls, to the specified lines and grades. Ensure that the subgrade is smooth, firm, and free from protruding objects or voids that would affect the proper placement of the wire baskets or damage the geotextile. For excavated material, refer to 402.03.01.

313.03.02 Geotextile. Place geotextile on the prepared subgrade. Overlap adjacent strips at least 2 ft. Replace or repair geotextile damaged during placement of the wire baskets.

313.03.03 Wire Baskets. Begin placement with the cutoff walls. Set the empty units on the geotextile and bind the vertical ends together with wire ties or interlocking fasteners spaced to permit stretching of the units to remove kinks. Use stretching methods that do not damage the baskets. Use stakes, pins, or other approved methods to ensure proper alignment.

313.03.04 Stone. Carefully fill the basket units with stone placed by hand or machine to ensure good alignment with a minimum of voids between stones. Avoid bulging of the mesh. Do not drop the stone from a height greater than 36 in. Place the stone to provide a minimum of two courses. Place the top layer of stone to a uniform surface. Avoid any bulging of the lid mesh. After a basket unit is filled, bend the lid over until it meets the ends of the unit. Secure the lid to the sides and ends with wire ties or interlocking fasteners. When a complete basket unit cannot be installed because of space limitations, cut the basket unit to fit as directed.

313.03.05 Backfill. Backfill any excavation voids existing along the edges of the completed gabions and compact in an acceptable manner.

313.04 MEASUREMENT AND PAYMENT. Gabions, including cutoff walls will be measured and paid for at the Contract unit price per cubic yard of stone filled wire baskets complete in place. The payment will be full compensation for all excavation, geotextile, stone, ties or fasteners, backfill, compaction, disposal of excess material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 314 — FLOWABLE BACKFILL

314.01 DESCRIPTION. Furnish, haul, and place flowable cement stabilized backfill material. When specified, use for utility cut backfill, pipe backfill, or for filling abandoned pipes.

314.02 MATERIALS. Flowable backfill consists of a mixture of fly ash, cement, and water. Certification by the manufacturer is required.

Cement	902.03
Fly Ash	902.06.04
Water	921.01

314.02.01 Fillers. When required, fillers shall be natural aggregates with a maximum size of 3/4 in. and may include sands. Bottom ash shall not be used as filler.

314.02.02 Components. Toxic and deleterious components shall not be used in the backfill mixture. The mixture shall have a 28 day, unconfined compressive strength of at least 100 psi based on the manufacturer's certification. Certification shall include the actual test data for each mixture to be used.

314.02.03 Analysis. Chemical analysis of the fly ash used in the mixture shall conform to U.S. EPA EP Toxicity Standards. Whenever the coal source is changed or replenished, and when fly ash from a different source is used, conduct an analysis of the fly ash from each stockpile. Submit the results of the analysis to the Engineer for approval prior to using the mixture.

314.03 CONSTRUCTION. Place the material according to the manufacturer's recommendations or as directed by the Engineer. Backfill utility trenches full depth to the top of the subgrade. Fill all voids during the backfill operation.

Protect the backfilled utility cut from freezing and traffic for 24 hours. Wait at least 24 hours after backfilling is complete and approved by the Engineer before beginning the paving operations.

Fill abandoned pipes with backfill after each end of the pipe has been properly plugged. Refer to 3030.03.10. Cut two holes into the plug at the upstream end and pump backfill into the pipe through one of the holes until the pipe is completely filled.

Keep and submit detailed records of all flowable backfill placed. Include the source of the fly ash, the date placed, the location, depth, and the quantity used.

314.04 MEASUREMENT AND PAYMENT. Flowable Backfill will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 315 — INFILTRATION TRENCHES

315.01 DESCRIPTION. Install infiltration trenches as specified.

315.02 MATERIALS.

Class I Riprap	901.02
Geotextile, Class as specified	921.09
PVC Pipe, Schedule 40	D 1785
Stone	M 43 No. 2

315.03 CONSTRUCTION. Do not place infiltration trenches in service until all of the contributing drainage area has been stabilized and approved. Restrict heavy equipment and traffic from the proposed infiltration trench location.

315.03.01 Excavation. Remove excavated material from the trench site. Ensure that trench walls and bottom are free of protruding objects that could damage the geotextile. When necessary, slope the trench walls. Ensure that the bottom dimensions and stone depth are as specified. Roughen the side walls of the trench. Grade the bottom of the trench flat. For excavated material, refer to 402.03.01.

315.03.02 Installation. Place geotextile on the sides of the trench and the top of the No. 2 stone. Do not cover the bottom of the trench. The geotextile for the sides of the trench shall overlap the top geotextile by 6 to 8 in. Extend the top geotextile the full width and length of the trench. All longitudinal joints in the top geotextile shall overlap at least 6 in. The upstream roll shall overlap the downstream roll by at least 2 ft, for a shingled effect.

Place an observation well vertically in the longitudinal center of each infiltration trench. Use 6 in. diameter perforated PVC pipe, Schedule 40. Place the pipe on a base plate at the bottom of the trench. Cap the well using a threaded PVC fitting and a vandal proof sewer cap. Set the cap 6 in. above ground, and mark the depth of the trench on the cap. Provide a plastic collar with ribs to prevent rotation of the well when removing the cap. When soil capping is used, construct the observation well using perforated PVC pipe within the No. 2 stone and non-perforated pipe through the soil capping.

All stone shall be clean and free of all soil and fines. Place the No. 2 stone in 12 in. lifts with no compaction. Avoid any intermixing of the soil and fines with the stone aggregate. Remove and replace contaminated aggregate. Cap the trench with at least 12 in. of stone or soil as specified.

315.04 MEASUREMENT AND PAYMENT. Infiltration Trenches will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for all excavation, stone, capping, riprap, geotextile, PVC pipe, fittings, cap, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

CATEGORY 400 STRUCTURES

SECTION 401 — MAINTAINING EXISTING BRIDGE DECK DURING LIFE OF CONTRACT

401.01 DESCRIPTION. Patch the existing bridge deck as required for maintenance of traffic.

401.02 MATERIALS.

Rapid Hardening Cementitious Material for Concrete Pavement Repairs	902.14
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Select patching material from the prequalified list of rapid hardening cementitious materials maintained by the Office of Materials Technology.

401.03 CONSTRUCTION. Periodically evaluate the existing deck with the Engineer to determine if any patching is necessary. Patch all holes over 1 in. deep having an area greater than 2 ft². Locations and limits of all patch areas shall be as approved.

The Traffic Manager shall confer with the Engineer before patching begins to decide on a plan for diverting or detouring traffic. Meet all traffic safety and traffic control requirements.

Areas requiring patching shall be clean and free of loose material and conform to the manufacturer's recommendations.

Protect waterways and roadways under the structure from falling debris. Do not dispose of removed material in waterways.

Place patching material to the top of the existing bridge deck surfaces.

Furnish and install new reinforcement when directed.

When opening to traffic prior to the patch achieving sufficient strength, cover the patch with steel plates as specified in 522.03.13. Build up areas around the plates with asphalt material.

401.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

401.04.01 Patching for Maintaining Existing Bridge Deck will be measured and paid for at the Contract unit price per square foot. The payment will also be full compensation for the removal and disposal of material required to prepare the patch area, including chipping and hand cleaning, as well as furnishing and placing reinforcing steel, forming, providing protective structures, floodlighting, and furnishing, placing, and removing any steel plates. Patches performed day or night will be paid for at the Contract unit price.

401.04.02 All work, materials, sequence of operations, equipment, protection vehicle, and channelization devices required to maintain traffic during each occurrence of patching including removal after patching is complete will be measured and paid for at the Contract unit price per each for the pertinent Maintenance of Traffic for Bridge Patching Operation item. When more than one patch is made under one movement of traffic for patching, the item will be paid for only once, regardless of the number of patches made or the length of time traffic is rerouted. If traffic is maintained more than once for a particular patching operation, the work will be measured and paid for only once.

SECTION 402 — STRUCTURE EXCAVATION (Class 3)

402.01 DESCRIPTION. Excavate and backfill for construction of bridges, box culverts, and other major structures.

402.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
Subfoundation Concrete	902.10, Mix No. 1

402.03 CONSTRUCTION. Sheet, shore, brace, and support all excavation contiguous to existing pavements and structures to prevent settlement, movement, or damage to the pavement or structure. Place excavated material in a manner to prevent damage to adjacent structures and incursion into waterways.

402.03.01 Backfill and Embankment Material. Use all suitable excavated material for backfill or store for future use. Do not waste excavated material without approval. Prior to using excavated material as

backfill, remove boulders, logs, and other unsuitable material. Dispose of unsuitable material in an approved disposal area.

402.03.02 Footing Elevations. The elevations for the bottom of the footings specified in the Contract Documents are approximate only; the Engineer may direct changes in dimensions or elevations of footings to secure a satisfactory foundation during the period of construction.

402.03.03 Footing Foundations. Place footings on suitable foundations. Do not drive piles or place concrete until the foundations are approved.

Clean all rock and other hard foundation material of loose material and cut to a firm surface, either level or stepped, as directed. Clean out and grout all seams and crevices. Remove all loose and disintegrated rock and thin strata. When concrete will rest on an excavated surface other than rock, do not disturb the bottom of the excavation. Perform final removal of the foundation material to grade just prior to placement of reinforcement steel and concrete. When an item is included for Subfoundation Investigation (Section 419), use the item as directed to verify the character of the foundation.

Place faces of footings plumb against undisturbed material, rock, sheeting, shoring, or forms. Faces of footings in rock shall bear against a minimum 1 ft depth of rock. If the excavation will not stand plumb, install sheeting, shoring, or forms as required. When specified, sheeting used to construct spread footings shall be left in place and cut off as specified in 410.03.10. When not specified, or when sheeting is used to construct pile-supported foundations, the sheeting may be removed.

Design all required sheeting and shoring. When the material retained by the sheeting and shoring is greater than 6 ft high, submit the details, procedures, and computations the same as specified for falsework details in TC-4.01 and Section 499. The experience specified under TC-4.01 will be waived.

After removing the forms, backfill the void between the footing and the embankment with subfoundation concrete or tamped fill utilizing crusher run aggregate CR-6. Compact the material to a density of 92 percent of the maximum density as tested per T 180, Method C. Use subfoundation concrete for backfill when footings are submerged. If the footings are below the water table, adjacent to railroad tracks, or more than 6 ft thick, submit footing form working drawings for approval.

Where foundation piles are used, excavate each pit to the as planned bottom of footing elevation before driving the piles. After driving is complete, remove loose and displaced material without damaging the piling. Leave a suitable bed to receive the footing concrete. For tremie

seal, the displaced material may remain provided the minimum thickness of footing concrete, pile embedment, and the required sealing of the foundation seal is maintained.

Where foundation piles are not used on substructure units, other than box culverts, and excavation is required below the as planned bottom of the foundation, backfill the additional excavation with subfoundation concrete or lower the footing elevation and deepen the footing as directed. Provide a rough finish to rock foundations that are to receive footing concrete. For box culverts, backfill additional excavated spaces under the barrels with selected backfill.

402.03.04 Cofferdams and Foundation Seals. When cofferdams or foundation seals are required, submit working drawings and a complete description of the process as specified in Section 499. Timber or bracing left in the cofferdams or cribs shall not extend into the substructure concrete. Construct cofferdams in a manner that protects the concrete from damage.

- (a) **Foundation Seal.** Refer to 420.03.05. When the foundation cannot be dewatered, the Engineer may require the construction of a concrete foundation seal. If a mud wave is created during the placement of the tremie seal, remove the displaced material to preserve the full foundation cross section specified. Then pump out the foundation and place the footing in the dry. When weighted cribs are employed and the crib's weight is utilized to overcome a part of the hydrostatic pressure acting against the bottom of the foundation seal, provide special anchorage such as dowels or keys to transfer the entire weight of the crib into the foundation seal. When a foundation seal is placed under water, vent or port the cofferdam at low water level as directed.
- (b) **Pumping.** Do not pump from the interior of the enclosure during the placing of concrete. Do not begin pumping from a sealed cofferdam until the seal has set sufficiently to withstand the hydrostatic pressure.
- (c) **Removal of Cofferdams or Cribs.** Remove cofferdams or cribs after the completion of, and without damage to the substructure.
- (d) **Stability of Foundation.** Stabilize the foundation area so that the concrete footing can be constructed in the dry.

402.03.05 Backfilling. Use suitable material for backfill. Continue backfilling to the surface of the surrounding ground or specified grade. Do not use Borrow until available project excavation is exhausted. Neatly grade the top surface of the backfilled areas. Compact as specified in Section 204 or 210.

Backfilling Against Structures. Backfill against various structures as follows:

- (a) **Brick Masonry.** Backfill no earlier than seven days after completion of the section.
- (b) **Concrete Structures.** Backfill when curing is completed and the concrete has achieved 80 percent of the specified compressive strength.
- (c) **Footings, Culverts, and Piers.** Deposit fill on both sides to approximately the same elevation at the same time.
- (d) **Abutments, Retaining Walls, Culverts, or Other Structures.** Place backfill in horizontal layers so that at all times there is a horizontal berm of uniformly compacted material behind the structure for a distance at least equal to the height of the abutment or wall remaining to be backfilled, except where undisturbed material protrudes into this area. Compact the berm as specified in 204.03. Jetting of fills or other hydraulic methods involving liquid or semiliquid pressure within the berm area are prohibited.

402.04 MEASUREMENT AND PAYMENT. Class 3 Excavation will be measured and paid for at the Contract unit price per cubic yard for the volume of material actually removed from within the limits specified.

Excavation for pipe culverts, culvert end walls, inlets, and manholes is excluded from Class 3 Excavation.

Payment will be full compensation for all excavation, backfill, filling void around footings due to removing forms, blasting, grout, dewatering, removal and disposal of excess or unsuitable material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. When a Class 3 Excavation item is not included in the Contract Documents, the excavation will not be measured but the cost will be incidental to other pertinent items.

No measurement or payment will be made for removing any liquids.

Class 3 Excavation will extend a maximum of 18 inches to vertical planes outside of the structure. Where blasting is required, a maximum of 6 inches will be allowed below the planned elevation.

The upper limits on existing ground or embankments will be the existing groundline or the lower limit of roadway excavation. The lower limit of the two will control.

The upper limits on preliminary embankments will be the bottom of the as planned footing elevation. For stepped footings, the upper limits will be the bottom of the as planned footing elevation of the highest portion of the footing. If the preliminary embankment has a surcharge, the upper limits will be the lower limit of roadway excavation.

402.04.01 Additional excavation required below the elevation specified in the Contract Documents and necessitated by the lowering or deepening of footings, or the placing of subfoundations or underpinning, will be measured and paid for at the Contract unit price for Class 3 Excavation.

402.04.02 Sheet piling, bracing, and shoring either removed or left in place, will not be measured but the cost will be incidental to other pertinent items unless otherwise specified.

402.04.03 Excavation necessary to expose or remove piles, grillages, sheet piling, cribbing, masonry, or other obstructions will not be measured nor paid for if the excavation occurs outside the limits of excavation. Removal and disposal of obstructions within the limits of excavation will not be measured separately but the cost will be included in the Contract unit price for Class 3 Excavation.

SECTIONS 403 — 404 RESERVED

SECTION 405 — REMOVAL OF EXISTING STRUCTURES

405.01 DESCRIPTION. Remove and dispose of, wholly or in part, designated structures.

405.02 MATERIALS. Not applicable.

405.03 CONSTRUCTION. Before removal operations begin, submit a list of the proposed equipment and the removal methods for approval.

Sheeting and shoring required for the removal of existing structures or portions thereof shall meet 402.03.03.

Unless otherwise specified, the limits of removal shall be 1 ft below the proposed groundline or to the limits necessary to avoid conflict with the proposed construction.

When remaining portions of an existing structure will be exposed to view in the final structure, make a neat 1 in. deep saw cut to separate the removal operations from the remaining concrete. Protect existing reinforcing steel as specified in 421.03.07.

Regardless of whether or not a hot mix asphalt (HMA) overlay is depicted in the Contract Documents, or if it is depicted but the actual thickness varies from what is shown, no additional compensation or credit will be made. The provisions of GP-4.05 will not apply.

405.03.01 Removal of Bridge Deck Slabs and Parapets. Protect the public against injury and damage from demolition operations. Erect temporary protective shields to prevent any material or debris from entering roadways, railroads, or waterways. Provide the underclearance specified in TC-6.12. Refer to 405.03.02 and .03 for additional requirements.

Submit protective shield working drawings per TC-4.01(b). Ensure that flooring and siding have no cracks or openings through which material particles may pass. Ensure that the shields are able to support over their entire area 150 lb/ft² in addition to their own dead weight.

The preceding weight requirement will be waived when the span to be removed is not over any of the following, or within range of rolling debris reaching any of the following:

- (a) Roadway, pedestrian walkway, bikeway, equestrian trail, parking area, navigable water, railroads and railroad property, or other traveled way.
- (b) Exposed utilities that are either aerial utilities crossing under the span or utilities located between stringers.
- (c) Environmental features such as historic ruins, endangered species habitat, etc.

When the weight requirement is waived but the deck slab is to be sawn into sections and removed by lifting from above, provide protection to prevent any loose particles from reaching restricted areas. In addition,

place a temporary construction fence under the area of demolition to prohibit accidental access by employees and pedestrians.

After the Engineer determines that the protective shields have served their purpose, remove and properly dispose of them.

405.03.02 Removal of Bridge Deck Slabs to be Replaced. Refer to the Contract Documents for deck removal restrictions, including sequence of locating and delineating structural elements that will remain in the completed structure, obtaining elevations, saw cutting, and equipment restrictions.

405.03.03 Removal of Existing Bridge. Refer to 405.03.01. Remove existing bridges (including piles) as specified, and from any area that will interfere with proposed construction as specified in 207.03.01.

405.04 MEASUREMENT AND PAYMENT. The removal of existing bridges and structures or portion thereof will be measured and paid for as specified. The payment will be full compensation for all excavation, backfill, saw cuts, professional engineer services, removal of existing shields and debris, temporary protective shields, temporary sheeting and shoring, hauling, disposal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. On deck replacement projects, payment also includes obtaining all deck elevations specified to determine rebound, computations necessary to place new deck at required elevation, and submitting all data for review.

Construction fence used to restrict access under demolition areas will not be measured but the cost will be incidental to the pertinent Removal of Existing Structure item. When an item for construction fence is included in the Contract Documents, that portion of the construction fence used to protect demolition areas will be excluded from the measurement and payment for that item.

405.04.01 Removal of Existing Structures will not be measured but will be paid for at the pertinent Contract lump sum price.

405.04.02 Removal of existing traffic barriers (parapets, railings, etc.) from bridges, including end posts, wing walls, and retaining walls will not be measured but will be paid for at the Contract lump sum price for the pertinent Removal of Existing Traffic Barrier item.

405.04.03 Removal of existing structures for which no specific pay item is included in the Contract Documents will not be measured but the cost will be incidental to other pertinent items specified.

SECTION 406 — DRILLED HOLES IN EXISTING MASONRY

406.01 DESCRIPTION. Drill holes for grouting of bars, bolts, or anchorages.

406.02 MATERIALS.

Grout

902.11(c)

406.03 CONSTRUCTION. Drill holes only in the solid portion of masonry. Do not drill at points where cracks exist. Drill holes at least 1/2 in. larger than the insert and at least 6 in. from the face of any masonry surface. Use at least No. 6 dowel bars. Clean the holes and fill two thirds full of grout. Place the insert, and allow to set at least 24 hours.

406.04 MEASUREMENT AND PAYMENT. Drilled Holes in Existing Masonry will be measured and paid for at the Contract unit price per linear foot of drilled hole. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Inserts will not be measured but the cost will be incidental to other pertinent items.

Drilled holes for which no specific pay item is included in the Contract Documents will not be measured but the cost will be incidental to the other pertinent items.

SECTIONS 407 — 409 RESERVED

SECTION 410 — PILING

410.01 DESCRIPTION. Furnish and install piling. When drilled shafts (caissons) are specified, refer to Section 412.

410.02 MATERIALS.

Sand

901.01

Concrete for Steel Pipe Piles

902.10, Mix No. 3
Slump 4-6 in.

Tremie Concrete for Steel Pipe Piles	902.10, Mix No. 4
Timber Piles	907.01
Timber Sheet Piles	907.01
Resin and Fiberglass Caps	907.01.01
Steel Pipe Piles	907.02
Steel H Piles	907.03
Steel Sheet Piles	907.04
Reinforcing for Steel Pipe Piles	908.01
Hardware	909.10
Water	921.01
Timber Preservatives	921.06

410.03 CONSTRUCTION. Ensure that piling ordered and delivered to the site is of the correct type and length.

410.03.01 Storage and Handling. Store and handle piling to avoid damage. Repair or replace damaged piling as directed.

410.03.02 Preparation for Driving. Do not drive piling until completing embankments and excavation.

Provide templates or other approved means to ensure that the piles are properly aligned and positioned.

Provide a cap or cushion so that hammer energy is transmitted to the pile evenly without damaging the top or butt. Ensure that the top of the pile, irrespective of type, is normal to the axis of the moving parts of the hammer.

410.03.03 Pile Tips.

- (a) Provide pointed timber piles where driving conditions require. The point shall be symmetrical and at least 4 in. diameter. Shod timber pile tips or bottoms with a metal shoe or point when specified.
- (b) Drift sharpen or bevel the bottom of timber sheet piling to wedge contiguous piles in tight contact.
- (c) Drive steel H piles without any special tip reinforcement unless otherwise specified.
- (d) Drive steel pipe piles open ended.

410.03.04 Splicing. Do not splice timber piles. If an isolated timber pile penetrates below planned tip elevation, thereby resulting in the top being below planned elevation, the Engineer will determine when replacement

is required, whether to supplement it with an additional pile, or when the structure can be changed without detriment.

When splicing of steel H piles and steel pipe piles is necessary, splice them as specified using electric arc welding conforming to AWS Structural Welding Code for the full periphery. The number of splices permitted shall be compatible with driving conditions at the site and the standard lengths of piling produced by manufacturers; however, only one section of each pile shall be less than 20 ft.

When welding is required above a specified maximum elevation, weld as specified in 430.03 excluding the submerged arc welding requirement. Welders shall be qualified to meet 430.03.19(a) or (b) for steel pipe piles 24 in. in diameter or greater, and to meet 430.03.19(b) for pipe piles less than 24 in. in diameter.

All welding above these limits shall receive 100 percent Magnetic Particle Inspection (MT) on the root pass and completed weld, and 100 percent Radiographic Inspection (RT), in accordance with AWS D1.5. Inspectors shall be approved by the Office of Materials Technology (OMT) as specified for certification testing in accordance with AWS D1.5.

Inspectors certified by an accredited/certified American Society for Non-Destructive Testing (ASNT), Level III in the inspection discipline, may submit certifications to OMT for review.

Where a manufactured pile type is designed to be spliced by screwing two pieces together or by the use of couplings or collars, and the details for the splice are not specified, submit the device for approval.

Drive piles in a continuous operation, and make splices prior to approaching the estimated tip elevation.

410.03.05 Test Piling. Drive test piles to determine the depth of penetration and the length of piling for structures. The Contract Documents will specify the test pile locations, minimum penetrations, bearing values, and estimated tip elevations. Order and drive the test piling from this information. Determine the actual safe bearing value of the test piling as specified in 410.03.09. From the test pile data and observed behavior, order the permanent piling.

410.03.06 Pile Driving. Submit a plan of the pile driving method including type of hammer prior to driving any piling.

Drive the permanent piles with the same hammer used to drive the test piles. If the hammer is changed, even if the energy ratings of the hammers are identical, drive additional test piles at no additional cost to the Administration.

Operate hammers at speeds recommended by the manufacturer for the bearing value specified. The manufacturer's manual for the hammer employed shall be available to the Engineer at the project site.

Hammer energy, for the purpose of these Specifications, is defined as the approved rated energy per blow of the power hammer.

Tests to determine the acceptability and energy rating of power hammers will be directed by the Engineer. Pay all costs, including the Administration's expenses, for determining approval and energy rating.

When considering the hammer for approval, the ratio of the weight of the pile to the weight of the striking unit will be evaluated to determine the adequacy of the hammer.

Construct leads or spuds to afford freedom of movement of the hammer during the driving phases. Drive the piles within the tolerance as specified without damaging the piles. Remove any leads that do not produce satisfactory results from the project.

Do not drive with the hammer out of the leads.

On all special, marine or water projects and pile bents, use leads of sufficient length that a follower will not be necessary. Provide guides and additional support to prevent excessive bending or buckling under the hammer blow when driving long piles and batter piles. Hold piles in place and alignment by templates or other approved means.

Do not perform external jetting of any pile. If it is necessary to remove material from within a pile shell to advance the pile tip or merely to obtain room for concreting, leave at least a 10 ft soil plug undisturbed at the tip of the pile. Install turbidity curtains around piles being cleaned when appropriate.

Auger or drill holes through strata that resists driving. Use an approved auger or drill that is no larger than the nominal diameter of a round pile or the minimum diameter of a circle in which an H pile will fit.

After the hole is completed, insert the pile and fill voids between the pile and the walls of the hole with dry sand. Complete the driving and then fill remaining voids with dry sand.

410.03.07 Pile Driving Tolerances.

- (a) **General.** Do not use foundation piles out of the specified position by more than 6 in. in any direction after driving, regardless of the length of piles. Variation from the vertical or from the batter shall not be more than 1/4 in./ft.
- (b) **H Piles.** Limit rotation of the pile to 25 degrees from the as planned axis.
- (c) **Bents.** Drive piles so that the cap may be placed as specified.

410.03.08 Unacceptable Piles. Take one or more of the following actions or propose other actions for approval:

- (a) Withdraw and replace the pile with a new pile.
- (b) Drive a second pile adjacent to the unacceptable pile.
- (c) Splice or build up the pile (except timber piles).
- (d) Extend a sufficient portion of the footing to properly embed the pile.

410.03.09 Bearing Value. Observe and report the behavior of the test pile from the time it is placed in the leads until it attains practical refusal or reaches a specified stratum. To provide a guide as to the probable supporting value at each position, the Engineer will compute the safe bearing value from the following formula:

$$P = \frac{2WH}{S + 0.1} \text{ for single acting power hammers}$$

$$P = \frac{2E}{S + 0.1} \text{ for double acting power hammers}$$

where:

- P = safe bearing value in pounds.
- H = height of fall in feet.
- W = weight in pounds of striking parts of hammer.
- E = approved hammer energy per blow in foot-pounds for double acting, differential acting, and diesel hammers.
- S = the average penetration in inches per blow for the last several inches of penetration.

The above formula is applicable only when:

- (a) The hammer is operating properly and at the manufacturer's recommended speed in the case of a power hammer.
- (b) The head of the pile is not broomed or crushed.
- (c) The penetration is reasonably quick and uniform.
- (d) There is no discernable bounce after the blow.
- (e) A follower is not used.

If the Contract does not provide for test loading, use the results of this formula as applied to the test piles to designate the proposed penetration or lengths of piles. However, evaluate the driving record of each pile to ensure its ability to carry the intended load.

Drive test piles in permanent vertical pile locations. Test piles found to be satisfactory shall be utilized as permanent piles.

410.03.10 Pile Cutoff and Removal. Cut off the tops of piles and pile casings, except timber piles that support timber caps, at the elevations specified. Make cuts on a true plane perpendicular to the axis of the pile unless otherwise specified. Cut off timber piles that support timber caps to ensure that the plane of the bottom of the cap will bear fully on the pile head. Shims shall not be placed between the timber cap and pile head.

Cut off piles used for sheeting and shoring to at least 1 ft below existing grade, channel bottom, or mud line as applicable. When specified, these piles may be removed. Dispose of all removed material.

410.03.11 Steel Pipe Piles. After driving, remove soil plugs to the specified elevation. Prior to placing filling (when specified) or reinforcement, use a suitable light to inspect the interior for the entire unplugged length. Do not fill or place reinforcement until the pile is approved.

Provide all required equipment for inspection including oxygen, light, boatswain's chair, and lift. Comply with Federal, State, and local safety regulations.

410.03.12 Concreting Steel Pipe Piles. Perform concreting as specified in Section 420. Perform reinforcement work as specified in Section 421. Securely fasten the reinforcement together to form a cage, positioned and held at a uniform distance from the shell.

Except as specified herein, use tie wire to secure tie bars and bands of cage reinforcement. For foundation (footing) piles, tack welding may be used, provided it is performed by an Administration certified welder.

For bents and column piles, tie bars, bands, and spacer lugs shall not be welded to the main reinforcing bars, except that a band may be placed at the top and bottom of the pile cage and all main bars welded to the band. Use tie wires to fasten the remainder of the intersections of ties and main bars.

Clean the areas in the top portion of the pile that are to be filled with reinforced concrete and tremie concrete. Place and cure tremie concrete prior to dewatering the top of the pile shell. Place the reinforcing unit in the top portion of the pile prior to filling with Mix No. 3 concrete.

Do not place concrete in any pile until completing driving within a radius of 15 ft or until all the piles for any unit of the structure (pier, bent, or abutment) have been driven to their final penetration and accepted. If this procedure is not feasible, discontinue driving within the above limits until the concrete in the last pile placed has set at least 72 hours.

Immediately prior to concreting, remove water and other foreign substances. Deposit the concrete in one continuous operation.

The restriction in Section 420 for dropping concrete more than 5 ft does not apply.

Set and fasten reinforcing steel cages in proper position in the pile before filling with concrete, except when the reinforcing steel cage extends 6 ft or less below the top of the pile, the concrete filling may be placed before installing the reinforcement. Thoroughly consolidate using mechanical vibrators from the bottom of the reinforcing steel cages to the pile top.

Do not disturb or apply loads to concreted piles until all concrete has been in place and cured at least 72 hours.

410.03.13 Treatment for Timber Pile Heads. Use an approved asphalt treatment to paint timber pile heads that are not to be embedded in concrete. After the asphalt has sufficiently cured, cover it with a glass resin composite shield. Apply the first coat of resin to the top and down the side at least 1 in. beyond the limits of the woven glass. Apply precut woven glass cloth using a 3 in. grooved aluminum roller to achieve "wet out." Neatly wrap woven glass cloth over the top of the pile, drape it down the side at least 2 in., and secure using copper nails. When the first coat of resin has taken a tack free set, apply a second coat of resin to seal the entire application.

410.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

410.04.01 Piling (permanent and test) will be measured and paid for at the Contract unit price per linear foot for the pertinent Piling item. The measured length of all piling will be from its tip up to final cutoff, unless otherwise specified. For test piles not utilized as permanent piles, the measurement for cutoff will be at the same elevation as the nearest proposed permanent pile or to actual top of test pile, whichever is lower. Where piling designated as test piles is accepted for use in the permanent structure, measurement will be made as test piles, and no additional allowance will be made in other piling items.

410.04.02 Furnishing and setup of pile driving equipment required for driving permanent and test piles will not be measured but the cost will be incidental to the Contract unit price for the pertinent Pile item.

When an item for Setup for Driving Pile is included in the Contract Documents, the furnishing and setup of pile driving equipment will be measured and paid for at the Contract unit price per each for the pertinent Setup for Driving Pile item. The unit price per each for the setup required for driving each pile for the proposed structure will be used regardless of the distance that the equipment is moved for each pile setup. A maximum of one setup will be paid per pile location. No additional compensation will be paid for any setup required for redriving or any additional driving of any pile no matter what reason the particular pile may require redriving or additional driving.

410.04.03 Pile points for steel H piles will be measured and paid for at the Contract unit price per each for the pertinent Pile Point for Steel H Pile item.

410.04.04 Timber sheet piling will be measured and paid for at the Contract unit price per 1000 board foot (MBM) for the pertinent Timber Sheet Piling item. Computation of quantities will be based on nominal thickness of lumber, the length of the sheet piling, and the average depth of the sheet piling from cutoff at the top to the tip of the sheet piling in the completed structure. No allowance will be made for waste.

410.04.05 Steel sheet piling will be measured and paid for at the Contract unit price per square foot as measured along the plane of surface for the pertinent Steel Sheet Piling item.

410.04.06 The following will not be measured but the cost will be incidental to other pertinent items:

- (a) When specified, tips for steel pipe piles.
- (b) Test pieces of sheet piling (timber or steel).
- (c) Dewatering, clean out, filler, reinforcement, and concrete used in steel pipe piles.
- (d) Pile splices.
- (e) Auguring, including sleeve and backfill when required.
- (f) Cleaning, painting, or coating of piling.
- (g) Piling or sheet piling for temporary structures, piles or sheet piling driven for the Contractor's convenience, or for any piles or sheet piling not specified.
- (h) Piling not approved by the Engineer, such as piles not properly driven, piles with questionable safe bearing values, piles damaged during driving, or piles driven below planned cutoff or the removal of any pile rejected by the Engineer as unsatisfactory.
- (i) Glass resin composite shield used on timber piles.

SECTION 411 — PILE LOAD TEST

411.01 DESCRIPTION. When a Load Test item is included in the Contract Documents, conduct and record load tests.

411.02 MATERIALS. Not applicable.

411.03 CONSTRUCTION. Ensure that the load test setup, the measuring system, the loading device, the loading procedure, the frequency of measuring the movement of piles, and the record keeping meet D 1143, unless otherwise specified.

At each load test location, the Engineer will provide driving criteria for the test pile. Then drive and load test the pile to the test load specified. If the pile fails to achieve this capacity, perform an additional load test on a second test pile. Locate this pile adjacent to the initial test pile and drive it in accordance with the revised driving criteria provided by the Engineer. When directed, redrive piles not meeting the required penetration resistance.

Use the same equipment and methodology for driving the load test piles that will be used for driving the permanent piles.

At each load test location, construct a test enclosure to protect all of the equipment including dial gauges, load cells, loading apparatus, and the personnel taking readings. When necessary, maintain a temperature of at least 50 F within the enclosure. Illuminate the test enclosure to allow taking readings at all times of the day. Ventilate the enclosure to prevent fogging or frosting of gauges.

At least seven days prior to the start of the first pile load test, submit drawings showing all details of the proposed load test setup. Include the method of applying the load, the reaction frame and reaction pile configuration (if used), and the placement and support of measuring devices. Revise the load test setup if directed.

Obtain the services of a professional engineer experienced in structural design and registered in the State of Maryland to design the reaction frame.

Ensure that the load test setup is capable of supporting the test load for the duration of the test.

Maintain a clear distance from reaction piles to the test pile of at least 10 times the distance from the midpoint of web to end of flange for H piles, and at least 10 times the pile top radius for pipe piles and timber piles.

Where necessary or if directed, brace the unsupported length of load test piles to prevent buckling and without influencing the test results.

Use dial gauges having an accuracy of 0.001 in. and a minimum travel of 2 in. as the primary instrument for measuring movement. Place three dial gauges spaced 120 degrees apart as the primary system to measure movement of the top of the pile. Use a scale, mirror, and piano wire as a secondary system.

Ensure that the load apparatus has a capacity of 150 percent of the test load and meets D 1143. Ensure that no jack is loaded in excess of 85 percent of the total capacity of the jack. If more than one hydraulic jack is used, provide jacks that are of the same piston diameter, connected to a common manifold and pressure gauge, and operated by a single hydraulic pump.

Apply loads uniformly without impact. If hydraulic jacks are used, equip them with automatic regulators so that constant pressure can be

maintained for the duration of the test without frequent manual adjustment.

Unless weights of known magnitude are used to load the test piles, use a load cell having an accuracy tolerance within plus or minus 2 percent of the applied load as the primary method of measuring the test load. Calibrate the load cell prior to the test and submit a copy of the calibration report. Provide a pressure gauge as a secondary system. Calibrate the pressure gauge, hydraulic ram, and hydraulic pump as a unit to an accuracy within 5 percent of the applied load (a single high capacity jack is preferred over multiple jacks). When a multiple jacking system is used, fit each jack with a pressure gauge in addition to the master gauge in order to detect malfunctions.

Recalibrate load measuring devices if required by observed performance.

Cut off the load test pile perpendicular to the longitudinal axis to allow for full bearing. Place a steel plate at least 1 in. thick over the cutoff surface in a manner that facilitates axial loading and even bearing on the test pile.

For all test piles driven to the embedded depths specified, use the standard loading procedure per D 1143 or as directed. Continue loading to the specified test load or to failure, whichever occurs first.

Provide a scale attached to the reaction piles that can be monitored with a transit to determine if the piles are moving.

If at any stage during the test, the Engineer detects malfunctioning of any furnished apparatus, or the load is being eccentrically applied, or the anchor piles are yielding, abandon the test and replace it with another test at no additional cost to the Administration. Ensure that all necessary personnel are present at the site at all times during the performance of the test to maintain the required load.

After the pile test program is complete, remove or cut off reaction piles as specified in 410.03.10.

Perform load tests on steel pipe piles prior to filling.

411.04 MEASUREMENT AND PAYMENT. Load tests will be measured and paid for at the Contract unit price per each for the pertinent Load Test item. The payment will be full compensation for furnishing and installing all equipment, drawings, monitoring, recording, removal of all devices at the completion of the tests, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. In the

event that a properly conducted load test fails to achieve the designated capacity, the additional tests will be measured and paid for at the Contract unit price per each under the Load Test item.

SECTION 412 — DRILLED SHAFTS (CAISSONS)

412.01 DESCRIPTION. Construct drilled shafts (caissons) as specified.

412.02 MATERIALS. Refer to 420.02 except as modified herein.

Concrete Mix No. 4	902.10
Reinforcing Steel	908
Steel Casings	A 252, Grade 2 or A 36

412.03 CONSTRUCTION. Refer to 402.03, 419.03, and 420.03, except as modified herein.

412.03.01 Subfoundation Investigation. When the Contract Documents include an item for Subfoundation Investigation, conduct a subfoundation investigation program prior to ordering or fabricating reinforcement for drilled shafts. Use this program to determine the elevation of suitable bearing stratum and the required depth of the drilled shafts. Select approximately a third of the drilled shaft locations spread over the total number of locations, and drill test holes at least 10 ft below the estimated drilled shaft length. After drilling the test holes, the Engineer will evaluate the data to determine the uniformity of the foundation materials. If the evaluation determines that more test holes are required, drill additional test holes at approved locations.

412.03.02 Shaft Installer. Obtain the services of a shaft installer having a proven record of experience and having successfully completed at least three projects with similar subsurface conditions, shaft sizes, depths, and minimum volumes of work as contained in the project. Submit evidence of pertinent experience for approval before proceeding with drilling shafts.

Furnish a Certified Drilled Shaft report containing the following information for each drilled shaft:

- (a) Top and bottom elevations.
- (b) Final center line location at top.
- (c) Variation of shaft from plumb.

- (d) Results of tests performed.
- (e) Levelness of bottom.
- (f) Seepage of water.
- (g) Top and bottom elevation of any casings left in place.
- (h) Any unusual conditions.
- (i) Variation of dimensions from planned.
- (j) Dates of start and completion of excavation.
- (k) Inspection, testing, and placement of concrete (including any delays in concreting and location of construction joints in shafts).
- (l) Reinforcing steel.
- (m) Any additional information relevant to the as-built drilled installation.

Record and maintain information pertinent to each drilled shaft and provide required data to other testing and inspection personnel.

Provide all facilities required for the safe and convenient conduct of the Engineer's inspection and testing procedures.

412.03.03 Geotechnical Engineer. When specified, employ the services of a qualified geotechnical engineer for inspection and testing for installation of drilled shafts. Ensure that the geotechnical engineer is a professional engineer registered in the State of Maryland, has a demonstrated record of experience with similar drilled installations, and is approved prior to beginning auguring for the drilled shafts.

The geotechnical engineer shall submit a plan containing the proposed methods to be used to inspect the drilled shafts as specified herein.

The geotechnical engineer shall visually inspect the bottom of each drilled shaft and perform tests as necessary to verify the bearing capacity. Drilled shafts shall be founded in material having the specified minimum design bearing capacity. The geotechnical engineer shall provide certification that the drilled shafts were properly drilled to a satisfactory depth and bearing.

412.03.04 Shaft Requirements. Excavate shafts by auguring, drilling, or hand excavation as necessary to reach the required bearing strata. When

earth walls cannot be maintained without spilling into the shaft, install casings or slurry as excavation proceeds. Ensure that the casings are full-length and watertight. The casings shall be of sufficient thickness to withstand compressive, displacement, and withdrawal stresses; and to maintain the shaft walls. Withdraw casings as concrete is placed unless otherwise specified.

The geotechnical engineer shall determine the final bottom elevation of drilled shafts when the services are required. All holes shall be inspected and approved.

Do not excavate holes for successive drilled shafts until adjacent holes are filled with concrete and allowed to set.

Drilled shaft tolerances:

- (a) Maximum permissible variation of center line locations is not more than $1/24$ th of the shaft diameter or 3 in., whichever is less.
- (b) Maximum out of plumb is 1.5 percent of the depth, 12.5 percent of the shaft diameter, or 15 in., whichever is less.
- (c) The top of the shaft or concrete cut-off elevation shall be within 1 in. of the design elevation.

If the specified tolerances are exceeded, provide corrective construction to compensate for excessive eccentricity at no additional cost to the Administration. Submit proposed methods of corrective construction for approval.

Excavate the bottom of drilled shafts to an undisturbed, level plane. Remove all loose material prior to placing concrete.

Dewater drilled shafts as required to facilitate excavation, inspection, and concreting.

Ensure that the each drilled shaft has been inspected before placing concrete.

Reinforcing Steel. Fabricate and place reinforcing steel cages for each drilled shaft as one continuous unit. Place reinforcement accurately and symmetrically about the axis of the hole, and keep securely in position during concrete placement.

Protect exposed ends of extended reinforcement from damage.

Concrete. Fill drilled shafts with concrete immediately after inspection and approval by the geotechnical engineer and the Engineer.

Place concrete in one continuous operation, in a smooth flow without segregating. Use mechanical vibration for consolidation of at least the top 25 ft of each shaft. Concrete may be free dropped up to 25 ft provided that the procedures ensure that the concrete falls vertically without hitting the inside walls of the hole or falling directly on the reinforcing steel. When the Engineer determines that the concrete placement procedures are unsatisfactory, place concrete by means of bottom discharge bucket, flexible drop chute, elephant trunk hopper, tremie, or pumping. Use chutes, tremies, or pumping where a drop of more than 25 ft is required.

Place concrete in the dry insofar as practicable. If excessive water occurs and it is not feasible to dewater the drilled pier shaft for concreting, place concrete by the tremie method as specified in 420.03.05. Control tremie placement operations to ensure that tremie is not broken during continuous placing from bottom to top. If approved, other methods of depositing concrete underwater may be used.

Maintain a sufficient head of concrete to prevent any reduction in the diameter of the drilled shaft by earth pressure and to prevent extraneous material from mixing with the concrete. Coordinate the withdrawal of temporary casings with concrete placement operations to maintain a head of concrete approximately 5 ft above the casing bottom.

Stop concrete placement at the top cut-off elevations shown on the Contract Documents. Screed the tops of drilled shafts level and give them a roughened surface finish. Where the cut-off elevation is above ground elevation, form the top section to extend the shaft to the required elevation.

Construction joints are permitted in drilled shafts if concrete placement operations must be interrupted, as accepted by the Engineer. Screed the surface of the construction joint level and give it a roughened surface. Apply an approved bonding compound prior to placing additional concrete.

The Engineer may require full-depth continuous coring of drilled concrete shafts where observations of temporary casing removal and concrete placement operations indicate cause for suspicion of quality of concrete, presence of voids, segregation, or other defects. Perform this work at no additional cost to the Administration.

Defective Drilled Shafts. Repair or replace defective drilled shafts as directed.

412.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

412.04.01 Drilled shafts including furnishing and setup of auguring equipment, auguring, drilling, excavating, dewatering, inspection, testing, services of the shaft installer and geotechnical engineer, sleeves, reinforcement, concrete, and disposal of excess and unsuitable material will be paid for at the Contract unit price per linear foot for the pertinent Drilled Shaft item.

412.04.02 When subfoundation investigation is specified, it will be measured and paid for as specified in 419.04.

SECTIONS 413 — 417 RESERVED

SECTION 418 — PROTECTIVE JACKETS FOR PILES

418.01 DESCRIPTION. Install protective jacket for piles.

418.02 MATERIALS.

Fine Aggregate	901.01
Portland Cement	902.03, Type II
Concrete Admixture	902.06
Water	921.01
Welded Wire Fabric	908.08
Fiberglass Protective Pile Jackets	921.11 and 418.02.01
Anchor/Standoff Devices	A 185
Stainless Steel Screws	A 193, Type 303

418.02.01 Jackets. Fabricate jackets for new piles in one solid piece with no longitudinal joint. Closure joints on jackets for existing piles need not be self-locking provided the joint can be field formed with fiberglass and is approved. Ensure that the field formed closure joint meets the tensile strength of the jacket. All jackets shall be at least 3/16 in. thick. Ensure that the surfaces of the fiberglass are free of bond inhibiting agents.

For steel and concrete piles, provide noncorrosive standoffs on the inside face of jackets to maintain the jackets in the required position.

418.02.02 Closure Joint Warranty. When closure joints are used for existing piles, furnish the Administration a written 5 year warranty against installation defects, and ensure that the manufacturer submits a similar warranty against manufacturing defects. Submit both prior to starting the installations.

418.02.03 Grout. Submit the proposed grout mix design and method of installation for approval.

Steel and Concrete Piles. Use grout consisting of at least 845 lb/yd³ of cement, 6 ± 1 percent of air entrainment by volume, and proportioned with fine aggregate and water to provide a pumpable mixture. The minimum 28 day compressive strength shall be 3500 psi.

Ready mixed grout will be permitted by written permission of the Engineer, and shall be from a manufacturer approved by the Office of Materials Technology.

Timber Piles. Submit grout consisting of water insensitive epoxy and fine aggregate mixed in accordance with the manufacturer's recommendations.

418.03 CONSTRUCTION. Prepare and submit working drawings for approval showing equipment, installation procedure including location of tremie pipes, injection port, method of sealing the bottom of the jacket, and method of support during grout placement. Refer to Section 499.

418.03.01 Cleaning Piles. Clean the piles of all surface contamination such as grease, oil, tar, loose rust, loose coatings, and marine organisms.

Water blast steel and concrete piles with a nozzle pressure of 8000 to 20 000 psi, and timber piles with a nozzle pressure of 3000 to 3500 psi. Clean the piles within 24 hours prior to placing the grout. Do not place jackets until the cleaning is approved.

418.03.02 Preparation of Protective Jackets. Clean and abrasive blast the inside faces of the jackets to remove any agents that will inhibit attachment of anchor devices and bonding of the grout. The Engineer may require these procedures to be repeated if they are not acceptable at the time of placement.

The Engineer will inspect the protective jackets prior to placement. Repair loose or damaged anchor devices and replace protective jackets deemed unsatisfactory.

Seal the space between the pile and the jacket at the bottom. Use only external temporary support devices to position the protective jackets during installation. Remove supports before final acceptance.

418.03.03 Filling Void. Fill the void between the pile and the protective jacket with grout placed by the tremie method using two tremie pipes or by pumping using an injection port located at the bottom of the protective jacket. Equip tremie pipes with hopper tops. Do not use bottom dump buckets.

Use approved mixing equipment in preparation and handling of the grout. Remove oil and other rust inhibitors from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used. Accurately measure all materials by volume or weight as they are fed into the mixer. Mix for at least one minute. The continuously agitated grout may be held in the mixer or agitator no more than one hour, or for 1-1/2 hours when the temperature falls below 70 F.

Place grout as one continuous operation for each pile. Take care in the placement of grout to obtain a sufficient flow to ensure proper distribution and bonding to the pile.

If emergency interruptions of continuous grout pumping become necessary, stop the operation and remove the jacket and the grout. Thoroughly clean the pile as specified in 418.03.01 prior to continuing the operation. Do not reuse the pile jacket unless it is removed prior to initial setting of the grout and is approved.

Finish the top of grout sloped to drain away from the pile. Remove all excess grout from the outside of the piles and jackets after filling.

418.03.04 Protective Jacket Inspection. The installation operations will be observed during all phases of construction. In the presence of the Engineer, remove the first two protective jackets installed to provide visual evidence that the desired results are being obtained. Do not begin removal until the grout has set sufficiently to maintain its shape. The Engineer will examine the grout for cavities, honeycombing, and other defects.

- (a) If the grout is satisfactory, the installation operations will be approved. Remove all grout as directed, and clean and reinstall a new jacket in conformance with these Specifications. Do not reuse the original protective jacket.
- (b) If the grout on only one of the installations is unsatisfactory, remove the third protective jacket installed, and inspect. If this

inspection is satisfactory, the installation operations will be approved. Reinstall the protective jackets as specified in (a).

- (c) If the grout is unsatisfactory upon removal of the protective jacket on both of the first two piles inspected, or on two out of the three piles inspected as specified in (b), submit modifications to the operations for approval before continuing. Continue these procedures until the installation operations are satisfactory.
- (d) Additional inspections will be performed whenever required.

418.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for fabricating, furnishing, and installing protective jackets including welded steel wire fabric, grout, excavation, and all material, labor, equipment, tools, and incidentals necessary to complete the work.

418.04.01 Protective jackets will be measured and paid for at the Contract unit price per each for the pertinent Protective Jacket for Pile item.

418.04.02 Protective jackets will be measured and paid for at the Contract unit price per linear foot (depth) for the pertinent Protective Jacket for Pile item.

418.04.03 Protective jacket inspections that are satisfactory and accepted, will be measured and paid for at the Contract unit price per each for the pertinent Protective Jacket Inspection item. Payment will also be full compensation for removal of the jacket, removal of the grout, cleaning, and reinstalling a protective jacket, welded steel wire fabric, and grout.

418.04.04 Protective jacket inspections that are unsatisfactory and rejected will not be measured or paid for. The Contractor shall remove the protective jacket, grout, and welded steel wire fabric, and clean the existing structure.

SECTION 419 — SUBFOUNDATION INVESTIGATION

419.01 DESCRIPTION. Conduct an investigation to verify the character and suitability of the subfoundation material for foundation purposes.

419.02 MATERIALS. Not applicable.

419.03 CONSTRUCTION. Drill test holes in accordance with T 206 and T 225 at least 10 working days prior to excavation or pile driving in that area. Notify the Engineer at least 10 working days prior to drilling. Drill holes at the locations and to the depths specified. Record all information on the Administration's boring log Form No. SHA 73.0-46, available from the Office of Materials Technology. Provide an approved geologist or a geotechnical engineer that is a professional engineer registered in the State of Maryland to ensure that the test holes conform to these Specifications.

Submit the drilling results within two working days after drilling any given hole. Within five working days after receipt, the Engineer will evaluate the subfoundation investigation to determine if any change in the as-planned excavation is necessary. Do not begin excavation until the Engineer's evaluation is received for that particular foundation.

419.04 MEASUREMENT AND PAYMENT. Subfoundation Investigation will be measured and paid for at the Contract unit price per linear foot for the actual total length of holes drilled. The payment will be full compensation for the geologist or geotechnical engineer services, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 420 — PORTLAND CEMENT CONCRETE STRUCTURES

420.01 DESCRIPTION. Furnish, place, finish, and cure concrete bridges, culverts, and miscellaneous structures including cofferdams, forms, and falsework.

420.02 MATERIALS.

Curing Materials	902.07
Form Release Compound	902.08
Concrete Mixes	902.10 and 420.02.04
Grout	902.11
Linseed Oil	902.12
Drains, Downspouts, Weep Holes, and Pipes	905
Reinforcement	908.01
Cast Iron Scuppers	909.04
Anchor Bolts	909.06

Steel Forms Which Remain	
In Place	909.11
Joint Sealer	911.01
Preformed Joint Fillers	911.02
Preformed Elastomeric	
Joint Seals	911.04
Water Stops and Flashing	911.08 and 913.05
Production Plants	915
Fusion Bonded Epoxy	917.02
Water	921.01
Epoxy Bonding Compound	921.04

420.02.01 Admixtures. Do not use calcium chloride or other admixtures containing chloride salts in concrete placed on steel bridge deck forms.

420.02.02 Requirements for Accessories. Ensure that accessories such as inserts and ties that will remain in completed superstructures within the top 5 in. of final deck slab concrete are either epoxy coated or made of material other than aluminum that will not rust. These same requirements pertain to accessories that will remain in parapets, sidewalks, or other portions of the structure designated to have epoxy coated reinforcing steel. Do not use inserts in the top half of slabs exposed to vehicular traffic unless specified.

420.02.03 Precast Reinforced Concrete Box Sections. Meet M 259 or M 273 including concrete design strength. All details shall be as specified. Construction joints between the walls and the bottom and top slabs are optional. Certify as specified in 305.03.06.

420.02.04 Composition of Concrete Mixes for Slip Form. For construction of parapets and median barriers on bridges, use Mix No. 6 with a 1 in. maximum slump. Measure the slump at the placement point as the concrete is charged into the slip form machine. Use crushed stone meeting M 43, size number 7 for the coarse aggregate, proportioned to be 63 percent of the total aggregate in the mix. Other size coarse aggregate may be used provided the slip form results are acceptable.

420.03 CONSTRUCTION. Produce concrete at the work site or away from the work site by an approved central mixing plant, or by approved truck mixing as specified in Section 915.

When specified, remove portions of existing parapets or end posts as specified in 405.03.

420.03.01 Equipment. Use equipment of sufficient capacity to complete any unit or section of concrete between construction joints in one continuous operation consistent with approved placement operations.

With written approval, hand mixing may be permitted for small volumes of concrete used in isolated portions of the structure where structural integrity is not critical and the volume does not exceed 1 yd³.

420.03.02 Forms.

(a) Design Criteria.

(1) **Design Loads.** Per AASHTO LRFD Bridge Construction Specifications, Temporary Works. Assume the lumber in the forms to weigh 50 lb/ft³.

(2) Design Stresses.

Timber Design. Per ACI Standard Recommended Practice for Concrete Formwork (ACI 347). Deflections for form members shall not exceed 1/270 of the span or 1/4 in. Unit stresses stipulated in AASHTO for treated timber may be increased by 25 percent, but shall not exceed the values listed below.

Compression Perpendicular to Grain	450 psi
Compression Parallel to Grain	1600 psi
Flexural Stress	1800 psi
Horizontal Shear	
Beams up to 6 in. deep	200 psi
Beams over 6 in. deep	150 psi
Axial Tension	1200 psi

Plywood. For plywood without backing, calculate the strength of plywood based on the grain of the face plies running parallel to its span. Install the plywood in this manner.

Steel Members for Forms. Per AASHTO LRFD Design Specifications and ASSHTO LRFD Bridge Construction Specifications. For design where no dynamic loading is involved, the AISC Standard Manual of Steel Construction, Allowable Stress Design may be used as the accepted design code.

Steel Forms Which Remain in Place. The maximum deflection shall not exceed 1/180 of the span and not in excess of 1/2 in. Do not use camber to compensate for deflection in excess of these limits. The design spans of the form sheets shall be the clear distance between beam or girder flanges less 2 in.

The unit working stress in the steel sheet and supporting members shall not be more than 0.725 of the specified minimum yield strength of the material furnished but not to exceed 36 000 psi. Compute physical design properties in accordance with the American Iron and Steel Institute Specification for Design of Cold Formed Steel Structural Members.

- (b) **Working Drawing Approval.** Submit detail, form, falsework, and centering plans and design loads for approval as specified in Section 499. Working drawings for forms shall include all members proposed for use as well as form ties and bracing. Do not submit details for form ties separately; incorporate them in the general working drawings submittal. The rate of placing concrete shall be noted on the working drawings. Approval of the working drawings does not relieve the Contractor of responsibility as specified in TC-4.01. The provisions of 430.03.28 also apply when working drawings are submitted for falsework and centering.
- (c) **Forms at Construction Joints and Corners.** Provide ties or bolts 3 to 6 in. from each side of construction joints for tightening the forms against the hardened adjacent concrete prior to placing fresh concrete. At joints where forms have been removed and reconstructed, extend the form over the concrete already in place; and draw tightly against the previously placed concrete. Provide fillets at all sharp corners, except when otherwise specified, and provide a bevel or draft in the case of all projections. Chamfer all exposed corners of concrete with 3/4 x 3/4 in. milled chamfer strips, except on unexposed footings or where specified.
- (d) **Form Scaffolds and Platforms.** Build form scaffolds and platforms along the outside of bridge deck fascias during construction of forms for bridge decks. Design and construct them as integral parts of the form supports. Furnish separate design calculations with the working drawing submission. Assume the responsibility of TC-4.01 even after approval of the working drawings.
- (e) **Forms for Unexposed Surfaces.** Ensure that sheathing, studs, and bracing are of sound material, and that studs and wales are straight, true, and surfaced on two edges to a uniform width. Ensure that the inside faces of the forms are constructed sufficiently smooth so that the resulting concrete surfaces are accurately formed.

(f) **Forms for Exposed Surfaces.** Unless otherwise specified in the Contract Documents, support the bridge deck concrete between stringers with steel forms which remain in place, except in panels where a longitudinal deck construction joint is located between stringers. Ensure that forms used for widening and rehabilitation provide exposed finished concrete surfaces that match the existing structure.

(1) **Lined Forms for Exposed Surfaces.** Use approved composition board, sanded plywood, or metal for contact surfaces of lined forms for surfaces exposed to weather or view. Ensure that all studs are surfaced two edges to a uniform width. The studs and backing shall be solid, straight, and free of detrimental defects. However, the backing need not be of the quality used for contact forms for unexposed surfaces.

Sheathing for form backing shall be surfaced two sides to a uniform thickness of at least the dimension approved on the working drawings. Ensure that form sheathing is built solidly, securely nailed to studs, and placed to prevent any bulging of the lining.

(2) **Unlined Forms for Exposed Surfaces.** Use five ply sanded plywood of the specified thickness for surfaces exposed to weather or view. Use plywood manufactured especially for concrete formwork using waterproof glue. All studs and wales shall be surfaced two edges to a uniform width.

Use full size sheets of plywood except where smaller pieces cover an entire area. Solidly back joints to prevent leakage, and nail the edges of abutting sheets to the same stud or blocking with sixpenny nails not more than 8 in. apart. Where rustication occurs, construct horizontal plywood joints behind a rustication strip. Otherwise, place horizontal joints at the same respective elevations in all portions of the structure. Where vertical rustication occurs, construct vertical joints in the lining behind a rustication strip. Otherwise, keep vertical joints to a minimum, butted tightly together and sealed with crack filler as the plywood is nailed in place.

(g) **Steel Forms Which Remain in Place.**

(1) **Installation.** The surface in contact with concrete shall be smooth and free of surface irregularities. Ensure that working drawings specify the grade of steel, the physical and sectional

properties, and a clear indication of where the forms are supported by steel beam flanges subject to tensile stresses.

Do not weld form supports to flanges of steel that are not considered weldable or to portions of flanges that are subject to tensile stresses.

Welding and welds per AWS Bridge Welding Code pertaining to fillet welds.

Unless otherwise specified, use steel forms between stringers to support bridge deck concrete, except where a longitudinal deck construction joint is located between stringers.

- (2) Procedure Check and Inspection.** Remove at least one section of the forms at a location and time selected by the Engineer from each span of each bridge in the Contract. If the bridge has a longitudinal joint, remove a form on each side of the joint from each span. Do this as soon after placing the concrete as practical to provide visual evidence that the concrete mix and the placement procedures are obtaining the desired results. Remove an additional section if the Engineer determines that there have been any changes in the concrete mix or in the placement procedures that warrant additional inspection.

At locations where sections of the forms are removed, replacement of the forms will not be required, but the adjacent metal forms and supports shall be repaired to present a neat appearance and ensure their satisfactory retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing, and other defects. If the Engineer finds irregularities but determines that the irregularities do not justify rejection of the work, repair the concrete as directed.

Give the concrete an ordinary surface finish as specified in 420.03.07(a). If the concrete where the form is removed is unsatisfactory, remove additional forms, as necessary, to inspect and repair the slab. Modify the method of construction as required to obtain satisfactory concrete. Remove all unsatisfactory concrete and replace or repair as directed.

Provide facilities required for the safe and convenient conduct of the Engineer's inspection procedures.

- (h) **Steel Forms Which Do Not Remain in Place.** The contact surface shall be smooth and free of bolts, bolt heads, nuts, rivet heads, welding seams, and surface irregularities. Forms that produce unacceptable results will be rejected, and shall not be reused.
- (1) **For Round Columns and Piers.** Use steel forms that are at least 10 gauge, have a minimum number of horizontal joints, and are column height.
- (2) **For Pier Caps and Crash Walls.** Prefabricated girder type steel forms may be used for forming pier caps or crash walls. Use one piece where practical for each element of these forms including side, bottom, and end. Arrange splices to provide a symmetrical pattern.
- (3) **For Reinforced Concrete Box Culverts and Rigid Frames.** Use steel forms or forms constructed of wood or composition wood panel sheathing set in metal frames. Steel forms for box culverts and rigid frames shall be at least 10 gauge.
- (i) **Fiber Column Forms.** Fiber column forms shall only be used for round columns. The forms shall produce columns truly round and straight. Protect forms from dampness before concrete is placed. Do not splice fiber forms.
- (j) **Release Agents.** Apply form release compound immediately before placing concrete.
- (k) **Temporary Supports.** Build temporary supports used for centering and falsework on good firm foundations. Unless otherwise provided, ensure that they bear upon strata at or below the frost line unless rock is available. Where required, drive piling for support. Ensure that the strength and bracing of the temporary supports will provide a completed structure having the shape specified. Use jacks or hardwood wedges in connection with the temporary supports to take up settlement either before or during placing of concrete. Set temporary supports to give the structural camber specified, and allowance for shrinkage and settlement. If during construction, any weakness, settlement, or distortion develops, stop the work and remove any masonry affected. Strengthen the temporary structures before resuming. Construct centering to permit gradual and uniform lowering.
- (l) **Defective Forms.** Use an approved device for removing or modifying steel forms which remain in place. Burning is prohibited.

- (m) **Form Ties.** Use approved form ties. Ensure that ties leave no metal closer than 2 in. from the surface. They shall not be fitted with lugs, cones, washers or other devices that act as spreaders within the form or for any purpose that leaves a hole larger than 7/8 in. diameter. When prefabricated steel girder forms are used, use tapered ties no greater than 1-1/2 in. diameter. Ensure that ties are clean and free of rust. When ties are removed, pressure grout the holes with a nonshrink mortar mixed to match the color and texture of the concrete.

Coat the removable portions of ties with a clear lubricant or other approved material.

During removal of form ties, avoid spalling the concrete on the exposed surface. Do not cut the ties back from the surface.

- (n) **Form Support Brackets or Devices.** Devices attached to previously placed concrete may be used, provided all parts are acceptable. No metal part of an insert, threader, or anchor that remains in the concrete shall be within 2-1/2 in. of the surface. Do not attach brackets or other devices until the concrete is cured and it has attained a compressive strength of at least 3000 psi. All voids left in the concrete after removal of brackets and other devices shall be no greater than 2 in. diameter. Fill them with mortar and finish the surface as specified in 420.03.07(a).

- (o) **Form Removal.** For determining the time when falsework and forms may be removed, backfill placed, and when loads may be applied to structures, make an adequate number of concrete test specimens in addition to those required to check the quality of the concrete being produced. After meeting all formwork requirements, remove and dispose of all forms except those specified to remain in place.

Do not use methods of form removal likely to cause overstressing of the concrete. Do not remove forms and their support without approval. Remove supports in a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.

- (p) **Year Built Marking.** Supply the correctly sized forms and molds, and cast the year of completion into each structure, as determined by the Engineer.

420.03.03 Anchor Bolt Placement. Place anchor bolts as specified in 430.03.31.

420.03.04 Concreting. Clean forms before placing concrete. Ensure that temporary struts, stays, and braces holding the forms in correct shape and alignment are not buried in the concrete. If faces of completed or proposed excavated footing areas are disturbed prior to concreting, extend the footings to bear on acceptable undisturbed faces at no additional cost to the Administration.

Place all concrete (except tremie concrete) in the dry.

- (a) **Foundations.** Assume responsibility for any reinforcement fabricated prior to approval of foundations. If bearing material varies more than assumed in design, the Engineer may direct the footing be lowered, raised, or deepened; subfoundation placed; piles used; or a combination of these methods used to best obtain bearing. If planned footings are changed vertically, revise reinforcing steel as required. Use plain nonreinforced Concrete Mix No. 1 to construct subfoundation concrete for bridges, retaining walls, and wing walls of box culverts or rigid frames. This concrete need not be vibrated, and the usual curing and cold weather requirements may be reduced to three days. Selected backfill using number 57 aggregate may be used for subfoundation for box culvert barrels, headwalls, and miscellaneous structures.
- (b) **Concrete Placement.** Avoid segregation of the material and the displacement of the reinforcement. The use of troughs, chutes, and pipes for conveying concrete more than 15 ft from the mixer to the forms will be permitted only when approved. Open troughs and chutes shall be metal or metal lined. Where segregation occurs due to steep slopes, equip chutes with baffles.

Where placing operations involve dropping the concrete more than 5 ft, deposit it through a tube made of sheet metal, canvas, or other approved material. Do not use aluminum hoppers or tubes. Keep lower ends as close as possible to the newly placed concrete but not more than 3 ft above the concrete. All tubes shall be at least 6 in. diameter unless otherwise directed. Do not disturb the forms after initial set of the concrete, and do not place any strain on the projecting ends of the reinforcement.

Place concrete in horizontal layers not more than 12 in. high except as provided herein. When less than the complete area of a layer is placed in one operation, terminate it in a vertical bulkhead. Place and vibrate each layer before the preceding layer has taken initial set.

Place concrete in columns and walls in one continuous operation unless otherwise directed. Allow concrete to set at least 12 hours before placing the caps.

Where walls, piers, columns, struts, and posts have horizontal construction joints, do not place succeeding lifts until the lower placement has set for 12 hours.

Prior to subsequent placement, clean all accumulations of mortar splashed upon the reinforcement. Avoid damaging the concrete seal bond near and at the surface of the concrete while cleaning the reinforcing steel.

(c) Superstructure Placement.

(1) Grade Controls for Bridge Deck Slabs. Place bridge deck slabs supported by new stringers to the specified line and grade. Take all necessary precautions, including a check on all new bridge seat elevations as the last order of work before setting stringers. Complete any adjustments resulting from this check before starting additional work. After the structural steel is set, make a final check of elevations of all the steel stringers at points corresponding to those for dead load deflection and finished roadway elevations. Make computations and have them approved. Set controls at proper elevations to produce finished tops of concrete bridge decks that will be true to the planned line and grade of the roadway.

Perform grade control for bridge deck slab replacements as specified in 405.03.02.

(2) Superstructure Placement Restrictions. Do not erect the superstructure until the substructure forms have been sufficiently stripped to determine the character of the concrete in the entire substructure. In all spans, use plywood forms to cast the concrete bridge deck slabs outside of the stringers.

Unless otherwise specified, pump concrete for deck slabs whenever the volume of concrete in the pour exceeds 50 yd³.

Place all superstructure concrete according to the following schedule:

SUPERSTRUCTURE CONCRETE PLACEMENT SCHEDULE		
DATES	BEGIN CONCRETE PLACEMENT AFTER	FINISH BURLAP PLACEMENT BEFORE
May 15 - June 15	7:00 PM	11:00 AM
June 16 - Aug. 14	9:00 PM	7:00 AM
Aug. 15 - Sept. 15	7:00 PM	11:00 AM
Sept. 16 - May 14	No time restrictions	

Do not place or work superstructure concrete in any manner when the temperature in an unshaded location at the placement site is above 80 F. Use floodlighting when existing light is less than 20 average horizontal ft-c over the construction area.

Submit a Situation Plan showing the locations and aiming of floodlights. After reviewing this plan, the Engineer will witness a test of the floodlighting system at the proposed construction area. The floodlighting system shall be capable of maintaining 20 ft-c without producing a glare on traffic. Floodlighting systems shall be as approved. When portable generators are used, have an emergency backup system available at all times on the job site.

- (3) Rate of Concreting for Bridge Deck Slabs.** Make provisions to ensure that the placement rate of concrete is at least 35 yd³/hour per crew. Under special circumstances, the Engineer may give written approval to lower this requirement.

Submit evidence of an adequate source of concrete and placing and finishing equipment capable of meeting the minimum rate of placement while providing the intended quality finish. Submit this evidence at least one week prior to the proposed placement of the bridge deck slab.

Place concrete in slab spans in one continuous operation and in one layer for each span.

Do not mound concrete on forms supported by beams, stringers, or girders. Distribute the concrete to a depth not exceeding the planned slab thickness plus 6 in. before spreading, consolidating, and finishing.

Follow the placing sequence in the numerical order specified without modification. Allow at least 40 hours between the completion of one placement and the start of the next numbered placement.

- (d) **Box Culverts.** If the top slab is the roadway riding surface, place as specified in 420.03.04(c). Construct box culverts by casting in place or use precast reinforced concrete box culvert sections. Whichever method is indicated in the Contract Documents, the alternate method may be used unless otherwise specified. However, all time constraints such as maintenance of traffic, curing, and completion date shall be met.

If precast sections are used, at least 15 ft of all box culvert ends and all footings, wing walls, headwalls, and toe walls shall be cast in place. Additionally, terminate the precast sections at least 1 ft from footings and toe walls. Show lifting devices on the working drawings. Fill lifting holes with nonshrink grout after the precast units are in place. Set the precast reinforced concrete box sections tightly together, and seal the joints per the manufacturer's recommendations.

Place the bottom slabs of cast in place concrete box culverts for their full depth in one mass or layer and allow to set at least 12 hours before performing any additional work.

Do not place the top slab on single cell box culverts spanning in excess of 10 ft and on multiple cell box culverts until the concrete in the sidewalls has set for at least 12 hours. Construction joints at the top of sidewalls may be omitted in some cases provided the top slabs are placed as follows:

- (1) For single cell box culverts spanning 10 ft or less, the sidewall construction joint may be omitted and the top slab placed on the sidewalls, provided the concrete in the sidewalls is allowed to set for approximately two hours before starting to place the top slab.
- (2) Regardless of size or number of cells, a written request may be made to place the top slab on the walls of box culverts per (1) above. Submit the proposed plan, including rate and method of placement, and type and size of equipment. With initial approval, the first section of the structure will serve as a demonstration to confirm that there is no excessive cracking or any other detriment, and that satisfactory results will be obtained. After receiving final approval, continue placing the

remainder of the box culvert. If at any time the Engineer determines that the results are no longer satisfactory, revert to placing the concrete with the 12 hour delay as specified above.

- (e) **Forming Concrete Parapets and Median Barriers on Bridges.** Either the slip form method or conventional fixed form method may be used. However, do not use the slip form method on bridges maintaining traffic or on parapets when railing is specified.

If the slip form method is proposed, demonstrate ability to produce acceptable results. If the demonstration is unacceptable or acceptable results are not maintained during production, stop the slip form operation, remove the unacceptable work, and modify the construction methods. If construction modifications do not produce acceptable results, use the fixed form method. No additional compensation will be made, and no increase will be made in any Contract price. Nor will any revisions be made to the amount of time to complete the Contract as a result of any required removals, modifications, or changes in the method of placing parapets or barriers.

Notify the Engineer in writing of the proposed method of constructing the parapets and median barriers prior to beginning superstructure work.

The following shall apply to the consideration of slip forming:

- (1) Submit evidence of being capable of producing high quality slip formwork. Prior to beginning any slip form construction, submit a detailed work plan. Include the type of equipment, materials, and procedures to be used, subcontractors involved in the construction, key personnel who will be performing the work (names, training, experience, etc.), as well as detailed information on the proposed process to satisfactorily complete the work.
- (2) When possible, include reference in the work plan to at least three other similar projects completed in the State of Maryland or surrounding states. As far as practical, these projects shall have been built using the same equipment, personnel, material, and procedures proposed for the project. The Engineer may visit these completed projects to evaluate the acceptability of the finished product.

If the Engineer determines that satisfactorily slip formed parapets or median barriers have been demonstrated at the locations submitted in the work plan, the requirements of the off bridge test site specified below may be waived, and the first 50 ft of slip forming on the bridge will be considered the test section for the structure. This test section shall be completed and approved prior to placing the remaining portions of parapet or bridge median barrier.

- (3) Do not begin any slip forming operation without written approval of the work plan.

Any proposed revisions or deviations to the approved work plan shall be submitted and approved prior to making the change.

If (2) above is not met, complete an acceptable off bridge test section prior to placing any portion of the parapet or bridge median barrier. Place the appropriate test section of parapet or median barrier using the same equipment, sensor line, support spacing, material, personnel, and procedures described in the work plan. This test section shall match the structure's horizontal curve as much as practical, be at least 50 ft long, and be placed at a location selected by the Contractor near the bridge site.

Place the off bridge test section with vertical irregularities varying upward and downward at least 3/4 in. Demonstrate that the method of slip forming can compensate for this deviation and provide a top of parapet or median barrier that is true to the proposed line and grade and not necessarily parallel to top of bridge deck. This necessitates that the equipment provide for variations in height of vertical face of parapet where it intersects the top of deck slab.

Position, support, and space the sensor line in the same manner that will be used on the bridge decks, with no stakes, holes, etc., used to support it. Use the sensor support spacing recommended by the slip form machine manufacturer and as necessary to maintain the planned line and grade. Use the same rate of slip forming proposed for the bridge. Saw cut joints in the test section at the same approximate spacing and in the same manner as proposed for the finished bridge. The Engineer will evaluate the procedure, material, equipment, and appearance of the test section.

Take three test cores from the test section at directed locations to determine the concrete quality. Honeycombing, sags, tears, or other evidence of poor quality concrete will be cause for rejection of the test section. If the test section is rejected, either place additional test sections until approved, or use the fixed form method.

Do not remove the accepted test section until all parapets or median barriers on the bridges are complete. The slip forming on the bridges will be compared to the approved test section to ensure that similar acceptable structures are being achieved. Following completion and acceptance of all bridge parapets and median barriers, remove and dispose of the off bridge test section.

The entire testing procedure, including removing and disposing of test units, regardless of whether the procedure is approved or rejected, shall be at no additional cost to the Administration.

When dual bridges are separated by a joint, construct the two parapets that make up the median barrier in separate operations; not simultaneously. Allow the first median parapet section to cure for at least 40 hours prior to constructing the second section of median parapet. Place additional reinforcing steel to brace the parapet against displacement during the extrusion process. A detail will be included in the Contract Documents. The alignment and rigidity of the reinforcing steel will be strictly enforced to ensure that the minimum clearances specified for concrete cover are maintained.

Ensure that an uninterrupted flow of concrete is provided to the slip form machine. Once the slip form machine is set in motion, keep it advancing until it reaches the proposed stopping point. Organize and schedule the operations in a manner that the next concrete truck will be able to move into position at the slip form machine as soon as the previous truck pulls away without interrupting the machine's uniform advancement. Under no circumstances may the slip forming be operated in a manner that requires removal of a concrete truck from the bridge before moving another truck into place.

Except for the slip form machine and its concrete supply trucks, do not allow vehicular traffic on the bridge while slip forming operations are in progress.

After setting up the slip form machine and placing the sensor wire, perform a dry run of the equipment in the presence of the Engineer. Demonstrate that the parapet or median barrier will envelop preset embedded obstacles and will meet with flush surfaces such as pull boxes, expansion joint plates, etc.

Use concrete of a consistency that the shape of the structure is maintained without support after extrusion. The surface shall be free of surface pits larger than 3/16 in. diameter. Finish the concrete with a light brushing with water only. Finishing with brush applications of grout is prohibited.

If a tear occurs at the top of the parapet or median barrier during the slip forming operation, remove it immediately. Make the repair using acceptable concrete practices. Blend the repair into the barrier to the extent that there is no distinguishable difference in the wall face or top. The rate at which the slip form machine is advanced shall be the same as used on the approved test section.

The shape of the finished parapet or median barrier shall conform to the dimensions specified. The vertical face at the bottom of the concrete safety shaped parapets and median barriers shall not exceed 3-1/2 in. Ensure that the finished parapet or median barrier does not deviate from the proposed grade and alignment in excess of 1/4 in./10 ft.

Use a diamond blade to saw cut joints in the finished parapet or median barrier. Make cuts and space joints as specified. The trapezoidal shaped control joints on the outside of parapets will not be required if slip forming is used. Terminate slip form placements only at a parapet control joint. Saw cut the joints as soon as possible after initial concrete set and after the concrete has set sufficiently to preclude raveling during the sawing. Complete the sawing the same day the concrete is extruded and before any shrinkage cracking occurs. Do not leave concrete overnight without saw cutting the joints.

When portions of the bridge are superelevated, produce the configuration specified, i.e., level top surface, wall normal to deck surface, etc.

- (f) **Temperature Controls.** Ensure concrete temperatures meet 902.10. Heat concrete below these temperatures by one of the following methods:

- (1) When the method of heated mixing water is used, do not introduce water above 170 F into the mix.
- (2) When the method of heated aggregates is used, heat aggregates containing frozen lumps separately. Do not allow materials containing frozen lumps, ice, or snow to enter the mixer. Heat aggregates by steam coils or other dry heat but do not discharge live steam or hot water into them. Do not use a flamethrower or any direct flame.

When the ambient air temperature is below 40 F, raise the temperature of the air in contact with the reinforcement to 40 F prior to placing concrete. When the ambient air temperature is above 70 F and the reinforcement or steel forms are exposed to the direct rays of the sun, cool the reinforcement and forms to 70 F or less by means of a water spray prior to placing concrete.

When abnormal wind or storms are forecast locally by the National Weather Service, do not place superstructure concrete during the period covered by the forecast.

- (g) **Pumping.** Provide approved equipment that is suitable and adequate in capacity for the work. Arrange the equipment so that no vibrations result that might damage freshly placed concrete. Do not use pumps or discharge lines containing parts made of aluminum.
- (h) **Use of Conveyors.** Concrete may be moved from the mixer to its final position by conveyors. Use conveyors in sections, by which concrete is disposed from one conveyor belt onto the next through a hopper. Limit the maximum rise on any individual section of the conveyor to 30 degrees from the horizontal. For concrete slumps less than 2 in., limit the belt travel speed to 900 ft/minute. Decrease this speed for slumps exceeding 2 in. Conveyers used for placement of decks shall be supported by main load carrying members. Place polyethylene or other acceptable material under the conveyor line to contain any spillage.

420.03.05 Depositing Concrete Under Water. Refer to 402.03.04. Do not deposit concrete in water or expose it to the action of water before setting, unless specified or approved. Use a tremie pipe that is at least 10 in. diameter and equipped with a watertight plug.

Equip the bottom of the pipe with a baffle or deflector plate. The number and location of pipes will be dependent on the size of the pour. Do not disturb the tremie concrete after placement, nor place successive

layers on top until the previously placed concrete has developed the necessary strength as determined by the Engineer. Do not deposit concrete in water that is less than 35 F. When concrete is deposited in water 36 to 45 F, heat the concrete and place it at a temperature of 60 to 80 F. Do not pump water during concrete placement. Regulate the consistency of the concrete to prevent segregation. Cut down portions of tremie concrete that project more than 6 in. above the top of the as-planned elevation.

- (a) **Cofferdams.** Where cofferdams are used, construct separate forms within the cofferdams except where footing concrete is to be placed against a base of undisturbed material and where the cofferdam is to remain in place and act as the concrete form. In the space between form and cofferdam, keep the water level below the bottom elevation of concrete for at least 12 hours.
- (b) **Concrete Seals.** When feasible, concrete seals for parts of structures under water shall be placed continuously from start to finish to avoid horizontal construction joints. Keep the surface of the concrete as nearly horizontal as practicable at all times to ensure thorough bonding. In these cases, place each succeeding layer of the seal before the preceding layer has taken its initial set. Maintain the slump of tremie concrete between 4 and 8 in. but as close to 4 in. as possible. After dewatering and prior to placing any succeeding layers of concrete, thoroughly clean the top of the foundation seal (tremie concrete).
- (c) **Concrete Exposed to Saline Water.** Do not allow saline water to come in direct contact with the concrete until it conforms to the following table:

CONCRETE IN SALINE WATER	
SALINE CONTENT OF WATER BY WEIGHT IN PARTS PER THOUSAND	SALINE WATER SHALL NOT CONTACT CONCRETE UNTIL FOLLOWING MINIMUM TIME IN DAYS HAS ELAPSED AFTER INITIAL SET*
0 to 10	0
10+ to 15	7
15+ to 20	14
20+ to 25	21
Over 25	30
* The Engineer may approve a waiver in writing.	

Unless otherwise specified, wet cure the concrete for at least seven days while being maintained at 50 F or above.

420.03.06 Consolidation. Except for concrete deposited under water, consolidate concrete by means of internal vibrators. These provisions also apply to precast members or units.

Apply vibration at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

- (a) **Internal Vibration.** Internal vibrators shall be of an approved type and design. The intensity of application shall visibly affect a mass of concrete of 1 in. slump over a radius of at least 18 in. and have a frequency of vibration of at least 4500 impulses per minute.
- (b) **External Vibration.** External vibrators shall be of an approved type and design. Use external vibration as directed for the following sections: very thin, very heavily reinforced, numerous inserts, or where form surfaces are sharply inclined or battered. For steel grid floors, consolidate filler concrete by applying external vibration to the steel grid.

420.03.07 Finishing Concrete Surfaces. Concrete surfaces shall be finished using one of the following types. However, use an ordinary surface finish as described in (a) below unless otherwise specified.

- (a) **Ordinary Surface.** Immediately following the removal of forms, remove all fins and irregular projections from all surfaces except those that are not to be exposed or not to be waterproofed. On all surfaces, thoroughly clean broken corners or edges and cavities. After having kept them thoroughly moist, point and true them with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Remove any excess mortar, and cure the mortar patches as specified in 420.03.09. Carefully tool and clean construction and expansion joints. Ensure that joint filler is exposed for its full length with clean and true edges. Resulting surfaces shall be true and uniform. If the surface cannot be repaired in an acceptable manner, apply a special surface finish as described in (b) below.
- (b) **Special Surface.** Remove fins and projections. Then saturate the surface with water and keep it wet for at least two hours. Thoroughly rub a grout mix of the same proportions as the concrete onto the surface by section using burlap pads or cork floats completely filling all voids, pits, and irregularities. After this grout has dried sufficiently, wipe off the excess using dry, clean burlap. Cure the surface as specified in 420.03.09(f), except

use a colorless liquid curing compound. Apply this finish to the exterior faces of cast-in-place superstructures and end posts for bridges over highways, and all interior faces of cast-in-place parapets, bridge median barriers, and end posts. Do not apply this finish to members constructed by the slip form method.

- (c) **Horizontal Surfaces.** Finish all upper horizontal surfaces such as the tops of parapets, copings, and bridge seats by placing an excess of concrete material in the forms and striking off even with a wood template. Apply a steel trowel finish to the tops of handrail (posts and caps), headwalls, parapets, wing walls, and barriers.

Finish the bridge seat bearing areas of the substructure masonry to the elevations specified. Check the elevation of each bearing area prior to finishing to ensure conformance. Ensure that each area is level in all directions, and make adjustments prior to the setting of the concrete. Steel trowel the area. Grind bearing areas that are not flat after final finishing to achieve an acceptable surface.

Bearing areas will be rejected whenever the elevation is below that of the surrounding masonry.

- (d) **Bridge Deck Slabs.** Use an approved power operated cylinder or roller finishing machine. Set the finishing machine and transverse construction joints parallel to the nearest support lines (abutment or pier). If the skew angle changes at supports, adjust the angle of the screed accordingly as the finishing machine progresses across the deck slab. Place the concrete so that the front edge of the newly placed concrete is as nearly as possible parallel to the skew of the finishing machine. Place the concrete uniformly but not more than 10 ft ahead of the finishing machine, and not more than 6 in. above the top elevation of the finished deck slab.

Do not span the finishing machine greater than the length recommended by the manufacturer. Combine machines or use two machines in which both use a common rail. The proposed method and the location and anchorage of accessories that will remain in the completed superstructures as a result of this requirement are subject to the approval of the Engineer and shall meet 420.02.02.

After the concrete has been struck off, check the surface with a long handled 10 ft straightedge operated in a position parallel to the center line of the structure. The straightedge shall be as light weight as possible to avoid distortion of the slab surface, and have a working face no more than 2 in. wide.

Progress longitudinally in overlapping 5 ft increments and transversely in 2 ft increments to locate any irregularities in the surface.

Finish the concrete surface with a full width strip of burlap, mechanically or manually dragged across the surface.

- (1) **Slab Grooving.** Groove all bridge decks including slab bridges and box culverts built to grade. Start the grooving operation after the bridge deck slab has been cured as specified in 420.03.10, and attained a minimum compressive strength as specified in 420.03.15. Groove the bridge deck perpendicular to the center line.

Use a mechanical saw device to cut grooves that are 1/8 in. wide, $3/16 \pm 1/16$ in. deep, and variably spaced from 5/8 to 7/8 in. apart. Extend the grooves across the slab to within 1 ft of the gutter lines. Do not cut across armored joints or any joint in which an existing joint seal may be damaged; stay clear by 2 ± 1 in. on each side. On joints skewed 70 degrees or less, make one pass parallel to the armored joint unless otherwise directed. Remove the residue resulting from grooving operations from all surfaces in an acceptable manner. Leave all surfaces in a washed, clean condition.

- (2) **Deck Slab Tolerances.** Any slabs found to have deficient thickness may be rejected. Limit surface deviation in a transverse or longitudinal direction to 1/8 in./10 ft from a straight line. For vertical curves, limit deviation (from the curve specified) to 1/8 in./10 ft in a longitudinal direction. Do corrective work prior to grooving.

- (e) **Sidewalks and Safety Curbs.** Use an approved screed to strike off the concrete to the elevation and slope specified. Wood float the concrete to give a gritty surface free from depressions or high spots. Then edge the joints with the appropriate edging tool. Strip curbs and finish as soon as possible.
- (f) **Culvert Slabs.** When the tops of culvert slabs are the roadway riding surface, finish them according to (d) above. If invert slabs and the tops of culvert slabs are not part of the roadway, or when they are to be overlaid with hot mix asphalt, screed them by hand or machine and apply a float finish. Maintain the surface within 1/4 in. of the grade specified.

Inverts of culverts having a span less than 10 ft need not be straightedged.

420.03.08 Curing. These requirements apply to curing of all concrete surfaces except bridge deck slabs or top surfaces of culverts with integral wearing surfaces, which shall be cured as specified in 420.03.10.

Start curing as soon as the concrete has set sufficiently.

Keep the surfaces wet, even in areas where there is no ready water supply.

- (a) Cure culvert invert slabs and all footings for five days using the method specified in 420.03.09(a),(b),(c), or (d).
- (b) Cure vertical surfaces in the forms for seven days. However, the forms may be removed after 24 hours for structural elements 6 ft or less in height, or after 48 hours for structural elements greater than 6 ft high, with the provisions specified herein. Cure the surface as specified in 420.03.09(d) for the remainder of the seven day curing period. Do not remove the forms when cold weather protection is required. Forms carrying loads shall remain in place for at least seven days and until the concrete has attained a compressive strength of 3000 psi. Internal bulkheads may be removed after the concrete has been in place for 24 hours, if it is necessary to do so to continue the work without interruption. When a higher strength concrete than specified is used, forms carrying loads shall remain in place for at least three and a half days and until the concrete has attained a compressive strength of 3000 psi.

Fiber column forms may be removed at times specified above, but no later than 10 days after placing concrete.

When parapets or median barriers on structures are formed by the slip form method, begin curing as specified in 420.03.09(f) using a fugitive dye liquid membrane-forming compound immediately after the concrete is finished. Immediately after each joint is saw cut, cure the concrete surfaces for the remainder of the seven days of cure as specified in 420.03.09(d).

- (c) Cure tops of end walls, end support walls, headwalls, etc., for three days with burlap or cotton mats as specified in 420.03.09(b) or (d), respectively.
- (d) Cure horizontal surfaces for seven days as specified in 420.03.09(b),(c),(d), or (e).

420.03.09 Curing Methods.

- (a) **Flooding.** Structure units that will be below water in the completed structure may be gradually flooded when approved after the concrete is 12 hours old, provided the curing water meets 921.01. Maintain the water at 35 F or above for the specified curing duration.
- (b) **Burlap.** Use two layers. Overlap successive strips at least 6 in. Place the second layer at least 45 degrees to the first layer, or in lieu of this, the 6 in. overlap of the second layer may be placed midway between the first layer. Thoroughly saturate by immersion in curing water for at least 24 hours prior to placement, and keep it saturated throughout the specified curing duration.
- (c) **White Opaque Polyethylene Backed Nonwoven Fabric.** Use one layer. Overlap successive strips at least 6 in. Thoroughly saturate by immersion in curing water for at least 24 hours prior to placement and keep it saturated throughout the specified curing duration.
- (d) **Cotton Mats.** Use one layer thoroughly saturated with curing water prior to placement and kept saturated throughout the specified curing duration. Keep the material in tight contact with the concrete.
- (e) **White Opaque Burlap Polyethylene or White Opaque Polyethylene Film.** Place white opaque burlap polyethylene sheeting, with the burlap side of the sheeting facing down, on at least one layer of wet burlap. When white opaque polyethylene film is used, place it on at least two layers of wet burlap. Only one layer of cotton mats is required in any usage. These materials may only be used atop the wet burlap or cotton mats on unobstructed flat and reasonably level surfaces.

Lap adjacent mats or sheets at least 1 ft. Bring the ends down around the sides of the concrete being cured and securely fasten to make an airtight seal.

Leave both of these materials in place for the same length of time as required for burlap or cotton mats. These protective coverings need not be wetted down; however, keep the covered burlap or cotton mats wet for the specified duration.

- (f) **Liquid Membrane.** Apply this material according to the manufacturer's recommendation or as directed. Apply by sprayers and keep it thoroughly agitated before and during use.

420.03.10 Bridge Deck Slabs. Cure bridge deck slabs and culvert top slabs with integral wearing surfaces, including sidewalks, as specified herein.

Have misting equipment available. Prior to placing concrete, operate the misting equipment for the Engineer to verify that the equipment and procedure are capable of misting the entire placement area without damaging the fresh concrete. Do this at the location of proposed use each day that a deck placement is to be made. Keep ample spare parts, water, fuel, etc. readily available. Keep an approved unit available for backup.

Cover the finished concrete with wet burlap as specified in 420.03.09(b). Progress by covering the concrete immediately after the concrete has been finished, but do not leave any portion of the concrete uncovered for more than 45 minutes after placement. Use mist spraying when directed and when the concrete is not covered with wet burlap within 30 minutes after placement. Misting does not relieve the requirement for covering the concrete within the 45 minutes after placement. Once misting is started, continue until wet burlap is complete in place.

After the concrete is covered with wet burlap, cure it as specified in 420.03.09(b) for the remainder of the seven day period. Keep the two layers of burlap continuously and uniformly saturated throughout the curing period. White opaque burlap polyethylene sheeting and white opaque polyethylene film or clear polyethylene film shall not be used over wet burlap except when approved for cold weather protection. Use a sufficient quantity of soaker hoses to meet these requirements. Take immediate action to remedy improper saturation of any area throughout the entire curing period.

Provide a sufficient number of experienced personnel and necessary equipment to ensure proper placement, protection, and curing of the concrete according to these Specifications.

Provide temporary troughs, dams, etc., necessary to keep runoff water from reaching any traveled roadway, shoulder, or sidewalk. Submit the proposed methods of controlling runoff water in these areas. Include locations of all troughs and dams, as well as the proposed methods of attaching them to any portions of the structure. Do not weld or drill holes in any portion of a permanent member of the structure.

The approved procedure will be evaluated after it is underway. If any areas are not functioning in an acceptable manner, modify them to satisfy the requirements for retaining and directing the flow of water.

In rehabilitation construction, where the full use of temporary troughs, dams, etc., is not practical, make approved modifications to the provisions for controlling the runoff water.

420.03.11 Construction Joints. Construction joints are permitted only where specified or authorized in writing.

Clean the surface of the hardened concrete and keep it moist until the additional concrete is placed. Use a grade strip to level the top surface of concrete. At chamfers, steel trowel the top surface of the concrete adjacent to the chamfer.

Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wing wall, use an inset form to produce a blocked in addition to the preceding placement. Ensure that the inset form will produce at least a 6 in. edge thickness of concrete in the succeeding placement.

Place epoxy bonding compound on the surface areas of concrete that existed prior to the beginning of the Contract that will be in contact with new concrete. Apply epoxy bonding compound to the entire face of all deck slab construction joints. Ensure that the surfaces to be coated are clean, sound, and dry. Mix and apply the bonding compound in accordance with the manufacturer's recommendations.

420.03.12 Linseed Oil Protective Coating. Apply to the integral concrete bridge deck slabs, box culvert wearing surfaces, and sidewalks on bridges and box culverts, when the pertinent Linseed Oil Protective Coating item appears in the Contract Documents.

Prior to the application of the linseed oil protective coating, ensure that the concrete surfaces to be treated are cured, dried, and thoroughly cleaned of all dust, dirt, and deleterious material; and that required permanent paint or tape lane markings have been applied on the structures.

If the concrete is wet, allow it to dry for one to two days at a temperature of at least 60 F. If the concrete surfaces are extremely dry, take the following actions as directed, and at no additional cost to the Administration:

- (a) Wet the concrete thoroughly and allow it to dry for one or two days.
- (b) Apply a third protective coating at the same rate per gallon as the second coat.

Ensure that the ambient temperature at the time of application is at least 50 F. Ensure that the ambient air temperature following the second application is at least 40 F. Apply two coats on all top surfaces that are not grooved. Apply the first coat at a rate of 40 yd²/gal. Apply the second coat at a rate of 67 yd²/gal. On bridge decks and top slabs of box culverts that are grooved, apply the first coat at a rate of 25 yd²/gal. Apply the second coat at a rate of 45 yd²/gal. Do not apply the second coat until the first coat is dry. If additional coats are required, allow at least 24 hours between them. The drying time may be increased as the ambient temperature falls below 70 F.

420.03.13 Cold Weather Protection. Protect and heat concrete after it has been placed when the air temperature in the shade and away from artificial heat drops to 40 F or lower at the time of placing or at any time within the number of days specified herein. Provide protection and heating as follows:

- (a) Protect ordinary concrete and maintain a temperature of at least 50 F for at least seven days following placement.
- (b) Do not heat concrete to more than 100 F. At the end of the heating period, cool the concrete surfaces to the temperature of the outside air by slowly reducing the artificial heat at a uniform rate until the temperature of the outside air is reached within a 24 hour period.

Have tarpaulins, insulating devices, and other suitable materials at the site to enclose or protect portions of the concrete requiring protection. Have materials as close as possible before placing the concrete, and install them as rapidly as possible to keep exposure to cold weather to a minimum. Where heating is required, completely enclose the spaces to be heated and use approved heaters to keep the temperature at required levels.

Provide a sufficient number of maximum/minimum thermometers to record temperatures in each concrete placement undergoing cold weather protection.

The curing period for all structure concrete requiring cold weather protection shall meet the cold weather protection period except when the normal curing period is longer.

420.03.14 Underpinning Old Foundations. If underpinning is required, perform the work as directed. Restore or lower the old foundations with Mix No. 6 concrete having a maximum slump of 1-1/2 in. Perform excavation and underpinning operations in part section, so as not to remove more than 10 percent of the supporting area under the old foundation at one time. When directed, install underpinning by hand,

pneumatic, or pumping processes. The usual curing and cold weather requirements will be deleted for the underpinning with other provisions for curing and protection improvised on the job as may be directed.

420.03.15 Loads on Concrete Structures. Refer to GP-5.10, TC-6.13 and .14. Do not erect structural steel or concrete superstructures on concrete substructures until curing is complete, all forms are removed, and substructure concrete has reached a compressive strength of 3000 psi.

Do not apply loads to any new portion of bridge deck or box culvert built to grade until the final section of that unit of the deck has completed its specified curing period. No vehicles, including heavy construction equipment, will be permitted on any new portion of bridge deck or box culvert built to grade until the concrete cylinder breaks for the final section of that unit of the deck has attained a compressive strength of 4500 psi. However, loads such as stored materials, lightweight equipment, concrete safety parapets, sidewalks, and median curbs, may be placed upon the concrete slab via crane or other lifting device when the concrete in the final section of that unit of the deck has attained a compressive strength of 3000 psi.

Do not place backfill on any new portion of box culverts not built to grade until the final section of that unit of the slab has completed its specified curing period and the concrete in that section has attained a compressive strength of 3000 psi.

420.03.16 Prevention and Removal of Stains on Concrete. Prevent rust from structural steel, and staining by asphalt materials or any other substance from discoloring any portion of the concrete. Use construction procedures that prevent staining of any of the concrete. Where unpainted structural steel is specified, protect the pier caps, columns, and abutments with a wrapping of reinforced polyethylene or similar material, and leave it in place to prevent staining until after the structure is completed. If any portion of the concrete is stained, remove the stain and restore the original color without damaging the concrete. Do the work as directed and at no additional cost to the Administration. Do not use chemical solvents without approval.

420.03.17 Safety Hazards. Perform gas detection in and ventilation of confined spaces as specified in TC-3.04.

420.03.18 Defective Work. Within 24 hours of removing the forms, remove and repair defective work as directed.

- (a) At the edges of material remaining in place, make a cut perpendicular to the finished surface to the full depth of the material removed, but not less than 1 in. If the removal of

defective concrete affects the structural requirements, remove and replace the member as directed.

- (b) Clean defective areas.
- (c) Coat defective areas with an epoxy bonding compound.
- (d) Patch defective areas with concrete mortar or epoxy matching the color, contour, and texture of surrounding concrete as close as possible.

420.04 MEASUREMENT AND PAYMENT. Portland cement concrete structures will be measured and paid for as specified. The payment will be full compensation for all forms and form removal, reinforcement steel, curing and misting, scuppers, grooving, mechanical, and electrical work, all cost incidental to the conducting of tests for oxygen content and presence of gases and applying mechanical ventilation to confined spaces, year built markings, and all material, labor, equipment (including safety equipment), tools and incidentals necessary to complete the work.

The construction of drainage and weep holes, any pipe necessary, expansion material, flashing, dampproofing, membrane waterproofing, epoxy bonding compound, joints and their placement will not be measured but the cost will be incidental to the concrete item. No deduction in concrete quantities will be made for pipes or conduits having diameters less than 8 in., reinforcement steel, anchors, or any other appurtenances.

420.04.01 Portland cement concrete for Footing Concrete, Subfoundation Concrete, and Tremie Concrete will be measured and paid for at the Contract unit price per cubic yard.

420.04.02 Portland cement concrete for Substructure Concrete for Bridge, Superstructure Concrete for Bridge, and Reinforced Concrete Box Culverts will not be measured but will be paid for at the Contract lump sum price. When an Epoxy Coated Reinforcing Steel Bars item for the pertinent structure is included in the Contract Documents, the cost for epoxy protective coated reinforcement steel will be excluded from the Contract lump sum price for Superstructure Concrete for Bridge. When a bridge deck rehabilitation project, other than bridge widenings, requires modification to the backwalls and wing walls and there is no substructure concrete item, the concrete will be incidental to the Superstructure Concrete item.

420.04.03 Wing walls and footings for reinforced concrete box culverts will not be measured but the cost will be incidental to the Reinforced Concrete Box Culvert item.

420.04.04 Parapets (including end posts) on bridges, wing walls, reinforced concrete box culverts, and retaining walls; or concrete median barriers on bridges and top slabs of reinforced concrete box culverts will not be measured but will be paid for at the Contract lump sum price for the pertinent Concrete Parapet or Concrete Median Barrier items.

420.04.05 Parapet and end post modifications on bridges, wing walls, reinforced concrete box culverts, and retaining walls; or concrete median barriers on bridges and top slabs of reinforced concrete box culverts will not be measured but will be paid for at the Contract lump sum price for the pertinent Parapet Modification item. The payment will also include saw cutting, removal of portions of the existing parapet or end post, drilling, and grouting.

420.04.06 Floodlighting for placement of superstructure concrete will be measured and paid for at the Contract unit price per night used for the pertinent Floodlighting item. The payment will also include fuel, backup generator, setup, relocation, and removal.

420.04.07 Linseed oil protective coating will be measured and paid for at the Contract unit price per square yard for the pertinent Linseed Oil Protective Coating item. The payment will be full compensation for all coats including time and cost when a third coat or the application of water is required on dry surfaces.

420.04.08 Cofferdams, temporary supports, or piling will not be measured but the cost will be incidental to the formwork.

420.04.09 Retaining walls will be measured and paid for as specified in 450.04.

SECTION 421 — REINFORCING STEEL

421.01 DESCRIPTION. Furnish and place uncoated and epoxy coated reinforcing steel.

421.02 MATERIALS.

Grout	902.11(c)
Deformed Steel Bars	908.01

Plain Round Steel Bars for Column Spirals	908.02
Wire Mesh	908.05 and .06
Fusion Bonded Epoxy Powder Coating for Steel and Touch Up System	Section 465 and 917.02
Galvanizing	A 153

421.02.01 Supports. Use approved coated metal, plastic, plastic tipped, or galvanized material. Aluminum is unacceptable. All materials are subject to approval.

For epoxy coated steel, use wire supports completely covered with 1.5 to 9.0 mils of adherent epoxy coating except for minimum necessary contact marks. Hold the reinforcing steel in place with plastic coated tie wires fabricated for this purpose.

Steel bars used as supports for epoxy coated steel shall be coated in the same manner as reinforcing steel.

421.03 CONSTRUCTION.

421.03.01 Working Drawings. Submit working drawings for approval prior to the start of any fabrication, unless otherwise specified. Refer to Section 499.

421.03.02 Plan Dimensions. All dimensions related to reinforcing steel are out to out measurement except the spacing is measured center to center.

421.03.03 Cutting and Bending. Cut and bend reinforcing bars at the mill or shop to the shapes specified before shipment to the job site. Bending shall not be performed in the field except to correct errors, damage by handling and shipping, or minor omissions in shop bending.

Saw or shear epoxy coated reinforcing bars on skewed bridges and in other locations that are specified to be cut in the field; flame cutting is prohibited.

Ensure that all bending conforms to the tolerances specified in the Contract Documents.

421.03.04 Shipping, Handling, and Protection of Material. Ship reinforcing steel bars in standard bundles; tagged and marked in accordance with the provisions of the Code of Standard Practice of the Concrete Reinforcing Steel Institute. Keep bundles intact, undamaged, and properly identified until ready for use.

Bundle coated steel together for shipment using excelsior or other approved materials, and banded using plastic or padded metal bands. Perform all lifting with a lifting beam and multiple supports consisting of a sufficient quantity of straps or slings to prevent abrasion within the bundle from excessive bending or distortion.

Store bundles at the site on suitable blocking or platforms at least 4 in. above any type of surface and vegetation. Keep free from vegetation growth, accumulations of dirt, oil, or other foreign material. Keep blocking sufficiently close to avoid bending and distortion of the bars. Correct any distortion of the bars or damage to epoxy coating as directed. Touch up any damage to the epoxy coating as specified in 465.03. Adequately cover epoxy coated bars for protection from ultraviolet rays from the time of delivery when they are to be stored outside for more than 90 days.

421.03.05 Placing and Fastening. Accurately place all reinforcing steel, including dowel bars, in the position specified in the Contract Documents or working drawings, and hold firmly during the depositing and setting of the concrete. Do not insert into the plastic concrete.

Tie all intersections, except alternate intersections need not be tied where spacing is less than 1 ft in each direction. On bridge decks and the top slabs of box culverts, tie all intersections in the top mat of reinforcing. Do not bend reinforcing steel bars after embedment in concrete.

Before placing concrete, clean all mortar from the reinforcing. Do not place concrete until the reinforcing bars are inspected and approved. Approval shall not relieve the Contractor of the responsibility for correcting problems caused by any shifting of the bars during the placement of concrete.

Support reinforcing bars and maintain their distances from faces of forms by using approved templates, blocks, ties, hangers, or other supports. Support bars in the bottom of footings on approved precast concrete blocks with embedded tie wires or suspend in place. Support bars in the tops of footings by using approved supports.

Do not use metal, metal with plastic tipped legs, or plastic chairs against formed surfaces that will be exposed in the finished structure.

The Engineer will perform a final visual inspection of epoxy coated steel at the construction site after the steel is in place and immediately prior to placing the concrete. Patch designated repair areas using epoxy as specified in 465.03. Do not place concrete on a patched area until the

patching material has cured for one hour. Allow four hours of normal working time after the reinforcing and forms are in place for the inspection.

421.03.06 Splicing. Furnish bars in the lengths and spliced as specified in the Contract Documents and approved working drawings. Do not perform additional splicing without approval. Make lap splices with the bars in contact and wired together.

Do not weld reinforcing steel or attachments thereto without authorization.

421.03.07 Tying New Concrete into Existing Concrete. On all projects where portions of existing structures are to be used in the finished structure and existing concrete is to be removed, straighten, clean, and protect the existing reinforcing steel to be incorporated in the final structure.

For exposed existing reinforcing steel that is to be incorporated into the final structure:

- (a) Cut out any that has lost 20 percent or more of its original cross sectional area as determined by the Engineer. Provide and place a new bar of the same diameter so as to have the minimum required lap at each end of the new bar, or modified as per (c).
- (b) Where the required bar lap length is available, use it as a dowel.
- (c) Where the required bar lap is not available or limits of concrete removal to achieve bar lap are too great, make a welded or approved mechanical splice.

When existing reinforcing steel extends into an area in which epoxy coated reinforcing steel is required, abrasive blast clean and epoxy coat using the touch up system. Refer to Section 465.

If expected reinforcing steel is missing, or a pattern differing from that shown on the existing Contract Documents is uncovered, contact the Office of Bridge Development for evaluation.

Where dowel bars are required to tie new concrete into an existing structure, install as specified in 406.03.

421.03.08 Substitution. Substitute different size bars only when approved by the Engineer. There will be no additional compensation for substituting larger size bars in lieu of the bars specified.

421.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for cleaning, coating, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

421.04.01 Reinforcing steel bars or epoxy coated reinforcing steel bars will not be measured but the cost will be incidental to other pertinent items specified unless a Reinforcing Steel Bars or Epoxy Coated Reinforcing Steel Bars item appears in the Contract Documents.

421.04.02 Reinforcing Steel Bars or Epoxy Coated Reinforcing Steel Bars will not be measured but will be paid for at the pertinent Contract lump sum price.

421.04.03 Reinforcing Steel Bars or Epoxy Coated Reinforcing Steel Bars will be measured and paid for at the Contract unit price per pound based on the original approved overall lengths of bars computed on the basis of the nominal unit weight per linear foot.

421.04.04 Incorporating existing reinforcing steel in the final structure including straightening, bending, splicing, and removal and replacement will not be measured but the cost will be included in the pertinent Concrete item.

SECTION 422 — DAMPPROOFING AND MEMBRANE WATERPROOFING

422.01 DESCRIPTION. Furnish and apply dampproofing and waterproofing to concrete surfaces.

422.02 MATERIALS.

Asphaltic Materials	913.01
Asphalt Primer	913.02
Fabric for Use with Asphalt	913.03
Membrane Waterproofing and Dampproofing	913.04

422.03 CONSTRUCTION. Apply dampproofing and waterproofing using asphaltic materials, primers, and fabric; or by the roll or sheet method as specified in 422.03.07.

422.03.01 Storage. Store waterproofing fabrics and membranes in a dry protected place. Keep containers of asphalt materials closed when not in use.

422.03.02 Surface Preparation. Do not apply dampproofing or membrane waterproofing until curing is complete and surfaces are protected from the cold. Ensure that all surfaces are dry, smooth, and free from projections and holes.

When dampproofing and membrane waterproofing are both specified for application, apply the membrane waterproofing first. Do not apply dampproofing or membrane waterproofing when the temperature is less than 40 F.

422.03.03 Dampproofing. If asphaltic coatings are used for dampproofing, use two prime coats and one seal coat. Apply dampproofing to the following concrete surfaces that will be in contact with backfill:

- (a) Rear face of abutments and abutment wing wall stems.
- (b) Rear faces of headwalls and wing walls for pipes 36 in. in diameter or larger and for culverts.
- (c) Rear face of retaining wall stems.
- (d) The following areas pertain to reinforced concrete box culverts:
 - (1) Top of top slabs when not built to grade.
 - (2) Entire outside surfaces of side walls.
 - (3) Additionally, bottom of bottom slabs of precast units.

422.03.04 Waterproofing. If asphaltic coatings are used, use a prime coat, three mop coats, and two layers of fabric.

Apply waterproofing to construction joints that are next to backfill above normal water surface when backfill is on one side and atmosphere on the other side. Apply a width of at least 16 in., centered on the joint.

422.03.05 Application of Dampproofing. Confine coatings to the areas to be covered. Prevent coating of parts of the structure exposed to view in the completed structure. Apply dampproofing to the full face of all contraction joints.

Apply the dampproofing according to the manufacturer's recommendations. When no recommendations are provided, apply the dampproofing material to the cured, cleaned, and dry surfaces as follows:

- (a) Paint with two coats of primer for absorptive treatment at a rate of $1/8$ gal/yd² per coat. Do not apply the second coat until the first coat has thoroughly dried. Do not heat this material.
- (b) After the second prime coat has thoroughly dried, apply one seal coat by brush or roller at a rate of $1/8$ gal/yd². When necessary, this material may be heated, but not in excess of 150 F.

422.03.06 Application of Membrane Waterproofing. Coat the cured, cleaned, and dry surfaces with a prime coat. Cover with mop coats and layers of fabric.

Coating Procedure. Coat with a primer at a rate of $1/8$ gal/yd². Apply the prime coat 24 hours in advance of applying any mop coats and ensure that it is dry before applying the first mopping. Do not heat the primer.

Heat asphalt for mop coats to a temperature between 300 and 350 F. Stir frequently to avoid local overheating. Provide heating kettles equipped with thermometers.

Begin the waterproofing at the low point, so that water will run over and not against or along the laps.

Make the first strip of fabric half width. Make the second full width, lapping the full width of the first sheet. Make the third and each succeeding strip thereafter full width and lapped so that there will be two layers of fabric at all points and three layers with laps not less than 2 in. wide at edges of strips. Make all laps at ends of strips at least 12 in. wide. Thoroughly seal down the cloth at all laps.

Beginning at the low point, mop a section 20 in. wide for the full length of the surface with the hot asphalt. Immediately after the mopping, press the first strip of fabric into place eliminating all air bubbles. Mop this strip and an adjacent section of the surface to a width equal to slightly more than half the width of the fabric, and press a full strip and a full width of the fabric into place as before. Then mop the forward or upper half of this second strip and mop an adjacent section of the concrete surface with hot asphalt. Apply the third strip of fabric shingled on so as to lap the first strip at least 2 in. Continue this process until the entire surface is covered. Then give the entire surface a final mopping of hot asphalt. Ensure that there is a complete coating of asphalt between all layers of fabric.

In all cases, ensure that the mopping on concrete covers the surface so that no gray spots are visible, and on cloth is sufficiently heavy to conceal the weave. Apply asphalt at the rates of 1.2 gal/yd² on horizontal surfaces

and 1.4 gal/yd² on vertical surfaces. Regulate the work so that at the close of a day's work, all cloth in place has received the coatings required for that stage of completion.

422.03.07 Roll or Sheet Waterproofing Membrane. An alternate system of waterproofing or dampproofing consisting of rolls or sheets of membrane material may be used in lieu of the above coatings. Apply the rolls or sheets according to the manufacturer's recommendations.

422.03.08 Membrane Care. At the edges of the membrane and at points punctured by appurtenances such as drains or pipes, flash it in an acceptable manner to prevent water from getting between the waterproofing and the waterproofed surface. Repair any damage to the membrane. Extend repairs beyond the outermost damaged portion, and extend the second ply at least 3 in. beyond the first.

422.04 MEASUREMENT AND PAYMENT. Dampproofing and membrane waterproofing will not be measured but the cost will be incidental to other pertinent items specified.

SECTION 423 — PNEUMATICALLY APPLIED MORTAR

423.01 DESCRIPTION. Remove deteriorated concrete, and furnish and place pneumatically applied mortar.

423.02 MATERIALS.

Curing Materials	902.07
Reinforcing Steel	908.01, 908.02, and 908.08
Anchor Bolts	909.06
Water	921.01

Use Type II cement meeting 902.03, and furnish in the original 94 lb paper sacks supplied from the cement manufacturer.

Use fine aggregate meeting the Fine Aggregate-Portland Cement Concrete requirements of 901.01. Ensure that the maximum moisture content does not exceed 6 percent by weight.

Pneumatically applied mortar shall have a 28 day compressive strength of 5000 to 9000 psi. Ensure that all mixes are approved prior to starting work.

423.02.01 Test Panels. When specified, prepare and cure test panels of various mix combinations, admixtures, and materials. Prepare one test panel for every 100 ft³ of mortar in place. Prepare additional test panels as directed. Panels shall be 36 in. square and 8 in. deep. Include the same reinforcing as the structure in at least half of each panel. A separate panel shall be fabricated by each application crew using the equipment for each mix design, and in each shooting position encountered.

Core each test panel and deliver the cores to the Laboratory for testing. Cores shall have a diameter of at least 4 in. and be at least 8 in. long. Cores will be tested in compression at 7, 14, and 28 days. Core strength correction will be per T 24.

The Engineer will examine the cut surface of each specimen. Expose additional surfaces by sawing or breaking the panel when necessary to check soundness and uniformity of the material. All cut or broken surfaces that are not dense and free from lamination and sand pockets will be rejected.

423.03 CONSTRUCTION. Submit the proposed methods of protecting the public against injury and damage from demolition operations. When required protective shields shall meet 405.03.01.

Provide safe access to all areas of the existing structure to be repaired. Prior to the start of any repair work, conduct a thorough inspection in the presence of the Engineer. The purpose of this inspection will be to identify the location and extent of concrete deterioration and repair. The Engineer will establish the extent of removal and determine when sound concrete is encountered.

Restrictions. Wait at least 72 hours after completing repairs to a section of a stringer or pier before chipping on any section that has a common side or point.

If at any time an area is identified as having deteriorated concrete beyond the following limits, immediately stop work in these areas. The Engineer will notify the Office of Bridge Development. Do not resume work until after obtaining approval from the Office of Bridge Development:

- (a) More than 6 in. beyond the original finish surface.
- (b) More than 3 in. beyond the reinforcing steel.
- (c) More than 1 in. beneath the bearing.

423.03.01 Equipment. Ensure that all equipment is calibrated and capable of thoroughly mixing all material.

Use a self-cleaning mixer capable of discharging all mixed material without any carry over from one batch to the next. Clean the mixing equipment at least once a day.

Ensure that the air compressor has ample capacity to maintain a supply of clean, dry air adequate to provide the required nozzle velocity for all parts of the work, while simultaneously operating a blowpipe for cleaning away rebound.

Ensure that the air and water pressure are constant and do not pulsate.

423.03.02 Storage. Store and handle cement as specified in 902.01. Store sand to prevent segregation or contamination of the material.

Store all reinforcing bundles at the site on suitable blocking or platforms at least 4 in. above all type of surfaces and vegetation. Keep the reinforcing free of dirt, oil, grease, paint, and other foreign matter.

423.03.03 Surface Preparation. Remove deteriorated areas of concrete to sound concrete with no more than a 30 lb chipping hammer. Continue chipping to at least 1 in. behind the reinforcing steel and until there is no sudden change in the depth of the cavity. Provide a perimeter having a shoulder perpendicular to the surface of the structure for a depth of at least 1 in.

After the Engineer has determined that it is sound, abrasive blast the cavity surface. Just prior to applying the mortar, thoroughly clean all surfaces followed by wetting and damp drying.

Contain all blast waste and loose concrete, and promptly remove it to an approved disposal site. Keep blast waste and loose concrete out of waterways.

423.03.04 Reinforcement. If sound concrete is encountered before the reinforcing steel is exposed, remove sound concrete to a depth of 1 in. behind the reinforcing steel. If sound concrete is found within 3-1/2 in. of the proposed finished surface, stop the removal and dowel additional No. 4 reinforcing bars installed at 12 in. center to center horizontally and vertically, 2 in. clear of proposed finished surface. Dowel per Section 406 except use any type grout specified in 902.11.

Abrasive blast all exposed existing reinforcing steel that will be incorporated in the new work to a near white finish to remove all rust, dirt, scale, and loose concrete. Cut out reinforcing bars that have lost

20 percent or more of their original dimension. Weld new bars in their place. Dual bars of equivalent or greater section may be used. Weld new reinforcing steel to existing reinforcing steel as specified. The Engineer will establish if reinforcing steel is to be reused or replaced.

In addition to the reinforcing steel, reinforce repaired areas with wire mesh.

For anchoring reinforcing to masonry surfaces, set at least 3/8 in. diameter expansion bolts in drilled holes, or set plain round No. 4 bars in approved dry packed mortar tightly driven in drilled holes. Ensure that drilled holes are at least 3 in. deep. All bolts and bars shall be set in solid masonry (not in mortar, joints, or cracks) and have heads or hooks on their outer ends. Where approved, mesh may be wired to existing reinforcing without the use of expansion bolts.

Cut mesh in sheets of proper size. Bend the separate sheets over templates to follow the outlines of the member or surface to be covered. Securely hold in a uniform position by tying to the bolts or bars with 14 gauge black annealed wire. Space ties at no more than 12 in.

Overlap adjacent sheets of mesh at least two squares. Tie them together with a 14 gauge black annealed wire at intervals not exceeding 18 in.

423.03.05 Guides. Use sufficient guides to obtain the full thickness of mortar specified and to ensure uniform and straight lines.

423.03.06 Mixing and Screening. Uniformly dry mix the cement and sand in a batch mixing machine. Discard mixed materials not applied within one hour. After the materials are dry mixed and before being charged into the placing machine, pass the mixture through a 3/8 in. screen.

423.03.07 Application. Build up each layer by several passes of the nozzle over the working area. Ensure that the mixture emerges in a steady, uninterrupted flow. Should the flow become intermittent for any cause, direct it away from the work until it becomes constant. Hold the nozzle perpendicular to the application surface, and at a distance from the work as required to obtain best results for the conditions. When shooting through reinforcement, hold the nozzle at a slight angle from perpendicular to permit better encasement.

For vertical surfaces, begin application at the bottom. Ensure that the first layer completely embeds the reinforcement.

Do not work rebound back into the construction, nor salvage it to be included in later batches.

Do not permit rebound and overspray to fall into waterways. Dispose of this material in an approved disposal site at no additional cost to the Administration.

When a layer of pneumatically applied mortar is to be covered by a succeeding layer, ensure that it has taken its initial set prior to proceeding. Then remove all laitance, loose material, and rebound by brooming. Use abrasive blasting to remove any laitance that has taken final set, and clean the surface with an air water jet. In addition, the Engineer will sound the surface with a hammer for hollow sounding areas that indicate rebound pockets or lack of bond.

423.03.08 Curing and Cold Weather Protection. Section 420. Keep mortar continuously wet for at least seven days after application. Liquid membrane forming compound will be permitted with prior approval.

423.03.09 Finishing. Finish the area of repair to match the existing structure.

423.04 MEASUREMENT AND PAYMENT. Pneumatically Applied Mortar will be measured and paid for at the Contract unit price per cubic foot of mortar in place. The payment will be full compensation for inspections, removal of existing concrete, abrasive blasting, and furnishing all cement, sand, water, test panels, drilled holes, reinforcing bars and wire mesh, mortar, expansion bolts, cores, storage, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 424 — RESERVED

SECTION 425 —LIGHTWEIGHT SUPERSTRUCTURE CONCRETE

425.01 DESCRIPTION. Furnish and install lightweight concrete.

425.02 MATERIALS.

Lightweight Concrete

902.10, Mix 10

425.03 CONSTRUCTION. Conform to 420.03 and as specified herein.

Handle lightweight aggregates in a manner that provides a thorough sprinkling of the aggregates during the stockpiling to produce damp aggregate. Sprinkle to obtain uniform distribution of moisture. Then permit the aggregates to drain as long as necessary to produce a uniform moisture content. Maintain the moisture content as much as practical until the aggregate is used. Add the admixtures to the mix according to the manufacturer's recommendations.

425.03.01 Existing Structures. Remove existing bridge decks according to 405.03.02. Note that the deck replacement material may be lighter than the existing deck and the deflection caused by the lighter material will be less than the material removed. Therefore, compute modified rebound figures to be used in lieu of dead load deflections to establish grade controls to produce finished tops of concrete bridge decks that will be true to as planned line and grade.

425.04 MEASUREMENT AND PAYMENT. Lightweight concrete structures will be measured and paid for as specified. The payment will be full compensation for all forms and form removal, reinforcing steel, curing and misting, scuppers, mechanical and electrical work, all cost incidental to the conducting of tests for oxygen content and presence of gases and applying mechanical ventilation to confined spaces, year built markings, and for all material, labor, equipment (including safety equipment), tools, and incidentals necessary to complete the work.

The construction of drainage and weep holes, any pipe necessary, expansion material, flashing, dampproofing, membrane waterproofing, epoxy bonding compound, joints and their placement will not be measured but the cost will be incidental to the lightweight concrete item. No deduction in lightweight concrete quantities will be made for pipes or conduits having diameters less than 8 in., reinforcing steel, anchors, or any other appurtenances.

425.04.01 Lightweight Superstructure Concrete will not be measured but will be paid for at the Contract lump sum price unless otherwise specified.

425.04.02 Lightweight concrete parapets and median barriers will not be measured but will be paid for at the Contract lump sum price for the pertinent Lightweight Concrete Parapet or Lightweight Concrete Median Barrier items.

425.04.03 Floodlighting will be measured and paid for as specified in 420.04.06.

425.04.04 Linseed Oil Protective Coating will be measured and paid for as specified in 420.04.07.

SECTION 426 — LATEX MODIFIED CONCRETE OVERLAY FOR BRIDGE DECKS

426.01 DESCRIPTION. Remove the specified amount of the existing bridge deck mechanically or through hydromilling, remove additional areas of deteriorated concrete, clean surface areas to be overlaid, replace deteriorated reinforcing steel, and place latex modified concrete (LMC).

Restrictions. Do not place LMC in Allegany, Garrett, and Washington counties between October 15 and May 30. In all other Counties, do not place LMC between December 1 and April 30. Do not remove any portion of existing bridge deck that will not be overlaid and cured in accordance with these restrictions.

426.02 MATERIALS.

Fine Aggregate	901.01
Coarse Aggregate	901.01, Size No. 7
Portland Cement Type I	902.03
Concrete for Patching	902.10
Latex Modified Concrete	902.13
Reinforcement	908
Water	921.01

426.03 CONSTRUCTION. Dispose of removed material at an approved spoil area.

426.03.01 Equipment. Ensure that all proposed equipment meets the requirements specified herein, and is approved.

Deck Removal Equipment.

- (a) **Existing Wearing Surface Removal.** This equipment is only required when the existing bridge contains a hot mix asphalt wearing surface. Provide equipment that is capable of removing the wearing surface without damaging armored joints that are to remain or the existing concrete surfaces beyond the specified

minimum removal depth. When pavement breakers are proposed, use broad faced chisel blades operated at a slight angle with the horizontal to peel the wearing surface off.

- (b) **Deck Surface Removal.** Power operated mechanical type and high pressure water jet type equipment shall be capable of uniformly removing the specified minimum depth from the existing concrete surface.

- (1) **Mechanical Type.** This equipment is limited to depths not closer than 1/2 in. from the top of the existing reinforcement.

When additional removal is required, use high pressure water jet, power driven hand tools, or hand tools.

- (2) **High Pressure Water Jet.** This equipment may be used to any depth above and below the reinforcing steel. Control the runoff water to keep it from reaching any traveled roadway, waterway, or any other designated area. Insufficient means of controlling runoff water or the concrete removal depth may be cause for rejection of this equipment. When this is the case, revert to the mechanical type, power driven hand tools, or handchipping at no additional cost to the Administration. However, only revert to the mechanical type equipment for removal of the specified minimum depth when the specified minimum depth is at least 1/2 in. above the existing reinforcement.

- (c) **Power Driven Hand Tools.** Use this equipment for removal of unsound concrete and for removal deeper than 1/2 in. above the top of existing reinforcement. This equipment is permitted with the following restrictions:

- (1) Do not use pavement breakers heavier than nominal 30 lb class.
- (2) Do not operate pavement breakers or mechanical chipping tools at an angle greater than 45 degrees measured from the surface of the deck.
- (3) Do not use chipping hammers heavier than a nominal 15 lb class for concrete removal beneath any reinforcing bars.

- (d) **Hand Tools.** Use hand tools such as hammers and chisels for removal of remaining particles of unsound concrete from beneath any reinforcing bar or to achieve the required depth.

- (e) **Abrasive Blasting.** Provide equipment capable of removing rust scale and old concrete from reinforcing bars and of removing small chips of concrete partially loosened by the removal operation.

LMC Proportioning and Mixing Equipment. Equipment used for mixing shall be self-contained, mobile, continuous mixing, and shall be:

- (a) Self-propelled and be capable of carrying sufficient unmixed dry bulk cement, sand, coarse aggregate, latex modifier, and water to produce at least 6 yd³ of concrete. Do not store aggregate in the mixing equipment overnight.
- (b) Capable of positive measurement of cement being introduced into the mix, have a recording meter visible at all times, and be equipped with a ticket printout that indicates the quantities being mixed.
- (c) Calibrated to accurately proportion the mix. Certification of the calibration by an approved testing authority will be accepted as evidence of the accuracy if the yield is shown to be true within a tolerance of 1.0 percent in conformance with MSMT 558.
- (d) Capable of providing positive control of the flow of water and latex emulsion into the mixing chamber. Water flow shall be indicated by flow meter and be readily adjustable to provide for minor variations in aggregate moisture.
- (e) Capable of being calibrated to automatically proportion and blend all components of indicated composition on a continuous or intermittent basis as required by the finishing operation. It shall discharge mixed material through a conventional chute directly in front of the finishing machine.
- (f) Capable of spraying water over the entire placement width as it moves ahead to ensure that the surface is wetted to receive the LMC.

Placing and Finishing Equipment. The combination of labor and equipment for proportioning, mixing, placing, and finishing LMC shall meet the following minimum requirements except when otherwise specified:

TOTAL OVERLAY AREA PER BRIDGE yd ²	MINIMUM OVERLAY RATE PER HR yd ³
0-328	1.0
329-492	1.5
493-656	2.0
over 656	2.5

- (a) Placing and finishing equipment includes hand tools for placement and brushing in freshly mixed LMC mortar and for distributing it to approximately the correct level for striking off with the screed.
- (b) Use an approved finishing machine for finishing all areas of work. The finishing machine shall be self-propelled and capable of forward and reverse movement under positive control. Provisions shall be made for raising all screeds to clear the screeded surface for traveling in reverse. Use a rotating cylinder type finishing machine. It shall span the placement transversely, and be equipped with one or more rotating steel cylinders, augers, and vibratory pans.
- (c) The finishing machine shall be designed so that when LMC is being mixed and placed under normal operating conditions at the minimum rate, the elapsed time between depositing the LMC on the concrete deck and final screeding does not exceed 10 minutes.
- (d) Ensure that construction is supervised by the LMC mixture's representative or as directed by the Engineer.

426.03.02 Deck Removal and Repairs. Remove material to the specified limits. The Engineer will inspect the entire exposed portion of the deck and determine if any repairs are required including the type and extent of the repair. Use power driven hand tools, hand tools, or high pressure water jet to remove deteriorated areas of deck down to sound concrete. After removing all deteriorated concrete, remove all rust, oil, or other foreign materials detrimental to achieving bond, followed by abrasive blasting, and air blast or vacuum as determined by the Engineer.

Repair any extraneous damage to the existing bridge that the Engineer deems to have been caused by the removal operations, at no additional cost to the Administration.

If the Engineer determines that the remaining concrete is deteriorated beyond the specified depth of scarification or determines that extraneous material has been removed beyond the specified depth during the scarification process that is not due to Contractor error, make revisions to achieve the new required depth of removal. This additional work will be measured and paid for according to 426.04.03.

Regardless of the depth of removal of existing concrete, place the LMC to the specified elevation and grade.

Existing reinforcing steel utilized in the finished deck shall meet 421.03.07, except thoroughly clean these bars by abrasive blasting. Where the bond between existing concrete and reinforcing steel has been destroyed, or where more than half the diameter of the steel is exposed, remove the concrete adjacent to the bar to a depth that will permit concrete bond to the entire periphery of the exposed bar. Ensure that this clearance is at least 1 in. unless lower bar mats make it impractical. Take measures to prevent cutting, stretching, or damaging exposed reinforcing steel.

Keep all areas from which unsound concrete has been removed free of slurry produced by hydromilling of concrete in adjacent areas. Plan the work so that this slurry will drain away from open areas. Remove slurry from prepared areas before proceeding with the surface preparation.

Repair spalled concrete, voids, and other defects that are located within the proposed LMC overlay area according to the methods specified herein. Each repair includes the removal of the additional deck material, all handchipping, and filling the repair area voids with LMC overlay while applying the overlay.

- (a) For cavities less than 1 in. deep, no additional work required.
- (b) For cavities 1 to 3 in. deep, place wire fabric as specified in 423.03.04. Wire fabric is not required for repair areas less than 2 ft².
- (c) For cavities over 3 in. deep but not full depth, meet the following:
 - (1) If the repair crosses a proposed construction joint, provide a 1-1/2 x 3 in. keyway at the vertical joint.
 - (2) Furnish and install temporary protective shields as specified in 405.03.01 when the depth of removal reaches half the original concrete deck thickness and deeper removal is anticipated.

- (d) For areas where the depth of removal is full depth, meet the following in addition to the requirements of (c):
 - (1) In large areas, supply forms to enable placement of the LMC overlay and support them by blocking from the stringers.
 - (2) In small areas, supply forms to enable placement of the LMC overlay. Forms may be suspended from existing reinforcing bars by wire ties.

426.03.03 Surface Preparation. Thoroughly clean the entire surface and abrasive blast before placing the overlay. Use abrasive blasting to clean all reinforcing bars of visible rust and clinging concrete detached from the deck and all areas of concrete against which the overlay is to be placed. Abrasive blasting may be required on the day the overlay is to be placed so that reinforcing bars are free of visible rust, as determined by the Engineer. Abrasive blast within 24 hours of placing the LMC overlay.

Further clean the surface by air blast followed by flushing with water. Prior to placing the LMC overlay, wet the surface and keep it wet for at least one hour. Remove puddles of free water.

426.03.04 Proportioning and Mixing LMC Materials. Mixers shall be clean and the ingredients accurately proportioned.

Mix LMC materials at the site according to the specified requirements for the equipment used. Ensure that the LMC discharged from the mixer is uniform in composition and consistency. Mixing shall enable finishing operations to proceed at a steady pace, with final finishing completed before the formation of the plastic surface film.

426.03.05 Placing and Finishing LMC Overlay. The LMC overlay will be the riding surface of the bridge. Place the top of the LMC overlay to the true as planned line and grade of the roadways. Take all necessary precautions to produce a finished top of LMC overlay that is smooth riding by placing the LMC overlay in a manner that meets the grade of the proposed adjoining portions of the new bridge decks and adjoining roadways.

Place and fasten screed rails in position to ensure finishing the new surface to the required profile. Anchorage for supporting rails shall provide horizontal and vertical stability. Do not treat screed rails with any compound to facilitate their removal.

The location of longitudinal joints (if not shown on the Contract Documents) will be determined by the Engineer based on avoiding joints in the vehicular wheel path as much as practical.

Take every reasonable precaution to secure a smooth riding bridge deck meeting 420.03.07(d). Prior to placement operations, review the equipment, procedures, personnel, and previous results with the Engineer. Inspection procedures will be reviewed to ensure coordination. Include the following precautions:

- (a) Completely clean all surfaces for approval prior to placing the LMC overlay.
- (b) Brush the LMC mixture onto the wetted, prepared surface. Ensure that all vertical and horizontal surfaces receive a thorough, even coating. Limit the rate of progress so that the brushed material does not become dry before it is covered with additional materials required for the final grade. Remove brushed material that has dried prior to LMC placement, and replace it in an acceptable manner. Dispose of coarse aggregate that accumulates from the brushing operations.
- (c) Place the LMC mixture to approximately 1/4 in. above grade and then screed with an approved power operated finishing machine to the specified line and grade. Use a suitable portable lightweight or wheeled work bridge behind the finishing operation. Hand finishing may be required along the edge. Joints shall be edge tooled, except when next to metal expansion dams, curbs, and previously placed lanes.
- (d) Separate the screed rails and construction bulkheads from the newly placed material by passing a pointing trowel along their inside face. Make the trowel cut for the entire depth and length of screed rails and bulkheads, after the mixture has stiffened sufficiently. Do not separate metal expansion dams from the overlay.

426.03.06 Curing. Cover the surface of the LMC overlay with a single layer of clean, wet burlap or wet cotton mat as soon as the surface will support it without deformation. Follow immediately with a layer of 4 mil polyethylene film, and cure the surface for 24 hours. After 24 hours, remove the curing material and air cure for an additional 72 hours. With approval, white opaque burlap polyethylene sheeting may be substituted for the polyethylene film, but this material does not replace the wet burlap or wet cotton mat.

426.03.07 Grooving. Groove per the applicable portions of 420.03.07(d)(1), but start after the LMC has been cured per 426.03.06.

426.03.08 Limitation of Operations. LMC placement includes the applicable deck placement restrictions specified in 420.03.04.

No traffic will be permitted on the LMC overlay until the curing of the material is completed and the compressive strength test has reached 3000 psi.

Do not place LMC and concrete adjacent to an LMC surface course less than 96 hours old. This restriction does not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

Do not grind or chip existing concrete pavement within 6 ft of LMC until the LMC has cured for at least 48 hours.

Do not place LMC at temperatures below 45 F. The LMC may be placed at 45 F, if rising temperature is predicted and anticipated for at least 8 hours.

At temperatures below 55 F, the Engineer will require a longer curing period and conformance with applicable portions of 420.03.13.

Remove and replace unsatisfactory LMC at no additional cost to the Administration. Any day during which the curing temperature falls below 50 F will not be counted as a curing day. When during the curing period the curing temperature falls below 35 F, the work may be considered as being unsatisfactory and rejected.

During delays up to one hour, several layers of wet burlap may be used to protect the end of the placement from drying. If the delay exceeds one hour, construct a dam or install a bulkhead and wait 12 hours before resuming placement operations. However, placement may continue provided a gap of sufficient length for the finishing machine to clear the previously placed LMC overlay is left in the lane or strip.

Protect freshly placed LMC overlays from sudden or unexpected rain. Stop all placing operations when it starts to rain. Remove and replace material damaged by rainfall, as determined by the Engineer, at no additional cost to the Administration.

Do not place linseed oil on LMC finished deck surfaces.

426.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all removing and cleaning, abrasive blasting, air blasting, flushing with water, forming, curing, disposal of material removed, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

426.04.01 Removal and Disposal of Existing Wearing Surface from Bridge will be measured and paid for at the Contract unit price per square yard for the actual surface area removed from the bridge deck.

426.04.02 Removal to the depth specified in the Contract Documents will not be measured but the cost will be incidental to the pertinent Latex Modified Concrete Overlay item.

426.04.03 Deck repairs, regardless of the method and depth, will not be measured but the cost will be incidental to the pertinent Latex Modified Concrete Overlay item.

426.04.04 Furnishing, placing, finishing, and curing of the LMC overlay will be measured and paid for at the Contract unit price per cubic yard for the Latex Modified Concrete Overlay item. Measurement for the volume of concrete will be based on the meter readings on the mixers dispensing the latex modified concrete excluding the calculated volume of any waste.

426.04.05 Repair Bar for Deck Reinforcement will be measured and paid for at the Contract unit price per linear foot.

426.04.06 When traffic bearing surfaces are required, supplying and removal of them and any repairs of damage to existing deck will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

426.04.07 Furnishing and installing any formwork required for full depth deck repairs will be measured and paid for at the Contract unit price per square foot for the pertinent Formwork for Full Depth Deck Repairs item. The measurement will be based upon the exposed opening at the bottom of the deck. The cost for form work extending beyond these limits will be incidental to the item.

SECTION 427 THRU 429 — RESERVED

SECTION 430 — METAL STRUCTURES

430.01 DESCRIPTION. Furnish, fabricate, transport, and erect steel beams, plate girders, trusses, grillages, columns and bents, shoes, pedestals, castings, miscellaneous steel, and incidental structural steel. Refer to Section 432 for bearings and Sections 435 and 436 for cleaning and painting new and existing structural steel, respectively.

Substitutes for Rolled Members. Fabricated shapes may be substituted for the specified rolled shape, provided the substitution is at no additional cost to the Administration and the fabricated shape meets the following requirements:

- (a) The moment of inertia is equal to or greater than the rolled shape for the full length of the member.
- (b) The depth is greater than or equal to the rolled shape and does not decrease the designated minimum underclearance.
- (c) The web or leg thickness is at least 1/2 in.
- (d) The flange thickness is at least 1 in., the flange width is at least 12 in., and the width to thickness ratio does not exceed 12.
- (e) It is made of the same material specified for the rolled shape.
- (f) All normal criteria for creating a welded member are adhered to.

430.02 MATERIALS.

Grout	902.11(c),(d),(e)
Metals	909
Bolts	A 325
Nuts	A 536 Grade C, D, and DH
Washers	F 436
Direct Tension Indicating Washers (DTI)	F 959

430.03 CONSTRUCTION. Unless otherwise specified, all welding and dimensional tolerances shall meet AWS D1.5.

430.03.01 Working Drawings. Refer to Section 499. If lateral bracing is required for shipping or erection, specify the details on the working drawings.

430.03.02 Work Scheduling. Refer to Section 499. At least two weeks prior to beginning shop work, notify the Engineer when and where to allow for inspection. Do not fabricate any materials unless otherwise directed.

430.03.03 Facilities for Shop Inspection. Furnish all facilities for the inspection of material and workmanship in the shop. Allow the inspector free access to the required areas of the premises and provide an approved office area.

430.03.04 Material Identification. Identify main member material by heat number.

430.03.05 Mill Orders. Furnish copies of mill orders and test reports.

430.03.06 Testing. Furnish sample specimens as directed without charge.

430.03.07 Defective Material and Workmanship. The acceptance of any material and workmanship will not deter subsequent rejection. Replace or repair rejected material and workmanship as directed.

430.03.08 Marking and Shipping. Paint or mark each member with an erection mark for identification. Furnish an erection diagram with erection marks clearly delineating the orientation of diaphragms.

Erection marks for field identification of members and weight marks for members weighing over 6000 lb shall be painted on surface areas previously painted with the shop coat. Material may be loaded for shipment when the shop coat is thoroughly dry, but not less than 24 hours after the paint has been applied.

Where unpainted steel is specified for a finished structure, do not place any company's name on the structural steel. Erection marks and inspection stamps shall appear only on the top surface of the top flange of girders, beams, and diaphragms unless otherwise directed.

Do not apply paint after the materials have been loaded for transport.

Furnish copies of material orders, shipping statements, and erection diagrams. Show the weight of the individual members on the shipping statements.

Load, transport, unload, and store structural material so that the metal is kept clean and does not become excessively stressed, deformed, or otherwise damaged.

When handling long steel members, place handling devices at approximately the quarter points. When storing and shipping members, place blocking at intervals that prevent sag and distortion. Keep beams and girders in an upright position during shipping, storage, and handling. For other members, keep the stronger axis vertical.

All girders having stiffeners the full height of the web on both sides of the web shall be adequately blocked before shipment. Locate this blocking at the quarter points and midpoint of the girder and at additional locations to ensure that the blocking interval does not exceed 25 ft.

For members too long to fit inside a truck or trailer, limit the cantilever to one quarter of the length of the member. Support members too long to comply with this requirement on dollies, additional vehicles, or other vehicles that fully support the long pieces as approved.

430.03.09 Storage of Material. Store fabricated material off the ground and protected from rust producing conditions. Keep materials free of dirt accumulation, oil, or other deleterious matter.

430.03.10 Changes and Substitutions. Do not make changes or substitutions in any approved drawing unless approved in writing by the Director, Office of Bridge Development.

430.03.11 Fabrication. Use bolted or welded fabrication and construction as specified or as directed.

When girders are to be curved by the heat shrinkage method, submit the proposed method.

430.03.12 Holes.

- (a) **Punched Holes.** The diameter of the die shall not exceed the diameter of the punch by more than 1/16 in. Holes requiring enlargement shall be reamed. Provide holes that are clean cut with no torn or ragged edges. Ensure that holes punched full size or subpunched are punched so that after the steel is assembled and before any reaming is done, a cylindrical pin 1/8 in. smaller in diameter than the nominal size of the punched hole can be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If this requirement is not met, the nonconforming punched pieces will be rejected. Holes not passing a pin 3/16 in. smaller in diameter than the nominal size of the punched hole will be rejected. Drifting done during assembling is permitted only to bring the parts into position but not to the extent that holes are enlarged or distorted. If the required accuracy cannot be obtained otherwise, holes for connections shall be subpunched and reamed with the members assembled instead of being punched full size.
- (b) **Reamed or Drilled Holes.** Holes shall be cylindrical, perpendicular to the member, and not more than 1/16 in. larger than the nominal diameter of the bolts. Where practical, direct the reamers by mechanical means. Remove burrs on the surface. Poor matching of holes will be cause for rejection. Use twist drills for reaming and drilling. If directed, take assemblies apart and remove burrs caused by drilling. Assemble connecting parts that require reamed or drilled holes, and securely hold them while reaming and drilling. Match mark them before disassembling. After holes are reamed or drilled, 85 percent of the holes in any contiguous group shall show no offset greater than 1/32 in. between adjacent thicknesses of metal.

- (c) **Subpunching and Reaming.** Holes in all field connections and field splices of main truss or arch members, continuous beams, plate girders, and rigid frames shall be subpunched and reamed while assembled in the shop unless otherwise specified. The assembly, including camber, alignment, accuracy of holes, and milled joints shall be acceptable to the Engineer before reaming is started.

Holes for floor beam and stringer field end connections shall be subpunched and reamed utilizing a template or reamed while assembled.

If specified, do additional subpunching and reaming as required. The accuracy of subpunched holes shall be the same as required for punched holes.

430.03.13 Shop Assembly. Surfaces of metal that will be in contact after assembly shall be cleaned. Ensure that parts of a member are assembled, well pinned, and firmly drawn together with bolts before starting reaming or tightening of fasteners. The member shall be free from twists, bends and other deformations. Ream material that has been punched full size, if necessary, prior to tightening of fasteners. Refer to 430.03.12(c).

Parts not completely fastened in the shop shall be secured with bolts to prevent damage in shipment and handling. Members assembled in the shop for reaming of field connections shall remain assembled until the Engineer's shop inspection.

430.03.14 Camber Diagram. Furnish a camber diagram showing the camber at each panel point for each truss, taken from actual measurements during truss assembly. For all beams and girders, furnish a camber diagram showing the camber at all splice points, points of dead load inflection, and any other points designated by the Engineer.

Stringers shall be cambered to the specified dimensions, when measured after completion of all shop welding. The maximum tolerance for camber is zero under to 3/4 in. over.

Make provisions for dead load deflections, fabricating tolerances, and irregularities at all points along all stringers so that the superstructure concrete may be placed to match the profile grade line.

430.03.15 Match Marking. Match mark connecting parts assembled in the shop for the purpose of reaming holes in field connections. Furnish a diagram showing these marks.

430.03.16 Use of High Strength Bolts and Lock-Pin and Collar Fasteners. Use high strength bolts and lock-pin and collar fasteners unless otherwise specified. Unfinished bolts or machine bolts may be used for the temporary erection of structural steel. Replace them with high strength bolts, lock-pin and collar fasteners, or welding for final erection. Use turned bolts only when specified. Draw the heads, nuts, and washers tightly against the work. Where bolts or lock-pin and collar fasteners are used in beveled surfaces, provide beveled washers to give full bearing to the head, nut, or collar except as otherwise specified in 430.03.17. Where high strength bolt assemblies are used for joint connections, perform the additional testing specified by the Office of Materials Technology.

430.03.17 High Strength Bolt Joint Requirements.

- (a) Use only one grade of bolts, nuts, and washers in a structure. Bolts may be supplied from various manufacturers provided that each bolt of a given length and diameter is made by the same manufacturer. Nuts and washers may be supplied from different manufacturers provided that the same manufacturers make all the respective nuts and washers to be used throughout the structure on all bolts having the same diameter. All bolts, nuts, and washers used with A 709, Grade 50W steel shall meet A 325, Type 3.
- (b) The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, use a smooth beveled washer to compensate for the lack of parallelism. When assembled, bolted parts shall fit solidly together and shall not be separated by gaskets or any other compressible material. The holes shall be truly cylindrical and at right angles to the surface of the metal so that both head and nut bear squarely against the metal. When assembled, all joint surfaces including those adjacent to the bolt heads, nuts, or washers, shall be free of scale (except tight mill scale), dirt, burrs, and other deleterious material and defects that would prevent solid seating of the parts. Contact surfaces within joints shall be free of oil, lacquer, and rust inhibitor. Refer to 435.01.01 for contact surfaces to be painted.
- (c) When all bolts in the joint are tight, every bolt shall conform to the minimum installation tension specified for its size by the Office of Material Technology. When field conditions prevent tightening at the nut, bolts may be tightened at the head, provided that the nut is prevented from turning. Place a washer under the element (nut or bolt head) turned in tightening. Threaded bolt connections shall be

tightened by the turn-of-nut method unless DTI's are opted for use. If impact wrenches are used, they shall be of adequate capacity and have a sufficient supply of air to perform the required tightening of each bolted connection.

- (d) To provide the bolt tension specified in 430.03.17(c), first bring enough bolts to a snug tight condition ensuring that the parts of the joint are in full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Place bolts in any remaining holes in the connection and bring to snug tightness. Then additionally tighten all bolts in the joint with tensioning progressing systematically from the most rigid part of connection to the free edges. Ensure that there is no rotation of the part not turned by the wrench during this operation.

After all bolts in the joint have been tightened to a snug tight condition as described above, tighten the joint by the applicable amount of nut rotation specified in the Nut Rotation from Snug Tight Condition table below. All bolt assemblies in the completed structure shall have full thread engagement, which is accomplished when the end of the bolt is flush with or extends beyond the outer face of the nut.

NUT ROTATION FROM SNUG TIGHT CONDITION			
DISPOSITION OF OUTER FACES OF BOLTED PARTS			
Bolt length (as measured from underside of head to extreme end of bolt)	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (beveled washers 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	2/3 turn	5/6 turn	1 turn

NOTE 1: This table is for coarse thread, heavy hexagon structural bolts of all sizes and lengths and heavy hexagon semifinished nuts.

NOTE 2: Nut rotation is rotation relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation: ± 30 degrees for bolts installed by 1/2 turn or less, and ± 45 degrees for bolts installed by 2/3 turn or more.

- (e) **Inspection.** The Engineer will be present during the installation and tightening of bolts to determine that the tightening procedure is followed and all bolts are properly tightened.

Provide a sufficient number of safe working platforms at splices for checking torque requirements. Maintain the platforms until all checking is complete and the splice is accepted.

Turn of Nut Method. Provide a calibrated torque wrench to be used as the inspection wrench and a calibrated bolt tension calibrator. Both shall be as approved.

Conduct the following inspections unless otherwise specified.

- (1) Three bolts of the same size, length, and condition as those under inspection shall be placed individually in the bolt tension calibration device. Place a washer under the part turned in tightening each bolt.
 - (2) Tighten each of the three bolts in the calibration device by any convenient means to the tension specified for its size. Then use the inspecting wrench to further tighten the bolt and determine the torque necessary to turn the nut or head 5 degrees (approximately 1 in. at 12 in. radius). Use the average torque measured in the tests of three bolts as the job inspecting torque to be used in the manner specified in (3).
 - (3) Use the inspecting wrench to inspect bolts represented in the sample above that have been tightened in the structure. Apply the job inspecting torque in the tightening direction to 10 percent of the bolts but not less than two bolts selected at random in each connection. If no nut or bolt head is turned, the connection will be accepted as properly tightened. If any nut or bolt head is turned, apply the job inspecting torque to all bolts in the connection; and tighten and reinspect all bolts whose nut or head is turned. Alternatively, the fabricator or erector may opt to retighten all of the bolts in the connection and then resubmit the connection for the specified inspection.
- (f) Do not reuse bolts, nuts, or washers that were previously torqued to installation tension as described in (d) or (e) above.

430.03.18 Lock-Pin and Collar Fastener Requirements.

- (a) Ensure that lock-pin and collar fasteners meet 430.03.17 for one manufacturer, weathering characteristics, sloped surfaces, and applicable inspection.

- (b) A representative sample of at least three sets of lock-pin and collar fasteners of each diameter, length, and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each assembly develops a tension at least 5 percent greater than the tension required for the comparable A 325 or A 490 bolt. Follow manufacturer's installation procedure for installation of bolts in the calibration device and in all connections. Perform periodic retesting when directed.
- (c) 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 additionally tighten all fasteners, 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 fasteners may require more than a single cycle of systematic partial tightening prior to final twist off of the control or indicator element of individual fasteners.

430.03.19 Welding. Welding of structures shall meet the Contract Documents and AASHTO/AWS Bridge Welding Code D1.5, unless otherwise specified.

The provisions contained herein apply to both shop and field welding.

Ensure that all welders, welding machine operators, and tackers employed to work on structures are approved by the Office of Materials Technology.

- (a) **Qualification Testing.** Welders will be approved based on Qualification Testing according to AASHTO/AWS Bridge Welding Code D1.5. The Office of Materials Technology (OMT), will conduct qualification testing.

Contact OMT at least 30 days prior to the start of welding operations to schedule testing. At the time of test, ensure that welders have an authorization. This authorization shall contain the welder's name, social security number, Contract number, and the Contractor's name and phone number.

- (b) Qualifications from Outside Sources.** Welders having certifications from outside sources in accordance with the AASHTO/AWS Bridge Welding Code D1.5 may submit that certification for approval to OMT.

Ensure that all field welders approved by OMT have a current Administration Welders Certification card available at all times for inspection.

Unless otherwise specified, only submerged arc welding will be permitted on members carrying primary stress. Members carrying primary stress are specified in 909.01.

After fabrication, no welding will be permitted on tension flanges for attachments such as metal forms and ty screws, except for specified steel stud shear developers.

Welding transversely across tension flanges of beams or girders will be cause for rejection, unless otherwise specified.

430.03.20 Inspection of Fabricated Metal Structures. Fabricated metal structures shall meet AASHTO/AWS Bridge Welding Code D1.5. Perform quality control inspection.

Prior to receiving source approval, a current approved quality control plan shall be on file with the Office of Materials Technology. This plan shall specify the frequency and method of inspection, and provide for documentation. Ensure that the inspection frequency is at least the minimum specified in AASHTO/AWS Bridge Welding Code D1.5. The Administration requires 30 days to review quality control plans not previously on file.

Keep complete and current records and make them available to the Administration's representatives at all times.

When work is completed, the documentation for all quality control tests and inspections shall become the property of the Administration.

430.03.21 Planing. Plane the top and bottom surfaces of steel slabs, base plates, and cap plates of columns and pedestals; or have the plates or slabs heat straightened. Ensure that parts of members in contact with them are faced. In planing the flat surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

430.03.22 Abutting Joints. Ensure that abutting joints in compression members and in tension members where specified, are faced and brought to an even bearing. Where joints are not faced, limit the opening to no more than 1/8 in.

430.03.23 End Connection Angles. Floor beams, stringers, and girders having end connection angles shall be built to the exact length back-to-back of connection angles. If end connections are faced, ensure that the finished thickness of the angles is not less than specified.

430.03.24 Main Members. Principal portions of main members carrying primary stress (refer to 909.01) shall be fabricated so that the direction of stress and rolling are the same.

430.03.25 Web Plates. At web splices, ensure that the clearance between the ends of the web plates is not more than 3/8 in. Ensure that the clearance at the top and bottom ends of the web splice plates is not more than 1/4 in.

430.03.26 Bent Plates. Unwelded, cold bent, load carrying, rolled steel plates shall be taken from the stock plates so that the bend line will be at right angles to the direction of rolling, except that cold bent ribs for orthotropic deck bridges may be bent in the direction of rolling if approved and shall meet the following:

MINIMUM COLD-BENDING RADII				
A 709 Grades	Thickness, in. (t)			
	Up to 3/4	Over 3/4 to 1, incl.	Over 1 to 2, incl.	Over 2
36	1.5t	1.5t	1.5t	2.0t
50	1.5t	1.5t	2.0t	2.5
50W	1.5t	1.5t	2.0t	2.5
HPS70W	1.5t	1.5t	2.5	3.0t
100	1.75t	2.25	4.5t	5.5t
100W	1.75t	2.25	4.5t	5.5t

- (a) Bend so that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal shall meet the following.
- (b) For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.

- (c) If a shorter radius is essential, bend the plates at a temperature no greater than 1200 F. Hot bent plates shall be taken from stock so that the bend line will be at right angles to the direction of rolling.
- (d) Before bending, round the corners of the plate to a radius of 1/16 in. throughout the portion of the plate where the bending is to occur.

430.03.27 Erection Plan. Submit an erection plan for approval outlining erection procedure of the main members. Submit the erection plan as specified in Section 499 and to the Director, Office of Bridge Development, at least 30 days prior to beginning erection. Include the numbers and types of equipment to be used including crane capacity, location of crane for lifting, falsework when required, and main member erection sequence and weight.

Ensure that all wheels and outriggers of a crane or wheels of a structural steel delivery truck are at a minimum distance from the rear face of an abutment equal to the vertical distance from the top of a spread footing or to the original groundline if the footing is on piles. Ensure that no other heavy construction equipment operates within this distance from the rear face of abutments.

Erect bridges with continuous main members in a manner providing the proper reactions, and avoiding overstressing main members.

When preparing erection plans and procedures, take into account the restrictions imposed by the Water Resources Administration relative to pollution or disturbance of existing waterways.

430.03.28 Falsework. Comply with the provisions specified in TC-4.01 and Section 499. Build and maintain the falsework in accordance with the approved falsework plans. Any changes subsequent to initial approval shall be proposed through the Contractor's professional engineer and be as approved.

Before permitting any loads to be placed on falsework, the Engineer shall receive written certification by the Contractor's professional engineer that the falsework system has been assembled in conformance with the approved falsework drawings. This certification shall be accompanied by a Certificate of Compliance stating that all manufactured materials and assemblies fully comply with the falsework design and plans. The Engineer may either accept the certificate or invoke any provision of GP-5.08. Perform all tests required at no additional cost to the Administration.

In addition to protective measures shown on the falsework plans, the Engineer may direct that further protection of falsework be provided against accidental collision by highway or construction traffic and equipment, traffic vibration, flood waters or high winds, etc., that are necessary for public safety and protection of the work.

430.03.29 Damaged or Defective Material. Submit a written procedure for correcting damaged or defective material to the Director, Office of Bridge Development. Do not proceed with corrections until approved. The Engineer will inspect damaged or defective material before and after correction. Make corrections in the presence of the Engineer.

430.03.30 Assembling Steel. Carefully handle material without bending, breaking, or otherwise damaging parts. Before assembly, clean the bearing surfaces and those to be in permanent contact. Before beginning field bolting and welding, adjust the structure to correct grade and alignment, and properly regulate the elevations of panel points (ends of floor beams). Fill half the holes in splices and field connections using bolts and cylindrical erection pins (40 percent bolts and 10 percent pins) before torquing high strength bolts. If the member will carry traffic during erection, fill three fourths of the holes before torquing. Cylindrical erection pins shall be 1/32 in. larger than the diameter of the fasteners.

430.03.31 Anchor Bolts. Per 909.06. Do not cast anchor bolts in the concrete. Create a template to locate the anchor bolt holes and use it to shift the reinforcement prior to placing the concrete to eliminate conflicts between the reinforcement and the anchor bolt holes.

Set anchor bolts in round holes drilled or cast in the concrete. Accurately position bolts by using templates set to correct location and alignment to ensure proper span lengths, and carefully set tops of bolts to proper elevation. Unless otherwise noted, install bolts plumb or normal to the finished bearing surface of the masonry.

Bolts shall have the portion below the bridge seat swedged. Drill or cast holes to a diameter at least 1 in. larger than the bolt diameter.

Do not paint anchor bolts, nuts, and washers.

After anchor bolts are finally and correctly positioned, completely fill the holes with grout; however, do not grout until all structural steel is set in its final position. After the masonry plates or shoes are set, use the same grout to fill the space between the bolts and the round holes of fixed plates and shoes. Do not fill slotted holes in expansion devices unless specified.

Maintain an air temperature of at least 40 F around the mortar surface for a period of three days unless otherwise recommended by the manufacturer.

When mortar filling is used, first check the depth of the hole by inserting and withdrawing the bolt. Then partially fill the hole with mortar, and immediately insert the bolt by forcing with uniform pressure or light blows from a hammer (flogging and running is prohibited) so that excess mortar is pushed out at the top of the hole. Remove excess mortar.

Set the bolt to project approximately 1/2 in. above the nut and ensure that it is threaded to approximately 1/2 in. below the nut in their final position.

Set rockers or expansion plates with slotted holes with the proper tilt or offset as determined by the temperature prevailing at the time and so that they will be in their midway position at 68 F or as specified.

430.03.32 Maintenance of Concrete. Keep all exposed concrete surfaces free from stains and discoloration. Prevent staining of the finished concrete surfaces where unpainted structural steel is specified. Remove any stains and restore the concrete to its original color.

430.03.33 Safety Hazards. Perform gas detection in and ventilation of confined spaces as specified in TC-3.04.

430.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all high strength bolt and lock-pin and collar fastener assembly testing and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

430.04.01 Fabricated Structural Steel will not be measured but will be paid for at the Contract lump sum price.

430.04.02 Fabricated Structural Steel will be measured and paid for at the Contract unit price per pound computed on the theoretical weight.

Where measurement and payment of Fabricated Structural Steel is based on weight, the weight will be computed on the basis of the net finished dimensions of the parts as shown on the approved working drawings, deducting for copes, cuts, clips, and all open holes.

Computations will be made on the basis of the following:

MATERIAL	POUNDS PER CUBIC FOOT
Aluminum, cast or wrought	173.0
Bronze, cast	536.0
Copper alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, rolled, cast, copper bearing, silicone, nickel and stainless	490.0
Zinc	450.0

The weight of rolled shapes will be computed on the basis of their nominal weight per foot as specified in the Contract Documents or listed in handbooks.

The weight of rolled shapes will be computed on the basis of their nominal weight for their width and thickness as specified, plus an estimated overrun computed as half the permissible variation in thickness and weight as tabulated in A 6.

The weight of all shop weld metal (not included in weighed unit) and field weld metal will be computed on the basis of the theoretical volume from dimensions of the welds.

The weight of temporary erection bolts, shop and field paint, boxes, crates and other containers used for shipping, and materials used for supporting members during transportation and erection is excluded from the calculation of weight for payment.

Structural members or materials which fail to conform to requirements of tests and all materials rejected as a result of these tests will not be measured or paid for under any method of payment.

430.04.03 When a pay item for Fabricated Structural Steel is not specified, the fabricated structural steel will not be measured but the cost will be incidental to other pertinent items.

430.04.04 Rotational capacity testing for high strength bolt assemblies will not be measured but the cost will be incidental to the Contract price for the Fabricated Structural Steel item or other pertinent items specified.

SECTION 431 — STEEL STUD SHEAR DEVELOPERS

431.01 DESCRIPTION. Furnish, fabricate, and install steel stud shear developers.

431.02 MATERIALS.

Steel Stud Shear Developers

909.05

431.03 CONSTRUCTION. Erect all structural steel and install all applicable forming and decking in a particular span before attaching shear developers to the structural steel. Install shear developers per AASHTO/AWS Bridge Welding Code D1.5. After welding is completed and prior to concrete placement, the Engineer will inspect all studs. Correct defects as directed.

431.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

431.04.01 Steel Stud Shear Developers will not be measured but will be paid for at the Contract lump sum price.

431.04.02 Steel stud shear developers for which there is no specific pay item included in the Contract Documents will not be measured but the cost will be incidental to other pertinent items specified.

431.04.03 Steel Stud Shear Developers will be measured and paid for at the Contract unit price per each.

SECTION 432 — BEARINGS

432.01 DESCRIPTION. Furnish and install bearings.

432.02 MATERIALS.

Steel Plates

909.02

Bronze or Copper Alloy

Bearing and Expansion Plates

910.01

Elastomeric Bearing Pads

910.02

Preformed Fabric Pads

910.02.03

Epoxy Adhesives

921.04

432.03 CONSTRUCTION.

432.03.01 Storage and Handling. Store all types of bearings at the site under cover and on suitable blocking or platform at least 4 in. above all types of surfaces and vegetation. Protect from damage at all times and, when placed, keep them dry, clean, free of dirt, oil, grease, and other foreign substances.

432.03.02 Installation. Place preformed fabric pad on surfaces meeting 420.03.07(c) prior to installing the masonry bearing plate.

Ensure that all bearings and pedestals of truss, stringer spans, and the center and end bearing of swing spans are rigidly and permanently located to correct alignments and elevations.

Refer to the applicable portions of Section 430 for the attachment of bearings or plates to steel superstructures.

432.03.03 Steel, Bronze, or Copper Bearings. When steel, bronze, or copper alloy bearings are specified, thoroughly clean the machined bearing surfaces immediately before installation. As soon as practicable after installation, apply one prime coat to all unpainted exposed surfaces of the bearings scheduled for painting. Then proceed with the application of the specified field coats.

432.03.04 Elastomeric Bearing Pads. Prior to installation, give the pads and abutting surfaces a final cleaning to ensure that they are free of dust, dirt, oil, grease, moisture, and other foreign substances. Use an approved solvent that is compatible with the adhesive prior to application of the epoxy adhesive. Mix and apply the epoxy adhesive according to the manufacturer's recommendations.

When elastomeric pads are used without masonry bearing plates, grind the masonry bearing surfaces to remove all laitance before applying the adhesive. Apply the adhesive to the surfaces of the masonry bearing areas that will be in contact with the bearing pads and to the full contact area of the bearing pad. After the pads are in place, use blocking or other approved mechanical methods to secure the pads in their final position until the adhesive sets.

Surface temperatures and predicted ambient air temperature for the next four hours shall be 50 F or higher at the time of application unless otherwise specified or recommended by the epoxy adhesive manufacturer and approved.

432.04 MEASUREMENT AND PAYMENT. Bearings will not be measured but the cost will be incidental to other pertinent items specified.

SECTION 433 — BRIDGE MOUNTED SIGN SUPPORTS

433.01 DESCRIPTION. Furnish and construct bridge mounted sign supports and sign luminaire supports. This work does not include sign panels, electrical work, or luminaires.

References to Grade 50W structural steel shall be construed to include similar structural steel having weathering characteristics.

433.02 MATERIALS.

Epoxy Grout	902.11(d)
Structural Steel	909.01
Anchor Bolts, Nuts and Washers	909.06
High Strength Bolts, Nuts and Washers	909.07
Paint	912.05, Paint System B

On new structures, construct the sign support using the same structural steel and fasteners used for the fabrication of the structure. When A 709, Grade 50W structural steel is used, make the vertical supports from material meeting A 709, Grade 36 or 50.

On existing structures, use structural steel meeting A 709, Grade 36 or 50 for the sign support. When the existing structure consists of A 709, Grade 50W structural steel, construct the sign support from steel meeting A 709, Grade 50W, except make the vertical supports from steel meeting A 709, Grade 36 or 50. Use fasteners meeting 909.07 and use Type 3 when used with A 709, Grade 50W.

Vertical supports for the sign panels shall be galvanized per A 123. All bolts, nuts, and similar fasteners in contact with the galvanized material shall be mechanically or hot dipped galvanized meeting the thickness, adherence, and quality requirements of A 153.

433.03 CONSTRUCTION. Construct the sign support according to the applicable portions of Section 430. Paint according to Section 435, except as specified herein.

Set the anchor bolts by epoxy grouting or casting in place when applicable.

On new structures, clean and paint the nongalvanized portions of the sign support using the same system specified for the structure. Portions of the sign support mounted on structures constructed with Grade 50W steel and attached to areas designated to be painted, shall also be cleaned and painted.

On existing structures not constructed with Grade 50W steel, either the entire sign support may be galvanized or those areas not designated to be galvanized may be painted. Refer to Section 435 for cleaning and painting nongalvanized portions of the sign support. Blast clean to a surface condition of Near White SSPC-SP 10 prior to painting. Unless otherwise specified, refer to 436.03.25 for repair of damaged coatings on existing structures.

Portions of the sign support mounted on existing structures constructed with Grade 50W steel and attached to areas that are painted shall also be cleaned and painted.

433.04 MEASUREMENT AND PAYMENT. Bridge Mounted Sign Supports will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 434 — RESERVED

SECTION 435 — CLEANING AND PAINTING NEW STRUCTURAL STEEL

435.01 DESCRIPTION. Clean and paint new structural steel used for work such as new construction, deck widening, and repairs that require installation of new structural steel. When the existing steel is not scheduled for repainting, this work will include repairing existing coatings damaged during the Contractor's operations and areas where new steel ties into existing steel. When the existing steel is scheduled for repainting, refer to Section 436. When the new or existing steel is prepared by abrasive blast cleaning in the field, refer to Section 436 for containment and environmental monitoring requirements.

435.01.01 Areas to be Coated. Areas of shop cleaning and priming, and field cleaning and painting pertain to the following surfaces:

- (a) **Nonweathering Steel - All surfaces.** Refer to 436.01.01(a).

(b) Weathering Steel.

- (1) The outside facing surfaces of the fascia stringers for all structures over roadways and for structures over water that contain curb openings. For dual structures, this includes the median fascia. These surfaces include the underside of the top flange, the web facing away from the structure, the top of the bottom flange, the outside edge of the bottom flange, the underside of the bottom flange, the inside edge of the bottom flange, and the top of the bottom flange on the inside facing surface up to and including the fillet weld. A sharp well defined transition between the new paint on the flange and the bare steel above the fillet is not required. Overspray onto the web is acceptable. All attached bearings are included in the cleaning and painting.
- (2) At abutments, the end 10 ft of all stringers and all other structural steel within the 10 ft area (e.g., stiffeners, cross bracing, and bearings).
- (3) At piers, 10 ft in each direction from the center line of the pier (giving a total length at each pier of 20 ft) and all other structural steel within the area.
- (4) At bolted field splices, 12 in. beyond the longest splice plate for each particular splice and all splice material.

(c) Roadway Joints.

- (1) **New Roadway Joints.** Prior to any shop painting operations, clean all surfaces of the expansion dam and backwall angles. Apply the prime coat in the shop to the entire area of the backwall and expansion dam angles including those areas in contact with concrete, except the portion that is masked to receive adhesive for the seal.
- (2) **Existing Roadway Joints and New Portions.** Prior to any painting operations on existing expansion joints and new steel used to modify them, all surfaces of the expansion dam angles and backwall angles to be painted or receive adhesive for the seal shall be thoroughly cleaned. The area that will be in contact with the seal shall then be completely masked for full length and depth of seal.

The backwall and expansion dam angles shall have all coats applied to the entire area that will be exposed in the finished structure, both above and below the seal.

435.01.02 General. Refer to 436.01.02.

435.01.03 Minimum Contracting Requirements for Field Painting. Refer to 436.01.03.

435.01.04 Definition of Bridge. Refer to 436.01.04.

435.02 MATERIALS.

Paint Systems

435.02.01 and 912.05

435.02.01 Paint Systems. Refer to 436.02.01.

New Steel (Includes New Structures, Repairs, and Widening). The paint shall meet Paint System B. Touch up paint for the shop primer prior to Coats II and III shall conform to Coat I of Paint System C as approved by the coating manufacturer.

Existing Coatings Damaged Due to Steel/Deck Repairs or New Connections. Use spot coats of Coat I of Paint System H, and Coats II and III of Paint System B.

Bolts and Field Welds. Prime all bolts and field welds with Coat I of Paint System C prior to the application of Paint System B, Coats II and III.

Roadway Joints. The color of the finish coat shall conform to Federal Standard 595, Color No. 26440.

(a) **New Roadway Joints.** 912.05, System B.

(b) **Existing Roadway Joints and New Portions.** 912.05, System E.

435.02.02 Abrasives. Refer to 436.02.02.

435.03 CONSTRUCTION.

435.03.01 Submittals. Refer to 436.03.01.

435.03.02 Inspection Equipment. The shop and field Contractor shall provide for the exclusive use of the Engineer, the equipment for the QA observations of the Contractor's cleaning and painting operations. Refer to 436.03.04.

435.03.03 Paint Quality Assurance (QA) Inspector Notification.

(a) **Field.** Refer to 436.03.05.

(b) **Shop.** Notify the Office of Materials Technology at least 5 working days prior to beginning cleaning and painting.

435.03.04 Floodlighting. Refer to 436.03.06.

435.03.05 Shop Priming of New Steel. Solvent clean, abrasive blast clean, and prime all new structural steel in the shop with Coat I of Paint System B. Perform blast cleaning and painting after all shop fabrication is complete.

435.03.06 Field Cleaning and Painting. Solvent clean, pressure wash, and hand/power tool clean the surfaces of the shop primed steel after it is erected. Follow with touch up using Coat I of Paint System C. Apply Coats II and III of Paint System B to all exposed structural steel in the completed structure.

When new steel is added to existing steel and the existing steel is not scheduled for repainting, repair the existing coating at new steel connection points and at locations where the existing coating is damaged by the steel installation work. Solvent clean and hand/vacuum-shrouded power tool clean the surfaces. Follow with the spot application of the penetrating sealer of Paint System H and the spot application of Coats II and III of Paint System B.

435.03.07 Painting Sequence. Refer to 436.03.08.

435.03.08 Surface Preparation. Prepare surfaces as specified in 435.03.09(a) thru (h), the pertinent SSPC Specifications, and the Contract Documents. Surface conditions shall meet the pertinent SSPC-VIS Standards. Surface preparation performed in the shop shall also meet 435.03.12.

435.03.09 Methods of Cleaning. Methods shown in the following table apply to both shop and field cleaning, and shall be performed in the order

shown. The methods are invoked based on the paint system specified. Refer to 436.03.10 for methods of cleaning.

SUBSTRATE CONDITION	PAINT SYSTEM	METHODS OF CLEANING
Abrasive Blast Cleaned Steel.	B (Coat I, II, and III)	Shop coating - (a) and (h)
		Shop touch up of damaged primer: Damage extending to substrate - (f) Damage not extending to substrate - (d) and (e)
		Field coating of shop primed steel - (a) and (b), followed by localized repair of damage: Damage extending to steel substrate - (f) Damage not extending to substrate - (d) and (e)
Bolts and Field Welds	C (Coat I) B (Coat II and III)	Field - (a) followed by (d) and (e)
Existing Coatings Damaged Due to Steel Repair, New Connection, or Contractor's Operations.	H (Coat I) B (Coat II and III)	Field - (a) followed by (d) and (e)
Existing Roadway Joints and Modified Portions	E (Coat I, II, and III)	Field - (a) followed by (f) or (h)

435.03.10 Base Metal Readings (BMR). BMR shall be obtained in the fabrication shop on the bare steel in conformance with SSPC-PA 2. Report this reading along with the dry film thickness readings from the shop for the shop applied coatings. If not obtained or reported, field inspectors will assume a 1.0 mil BMR in conformance with SSPC-PA 2.

435.03.11 Repair of Surface Imperfections. Refer to 436.03.13.

435.03.12 Surface Condition Prior to Painting. Refer to 436.03.15.

435.03.13 Paint Storage and Mixing. Refer to 436.03.16.

435.03.14 Paint Representative. Refer to 436.03.17.

435.03.15 Shop Priming and Field Finish Painting. Meet SSPC-PA 1 for painting application and 435.03.16 thru .21.

435.03.16 Time Restrictions for Field Painting. Do not apply field paint between December 15 and April 15. Apply shop paint at any time provided it is done indoors under controlled environmental conditions and in conformance with the manufacturer's recommendations.

435.03.17 Weather Restrictions for Painting. Refer to 436.03.20.

435.03.18 Shop Application of Prime Coat. Apply the prime coat in the shop from agitated containers and as recommended by the manufacturer in a single application employing multiple spray passes. Apply the dry film thickness specified in 912.05, except reduce the thickness to approximately 1.0 mil within the areas of field welding and on the top and both edges of the top flange where steel stud shear developers will be attached. Measurements shall be according to SSPC-PA 2.

Remove all dry spray, runs, mud cracking, and damaged primer. Feather the area prior to touch up so that the repainted surface has a reasonably smooth appearance. Use organic zinc primer to touch up the inorganic zinc primer coat in the shop and field unless otherwise approved by the manufacturer and the Engineer. Ensure that touch ups have the same dry film thickness as the coat being repaired. Organic zinc may be applied by brush.

435.03.19 Field Application of Prime, Intermediate, and Finish Coats. Prior to field coating, pressure wash the surfaces of the steel with potable water as specified in 436.03.10(b) to remove dirt and contaminants as described in 436.03.15.

Unless otherwise specified, apply Coats II and III after all field welded areas, bolted areas, and damaged primer coatings are cleaned and primed as specified or as directed.

Apply all paint according to the manufacturer's recommendations except the dry film thickness shall conform to 912.05. Spray painting will be permitted provided the Engineer approves the location and method of spray application. Paint all areas adjacent to machinery and mechanical components, etc., by brush application unless the Engineer approves spray application. Surfaces inaccessible for painting by regular means shall be painted using sheepskin daubers or by other means as necessary to ensure coverage of the proper coating thickness.

The thickness measuring instruments shall be maintained, calibrated, adjusted, and measurements taken in conformance with SSPC-PA 2. Stripe coat all edges, outside corners, crevices, welds (including welds of fabricated members), rivets, bolts, nuts, and washers. Apply a stripe coat of the intermediate coat prior to the application of the full intermediate coat. Apply a stripe coat of the finish coat prior to the application of the full finish coat. Apply stripe coats by brush, dauber, or roller.

Ensure that each coat is free of shadow-through, skips, misses, and thin or heavy coating thickness. Repair defects prior to the application of the next coat. Keep the surface to be coated dust free during painting operations, and protect newly coated surfaces from the cleaning operations. If a previously cleaned area becomes soiled, contaminated, or rusted, reclean the area to the specified condition and completely recoat at no additional cost to the Administration.

Apply the finish coat within 30 days after the intermediate coat unless approved in writing by the paint manufacturer. If the recoat window is exceeded, reclean the surface as approved by the paint manufacturer and the Engineer.

435.03.20 Bolts and Field Welds. Do not shop coat bolts for field assembly. After field welding and prior to applying Coat II (first field coat) clean these bolts, field welds, and adjacent areas. Cleaning shall be as specified in 435.03.09. Apply the first field coat (Coat II) within 24 hours of cleaning. Before Coat II is applied, solvent clean any prime coat stained from rusted bolts according to SSPC-SP 1.

435.03.21 Control of Overspray and Spills. Refer to 436.03.22.

435.03.22 Caulking. Refer to 436.03.23.

435.03.23 Defective Work. Refer to 436.03.24.

435.03.24 Repair of Coatings. Refer to 435.03.09.

435.03.25 Final Identification. Refer to 436.03.26.

435.03.26 Field Cleaning Waste Containment. Refer to 436.03.27.

435.03.27 Field Cleaning Containment System Plan Guidelines. Refer to 436.03.28.

435.03.28 Containment System Requirements by Method of Preparation. Refer to 436.03.29.

435.03.29 Worker Protection. Refer to 436.03.30.

435.03.30 Environmental Protection. Refer to 436.03.32.

435.03.31 Environmental Protection Plan of Action. Refer to 436.03.33.

435.03.32 Methods for Assessing Emissions. Refer to 436.03.34.

435.03.33 Field Cleaning Waste Disposal. Refer to 436.03.35.

435.03.34 Waste Handling Plan of Action. Refer to 436.03.36.

435.03.35 Waste Sampling and Analysis. Refer to 436.03.37.

435.03.36 Hazardous Waste Transportation and Disposal. Refer to 436.03.40.

435.03.37 Nonhazardous Waste Disposal. Refer to 436.03.41.

435.04 MEASUREMENT AND PAYMENT. The Contract unit price for the item specified will be full compensation for all cleaning and painting, scaffolding, platforms, containment systems, permits, working drawings, daily quality control records, professional engineer's services used for containment, industrial hygienist services, air monitoring, sampling and testing of materials for toxic metal content, including any revisions and resubmissions that may be required during the execution of the work, providing safe access for inspections, hand wash station/clean up area, floodlighting, test plates, drums, collection and storage at the temporary storage site, hauling and disposal at an approved industrial waste site or hazardous waste site, removing and replacing planking, removal of debris, and all material, labor, equipment (including test equipment), tools, and incidentals necessary to complete the work.

435.04.01 Cleaning and painting new structural steel will not be measured but the cost will be incidental to the pertinent Fabricated Structural Steel item.

435.04.02 All costs associated with repair of existing coatings due to new connections and existing coatings damaged during steel/deck repairs will not be measured but will be incidental to the pertinent Repair, Structural Steel, or Cleaning and Painting items.

SECTION 436 — CLEANING AND PAINTING EXISTING STRUCTURAL STEEL

436.01 DESCRIPTION. Clean and paint existing structural steel, and repair existing coatings damaged during repairs or by the Contractor's operations. Refer to Section 435 for cleaning and painting new structural steel.

436.01.01 Definitions of Areas to be Cleaned and Painted. The following terms designate the specific areas to be cleaned and painted:

- (a) **All Steel Surfaces.** Steel superstructure elements including but not limited to steel beams, girders, rockers, bearing assemblies, trusses, floor beams, stringers, joists, purlins, cross-bracings, lateral-bracings, diaphragms, sway-bracings, scupper downspouts, and support brackets for utilities, light poles, and sidewalks. It does not include substructure elements, railings, sign structures, utilities, or light poles.

- (b) **Outside Facing Surfaces of Beams.** The exterior/fascia beams of the structure, including the underside of the top flange and the web facing away from the structure, the top of the bottom flange, the outside edge of the bottom flange, the underside of the bottom flange, the inside edge of the bottom flange, and a portion of the top of the bottom flange on the inside facing surface. The transition between the existing and new coating on the top of the bottom flange shall occur approximately half way between the edge of the flange and the fillet. A sharp well-defined transition between the new and existing coating is not required, but the existing coating shall be feathered. Clean and paint all attached bearings.

- (c) **Inside Facing Surfaces of Beams.** Beams adjacent to longitudinal joints including the underside of the top flange and the web facing toward the longitudinal joint, the top of the bottom flange, the inside edge of the bottom flange, the underside of the bottom flange, the outside edge of the bottom flange, and a portion of the top of the bottom flange on the outside facing surface. The transition between the existing and new coating on the top of the bottom flange shall occur approximately half way between the edge of the flange and the fillet. A sharp well-defined transition between the new and existing coating is not required, but the existing coating shall be feathered. Clean and paint all attached bearings.

- (d) **Bearings and Beam Ends.** Bearing assemblies and structural steel for the specified distance from the ends of the beams at the abutments, and the specified distance in each direction from the center line of the piers for a total of twice the specified distance.

- (e) **Roadway Joints.** All roadway joint steel on the outside, top, and inside surfaces of the parapets, and from the parapet to the first pavement marking.

The paint system, finish coat color, and areas to be cleaned and painted for each structure shall be as specified in the Cleaning and Painting Table included in the Contract Documents.

436.01.02 General. Perform the work according to SSPC Standards and the manufacturer's recommendations.

Notify the Engineer of structural defects including cracks, missing bolts or rivets, and deterioration detected during cleaning and painting.

Protect utility pipes, conductors, light fixtures, and conduits from these operations. Do not clean and paint them unless specified.

Perform Quality Control (QC) inspections to ensure that each phase of the work meets Specification requirements.

All maintenance of traffic required for corrective action shall be at no additional cost to the Administration. When a railroad is included in the project, all railroad fees shall be as specified, except that any additional impact on the railroad and associated fees due to corrective actions or additional inspections shall be at no additional cost to the Administration.

Ensure that all operations meet the requirements of OSHA, including exposure to lead, arsenic, and cadmium. Comply with 29 CFR 1926 construction standards and the applicable Federal, State, and local laws, including COMAR 26.16.01.

Existing paint systems and abrasives used for blast cleaning may include toxic metals such as lead, arsenic, cadmium, and chromium. Consider them as hazardous waste when removed, unless tests conducted as specified in the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311 prove otherwise.

Prior to bidding, become familiar with the current environmental regulations and safety procedures. In accordance with the EPA's RCRA regulation, the Administration shall be considered the "Waste Generator" of the paint wastes generated by the work on existing structures.

The Contractor shall be considered the "Hazardous Waste Generator" of all other waste associated with the work. These include wastes produced such as petroleum waste, solvent related waste, unapplied waste

paints, used rags, used protective clothing, and other personal protective clothing (PPE) determined to be wastes. Obtain an EPA Hazardous Waste Generator ID Number, and dispose of waste under manifest as required by RCRA (40 CFR 260 thru 265, and 271).

Prevent waste from entering into the environment by containing, collecting, storing, testing, and disposing of all waste in accordance with Federal, State, and local regulations.

436.01.03 Minimum Contracting Requirements for Field Painting.

The Contractor/subcontractor removing or applying paint shall be certified as specified in (a) below. When the paint being removed contains toxic metals, the Contractor/subcontractor removing the paint shall be certified as specified in (b) below. All certificates shall be effective prior to Award of Contract and shall remain in effect for the duration of the Contract. Refer to 436.03.01.

- (a) **SSPC-QP1.** Standard Procedure for Evaluating Qualifications of Painting Contractors: Field Application to Complex Structures.
- (b) **SSPC-QP2, Category A.** Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint.

436.01.04 Definition of Bridge. The definition of the word “Bridge” as defined in TC-1.03 does not apply to this Specification. References to “Bridges” in this Specification shall mean any structure carrying traffic, regardless of their length.

436.02 MATERIALS.

Paint Systems

436.02.01 and 912.05

436.02.01 Paint Systems. All coats within the paint systems specified herein shall be from the same manufacturer. When more than one paint system is used, all overlapping paint systems shall be from the same manufacturer. The color of the touch up finish coat on existing steel shall match the existing finish coat. The color of the finish coat shall be as specified.

436.02.02 Abrasives. Abrasive media shall produce blasted surfaces having a surface profile height of 1.5 to 4.0 mils as determined according to D 4417, Method C. Provide material safety data sheets (MSDS) for the abrasives and a letter from the abrasive supplier indicating that

expendable abrasives meet SSPC-AB 1, and recyclable abrasives meet SSPC-AB 3. Verify the cleanliness of recycled abrasives according to SSPC-AB 2.

436.03 CONSTRUCTION.

436.03.01 Submittals. Submit the following drawings, plans, and information for accomplishing the work. Except for (e) below, submit six copies on company letterhead to the Office of Bridge Development, Bridge Inspection and Remedial Engineering Division. Do not proceed with the work until the submittals are approved by the Administration.

- (a) **Copy of SSPC-QP Certification.** Refer to 436.01.03.
- (b) **Personnel Qualifications.** Provide applicable personnel qualifications to the Project Engineer prior to using the personnel on site. Refer to 436.03.02.
- (c) **Quality Control (QC) Plans.** Refer to 436.03.03 for detailed submittal requirements for shop and field Quality Control Plans. Send all shop QC Plan submittals to the Office of Materials Technology. Submittals shall meet 900.01 and 912.01. Submit all field QC Plans as specified in 436.03.01.
- (d) **Paint Manufacturer Certifications and Letters.** Submit the following information per 900.01 and 912.01 to the Office of Materials Technology:
 - (1) When detergents or additives are proposed to be incorporated into the water used for washing, provide MSDS and a letter from the coating manufacturer that approves the use of the detergents with their coating.
 - (2) The manufacturer shall provide a letter that approves any proposed solvents for use in solvent cleaning prior to painting or between coats. Provide MSDS for the solvents.
 - (3) Provide the paint manufacturer's application and thinning instructions, MSDS, and product data sheets.
 - (4) When caulking is used, provide a letter from the coating manufacturer identifying the recommended caulking material, the application sequence for integrating the caulking into the

coating system between Coats II and III, and the minimum cure time prior to paint application.

- (5) If the only portion of bridge to be painted is the roadway joint, the paint need not be tested by the Laboratory if, prior to use, a copy of the certified test results has been furnished to the Engineer specifying that the paint conforms to Section 912.
- (e) **Containment Plans.** Refer to 436.03.28 and .29. Make submittals as specified in Section 499..
- (f) **Worker Protection Compliance Program.** Required when abrasive blast cleaning is conducted in the field or paint containing toxic metals is being disturbed. Refer to 436.03.31.
- (g) **Environmental Protection Plan of Action.** Required when abrasive blast cleaning is conducted in the field or paint containing toxic metals is being disturbed. Refer to 436.03.33.
- (h) **Waste Handling Program.** Required for the handling of all hazardous waste regardless of the presence of toxic metals. The Waste Handling Program shall also include disposal of unused paint and solvent. Refer to 436.03.36. A written program is not required for the handling of nonhazardous waste.

Do not construe approval of the submittals to imply approval of any particular method or sequence for conducting the work, or for addressing health and safety concerns. Approval of the proposed plans shall not remove the responsibility to conduct the work in accordance with Federal, State, or local regulations, this Specification, or to protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor remains responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

436.03.02 Personnel Qualifications and Responsibilities. Provide documentation that all applicable project personnel meet the training and accreditation requirements of COMAR 26.16.01.

- (a) **QC Inspectors.** A QC inspector shall be on site full time during cleaning and painting operations. Provide documentation that personnel performing quality control related functions are

experienced and qualified to perform the work, and have completed the training specified for SSPC-QP1, and when paint containing toxic metals is being disturbed, SSPC-QP2.

- (b) **Competent Person.** A competent person as specified in SSPC-QP2 shall be on site full time when paint containing toxic metals is being disturbed. This person shall perform all quality control related functions involving the oversight of worker and environmental protection, containment performance, and waste handling. Provide documentation of qualifications, including experience and records of training as specified in SSPC-QP2. This person shall hold a current SSPC C3 Competent Person Certificate or current C5 refresher, a certificate of completion of 29 CFR 1926.62(l) Lead in Construction Training, and shall be accredited in accordance with COMAR 26.16.01.
- (c) **Certified Industrial Hygienist (CIH).** Provide the services of a CIH when the work involves the disturbance or removal of paint containing toxic metals. Provide evidence that the CIH has the following qualifications and insurance requirements:
- (1) Certification by the American Board of Industrial Hygiene.
 - (2) Field sampling and oversight experience involving removal of paint that contains toxic metals from structures.
 - (3) \$1 000 000 errors and omissions insurance coverage for this type of work.

All field sampling and testing shall be performed by the CIH or by an employee working under the direct supervision of the CIH, and shall be witnessed by a representative of the Administration. Notify the Bridge Inspection and Remedial Engineering Division at least 24 hours prior to sampling and testing.

The CIH shall review all results of sampling and testing performed on the project. The CIH, or a person working under the direction of the CIH, shall prepare written reports interpreting these results for compliance to the applicable regulations. Submit a copy of all reports, analysis, etc., to the Engineer within five working days after sampling.

Submit a written certification within five days after the end of each month stating that the Contractor has complied with the Plans of

Action and Compliance Programs specified within this Specification for worker protection, environmental protection, and waste handling; and has addressed any deficiencies found. The certification shall be prepared and signed by the CIH or a person working under the direction of the CIH.

436.03.03 Quality Control (QC) Plan, Inspection Procedures, and Recording Systems. Submit a Quality Control Plan for providing daily job quality control per SSPC-QP1 for surface preparation and painting operations. The Quality Control Plan shall include the following:

- (a) Records of standards and specifications for coating inspection work and their utilization.
- (b) System for filing inspection reports.
- (c) Demonstration that inspection equipment and calibration standards and procedures for calibrating the inspection equipment are available.
- (d) Procedures to stop nonconforming work.
- (e) Procedures for verifying proper coating application.
- (f) Procedures to ensure that each major operation is inspected and the inspection results documented. Contractor QC inspections shall include:
 - (1) Effectiveness of protective coverings to control project debris, paint spatters, overspray, drips, paint spills, etc., while painting over roadways, waterways, machinery areas, and areas in the vicinity of abutments and private properties.
 - (2) Ambient conditions.
 - (3) Compressed air cleanliness and, if required, acceptability for breathing.
 - (4) Surface preparation (solvent cleaning, pressure washing, hand/power tool or abrasive blast cleaning, etc.).
 - (5) Coating application (specified materials, mixing, thinning, and wet film thickness).

- (6) Dry film thickness per coat.
- (7) Recoat times and cleanliness between coats.
- (8) Coating continuity and coverage (free from runs, sags, overspray, dryspray, pinholes, shadow-through, skips, etc.).

Maintain on site copies of the Contractor's daily job quality control records and make them available to the Engineer at any time. Submit records from on site audits.

436.03.04 Inspection Equipment. Provide for the exclusive use of the Engineer, the following equipment for the QA observations of the cleaning and painting operations. Maintain, calibrate, and verify the equipment in a condition that is satisfactory to the Engineer. The equipment will remain the property of the Contractor at the conclusion of the Contract.

- (a) The latest editions of SSPC-Vis 1, SSPC-Vis 3, or SSPC-Vis 4, as applicable to the project, or other approved visual standards.
- (b) SSPC Manual Volumes 1 and 2 (Latest Editions).
- (c) Spring Micrometer with Coarse and Extra Coarse Surface Profile Replica Tape.
- (d) Electric or Sling Psychrometer, F.
- (e) U.S. Weather Bureau Psychrometric Tables.
- (f) Surface Thermometer, 0 to 150 F.
- (g) Probe Thermometer for Paint Temperature.
- (h) High/Low Thermometer for Paint Storage Area.
- (i) Wet Film Thickness Gauge.
- (j) Digital Magnetic Dry Film Coating Thickness Gauge capable of transferring data to a computer (SSPC-PA 2, Type 2).
- (k) Plastic Calibration Shims for Digital Magnetic Dry Film Thickness Gauge.
- (l) Inspector's Mirror.

- (m) Wind Meter.
- (n) Clean, White, Lint-Free, Absorbent Rags.
- (o) Light Meter for measuring light intensity during surface preparation, painting, and inspection work.
- (p) Putty Knife at least 40 mils thick and 1 to 3 in. wide.
- (q) Blotter Paper.

436.03.05 Paint Quality Assurance (QA) Inspector Notification.

Notify the Bridge Inspection and Remedial Engineering Division at least five working days prior to beginning field cleaning and painting of new and existing steel. A paint inspector will be provided to assist the Engineer in performing the QA observations of the cleaning and painting portion of the work. Failure to comply with this notification shall be cause for not accepting the work performed. Paint applied without QA acceptance may be required to be removed and reapplied at no additional cost to the Administration. Any test to determine acceptance shall be at no additional cost to the Administration. Do not perform additional work until a determination has been made.

436.03.06 Floodlighting. Provide floodlighting, including power sources, to supply adequate illumination to all surfaces being prepared, painted, or inspected, including the underside and inside of the containment system, when containment is employed. Floodlighting shall meet SSPC-Technology Guide No. 12, be maintained in good working condition, and be of an approved design. Adjust the floodlighting to avoid glare to marine and vehicular traffic.

436.03.07 Field Cleaning and Painting. Refer to the Contract Documents for the appropriate cleaning and painting requirements.

436.03.08 Painting Sequence. Do not paint the outside facing surfaces of beams until all concrete has been placed and parapet form brackets removed. However, the primer coat may be applied to these areas prior to placing the form brackets provided that it is properly touched up prior to placing the next coat of paint. Protect concrete from being stained by painting operations. Restore painted or stained concrete surfaces to originally intended color without damaging the concrete.

Proceed with cleaning and painting by sections, bays, or other readily identifiable part of the work as approved.

Start the work at the top and proceed toward the bottom.

436.03.09 Surface Preparation. Prepare surfaces as specified in the pertinent SSPC Specifications and the Contract Documents. Surface conditions shall meet the pertinent SSPC-VIS Standards, and the test plates/sections specified in 436.03.11.

436.03.10 Methods of Cleaning. Methods shown in the following table apply to both shop and field cleaning and shall be performed in the order shown. The methods are invoked based on the Paint System specified.

PAINT SYSTEM	SUBSTRATE	METHOD OF CLEANING
C & D	Abrasive blast cleaned steel	Existing Paint to be Removed - Localized (a) and (b) and complete (h)
E, F, & H	Overcoating existing paint	Existing Paint to be Overcoated - Localized (a) and complete (c) followed by (d) and (e)

(a) **Solvent Cleaning.** Use solvents, emulsions, cleaning compounds, steam cleaning, or similar approved materials and methods in accordance with SSPC-SP 1 to remove grease, oil, diesel smoke residue, soot, and similar surface contaminants. Use soap steam cleaning for steel open grid decks and walkways and machinery areas of drawbridges. Before it evaporates, remove contaminated solvent by wiping or rinsing with clean solvent to prevent a film of contaminants from remaining on the surface. Solvent wiping may be required between coats. Use solvent approved in writing by the paint manufacturer.

(b) **Low Pressure Water Cleaning (LPWC).** Use potable water on all bearings, transverse and longitudinal joints, and beam ends prior to abrasive blast cleaning to remove salts, bird droppings, dirt, and debris. At beam ends, wash to the limits defined in 436.01.01(d). Use LPWC as necessary between coats to remove surface contamination.

Perform LPWC per SSPC-SP 12, except use a nozzle pressure of 2000 to 2500 psi together with a rotating tip 12 to 18 in. from the surface. The pressure washer shall be equipped with easily accessible gauges and a pressure regulator. Perform LPWC no more than 96 hours prior to blast cleaning. Use this method to remove concrete spatter, dirt, debris, salt contaminants, grease, oil,

and similar surface interference material from newly coated structures prior to the application of additional coats. Should the surface not be blast cleaned within 96 hours after LPWC, the Engineer will determine if additional preparation is required.

When the water is to be recycled and the coating being cleaned contains toxic metals, test for toxic metals before reuse. Do not reuse water that exceeds the threshold value for any toxic metal.

- (c) **High Pressure Water Cleaning (HPWC).** Use potable water prior to hand and power tool cleaning in preparation for overcoating to remove loose paint, loose rust, loose mill scale, salts, bird droppings, dirt, debris, grease, oil, hydrocarbons, diesel smoke residue, soot, chalk, and similar surface interference material.

Perform HPWC per SSPC-SP 12, WJ-4, except use nozzle pressures of 4000 to 6000 psi and a rotating tip. A biodegradable detergent may be added to the water for the removal of grease, oil, and hydrocarbons if approved. The pressure washer shall be equipped with easily accessible gauges and a pressure regulator. Perform the cleaning at close range to the surface, approximately 6 in., using a pattern of overlapping drops followed by cross-hatching with the same overlap. At the end of cleaning, ensure that the swirling patterns created by the rotating tip are not visible on the surface. Perform the HPWC within 96 hours of applying the first coat. Should the surface not be painted within 96 hours, the Engineer will determine if additional preparation is required.

When the water is to be recycled, and the coating being cleaned contains toxic metals, test for toxic metals before reuse. Do not use water that exceeds the threshold value for any toxic metal.

- (d) **Power Tool Cleaning.** Perform per SSPC-SP 3 and as depicted in SSPC-Vis 3. The use of 40 grit sanding discs is recommended. Refer to (e) for inaccessible areas.
- (e) **Hand Tool Cleaning.** Perform per SSPC-SP 2. The use of 60 grit sanding paper is recommended. Restrict the use of this method to areas that are inaccessible for power tool cleaning.
- (f) **Power Tool Cleaning to Bare Metal.** Perform per SSPC-SP 11 and as depicted in SSPC-Vis 3, with a surface profile of at least 1.0 mil.

- (g) **Brush Off Blast Cleaning.** The end surface condition shall meet SSPC-SP 7, Brush Off Blast Cleaning and as depicted in SSPC-Vis 1. Ensure that abrasives are dry and free of oils, grease, and other harmful materials such as lead dust, at the time of use.

- (h) **Near White Metal Abrasive Blast Cleaning.** Do not use steel shot in the field. When using steel shot in the shop, add a sufficient amount of steel grit. Maintain the mixture to produce an etched surface texture, as opposed to the peened surface texture that results when blast cleaning with shot alone. The end surface condition shall meet SSPC-SP 10, Near White, and as depicted in SSPC Vis 1. Ensure that abrasives are dry and free of oils, grease, and other harmful materials such as lead dust at the time of use.

436.03.11 Test Plates/Sections. When abrasive blast cleaning is specified, furnish two 12 x 12 x 1/4 in. steel test plates and clean them to meet SSPC VIS Standards and the Contract Documents. Apply a clear protective coating to these standard test plates and use them as a job sample standard for cleaning operations. When approved as an alternative to the test plates, portions of an actual work piece may be used in order to reach agreement on the degree of cleaning before production surface preparation begins. When the SSPC VIS Standards accurately depict the agreed upon degree of cleaning on the test section, the prepared section does not have to be sealed and retained for future reference. When the SSPC VIS Standards do not accurately depict the degree of cleaning, the test section shall be sealed and retained, or the test plates utilized. For the production cleaning operations, the written requirements of this Specification, the SSPC definitions, the test plates, and the SSPC VIS Standards shall be used in that order for determining compliance with the Contractual requirements.

436.03.12 Removal of Vegetation, Planking, and Signage. Prior to surface preparation, remove vegetation overhanging or fouling the structure.

When the structure has planking (timber or plywood) between the beams, carefully remove it in the areas of work operations. Store and maintain the planking in good condition. Dispose of all debris on the planking. Unless otherwise directed, the planking will not have to be reinstalled until cleaning and painting operations are complete. The Engineer may direct that portions of the planking be reinstalled prior to opening any lane to traffic during the same working day. The Engineer may also direct that planking be reinstalled during periods of work stoppage.

When the fascia webs of the structure contain street identification signs, remove them prior to beginning cleaning operations in the area. Clean and paint areas exposed by the sign removal, including bolt holes. Whenever a sign is removed, notify the Engineer. The Engineer will notify the Office of Traffic and Safety's Chief, Traffic Operations Division. Street signs may be reinstalled by the Office of Traffic and Safety utilizing the Contractor's maintenance of traffic. They will coordinate this work with the Contractor.

436.03.13 Repair of Surface Imperfections. Regardless of the method of cleaning, remove surface imperfections such as sharp fins and slivers, rust scale, weld spatter, and pack rust by a combination of cleaning procedures such as using hand or power impact tools (chipping hammers or scaling hammers), blast cleaning, etc., without scarring good steel.

436.03.14 Feathering and Removal of Defects in Existing Coating. For projects involving the touch up or overcoating of newly installed steel or existing coatings in the field, regardless of the method used for cleaning, feather the edges of old paint permitted to remain. Remove portions of paint on previously painted surfaces that are chalky, powdered, cracked, or otherwise unacceptable. Remove runs and sags in the existing paint on the outside facing surfaces of fascia beams over highways. Ensure a smooth appearance after application of the new coating.

436.03.15 Surface Condition Prior to Painting. Remove residual dust, dirt, and grease from the surface as the final procedure prior to painting and between coats whenever the coating is contaminated. Cleaning includes the removal of all dust, puddles, grease, oil, exhaust from trucks, debris, concrete spatter, and other foreign matter on the surfaces being painted. Also remove debris on surfaces adjacent to those being painted. Concrete spatter stains that discolor the primer need not be removed provided material is not dislodged when wiping the surface with a cloth. Cleaning involves vacuuming, solvent cleaning, hand/power tool cleaning, and pressure washing as appropriate. Should an area of previously cleaned steel become soiled, contaminated, or rusted, reclean the area prior to painting at no additional cost to the Administration.

Prior to the application of paint in the shop and field, the QC personnel shall inspect the surfaces and establish that they have been prepared according to the Specifications. Upon QC acceptance, obtain approval that the surfaces to be painted during that day have been cleaned as specified.

436.03.16 Paint Storage and Mixing. Store paints and thinners in well ventilated areas that are not subject to excessive heat, open flames, electrical discharge, and direct rays of the sun. Adhere to the manufacturer's recommendations. Store materials in heated areas when necessary. Use materials on a rotating stock basis, and leave containers closed until used. Do not use paints that cannot be stirred to normal consistency. Store paint in tightly covered containers at an ambient temperature of at least 45 F. Maintain containers in a clean condition, free of foreign materials and residue.

Remove and discard thin skins formed in the container. Do not use material that is livered, gelled, thick skinned, or otherwise questionable.

Mix paints per manufacturer's instructions and as approved. Do not thin the paint unless authorized by the paint manufacturer and approved. The Engineer shall be present whenever the paint is thinned. Do not use materials that are beyond their pot life or shelf life. For multiple component paints, only complete kits shall be mixed and used. Partial kit mixing is prohibited.

Remove waste chemical solutions, oily rags, and other waste daily. Take precautionary measures to ensure protection of workers and work areas from fire hazards and health hazards resulting from handling, mixing, and applying materials.

436.03.17 Paint Representative. The representative shall be a technical representative of the paint manufacturer and shall be present during the initial execution of the work to approve with the Engineer the degree of cleanliness prior to painting, and the method of application of the coating system. The Engineer may stop paint operations for failure to meet this requirement regardless of the reason for the failure. Areas cleaned prior to ceasing paint operations shall be re-cleaned if required.

436.03.18 Field Painting. Meet SSPC-PA 1 for painting application and 436.03.19 thru .22.

436.03.19 Time Restrictions for Field Painting. Do not perform field painting between December 15 and April 15.

436.03.20 Weather Restrictions for Painting. All surfaces to be painted shall be sound and cleaned per the Contract Documents. Do not paint when:

- (a) There is rain, snow, fog, or mist dampening the surface.
- (b) The relative humidity exceeds the maximum humidity specified by the paint manufacturer.
- (c) The ambient air temperature in the shade is below 40 F.
- (d) The surface temperature is below the minimum temperature specified by the paint manufacturer; however, paint shall not be applied when the surface temperature is below 35 F.
- (e) The surface temperature is expected to drop to 32 F or below before the paint has cured the minimum time and temperature for recoat specified by the manufacturer.
- (f) The surface temperature is less than 5 F above the dew point.
- (g) The surface temperature exceeds the value recommended by the manufacturer.

Whenever it is suspected that moisture is condensing upon the surface, the psychrometer will be used to check dew point, etc. If the conditions measured by the psychrometer are marginal, the Engineer may permit a well defined area of the surface to be lightly moistened with a damp cloth and observed. If the dampness evaporates in 15 minutes, the surface will be considered satisfactory for the application of paint. Regardless of any environmental test results, when fresh paint is damaged by the elements, replace or repair the paint at no additional cost to the Administration.

Schedule the operations so that all cleaned surfaces are painted within 24 hours. If rust bloom appears or the air or steel temperature falls below five degrees above the dew point after cleaning and prior to application of the primer coat, reclean the affected areas to the satisfaction of the Engineer at no additional cost to the Administration.

436.03.21 Application of Prime, Intermediate, and Finish Coats. All surfaces shall meet the specified degree of preparation prior to the application of the paint system.

Apply all paint according to the manufacturer's recommendations except the dry film thickness shall conform to 912.05. Spray painting will be permitted provided the Engineer approves the location and method of spray application. Paint all areas adjacent to machinery and mechanical components, etc., by brush application unless the Engineer approves spray

application. Surfaces inaccessible for painting by regular means shall be painted using sheepskin daubers or by other means as necessary to ensure coverage of the proper coating thickness.

The thickness measuring instrument shall be maintained, calibrated, adjusted, and measurements taken in conformance with SSPC-PA 2. Stripe coats shall be applied using brush, dauber, or roller to all edges, outside corners, crevices, welds, rivets, bolts, nuts, and washers prior to application of coatings in conformance with the following schedule:

SYSTEM	COAT
B	II & III
C	I* & II
E	I & II
F	II & III
H	II & III

*Striping of Coat I is permitted after the application of Coat I if the stripe coat is tinted per manufacturer's recommendation.

Ensure that each coat is free of shadow-through, skips, misses, and thin or heavy coating thickness. Repair defects prior to application of the next coat. Keep the surface to be coated dust-free during painting operations, and protect newly coated surfaces from the cleaning operations. When a previously cleaned or painted area becomes soiled, contaminated, or rusted, reclean the area to the specified condition and completely recoat at no additional cost to the Administration.

Apply each coat within 30 days after the prior coat, unless approved in writing by the paint manufacturer. If the recoat window is exceeded, reclean the surface as approved by the paint manufacturer and the Engineer.

436.03.22 Control of Overspray and Spills. Protect the environment from paint droplets, overspray, and spills by providing containment for the paint application area. Assume responsibility for any damage resulting from wind and cleaning and painting operations. Up to 2 in. of overspray will be permitted onto the adjacent surface of the bridge deck next to the top flange. No other overspray will be permitted. Whenever the method of protection fails to function at the required level of efficiency, immediately suspend all operations except those associated with minimizing adverse impact to the environment. Do not resume

operations until modifications have been made to correct the cause of the failure. Use fire retardant containment screens, curtains, and tarpaulins.

Paint operations may be stopped by the Engineer due to wind. However, operations shall stop if the wind velocity exceeds 20 mph, unless specific and approved precautions are taken to prevent the escape of paint droplets and overspray.

436.03.23 Caulking. Caulk the following areas with a material approved by the paint manufacturer. Install caulking between the intermediate and finish coats:

- (a) Areas of plate delamination that are 1/8 in. or greater that cannot be cleaned and sealed during the application of the coatings.
- (b) Gaps between steel members that are 1/8 in. or greater that cannot be cleaned and sealed during the application of the coatings.
- (c) Interface between the steel and concrete surfaces where through-girders penetrate the concrete. Apply caulking to the surfaces above the deck only. Do not caulk surfaces below the deck.
- (d) Gaps at the interface of steel and concrete surfaces that cannot be cleaned and painted.

436.03.24 Defective Work. Neither conditions during application nor Laboratory acceptance of paint shall remove the responsibility of obtaining a satisfactory paint system. When rusting occurs or a paint coat lifts, blisters, wrinkles, or shows evidence of having been applied under unfavorable conditions, the workmanship is poor, impure or unauthorized paint has been used, or for any other reason the painting is unsatisfactory, remove the affected paint and thoroughly clean the steel and repaint. Ensure that there is a uniform appearance throughout the structure.

436.03.25 Repair of Damaged Coatings due to Contractor Operations. Notify the Bridge Inspection and Remedial Engineering Division to determine the methods of cleaning and painting to be used.

436.03.26 Final Identification. When the final coat of paint is dry, stencil a legend on the structure indicating the type of paint used in each coat, and the month and year in which each application was completed. The letters shall be 2 to 2-1/2 in. high and be applied with black paint to the inside surface of a fascia beam near the abutment at a location

selected by the Engineer. Stencil paint shall be compatible with the paint system applied. When more than one paint system is used, apply additional stencils.

436.03.27 Field Cleaning Waste Containment. Meet the SSPC Guide 6 containment levels specified in 436.03.28 and .29. Applicable portions of these requirements apply to shops when existing steel coated with hazardous material is cleaned in the shop. With the exception of paint removal on the top flanges of members in preparation for deck replacement, provide a written Containment System Plan per 436.03.28 unless otherwise directed.

436.03.28 Field Cleaning Containment System Plan Guidelines.

Unless otherwise directed, the following submittal requirements apply when a containment system is specified, regardless of the presence of toxic metals. Even if a written Containment Plan is not required, meet the technical requirements listed below when containment is used. Provide all submittals to the Office of Bridge Development, Working Drawing Review Section. Provide the following:

- (a) Working drawings of the proposed containment system, showing the design of the paint removal, containment, rigging, and ventilation system (if applicable), including all calculations and assumptions. The working drawings shall:
 - (1) Indicate which structures are covered by the plans submitted. Show the containment system in plan and elevation views, including details of clips and hangers.
 - (2) Identify all containment system components on the plan sheets.
 - (3) Indicate the type and size of scaffolding or rigging to be used.
 - (4) Indicate sizes of the containment areas, and when ventilation is specified, the capacity of the dust collectors, equipment data sheets, and types of airflow systems to be provided including volume of air from ventilation fans and minimum velocity of air movement.
- (b) The containment system and equipment shall not encroach upon the minimum structure clearances specified.
- (c) Secure all curtains, screens, and tarpaulins used for containment. Make connections to the steel work of the structure with clamps or

other approved devices. Do not drill holes into the existing structure or weld to the existing steel work. Do not make permanent attachments or fastenings to the structure. Do not attach any load to the structure railings unless details and calculations showing loading have been approved.

- (d) Use fire retardant containment curtains, screens, and tarpaulins.
- (e) Indicate maximum waste load permitted on the containment system, expressed in inches of debris.
- (f) Indicate all restrictions on the structure, and if it is posted.
- (g) When the containment or rigging system or methods of erection will apply a load to the structure (e.g., suspended platform) the submittals shall include an analysis of the load that will be added to the existing structure, including blast waste. When vehicles containing surface preparation materials or waste will be stationed on the structure, indicate allowable load and location. The load analysis shall be performed, signed, and sealed by a professional engineer registered in the State of Maryland. The analysis shall ensure that the system will not affect the structural integrity of the structure.

When the containment or rigging system does not impose a load to the structure (e.g., tarpaulin materials suspended from the structure at an abutment or cables and picks used for access), a professional engineer analysis and review of the drawings is not required.

- (h) All drawings requiring a professional engineer review and seal as defined in (g) above shall be prepared and submitted per Section 499. Drawings not requiring a professional engineer review and seal can be provided on standard paper. Submit 10 copies of each drawing. When a professional engineer stamp is required, each sheet shall be signed and sealed by the professional engineer. The submittal letter shall be on company letterhead. At least one copy of the submittal shall have an original seal.
- (i) When the structure is over water, show a skimming boom for emergency backup.

436.03.29 Containment System Requirements by Method of Preparation. Refer to 436.03.10.

- (a) **Washing.** When pressure washing newly installed steel coated only with inorganic zinc primer, the surfaces may be washed without any containment or collection of the water. Prevent spray and runoff water from entering traveled areas such as roadways, walkways, and railroads.

Whenever pressure washing is being performed on other painted surfaces, prevent paint chips from falling into rivers, streams, wetlands, wetland buffers, or other bodies of water, and when specified, from falling onto the ground. Should inadvertent spills or releases of paint chips occur, clean them up before the end of the shift, or immediately if directed.

- (1) When pressure washing paint containing toxic metals or inorganic zinc/vinyl systems, the containment shall meet SSPC Class 2W. All wash water and debris shall be collected and disposed of per the applicable regulations and 436.03.27 and .35, respectively. Prevent paint chips from falling onto the ground.
 - (2) When pressure washing all other systems (systems other than inorganic zinc, inorganic zinc/vinyl, or systems that contain toxic metals), collect all dislodged paint chips, but the water need not be captured. When dislodged chips are collected on suspended containment screens, the maximum mesh opening shall be 17 mils. When working over ground, chips may be collected from the ground in lieu of utilizing containment screens, provided all chips are collected before the end of the shift. Dispose of collected paint chips and debris per applicable regulations and 436.03.35.
- (b) **Power Tool and Hand Tool Cleaning.** Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water. Should inadvertent spills or releases of paint chips occur, clean them up before the end of the shift, or immediately if directed.
- (1) If paint system contains toxic metals, the containment for open power tool cleaning shall meet SSPC Class 2P. Dispose of collected paint chips and debris per the applicable regulations and 436.03.35.
 - (2) If paint system does not contain toxic metals, the containment for open power tool cleaning shall meet SSPC Class 3P.

Dispose of collected paint chips and debris per the applicable regulations and 436.03.35.

- (3) For roadway joints and other small areas approved by the Engineer, High Efficiency Particulate Air (HEPA) filter vacuum shrouded power tools may be used in lieu of containment in areas of paint containing toxic or nontoxic metals. Vacuum-shrouded power tools may eliminate the need for containment if it can be demonstrated that all paint chips and debris are sufficiently collected by the vacuum.

(c) Spot Abrasive Blast Cleaning or Brush Off Blast Cleaning.

Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water. Should inadvertent spills or releases of abrasives or paint chips occur, clean them up before the end of the shift, or immediately if directed.

With the exception of new steel installed with inorganic zinc primer, the containment for spot abrasive blast cleaning or brush off blast cleaning (regardless of the presence of toxic metals) shall meet SSPC Class 2A. Dispose of collected paint chips and debris per the applicable regulations and 436.03.35.

Containment for spot abrasive blast cleaning or brush off blast cleaning of newly installed inorganic zinc primer shall meet SSPC Class 3A. Dispose of collected paint chips and debris per the applicable regulations and 436.03.35.

(d) Total Paint Removal by Abrasive Blast Cleaning.

Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water. Should inadvertent spills or releases of abrasives or paint chips occur, clean them up before the end of the shift, or immediately if directed.

When totally removing any coatings by abrasive blast cleaning (regardless of the presence of toxic metals), the containment shall meet SSPC Class 2A. Dispose of collected paint chips and debris per the applicable regulations and 436.03.35.

Meet ambient air and worker exposure requirements established by the Maryland Department of the Environment and MOSH.

Maintain containment systems while work is in progress. Do not deviate from the approved working drawings. Deny public access to all rigging, scaffolding, containment systems, and work sites at all times.

When cleaning structures over water, provide a skimming boom for emergency backup consisting of a float with a skirt or other approved system that shall be employed immediately to collect floating debris. Clean the skimming boom at least once a day. Upon completion of the project, clean the skimming materials or if cleaning is not possible or practical, dispose of as hazardous or nonhazardous waste as applicable.

436.03.30 Worker Protection and Exposure Monitoring. In addition to complying with all applicable OSHA and MOSH regulations, when the project involves coatings that contain toxic metals, provide the services of a CIH per 436.03.02(c) and submit a Worker Protection Compliance Program per 436.03.31. The CIH, or a technician working under the direction of the CIH shall monitor worker exposures during paint disturbance operations at each structure and provide worker protection oversight.

Regardless of the presence of toxic metals, provide a hand wash station with soap and towels at each work site. As dictated by the monitoring results and the applicable OSHA standards, provide a clean up area with a shower, soap, hot and cold potable pressurized water; a change area with a locker; and an approved container for collecting and disposing of waste at each work site. The hand wash and shower facilities shall be available for Contractor and Administration personnel. Hygiene facilities shall meet 29 CFR 1926.51, Sanitation Standard.

436.03.31 Worker Protection Compliance Program. A Worker Protection Compliance Program is not required when the coatings being disturbed do not contain toxic metals.

The program shall be on company letterhead and meet OSHA and the MOSH - Lead in Construction Standards, and other applicable toxic metal standards. The Compliance Program shall be reviewed and signed by the CIH and at least one copy of the submittal shall have an original CIH seal. The program shall include a commitment for the CIH, or a person working under the direction of the CIH, to provide written certification each month that the Contractor has complied with the Worker Protection Compliance Program, including biological monitoring. The letter shall be provided to the Contractor within five working days after the end of the month, and the Contractor shall provide the Engineer with a copy of the letter the following workday.

436.03.32 Environmental Protection. At the end of the shift each day and upon completion of all project activities, the surrounding property and the entire project area shall be cleaned free of visible debris from the cleaning and painting activities.

436.03.33 Environmental Protection Plan of Action (EPPA). An EPPA confirming that the environment is protected from contamination is required when the coatings are being abrasive blast cleaned (regardless of the presence of toxic metals), or the coating being disturbed contains toxic metals (regardless of the method of preparation). When an EPPA is required, it shall be reviewed and sealed by a CIH and shall include procedures for monitoring air, soil, and water.

Include a location plan showing the type and location of high volume ambient air monitors if applicable, and the procedures that will be followed for visible emissions assessments and inspections of the soil, water, surrounding property and structures, and pavement. Submit six copies of each plan signed and sealed by the CIH. All submittals shall be in writing and on company letterhead. At least one copy shall have an original seal. Address the proposed procedures that will be implemented for the following as defined in 436.03.34:

- (a) For any paint disturbance using dry methods of preparation, address the daily visual emissions observations that will be performed and the corrective action that will be implemented in the event emissions or releases occur.
- (b) When paint containing toxic metals is being disturbed, address the provisions for high volume ambient air monitoring (TSP-Monitoring); monitor citing, calibration, and operation; filter handling and shipping; and laboratory analysis, including the name and qualifications of the laboratory. Test results shall be reviewed and summarized by the CIH, and provided to the Contractor within five days of sample collection. Provide copies to the Engineer the following work day after receipt.
- (c) For any paint disturbance, address the visual assessments for soil/water/sediment that will be undertaken each day and upon project completion, together with the proposed clean up activities.
- (d) Include a commitment from the CIH or a person working under the direction of the CIH, that within five days after the end of the month a written certification will be furnished certifying that the

Contractor has complied with the EPPA. Provide a copy of the letter to the Engineer the following work day after receipt.

436.03.34 Methods for Assessing Emissions. Unless otherwise specified, the following requirements apply to all projects, regardless of the presence of toxic metals:

- (a) **SSPC Level 1 Visible Emissions.** The following Level 1 visible emissions criteria apply when any paint is disturbed by dry methods such as blast cleaning or power tool cleaning.

Level 1 Emissions are defined as random visible emissions of a cumulative duration of no more than 1 percent of the workday or approximately five minutes in an eight-hour day. Level 1 is required for all structures. The Contractor's QC person, or Competent Person in the case of toxic metals projects, shall perform at least two 15 minute documented observations during each work shift. In addition to the 15-minute observations, all Contractor personnel shall be directed to routinely observe the work area and to report unacceptable emissions to QC or supervisory personnel, or to the Competent Person. When unacceptable emissions are detected, locate and immediately correct the source of the emissions. Retain the records on site, and make them available to the Engineer.

The visible emissions criteria are not required when the paint is cleaned or disturbed using water. When water is used on existing coatings that contain toxic metals or on inorganic zinc/vinyl systems, all water shall be collected and emissions are prohibited. When water is used to clean all other coating systems, the water need not be collected and emissions are not restricted.

- (b) **Ambient Air Monitoring.** Unless otherwise directed, ambient air monitoring is required when the coatings being disturbed contain toxic metals, and whenever the paint removal operations are located within 500 ft of houses, schools, parks, playgrounds, shopping areas, or similar areas of public exposure.

- (1) **Abrasive Blast Cleaning.** Daily ambient air monitoring at each structure being abrasive blast cleaned shall begin one day prior to beginning work and during the first 10 days of productive abrasive blast cleaning operations. When the results indicate that the containment is controlling emissions, full time monitoring may be discontinued unless otherwise

directed. However, monitoring shall be repeated for two consecutive days every month thereafter during the work shift while blast cleaning or other dust producing operations are underway.

When the results of the original 10 days of monitoring or the periodic monthly tests are unacceptable, monitoring shall continue full time. Monthly monitoring may be initiated or resumed only when approved, and only after the results of the testing indicates that the containment is controlling emissions.

Full time monitoring shall also be resumed when unacceptable visible emissions or residues are observed on the ground or water.

- (2) **Hand and Power Tool Cleaning.** Begin daily ambient air monitoring at each structure one day prior to beginning work and during the first five days of hand tool cleaning and power tool cleaning. When the results indicate that the containment is controlling emissions, full time monitoring may be discontinued, unless otherwise directed. Resume monitoring when visible residues are observed on the ground or in the water, or visible dust is observed exceeding the Visible Emissions criteria established above.
- (3) **Monitor Placement and Reporting.** Place total suspended particulate (TSP) monitors in areas of potential public exposure (e.g., adjacent to homes, businesses, parks, or pedestrian walkways) that are within 500 ft of each project site during cleaning operations in conformance with Method D of SSPC Guide 6. The CIH shall provide for Engineer acceptance, the proposed monitoring locations in advance, together with the rationale for the selection of each site. Monitoring shall be conducted at least seven hours per work shift. All TSP monitoring samples shall be analyzed using Method 40 CFR 50 Appendix B and G by a laboratory approved by the American Board of Industrial Hygiene.

The CIH shall use an Adjusted Daily Allowance (ADA) as described in SSPC Guide 6 (not an average daily allowance) for evaluating the TSP monitoring results. The CIH, or a person working under the direction of the CIH, shall provide the Contractor with a written report and analysis of monitoring results, including the relevant acceptance criteria based on the

ADA, within five days of sample collection. Provide the results to the Engineer the following work day after receipt.

- (c) **Removal of Visible Project Debris.** At the end of the shift each day and upon completion of all project activities, the surrounding property, structures, and the entire project area shall be cleaned free of visible project debris.

Prevent paint chips, abrasives, dust, and debris from being deposited onto surrounding property, vehicles, concrete, pavement, slope protection, soil, water, sediment, etc. When there are spills or releases of such material, immediately shut down the operations producing the emissions and clean up the debris. Change work practices, modify the containment, or take other appropriate corrective action as needed to prevent similar releases from occurring in the future. Contain and collect water used for washing paint containing toxic metals or existing inorganic zinc/vinyl systems. Water used to wash all other paint systems need not be contained and may contact the ground and water.

436.03.35 Field Cleaning Waste Disposal. Store all project waste, regardless of the presence of toxic metals, in roll-offs or sealed 55-gallon drums. Containers shall be labeled with the structure number, Contract number, Contractor's name, contents, and the date. Refer to 436.03.36 thru .41.

When the waste is hazardous, comply with SSPC Guide 7. Each day, collect clothing and other waste material and seal them in approved containers. When drums are used, they shall be sealed 55-gallon open head type drums meeting I.C.C. Specification 17-H. All containers shall be in new condition.

436.03.36 Waste Handling Plan of Action. Required for the handling, storage, and disposal of all hazardous waste, regardless of the presence of toxic metals. When the project involves the removal of paint containing toxic metals, the program shall be signed and sealed by the CIH. At least one copy of the submittal shall have an original seal.

The Plan of Action shall address the following:

- (a) Names, addresses, and licenses for the proposed hazardous waste transporters and disposal facilities.
- (b) Hazardous waste handling and storage procedures.

- (c) Waste and waste water sampling and analysis procedures.
- (d) Provide all test results to the Engineer within five days of sample collection.

436.03.37 Waste Sampling and Analysis. When the project involves hazardous waste, the CIH, or an employee working under the direct supervision of the CIH, shall take at least four samples of the accumulated residues of each waste stream collected at each structure or a sample from every third drum, whichever is greater. All sampling shall be random and representative.

The samples shall be analyzed for TCLP as outlined in COMAR 26.13.02 and the EPA Test Procedure Manual, SW-846 for all RCRA 8 Metals. Waste shall not accumulate for more than 30 days before sampling. The representative samples collected shall be analyzed by an approved laboratory and the results returned to the Engineer within five working days of collection. Additional samples may be required if the average test results exceed 3.5 mg/l for lead, or exceed the threshold levels for other toxic metals allowed by COMAR and EPA procedures. The disposal method will be based on the results of these analyses, except that waste generated using steel abrasives shall be handled, stored, and disposed of as hazardous waste regardless of the test results.

436.03.38 Temporary Waste Storage Site. Obtain an approved temporary storage site, and haul the waste material away from the work site at the end of each working day. Ensure that the storage site prevents the migration of the contaminated material into the environment and that it is protected from vandalism and unauthorized access by the general public. Remove the waste from the temporary storage site within 75 days from the initial date of accumulation or before the completion of work, whichever comes first. When the Contract Documents specify that the waste containers shall be stored at a particular facility owned by the Administration, contact that facility to schedule delivery.

436.03.39 Waste Water Disposal. Test the waste water collected from bridge washing and hygiene facilities for toxic metals. Tests shall be performed using EPA Method 6010 by a laboratory approved by the American Board of Industrial Hygiene.

Provide the Engineer with the test results and written plans for the disposal of the water, including the name and address of the licensed transporter and disposal facility. If the local publicly owned treatment

works (POTW) authorizes the disposal of the water down the sanitary sewer system, provide a letter from the POTW authorizing the disposal.

436.03.40 Hazardous Waste Transportation and Disposal. Maryland law provides that when samples tested using TCLP exceed the threshold value (5 mg/l for lead), they shall be considered hazardous waste and be removed under manifest by a licensed hazardous waste transporter to a permitted disposal facility. When tested waste material is determined to be hazardous waste, request through the Administration an EPA identification number as specified in COMAR 26.13.03.03. Provide the Engineer with written plans for the transportation and disposal of the waste, including the name and address of the licensed transporter and disposal facility.

Waste containing less than the threshold value by the TCLP test, including the confidence interval, shall be disposed of in accordance with 436.03.41 for RCRA 8 Metals.

Prepare a manifest for hazardous waste to be transported from the approved temporary storage site. The manifests shall be prepared and contain the information stipulated in COMAR 26.13.03.04 and as otherwise required by State regulations. Forward the manifests to the Bridge Inspection and Remedial Engineering Division.

Drums of other wastes, such as solvent contaminated rags, disposable protective clothing, disposed dust collector filters, and other contaminated substances shall be sampled individually and tested appropriately.

COMAR 26.13.03.05 stipulates the "Pre-Transport" requirements and the amount of time permitted for the accumulation of hazardous waste. Waste shall be transported by a certified waste hauler to a landfill permitted to accept this material.

Obtain a list of certified haulers and other information regarding handling and disposal of blast waste by contacting the Department of Environment, Hazardous Waste Administration.

436.03.41 Nonhazardous Waste Disposal. Waste containing less than the threshold value (refer to 436.03.40) by the TCLP test, including the confidence interval, may be disposed of as an industrial waste at a landfill permitted to accept this material. Dispose of all waste in accordance with and local regulations.

Waste containers/dumpsters shall be covered when not in an active filling process.

436.04 MEASUREMENT AND PAYMENT. The Contract unit price for the item specified will be full compensation for all cleaning and painting, scaffolding, platforms, containment systems, permits, working drawings, daily quality control records, professional engineer's services used for containment, industrial hygienist services, air monitoring, sampling and testing of materials for toxic metal content, including any revisions and resubmissions that may be required during the execution of the work, providing safe access for inspections, hand wash station/clean up area, floodlighting, test plates, drums, collection and storage at the temporary storage site, hauling and disposal at an approved industrial waste site or hazardous waste site, removing and replacing planking, removal of debris, and all material, labor, equipment (including test equipment), tools, and incidentals necessary to complete the work.

436.04.01 Cleaning and painting existing structural steel will not be measured but will be paid for at the Contract lump sum price for the pertinent Cleaning and Painting item.

436.04.02 All costs associated with repair of existing coatings due to new construction, structural repairs, and damage caused by Contractor's operations will not be measured but will be incidental to the pertinent Repair, Structural Steel, or Cleaning and Painting items included.

SECTION 437 THRU 439 — RESERVED

SECTION 440 — PRESTRESSED CONCRETE BEAMS AND SLAB PANELS

440.01 DESCRIPTION. Furnish and place prestressed concrete beams and slab panels, elastomeric bearing pads, bearing plates and other embedded items, all steel strands, jacks, and other required devices. The concrete overlay riding surface for slab panel bridges is included in this work.

440.02 MATERIALS.

Fine Aggregate	901.01
Coarse Aggregate	901.01

Fine Aggregate for Overlay Bonding Grout	901.01, Fine Aggregate/Sand Mortar and Epoxies
Cement	902.03
Admixtures:	
Air Entraining	902.06.01
Retarding	902.06.02
Water Reducing	902.06.02, .03
Pozzolans	902.06.04, .05
Concrete Overlay	902.10, Mix No. 8
Nonshrink Grout	902.11(c)
Reinforcing Steel	908.01
Welded Steel Wire Fabric	908.05
Prestressing Strand	908.11
Elastomeric Bearing Pads	910.02
Closed Cell Neoprene Sponge Elastomer	911.10
Fusion Bonded Epoxy Powder Coating for Steel	917.02
Water	921.01
Epoxy Adhesive	921.04
Threaded Tie Rods	A 722
Tie Rod Heavy Hex Nuts	Supplied by tie rod manufacturer; shall provide full tensile strength of tie rod
Concrete Protective Coatings	Contract Documents

440.02.01 Portland Cement Concrete. Ensure that the composition, proportioning, and mixing of concrete produces a homogeneous concrete mixture of a quality that meets the specified material and design requirements.

The required cylinder strength of the concrete at transfer of the tensioning load and the minimum required cylinder strength of the concrete at 28 days will be specified. Include an air entraining admixture and a Type D or G admixture in the concrete mix.

Type G high range water reducing admixtures may only be used if the Engineer determines that the producer can design and show by trial mix that the concrete meets the specified strength requirements and the following:

- (a) Maximum slump of 6 in.

- (b) Air content of $5\frac{1}{2} \pm 1\frac{1}{2}$ percent.
- (c) Cement factor of at least 700 lb/yd^3 .
- (d) Maximum WCM ratio of 0.45.

Testing. Allow the Engineer to take six test cylinders from each member or members cast and cured with the beam as a unit for the purpose of checking the quality of the concrete being produced, for determining the time when forms may be removed, and for determining the time when prestressing forces may be applied to a member. Provide metal or plastic molds for all test cylinders. Have the manufacturer's quality control technician make at least three test cylinders and cure under laboratory conditions as specified in T 126. Have the technician make and test the test cylinders at the manufacturing site according to T 22 in the presence of the Engineer.

440.02.02 Reinforcing Steel and Tie Rod Tubes. Except for prestressing strands, all reinforcing steel in and extending from beams and slab panels, and in the concrete overlay shall be epoxy coated.

Tie rod tubes shall consist of corrugated, rigid or semi-rigid type, galvanized steel sheathing, or rigid plastic sheathing.

440.02.03 Debonding Material. Use solid or split plastic sheathing having a thickness of at least 0.025 in. for debonding of pretensioning steel strands.

440.02.04 Joint Sealers. Per the manufacturer's specifications.

440.02.05 Overlay Bonding Grout. Use equal parts by weight of portland cement and sand, and mix with sufficient water to produce a slurry. Mix to a consistency that provides for application with a stiff brush or broom in a thin, even coating that will not run or puddle.

440.03 CONSTRUCTION.

440.03.01 Working Drawings. Refer to Section 499. Address reinforcing, anchorages, steel strand profiles, lifting inserts, and all other pertinent information.

If methods other than specified are proposed, submit changes per Section 499. When proposed changes are accepted or rejected, construct members accordingly at no additional cost to the Administration.

440.03.02 Prestressed Concrete Plants. The prestressed concrete manufacturing plant shall be registered and certified under the Precast/Prestressed Concrete Institute Program. Submit a valid certificate to the Engineer prior to the start of production.

440.03.03 Beds and Forms. Support casting beds on unyielding foundations. Clean the beds and forms after each use. Prevent accumulation of bond breakers.

Prior to stringing steel strands, inspect the bottom of forms for cleanliness and alignment. Coat the contact surfaces of forms with bond breaker that dries to a surface hardness. Ensure that the coating is dry to prevent contamination of the steel strand.

440.03.04 Meetings. Conduct a pre-pour meeting prior to beginning any prestress concrete work. Ensure a representative of the prestress concrete plant is present.

440.03.05 Protection of Prestressing Steel Strand. Store under shelter and keep it free of deleterious material such as grease, oil, wax, dirt, paint, loose rust, or other similar contaminants. Do not use steel showing corrosion, etching, pitting, or scaling. A light coating of surface rust is acceptable if it can be removed completely from the steel by wiping with a cloth.

Do not store on a surface that contributes to galvanic or battery action.

Do not use steel strand as a ground for electric welding. Protect it from electric welding sparks.

440.03.06 Reinforcing Steel, Inserts, and Chairs. Place reinforcing steel within the specified tolerances, and secure it to beds and forms using chairs, blocking, or ties. Fabricate cages of bars by tying only. Do not support cages by tensioned strands. Bend tie wire ends into the slab panel. Show the type and placement of inserts on the working drawings.

Except for stainless steel accessories, recess form ties, chairs, and inserts in the concrete by at least 1 in.

440.03.07 Methods of Force Measurement. Use one of the following methods as the primary measuring system. Check it by using one of the other methods as a secondary measuring system:

- (a) **Curves.** Use current stress-strain or elongation curves furnished by the strand manufacturer. An average modulus may be used if acceptable to the Engineer. Provide means for measuring the elongations of the strands to at least 1/8 in.
- (b) **Pressure Gauges.** Use gauges to measure force by the pressure applied to hydraulic jacks. These gauges shall be furnished with dials calibrated with the jacking system.
- (c) **Dynamometers.** Dynamometers connected in tension to the stressing system for the initial force may be used.

Gauging System. Use tensioning systems equipped with accurately calibrated hydraulic gauges, dynamometers, load cells, or other devices for measuring the stressing load to an accuracy of reading within 2 percent. Have a qualified testing laboratory calibrate and issue a certified calibration curve with each gauge. Recalibrate a gauging system whenever it shows erratic results; at intervals not exceeding six months, and when directed. Gauges for single strand jacks may be calibrated by an acceptable and calibrated load cell. Calibrate gauges for large multiple strand jacks, acting singly or in parallel, by proving rings or by load cells placed on either side of the movable end carriage. All jacks and gauges shall be calibrated by an independent laboratory at no additional cost to the Administration and documentation forwarded to the Engineer.

Provide pressure gauges and dynamometers preferably with full pressure and load capacities of approximately twice their normal working range. Limit loads to within 25 to 75 percent of the total graduated capacity, unless calibration data establishes consistent accuracy over a wider range.

Each gauge shall indicate loads directly in pounds or be accompanied by a chart with which the dial reading can be converted into pounds.

Tensioning systems employing hydraulic gauges shall be equipped with appropriate bypass pipes, valves, and fittings so the gauge reading remains steady until the jacking load is released.

Gauge readings, elongation measurements, and calculations for elongation shall include appropriate allowances for operational losses in the tensioning system due to strand slippage, movement of anchorages and abutments, elongation of abutment anchorage rods, strand rotation, temperature variation, friction, bed shorting, and other forces and influences acting on the strand.

In multiple strand tensioning systems, clean and lubricate the sliding surfaces to minimize friction. Establish a force override (compensatory operational loss correction) for standard strand pattern series.

Thermal Effects. Increase the design prestress force by 0.5 percent for each 5 F ambient temperature below 80 F. No adjustment is required when the ambient temperature is above 80 F. Do not stress steel strands when the ambient temperature is below 40 F. After the steel strands are tensioned, maintain the temperature of the air surrounding the steel strands at 40 F or more until the prestress force is transferred to the concrete.

Control of Jacking Force. Use either manual or automatic pressure cutoff valves for stopping the jacks at the required load. Use automatic cutoffs capable of adjustment to ensure that the jacking load corresponds to the required load. Verify the setting accuracy for the automatic cutoff valves whenever there is reason to suspect improper results and at the beginning of each day's operation.

440.03.08 Stringing Steel Strands. Do not reuse strands containing former vise grip points unless the points are outside the new vise locations. Do not reuse strands that have been draped.

All steel strands shall have the same lay or direction of twist. Use shears or abrasive cutting wheels to cut the ends. Position over chairs to eliminate sagging of strands in the bottom rows.

440.03.09 Steel Strand Splices. Only one splice is permitted per strand. For single strand tensioning, the number of strands that may be spliced in each bed is not restricted. For multiple strand tensioning, either splice all strands and adjust the elongation for average slippage, or no splices are permitted.

440.03.10 Steel Strand Vises. Vises shall be capable of anchoring stressing loads positively with minimum slippage and shall be cleaned, lubricated, and inspected between each use. Do not use grips that show wear or distortion, or that allow slippage in excess of 1/4 in. Clean and inspect the full set of vises before starting each prestressing operation.

The maximum permissible time for holding tensioned strands in the bed before placing concrete is 72 hours.

440.03.11 Wire Failure in Steel Strands. Remove and replace any seven wire steel strand that contains a broken wire. Check all strands for wire breakage before placing concrete.

440.03.12 Pretensioning. Apply the specified total load to each strand. Apply the load as a total of two loading stages. The initial load shall straighten the strand, eliminate slack, and provide a starting or reference point for measuring elongation.

Limit the initial load to 10 percent of the specified tensioning force. Any initial loading exceeding 10 percent shall be approved by the Engineer (i.e. multiple bed casting). Measure the initial load within a tolerance of ± 100 lb. Do not use the initial elongation measurement to determine the initial force.

In all stressing operations, keep the stressing force symmetrical about the vertical axis; however, in tensioning single strands, the initial and final loads may be applied in immediate succession to each strand.

Use jack mounted pressure gauges as the primary system of force measurement for the final tensioning of straight single strands. Check elongation against pressure gauge readings on all strands. Check vise slippage. The computed elongation, including operational losses and equivalent elongation for the initial tensioning force, shall agree with the pressure gauge reading within 3 percent.

Use jack mounted pressure gauges as the primary system of force measurement for the final tensioning of multiple strands. For uniform application of load to the strands, the position of the face of the anchorage at final load shall be parallel to its position under initial load. Verify parallel movement by measurement of equal movement on opposite anchorage sides and by checking the plumb position of the anchorage before and after final load application. Check vise slippage.

After stressing the steel strands as specified and placing all other reinforcement, cast the concrete member to the specified length. Maintain strand stress between anchorages until the concrete has reached the specified compressive strength.

440.03.13 Steel Strand Tensioning. In all methods of tensioning, measure the stress induced in the strands both by jacking gauges and by elongation.

If any jack or gauge appears to be giving erratic results or gauge pressures and elongations indicate materially different stresses during manufacturing, recalibration will be required. Provide means for measuring elongation to the nearest 1/8 in.

For differences in indicated stress between jack pressure and elongation of up to 5 percent, place the difference so that the discrepancy will be on the side of a slight overstress rather than understress. For discrepancies in excess of 5 percent, carefully check the entire operation and determine the source of the discrepancy before proceeding.

Thoroughly seal split plastic sheathing for debonded steel strands with tape prior to placing concrete.

Cut all pretensioned steel strands flush with the end of the member. Where the end of the member will not be covered by concrete, clean the exposed ends of the strands and the concrete face. Use wire brushing or abrasive blast cleaning to remove all dirt and residue that is not firmly bonded to the metal and concrete surfaces. Coat the strands and the concrete face with a protective coating as specified. Work the protective coating into all voids in the strands.

440.03.14 Surface Finish and Curing. Rough finish the top surface of all members with a rake, wire brush, or other approved means to a full amplitude of 1/4 in. Begin initial curing of all members by fogging, wet burlap, or other approved methods as soon as the concrete is hardened sufficiently to withstand surface damage. Continue the initial curing until the concrete has attained its initial set, but at least three hours; however, when a retarding agent is used, continue the initial curing for at least five hours. Following the initial curing, resume curing using an accelerated curing method.

Accelerated Curing. Use one of the following methods to accelerate curing of the concrete:

- (a) **Low Pressure Steam Curing.** Use a suitable enclosure to contain the live steam and minimize moisture and heat loss. Ensure that the concrete has attained initial set before application of the live steam.

Do not permit live steam to be directed on the concrete or the forms so as to cause localized high temperatures. Maintain the temperature of the interior of the enclosure at 80 to 160 F. During initial application of the steam, increase the ambient air

temperature within the enclosure at a rate not to exceed 40 F per hour. Hold the maximum temperature until the concrete has reached the required release strength. Maintain the steam temperature and the curing temperature uniformly throughout the extremities of the prestressed member. At the end of curing, reduce the concrete temperature at an average of 40 F per hour.

Ensure that the producer furnishes at least one recording thermometer for each enclosure. If the enclosure is longer than 300 ft, furnish an additional recording thermometer for each additional 300 ft of length or fraction thereof. The temperature at any point within the enclosure shall not vary more than 10 F from that of the recording thermometer or the average of the recording thermometers if more than one is used.

- (b) **Radiant Heat Curing.** Radiant heat may be applied by means of pipes circulating steam, hot oil, or hot water, or by electric heating elements. Provide a suitable enclosure to contain the heat. Minimize moisture loss by covering all exposed concrete surfaces with plastic sheeting or by applying an approved liquid membrane curing compound to all exposed surfaces. Uniformly maintain the heat application throughout the extremities of the member. Apply the same temperature constraints as outlined for low pressure steam curing.

440.03.15 Detensioning.

- (a) **Slab Panels.** Do not transfer the tension force to the prestress slab panel until the concrete strength as indicated by cylinder strengths meets the specified transfer strength. Except to move to storage, ensure that the design strength is met before handling the slab panel or releasing it for shipment. Prior to detensioning, remove or loosen forms, ties, inserts, hold downs, and other devices that restrict longitudinal movement along the bed, or use a method and sequence to minimize longitudinal movement.

Release prestressing forces using a method that minimizes sudden or shock loading.

Single strand detensioning may be accomplished by heat cutting the strands. The sequence shall maintain prestressing forces nearly symmetrical around the slab panel's vertical axis.

Eccentricity around the vertical axis shall be limited to one strand. Obtain approval of the cutting pattern prior to use.

Multiple strand detensioning may be accomplished by gradually reducing the force applied to each strand equally and simultaneously.

(b) Beams. The schedule for detensioning of beams having deflected steel strands shall incorporate the following:

- (1)** The manufacturer's sequence of releasing deflected steel strands and uplift points shall be approved.
- (2)** All hold down devices for deflected steel strands shall be disengaged, and all hold down bolts removed from the beams.
- (3)** The manufacturer's sequence of releasing the remaining straight steel strands shall be as approved.

All hold down devices may be released prior to release of tension in deflected steel strands if:

- (1)** The weight of the prestressed beam is more than twice the total of the forces required to hold the steel strands in the low position.
- (2)** The weight or other approved vertical restraints are applied directly over the hold down points to counteract the uplifting forces, at least until the release of deflected steel strands has proceeded to a point that the residual uplifting forces are less than half the weight of the beam. Follow all procedures for releasing prestressing forces of deflected steel strands. Failure to follow these procedures may result in the rejection of the beams.

Adequately separate all beams in storage immediately following removal from the bed to facilitate the repair of surface blemishes and to allow inspection of the finished surfaces.

440.03.16 Camber. During the period of beam fabrication, select a representative number of beams to be known as "Camber Control Beams", subject to approval.

Clearly and permanently identify them so that the camber readings taken as indicated below can be associated with the proper beam.

Take camber readings as follows:

- (a) Just prior to prestressing.
- (b) Immediately after prestressing.
- (c) At weekly intervals thereafter within the three months after casting.
- (d) At biweekly intervals, after the three month period expires.
- (e) Just prior to shipment from the casting yard to the job site.
- (f) Continue camber determinations at these intervals if the beams are stored or stockpiled at the job site.

Furnish two copies of the camber reports prior to erecting the beam.

440.03.17 Tolerances. The tolerances for each beam or slab panel shall be as shown in Tables 440.03.17 A or B, respectively unless otherwise specified:

TABLE 440.03.17 A

PRESTRESSED CONCRETE BEAM	TOLERANCE
Depth (overall)	$\pm 1/4$ in.
Width (flanges & fillets)	$\pm 1/4$ in.
Width (web)	$\pm 1/4$ in.
Length of Beam	$\pm 1/8$ in. per 10 ft or $1/2$ in. whichever is greater
Exposed Beam Ends (deviation from square or designated skew)	Horizontal $\pm 1/4$ in. Vertical $\pm 1/8$ in. per ft of beam height
Side Inserts (spacing between center of inserts and from the centers of inserts to the ends of the beams)	$\pm 1/2$ in.
Bearing Plate (spacing from the centers of bearing plates to the ends of the beams)	$\pm 1/2$ in.
Stirrup Bars: Average of all bars Individual bar longitudinal spacing	$\pm 1/2$ in. ± 1 in.
Horizontal Alignment (deviation from a straight line parallel to the center line of beam)	$1/8$ in. per 10 ft, max
Camber Differential between adjacent beams of same type and steel strand pattern	$1/8$ in. per 10 ft at time of erection or $1/2$ in. max
Center of Gravity of steel strand group	$\pm 1/4$ in.
Center of Gravity of depressed group steel strand at end of beam	$\pm 1/2$ in.
Position of hold down points for depressed strand	± 6 in.

TABLE 440.03.17 B

PRESTRESSED CONCRETE SLAB PANEL	TOLERANCE
Depth (overall)	+1/2 in., -1/4 in.
Width (overall)	± 1/4 in.
Slab Panel Length @ center line (based on design length specified)	± 1/2 in.
Horizontal Alignment (deviation from a straight line parallel to the slab panel center line)	1/4 in. max
Horizontal Misalignment of adjacent form sections	1/2 in. max
Camber Deviation from specified camber, as measured at prestress transfer or at the beginning of slab panel storage at the fabrication plant	± 1/2 in.
Location of each strand	± 1/8 in.
Center of Gravity of strand group	± 1/4 in.
Stirrup Bars (longitudinal spacing)	± 1 in.
Longitudinal Position of handling devices	± 3 in.
Concrete Bearing Area (variation from plane surface when tested with a straightedge through middle half of slab panel)	± 1/8 in.
Tie Rod Tubes (spacing between the tube centers and from tube centers to slab panel ends)	± 1/2 in.
Tie Rod Tubes (spacing from tube center to slab panel bottom)	± 3/8 in.
Threaded Inserts (spacing between the center of inserts and from center of inserts to ends of slab panels)	± 1/2 in.
Skew Ends (deviation from designated skew)	± 1/2 in.
Vertical Ends (deviation from specified dimension)	± 3/8 in.

440.03.18 Slab Panel Plant Assembly. Before shipping the slab panel units to the job site, assemble all slab panels for the entire bridge width to ensure that there is no misalignment. Any misalignment of the holes will

be cause for rejection of the affected slab panels. Do not drill or core holes into the slab panels.

440.03.19 Marking, Handling, Shipping, and Storage. Mark each member with an erection mark for identification, weight marks for beams 6000 lb or more, and inspection stamps. For beams, paint the erection marks on the top surface of the top flange. Do not place markings of any kind on any surface of a beam that will be visible in the completed structure.

Mark slab panels with an individual, consecutive identification mark at a permanently exposed location. The identification mark shall match that shown on the approved working drawings.

Furnish an erection diagram clearly indicating erection marks that show the position of the member in the structure.

Utilize the cast-in-place lifting devices and a sufficient number of cranes and spreader beams whenever the prestress concrete members are lifted.

Furnish copies of material orders and shipping statements. Show the weight of each individual prestress concrete member.

During shipment, ensure that blocking is placed at intervals that will prevent sag and distortion. Ship all members in the upright position, adequately braced and supported to dampen vibrations during transport as shown on the working drawings. Members too long to fit inside of a truck or trailer shall not cantilever beyond the bed more than one quarter of their length. Support members too long to comply with this requirement on dollies, additional vehicles, or other vehicles that will support the long pieces as approved.

Load restrictions are as specified in GP-5.10. Do not ship prestress members until approved, at least five days have elapsed since the prestress transfer, and the minimum 28 day compressive strength has been attained.

Store beams off the ground in an upright position. Protect them as far as practical from surface deterioration, and keep them free of accumulations of dirt, oil, and other deleterious material.

440.03.20 Erection. Refer to 430.03.27, .28, .29, .31, .32, and .33.

Slab Panels. Immediately prior to erecting slab panels, clean the abrasive blasted shear key surfaces with compressed air, stiff bristle fiber brushes, or vacuuming. Pull the slab panels together and field tighten in the transverse direction using tie rods. Perform field tightening by placing the washer and nut on the tensioning end of the tie rod and running them down to the recessed concrete face. Attach a jacking assembly or other type of loading apparatus to the threads extending beyond the nut. Provide the Engineer with certification that the gauge or other load measuring device has been calibrated within one year; however, the Engineer may require the load measuring device to be recalibrated if it appears to have been damaged or mishandled. The loading apparatus shall be capable of applying a load to the tie rod nut equal to 80 000 lb for spans up to 35 ft and 120 000 lb for spans greater than 35 ft. Maintain the load until the tie rod nut is snug tight as defined in 430.03.17(d). Do not use a torque wrench to apply the tensioning load. After tightening, grout all tie rod holes.

After field tightening all slab panels, seal the joint below the shear keys using an approved method. Then grout the shear keys by overfilling the joints. Drive the grout or compactly tamp it into the keyways; do not vibrate. After a half hour, strike off the excess grout flush with the top of the panels. Follow the manufacturer's recommendations for grouting in cold or hot weather.

Equipment may be placed on the slab unit prior to placing the concrete overlay if all slab units are in place, the tie rods are tensioned, and the joints have been grouted for at least two days.

440.03.21 Bearing Pads. Store them at the site on suitable blocking or platforms at least 4 in. above all surfaces and vegetation. Keep free from vegetation growth and accumulations of dirt, oil, and other foreign material.

Coat the surfaces of the concrete bearing areas that will be in contact with the bearing pads and the full contact area of the bearing pads with epoxy adhesive. Adhere to the manufacturer's recommendations for mixing and applying the epoxy adhesive material. The surface temperatures when applying epoxy adhesive shall be at least 50 F with a predicted ambient temperature for the next four hours of 50 F or above. Ensure that the surfaces are clean, dry, and sound. Be prepared to use water jets, abrasive blasting, and air blasting, for satisfactorily cleaning the surfaces.

Accurately set the bearing pads in the epoxy adhesive and secure them in place by blocking or other mechanical means until the adhesive sets.

440.03.22 Placing and Finishing Concrete Overlay. Place, cure, groove, protect, etc., the overlay according to 420.03 including superstructure placement restrictions.

Place the top of the overlay to the true as planned line and grade of the roadways. Place the overlay in a manner that meets the grade of the proposed adjoining portions of the new bridge decks and adjoining roadways.

Place the entire bridge slab overlay in one continuous pour. No transverse or longitudinal joints will be permitted.

Place the finishing machine's supporting rails outside the overlay. Do not use hold down devices that are shot or drilled into the concrete. Submit plans for anchoring support rails and the concrete placing procedure for approval.

Take precautions to secure a smooth riding bridge deck meeting 420.03.07(d). Prior to placement operations, review the equipment, procedures, and personnel with the Engineer. The inspection procedures will be reviewed to ensure coordination. Take the following precautions:

- (a) Before placing the overlay, thoroughly clean and abrasive blast the entire surface that will be in contact with the overlay. Perform abrasive blasting within 24 hours prior to placing the overlay. Then clean the surface by air blast followed by flushing with water. Prior to placing the overlay, wet the surface and keep it wet for at least one hour and remove puddles of water.

No loads, other than construction equipment, will be permitted on any portion of the bridge deck that has undergone preparation prior to placement and curing of concrete overlay.

- (b) After cleaning the surface and immediately before placing the concrete overlay, scrub a thin coating of the overlay bonding grout into the prepared surface. Ensure that all parts receive a thorough, even coating and that no excess grout collects in pockets. Control the rate of grout application so that the grout does not become dry before it is covered with the overlay.

- (c) Utilize a suitable portable lightweight or wheeled work bridge behind the finishing operation. Hand finishing may be required along the edge of placements.

440.04 MEASUREMENT AND PAYMENT. Prestressed concrete members will not be measured but will be paid for at the Contract lump sum price for the pertinent Prestress Concrete Beams or Prestress Concrete Slab Panels item. The payment will be full compensation for all concrete, forms, reinforcing, bearing pads, steel strands, sheathing, steel components, steel rods, inserts, tensioning, grout, bearing assemblies, epoxy adhesive, testing, furnishing, and applying concrete protective coatings when specified, transporting, storage, erection, and for all material, labor, equipment, tools and incidentals necessary to complete the work.

440.04.01 Concrete overlay for the precast concrete slab bridge deck will not be measured but will be paid for at the Contract lump sum price for the pertinent Superstructure Concrete item. The payment will be full compensation for surface preparation, overlay bonding grout, furnishing, placing, finishing, curing and grooving the concrete overlay; fabricating, coating and placing the epoxy coated welded steel wire fabric or reinforcing steel within the concrete overlay, roadway angle, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 441 THRU 449 — RESERVED

SECTION 450 — RETAINING WALLS

450.01 DESCRIPTION. Construct cast-in-place reinforced concrete footings and stems conforming to the AASHTO definitions of rigid retaining walls. When retaining wall mounted noise barriers are specified, the anchorage assemblies are included in the retaining wall. All components shall be as specified unless prior approval for alternatives is obtained from the Administration.

When piles or drilled shafts (caissons) are specified, refer to Sections 410 and 412, respectively.

450.01.01 Preapproved Alternate Retaining Walls. Alternate retaining walls may only be used when specified. Only those retaining walls specified will be permitted. All other retaining walls, even though they

are preapproved or have been previously used on Administration projects, are prohibited for use. The Administration will not consider any other alternate retaining walls as a value engineering change proposal.

Enforcement. These requirements will be enforced on all projects.

Preapproved Alternate Retaining Wall List. Alternate retaining walls are selected from the list of Preapproved Alternate Retaining Walls, which is maintained by the Office of Bridge Development. Procedures for adding products to the prequalified list may be obtained from the Office of Bridge Development.

Alternate retaining walls that have been previously used on Administration projects without complying with the preapproval requirements shall be formally submitted through these procedures before they will be added to the Preapproved Lists for consideration to be used on future projects. These and other retaining wall systems may be submitted for addition to the Preapproved Lists, but the Administration will not permit these submittals to be used on an advertised or awarded project.

Deviations. Submit any proposed deviation in materials, post size or shape; panel size or shape; reinforcing type, size, or placement from what is shown in the Contract Documents or from the preapproved alternate retaining wall details on file in the Administration's Office of Bridge Development. All costs for reviews, whether the details are accepted or rejected, shall be borne by the Contractor. Any fabrication or creation of any retaining wall element that is a deviation and is made prior to written approval of the Administration shall be at the risk of the Contractor.

Contract Documents for Preapproved Alternates. If electing to use preapproved alternate retaining wall systems, only one type retaining wall may be constructed throughout the Contract. Submit substitute plans, design calculations, and specifications. Plans shall be similar in size and detail to advertised documents. Working drawings from the fabricator are not acceptable as substitute plan submissions. Include drainage details and all revisions required to construct the alternate retaining wall system. All plans, calculations, and specifications shall be prepared, signed, and sealed by a professional engineer registered in the State of Maryland, and who has experience in design of the proposed alternate retaining wall system. The substitute plans shall bear the Administration's title block and be furnished on reproducible paper, linen, or mylar. Contract

Documents for construction of alternate retaining walls shall conform to the Policy and Procedures of the Office of Bridge Development. These Plans will be issued as a Contract revision replacing the Administration's Plans and be kept by the Administration as permanent records. All work pertaining to Contract Documents for preapproved alternates shall be at no additional cost to the Administration.

After substitute Plans are approved and issued as a redline revision, submit working drawings bearing the fabricator or supplier's title block for review and approval to the Administration or directly to the consulting engineer as directed by Section 499.

450.02 MATERIALS. Refer to 420.02. When retaining wall mounted noise barriers are specified, refer to 455.02 for the anchorage materials.

Sample Panel. Refer to the Architectural Treatment specifications in the Contract Documents.

Some projects may require a specified surface such as an ashlar stone pattern, or matching a similar structure or stonework in the area. The Contractor may request or the Engineer may direct that the sample of the texture be submitted for approval prior to submission of the sample panel containing the specified stain.

450.02.01 Reinforcement. Reinforcing bars and welded wire fabric in retaining walls that are less than 10 ft from the edge of paved surface (includes shoulders) shall be epoxy coated. Supports for epoxy coated reinforcement shall be coated the same as the reinforcing steel.

450.02.02 Backfill for Preapproved Alternates. Use size No. 57 stone as backfill for all preapproved alternate retaining walls, regardless of the type backfill recommended or specified by the retaining wall manufacturer. Use geotextile when specified.

450.02.03 Concrete Stain. When a color is specified for the exposed surfaces of the retaining wall, select the stain from the Prequalified List of concrete stains maintained by the Office of Materials Technology. The color number shall meet Federal Standard 595.

450.02.04 Textures.

- (a) Unless otherwise specified, the exposed surfaces of the retaining wall shall receive a special surface treatment as specified in 420.03.07(b).

- (b) When a special texture is specified, it shall be produced by using an approved form liner.

450.02.05 Preapproved Alternate Retaining Wall. Match the materials and details as approved and on file in the Office of Bridge Development.

450.03 CONSTRUCTION. Construct retaining walls as shown on the Plans, as specified in 420.03, and herein. Construct alternate retaining walls according to the details and specifications that are on file with the Office of Bridge Development. Should any detail or specification change, the retaining wall firm shall submit the revision for review and approval prior to using that revision on Administration projects. Revisions shall not be submitted for projects that are already bid.

Do not apply any loading to retaining wall concrete until the concrete in that portion has attained a compressive strength of at least 3000 psi. In addition, complete the backfilling prior to placing any other loads on the wall.

450.03.01 Concrete Stain. When stain is specified, apply two coats according to the manufacturer's recommendations or as directed. Before application, ensure that all surfaces are structurally sound, clean, dry, fully cured, and free from dust, curing agents, form release agents, efflorescence, scale, and other foreign materials.

450.03.02 Anchor Bolt Assemblies. When required, install as specified. Refer to Section 455. All holes and welding required in the assemblies shall be done before galvanizing. Keep all assemblies free of oil and mill coatings.

450.04 MEASUREMENT AND PAYMENT. Retaining walls will not be measured but will be paid for at the Contract lump sum price for the pertinent Retaining Wall item. The payment will be full compensation for all piles, caissons, footings, forms and form removal, architectural treatment, reinforcement steel, concrete, curing, anchorage assemblies, stains and coatings, excavation, sheeting and shoring, drainage systems, backfill (including size no. 57 stone and geotextiles for alternate retaining walls), and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

When specific items for Piles for Retaining Walls are included in the Contract Documents, they will be measured and paid for as specified in 410.04.

When specific items for Drilled Shafts (Caissons) for Retaining Walls are included in the Contract Documents, they will be measured and paid for as specified in 412.04.

SECTION 451 THRU 454 — RESERVED

SECTION 455 — NOISE BARRIERS

455.01 DESCRIPTION. Construct noise barriers. The Standard Noise Barrier System consists of precast concrete panels, steel or concrete posts, concrete foundations, fire hose connections, doors, and hardware necessary to construct a noise barrier. Either steel or concrete posts may be used, but the same type of post shall be used throughout an entire noise barrier system.

When drilled shafts (caissons) are specified, refer to Section 412.

Bidders may view samples of the proposed panel finishes by contacting the Office of Highway Development, Director's Office.

455.01.01 Special Bidding Instructions. When the Contract Documents permit optional post spacings, place the bid in the appropriate items for the post spacing selected. Only bid the items pertaining to the selected post spacing. All remaining items pertaining to the alternate post spacings not selected shall be filled in as "\$0.00". Only one alternate post spacing may be bid per barrier.

455.01.02 Preapproved Alternate Noise Barriers. Alternate noise barriers may only be used when specified. Only those noise barriers specified will be permitted. All other noise barriers, even though they are preapproved or have been previously used on Administration projects, shall not be used on the project. The Administration will not consider any other alternate noise barriers as a value engineering change proposal.

Enforcement. These requirements will be enforced on all projects.

Preapproved Alternate Noise Barrier List. Alternate noise barriers are selected from the list of Preapproved Alternate Noise Barriers, which is maintained by the Office of Bridge Development. Procedures for adding products to the prequalified list may be obtained from the Office of Bridge Development.

Alternate noise barriers that have been previously used on Administration projects without complying with the preapproval requirements shall be formally submitted through these procedures before they will be added to the Preapproved Lists for consideration to be used on future projects. These and other noise barrier systems may be submitted for addition to the Preapproved Lists, but the Administration will not permit these submittals to be used on an advertised or awarded project.

Deviations. Any proposed deviation in materials, post size or shape; panel size or shape; reinforcing type, size, or placement from what is shown on the Plans or from any preapproved alternates allowed on this project will be reviewed by the Administration's noise barrier consultant. All costs for these reviews, whether the details are accepted or rejected, shall be borne by the Contractor. Any fabrication or creation of any noise barrier element that is a deviation and is made prior to written approval of the Administration shall be at the risk of the Contractor.

455.01.03 Contract Documents for Preapproved Alternate Systems or Alternate Post Spacing. When the Contract Documents permit and the Contractor elects to use preapproved alternate noise barrier systems or alternate post spacing not shown on the Plans, the Administration will furnish substitute Plans and specifications to the Contractor within 30 days after issuing Notice to Proceed. Only one type noise barrier may be used per barrier.

The substitute Plans may include other pertinent modifications and aesthetic changes necessitated by the selection such as: requiring tapered panels; grade beams or offset brackets, doublewide panels; larger or smaller caissons; additional grade beams and offset brackets or doublewide panels; or higher panels, if the changes in elevation between adjacent panels are determined to be too severe. No additional compensation will be given to the Contractor due to revisions detailed in the substitute Plans and specifications.

The substitute Plans will be issued as a Contract revision replacing the advertised Plans. All work under this Section, including any changes required in grading, drainage, paving, utility locations, and permits that are a direct result of the substitute Plans, shall be done at no additional cost to the Administration.

After substitute Plans are issued as a redline revision, submit working drawings bearing the fabricator or supplier's title block as specified in Section 499.

455.02 MATERIALS.

Reinforcement for Concrete Structures	421.02
Concrete Stain	921.12, Color No. as specified
Concrete	902.10
Pretensioning Strand	908.11, 1/2 in. diameter seven wire
Elastomeric Bearing Pads	910.02.01
Elastomeric Shims	911.12
Fusion Bonded Polyester Coating	917.03, Color as specified for stain on highway side of roadway
Anchor Assembly	
Plate	A 36
Rods	F 1554, Grade 55, S1 (Chemical Composition and Carbon Equivalent)
Nuts	A 563
Washers	F 436
Steel Posts (Including Plates and Shapes)	A 709, Grade 50W

Supply fire hose connections, fire doors, miscellaneous hardware, etc., as specified.

455.02.01 Hardware. No material substitutions will be permitted for anchor rods, nuts, and washers. These items shall be hot dip galvanized to meet A 153.

455.02.02 Epoxy Zinc Rich Primer. Prior to applying the polyester powder coating, apply an epoxy zinc rich primer provided by the polyester coater. The material shall withstand temperatures used for the polyester powder coating process, and shall be subject to approval.

455.02.03 Precast Concrete Panels. Cast each panel with an embossed or impressed, legible, and unique identification number located on a portion of the panel that will not be visible in the completed structure. Panels will be rejected at any phase if identification numbers appear to have been tampered with or altered in any manner. Use Mix No. 6 concrete, except use a design compressive strength of 5000 psi.

When exposed aggregate is specified, use coarse aggregate meeting AASHTO size no. 57 washed quartz gravel.

The layout of stacked noise barrier panels shall ensure that the seams/joints between panels are consistent with the specified aesthetic design. This applies to all panels within the proposed noise barrier system, not just the panels between two posts. Do not alternate full height panels and stacked panels on a continuous section of a noise barrier. If full height panels are required at certain locations adjacent to stacked panels, provide a false joint to give the appearance of stacked panels.

Form liner seams/joints shall be as specified and shall not be visible in the noise barrier system unless they are an integral part of the noise barrier system's aesthetic design. This applies to all components of the noise barrier system (panels, posts, etc.) and applies to both full height and stacked panel designs.

Caulking and coating material shall be compatible with the aesthetic aspects and acoustical requirements of the proposed noise barrier system.

Textures. Consider all panel surfaces as having architectural finishes and carefully produce a consistent, high quality finish. When stacked panel systems are used, ensure that the panels stacked within a single frame match in quality and appearance. Make aesthetic inspections for all panels in outdoor lighting conditions. Panels failing to conform to these requirements may be rejected.

Take measures to prevent cement laden spray and spatter created from the process of exposing the aggregate from adhering to the finish surfaces of other panels. Wash surfaces of all panels to remove cement laden spray, dust, and all other foreign matter prior to shipping. Do not use abrasive blasting to expose the aggregate.

Unless otherwise specified, the finishes for the panels shall be as follows:

- (a) Exposed aggregate finishes shall be produced on the bottom side of each panel in the precast form.
- (b) Double Rake finishes shall be produced on the top side of each panel.

Sample Panels. Refer to Architectural Treatment specifications in the Contract Documents.

Additionally, after the small sample panels and working drawings are approved, erect a full-size frame set panel (a single full height panel or a complete set of stacked panels assembled full height) between two posts at the precasting site, and prepare them for visual inspection. The frame set panel will be used to determine conformance with the Contract Documents for finishes, and to determine the quality of the fit and finish. This frame set panel shall have the textures specified in (a) and (b) above on the appropriate highway and residential sides as well as caps or any other specified finishes. Make the frame set panel available outdoors with both sides visible for inspection. Upon written approval by the Administration, produce all subsequent panels equal in appearance to this approved panel. Transport this panel to the project site and use it as one of the panels in the noise barrier after all other panels have been accepted.

Supply a frame set panel for inspection for each barrier finish type on the project.

Sample Panel Digital Photograph Inspection. Refer to Architectural Treatment specifications in the Contract Documents.

Reinforcement. Reinforcement bars and welded wire fabric in concrete barrier panels that are less than 10 ft from the edge of paved surfaces, including shoulders, shall be epoxy coated. Supports for epoxy coated reinforcement shall be coated the same as the reinforcement steel.

455.02.04 Concrete Posts. Use Mix No. 6 concrete except use a design compressive strength of 5000 psi. When exposed aggregate is specified, use coarse aggregate meeting AASHTO size no. 57 washed quartz gravel. When concrete posts include base plates, galvanize plates and all hardware to meet A 123 and A 153.

Textures.

Unless otherwise specified, finish the posts as follows:

- (a) Produce exposed aggregate finish on the bottom side of posts in the precast form.
- (b) Produce Double Rake finish on the top side of posts.

Sample Posts. When concrete posts are used, submit a 24 in. long sample of the concrete post to the construction site for approval. Submit the sample with the panel samples as specified in 455.02.03. Ensure that the sample post exhibits the specified finishes.

455.03 CONSTRUCTION. Refer to Section 450 for additional requirements for noise barriers mounted on top of retaining walls. Perform all welding per AWS D1.1.

455.03.01 Galvanizing. All holes and welding required in the hardware shall be done before galvanizing. Ensure that all hardware is free of oil and mill coatings. Ensure that all welds are ground smooth, all weld spatter removed, and hardware is free of burrs, pits, rust, or other surface imperfections.

455.03.02 Anchor Assemblies. Assemble anchor assemblies and place them at the specified elevation and spacing. Use templates for proper alignment and spacing of all anchor assemblies prior to concrete placement. Ensure that the threads of the anchors are long enough to provide room for a 1 in. concrete encasement, leveling nuts, washers, base plate, and at least a 1/2 in. protrusion through the top of the top nut when the noise barrier is properly installed.

455.03.03 Posts. Erect all posts plumb at the specified alignment, and at the appropriate spacing.

Embedded Concrete Posts. When concrete posts are used, erect them using a temporary support system to ensure the vertical and horizontal alignment and specified elevation. Temporary support systems shall include fixed ties between the post being set and a previously set post. Submit the design of the temporary support on the concrete post working drawings prior to erection. Leave the support system in place for at least 40 hours after completing the concrete placement for the drilled shaft that encases the post.

Polyester Coated Steel Posts. Steel posts shall be completely fabricated, including base plates and all holes drilled, before application of the polyester coating system.

Ensure that posts are free of oil and mill coatings. Ensure that all welds are ground smooth, all weld spatter removed, and hardware is free of burrs, pits, rust, or other surface imperfections.

Abrasive blast all steel posts and other nongalvanized items to meet an SSPC-SP 10 surface condition of Near White. Protect the cleaned surfaces from conditions of high humidity, rainfall, and surface moisture, and do not allow to flash rust. Apply and cure the epoxy zinc rich primer to a dry film thickness of at least 3 mils prior to the application of the

polyester powder coating. Ensure that all solvents in the epoxy zinc rich primer are removed prior to the application of the polyester powder coating.

When galvanized surfaces are to be polyester coated, roughen the galvanizing with a brush off blast cleaning according to SSPC-SP 7 prior to applying the polyester coating.

Apply the polyester coating using an electrostatic spray system. Provide a polyester coating thickness after cure of 6 ± 2 mils. The total thickness of coating, primer plus polyester coating, shall be 7 to 12 mils when measured according to G 12.

After coating, randomly check the posts for continuity using a 67-1/2 volt wet sponge detector to check for holidays, pinholes, and discontinuities. Check the coating thickness with a properly calibrated magnetic gauge. Use a liquid touch-up to repair limited minor defects. Wrap all polyester coated posts to ensure safe arrival at the job site. At the job site and during installation, take measures to prevent damage to the posts.

455.03.04 Precast Concrete Panels. Fabricate and install precast concrete panels as specified.

Submit working drawings that provide for all accessories, additional reinforcement steel, materials, and methods not specifically indicated, but that are essential for transportation, handling, installation, or construction of the panels.

Show the size, shape, and location of all panels and include complete reinforcement and connection details. When specified, show the method and sequence of erection, method of plumbing panels and adjusting connections, and the loads and movements due to erection.

All lifting devices and inserts used externally, or installed in the panel, shall have a factor of safety of four as determined under the loading conditions anticipated during the course of manufacture, storage, delivery, and erection. Include all inserts on the working drawings.

When steel posts are used, protect the inner-coated steel surfaces from being scratched, marred, or chipped during panel installation. The protective material shall not be visible in the finished structure. Do not use grease or similar lubricants.

Defects and Tolerances. Place concrete in a manner so that there are no cold joints. Cracked panels or panels determined by the Engineer to be nonrepairable or do not conform to the following tolerances will be rejected, and shall be replaced with acceptable panels.

- (a) Panel dimensions shall be within 3/16 in. except for panels with an effective thickness of less than 4 in. where the thickness shall be within 1/8 in.
- (b) Panel squareness for rectangular panels shall be within 1/2 in.
- (c) Panel surface defects on textured-finished surfaces shall not exceed 5/16 in. per 5 ft.
- (d) Tongue and groove joints shall be constructed within 1/8 in. of the dimensions specified.

Shipping, Handling, and Erection. Protect panels by padding or other means to prevent cracking, staining, chipping, or spalling of the concrete during handling, storage, transporting, and erection. Support or brace panels during installation to ensure safety. Maintain bracing or supports until proper alignment and adequate permanent support has been provided. Do not leave any panel in an unsafe support condition.

The Engineer will evaluate damaged panels to determine whether they can be used. If acceptable, repair damaged panels in an approved manner.

Erect panels centered between posts. Where a panel is not erected within the tolerances assumed in the connection design, the structural adequacy of the installation will be checked by the Office of Bridge Development, and the connection design shall be modified as required. Changes, other than adjustments within the specified tolerances, shall be made only after approval.

Panels will be inspected again after erection to determine if they have been damaged.

455.03.05 Concrete Stain. Apply prior to backfilling. For concrete posts, use water blasting or other mechanical means to provide a surface for improved adhesion. Apply two coats according to the manufacturer's recommendations and as directed. Apply to the top and full height of the panels, but do not apply to exposed aggregate surfaces. Before

application, ensure that all surfaces are defect free, structurally sound, clean, dry, fully cured, and free from dirt, dust, curing agents and form release agents, efflorescence, scale, and other foreign materials.

455.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Modifications such as an increase or decrease in the size or number of grade beams, drilled shafts (caissons), or retaining walls, special anchorages, conflicts with utilities or other obstructions when the utilities or obstructions were noted in the Contract Documents, or any other modifications required due to the Contractor's selection of an alternate spacing, or a preapproved alternate noise barrier when permitted, will be incidental to the item.

455.04.01 Noise Barrier System panels will be measured and paid for at the Contract unit price per square foot of barrier including posts and panels and samples thereof, architectural and noise absorptive finishes, stains and coatings, base plates, anchor assemblies (except when noise barriers are mounted on retaining walls), construction templates, temporary supports, steel post protection during panel installation, doors, fire hose connections, excavation, backfill, caulking, and hardware. Measurement will be based on the as-planned dimensions, using the length along the face of the barrier times the panel height. The cost of any reviews for proposed deviations specified in 455.01.02 will be deducted from the monies due the Contractor.

455.04.02 Grade Beams and Offset Brackets will not be measured but will be paid for at the pertinent Contract lump sum price, which also includes excavation, reinforcement, concrete, and backfill.

455.04.03 Drilled Shafts (Caissons) will be measured and paid for as specified in 412.04.

455.04.04 Retaining walls will be measured and paid for as specified in 450.04.

SECTION 456 THRU 459 — RESERVED

SECTION 460 — EXPANSION JOINTS IN STRUCTURES

460.01 DESCRIPTION. Furnish, fabricate, and install preformed joint fillers, preformed elastomeric joint seals, troughs, structural steel, and metal plates to be utilized in providing expansion and contraction capabilities in structures.

460.02 MATERIALS.

Hardware for Drainage Troughs	909.06
Preformed Joint Fillers	911.02
Preformed Polychloroprene Elastomeric Compression Joint Seals	911.04
Lubricant Adhesive	911.04.03
Troughs	911.11
Structural Steel	A 709, Grade 36

All structural steel for drainage troughs shall be hot dip galvanized to meet A 123 and A 153.

Ensure that troughs meet the thickness requirements for the type of material supplied. Place joints and splices for drainage troughs only where specified.

460.02.01 Paint. Refer to Section 435.

460.03 CONSTRUCTION. Store expansion joint material delivered to the bridge site under cover on platforms at least 4 in. above all types of surfaces and vegetation. Protect it at all times from damage and when placed ensure that it is free from dirt, oil, grease, or other foreign substances. All welding shall meet AWS D1.1 unless otherwise specified. All material and installation methods shall be approved prior to installation of any expansion joint material.

Provide the longest possible lengths of the preformed material with a minimum of joints. Lengths less than 4 ft shall be one piece. Cut material to a clean, true edge. Ensure straight lines at the joint.

When installing the seal, do not use any type of equipment that will damage the seal. Remove and replace damaged seals.

Cleaning And Painting. Refer to Section 435.

Joint Replacement and Modification. Where the Contract Documents specify replacement or modification to existing expansion joints on bridges on which traffic will be maintained, have available a supply of steel plates at least 4 x 8 ft and 1 in. thick. Place these plates over the joints if traffic has to be restored before the concrete has cured and at any time the unfinished work will interfere with traffic.

Where the Contract Documents specify modification to existing expansion joints, remove the concrete as specified in 405.03.

Where the Contract Documents only specify replacement of existing roadway joint seal, the work shall include cleaning and painting the joint.

Thoroughly clean existing drainage troughs to remain of all debris. Clean and paint all exposed metal where noted on the Plans or as directed.

All angles shall be cut with a saw. All holes and slots shall be drilled. Do not cut with a torch.

Power tool clean to bare metal and paint any areas where the existing steel coating is damaged due to the installation of new troughs.

After the joints are complete in place and just prior to placing the compression seal, remove the masking tape and residue, and install the seal. Then apply the finish coat to the exposed portion of the angles above the seal.

Joint Seals in Bridge Decks. Place transverse compression seals in one piece for the entire length of the roadway joint. Shop and field splices are prohibited. Use the longest compression seal pieces as practicable for longitudinal bridge joints.

Apply the lubricant adhesive according to the manufacturer's recommendations. If the seal is stretched in excess of 5 percent, remove and reinstall the seal as directed.

460.03.01 In-Place Testing. Subject the completed joint to a water test to detect any leakage. Conduct the test at least five days after completing the joint. Provide all facilities required for the Engineer's inspections of the underdeck areas. Cover the roadway section of the joint from curb to curb, or parapet to parapet, with at least 1 in. of water. If this is not possible, perform the water test in part section along the joint. When testing subsequent part sections, overlap at least 1 ft of the joint previously tested.

Maintain the ponding for a period of five hours for the entire roadway or each section of joint being tested. During and at the conclusion of the test, examine the underside of the joint for leakage. The expansion joint seal will be considered watertight if no obvious wetness is visible. If the joint system exhibits evidence of water leakage at any point, locate and repair all leaks.

When repairs are required, perform a subsequent water test.

If the joint leaks after the second test, remove, replace, and retest the seal.

460.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing, fabricating, and placing structural steel, roadway seals, drainage troughs, catch basins, downspouts, cleaning, painting, and all material, labor, equipment, tools and incidentals necessary to complete the work.

460.04.01 Joints in structures will not be measured but the cost will be incidental to the pertinent Superstructure Concrete item.

460.04.02 When an item for Modifying Existing Bridge Roadway Joints is included in the Contract Documents, the cost of furnishing, fabricating, and placing new structural steel, new roadway seals, modifying existing joints on bridge roadway including saw cutting and removal of existing concrete, new concrete, steel plates, cutting of existing steel, welding, drainage troughs, catch basins, downspouts, etc., shall also be included in the Contract unit price per linear foot for the item. The measurement will include the horizontal distance from the inside face to inside face of parapets plus the vertical distance of the curb faces and parapets.

460.04.03 When an item for Drainage Trough for Bridge is included in the Contract Documents, the furnishing and placing of drainage troughs including catch basins, downspouts, structural steel, and hardware will be measured and paid for at the pertinent Contract unit price per linear foot. This price will include cutting of angles, cleaning, painting, drilling of concrete, expansion bolts, etc. The measurement will be the center line distance from end to end of the installed drainage trough fabric.

460.04.04 Cleaning existing drainage troughs and cleaning and painting metal attachments will not be measured but the cost will be incidental to other pertinent items.

SECTION 461 — METAL RAILING

461.01 DESCRIPTION. Furnish, fabricate, coat, and install metal railings.

461.02 MATERIALS. Refer to the Contract Documents.

461.03 CONSTRUCTION. Fabricate and install all railings as specified.

Submit working drawing as specified in Section 499.

461.03.01 Production, Handling, and Shipment. Store all parts at the site on suitable blocking or platform at least 4 in. above any type surface or vegetation, and protect from corrosion or damage. Keep materials free from dirt, oil, grease, and other foreign matter. Protect surfaces to be painted, both in the shop and in the field. Repair or replace damaged material as directed.

461.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

461.04.01 Metal Railing will be measured and paid for at the Contract unit price per linear foot.

461.04.02 Metal Railing will not be measured but will be paid for at the Contract lump sum price.

461.04.03 Metal railing for which no specific item is included will not be measured but the cost will be incidental to other pertinent items.

SECTION 462 — TIMBER STRUCTURES

462.01 DESCRIPTION. Construct structures or portions of structures using timber, including fabricating, erecting, treating, and coating of the timber elements.

For timber piling refer to Section 410. For concrete refer to Section 420. For structural steel refer to Section 430.

462.02 MATERIALS.

Asphalt Cement	904.01
Structural Steel	909.01
Gray Iron Castings	909.04
Bolts and Hardware	909.10
Structural Timber	921.05
Preservative Treatments for Timber	921.06
Metal Timber Connectors	Per manufacturer and as approved
Galvanizing	A 153
Fire Stops and Galvanized Sheet Metal	A 653, Coating Designation G 90

462.03 CONSTRUCTION.

462.03.01 Storage and Handling. Store timber in open stacked piles at the site on suitable blocking or platform at least 12 in. above any type of surface or vegetation in a manner to shed water and prevent warping. Protect it from weather by a suitable covering. Clear the storage site of weeds and rubbish before placing material and throughout the storage period. Ensure that the site selected is not subject to flooding. Handle using rope or nylon slings to prevent the breaking of outer fibers, bruising, or penetrating the surface.

462.03.02 Cutting and Boring. When practical, cut and bore treated timbers before pressure treatment. Brush coat all cuts in treated timbers and all abrasions (after being carefully trimmed) with two applications of an approved wood preservative before installing the timber in the structure. When it is determined that treated timbers are damaged beyond repair, remove them from the project and replace them.

When forms or temporary braces are attached to treated timber with nails or spikes, fill the holes by driving galvanized nails or spikes flush with the surface.

462.03.03 Bolt Holes. When holes are bored after treatment, fill them with asphalt cement applied with a caulking gun, or as directed, before inserting bolts. Place asphalt cement coated plugs in holes that are not to receive bolts.

462.03.04 Coating Untreated Surfaces. In untreated timber structures, coat all contact surfaces between members (except adjacent flooring members) with two coats of an approved preservative before assembly. Similarly coat the back faces of bulkheads and all surfaces of timber that will come in contact with earth, metal, or other timber. Coat the ends of timber members in the same manner.

462.03.05 Protection of Ends of Caps, Wales, and Planks. Cover the ends of all caps, wales, and planks with resin glass composite shields as approved. Apply the shields as follows:

- (a) Remove all dirt and other loose material from area to be capped.
- (b) Apply the first coat of resin to the top and 4 in. down the side of the member.
- (c) Apply precut glass cloth, using a 3 in. grooved aluminum roller to achieve “wet-out”, and anchor using brass staples.
- (d) When the initial coat of resin has taken a tack free set, apply a second coat of resin to seal the entire application.

462.03.06 Diameter of Holes. Holes bored in timber structures shall meet the following for the listed connectors:

- (a) Round drift bolts, spikes, and dowels - 1/16 in. less than the diameter of the device.
- (b) Square drift bolts, spikes, and dowels - equal to the smallest dimension of the device.
- (c) Machine bolts - same as the diameter of the bolts.
- (d) Rods - 1/16 in. larger than the diameter of the rods.
- (e) Lag screws - equal to the diameter of the screw at the base of the thread.
- (f) Connector bolts - 1/16 in. larger than the diameter of the connector bolts.

462.03.07 Bolt Assemblies. Bolt heads and nuts that come in contact with the timber shall be fitted with a washer of the size and type specified. After all nuts are adequately tightened, burr the bolt threads.

462.03.08 Countersinking. Countersink wherever smooth faces are required. In treated timber, paint recesses formed in horizontal surfaces with an approved preservative. After the bolt or screw is in place, fill recesses with an approved asphalt coating.

462.03.09 Connectors. Bore connector holes through members to be connected. Bore perpendicular to the face of the timber. When spike grids or split ring connectors are specified, install them according to the manufacturer's recommendations.

462.03.10 Framing. Accurately cut and frame all timber to provide even bearing over the entire contact surface. When making joints, shimming and open joints are prohibited.

462.03.11 Sills. Ensure that sills have true and even bearing on mudsills or concrete pedestals. Remove all earth from contact with sills.

462.03.12 Timber Caps. Place timber caps to secure an even and uniform bearing over the tops of the supporting posts or piles and to secure an even alignment of their ends. Secure all caps by drift bolts or as specified. Locate the drift bolts in the center of the post or pile.

462.03.13 Bracing. Bolt the ends of bracing through the pile, post, or cap. Bolt intermediate intersections also. Use spikes or nails in addition to bolts. When bracing intersects, use filler blocks with a bolted connection.

462.03.14 Stringers. Place stringers in position so that knots near edges are in the top portions of the stringers. Size bottom edges of stringers to provide uniform depth at bearings.

Outside stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated at least 1/2 in. and securely fastened by drift bolts where specified. When stringers are two panels long, stagger the joints. Toenail cross bridging between stringers with at least two nails in each end. Leave the lower ends of all bridging and one side of each diaphragm disconnected and free to move until after the deck above is securely fastened to the stringers.

462.03.15 Floor Planking. Unless otherwise specified, floor planking shall be S1S1E, hit or miss, and have a uniform thickness with a maximum tolerance of 1/8 in. Where necessary to maintain traffic, lay

planks in half-of-bridge width sections. Timber plank floors shall always be accompanied with suitable hold down devices. Spike the planks to every stringer, joist, and nailer with at least two spikes. The length of the spikes shall be at least twice the thickness of the plank. Where planks will be under wheel guards or hold down devices, carefully select planks of as near equal thickness as possible. Before any hold down or wheel guard is bolted, firmly drive treated shims or wedges between low planks and either the hold down or the wheel guard so that all planks are held down with equal pressure. The shims shall occupy at least 50 percent of the area between the bottom of either the hold down or wheel guard and the top of the plank.

462.03.16 Bridge Railings and Wheel Guards. Bridge railings shall meet a minimum of Test Level 1 (TL-1) as specified in the AASHTO LRFD Bridge Design Specifications, Railings. All dimensions for timber rail, posts, and spacers shall be the actual dimensions of the timber.

Locate bridge rail and wheel guard splices so that rail and guard members are continuous over at least two posts. Install bridge railings and wheel guards in sections not less than 12 ft long. Splices shall be shiplapped with the lap equal to 8 in. or the greater side of the piece, whichever is larger.

462.04 MEASUREMENT AND PAYMENT. Piles are excluded. The payment will be full compensation for all timber (treated or untreated) storage and handling, finishing of pile bents and abutments, preservative, composite shields, asphalt cement, metal components, drilling holes, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

462.04.01 Timber structures will be measured and paid for at the Contract unit price per 1000 board feet “MBM”. The computation of quantities will be based on the nominal sizes specified and the exact overall net length of pieces remaining in the completed structure. No allowance will be made for waste.

462.04.02 Timber structures will not be measured but will be paid for at the Contract lump sum price.

SECTION 463 — BRICK MASONRY

463.01 DESCRIPTION. Construct brick masonry as specified.

463.02 MATERIALS.

Curing Compound	902.07.03
Brick	903
Mortar	903.06
Fusion Bonded Epoxy	
Powdered Coatings	917.02
Water	921.01
Dove Tail Anchors	As specified

Sample Panel. When specified, prepare and deliver a sample panel measuring at least 24 x 24 in. to the construction site for approval prior to beginning work. The panel shall be typical of the brickwork to be used on the project. Receive the Administration's approval of the panel before beginning the brickwork on the project. Keep the sample panel on the project site. All subsequent brickwork shall be equal in appearance to this approved panel.

463.03 CONSTRUCTION. Unless otherwise specified, lay all brick masonry in level courses with faces plumb, square, and true to the dimensions specified. Ensure that all exposed surfaces are smooth. Lay brick masonry for parapets and end posts parallel to the roadway or barrier.

Construct brick facing as specified.

463.03.01 Bond. Unless otherwise specified, lay brick masonry in running bond. Lay adjoining courses to break joints by half brick as nearly as practical.

463.03.02 Bricklaying. Spray all brick with water to dampen the surface prior to laying. Only use fresh plastic mortar that is soft and workable when placed on the wall. Spread a layer of mortar on the beds and make not more than a shallow furrow in it that can be readily closed by the laying of the brick. Solidly fill all bed and head joints with mortar. Fully butter end joints of stretchers and side or cross joints of headers with mortar and make a shoved joint so that mortar is squeezed out at the top of the joint. Ensure that no brick is jarred or moved after it has been fully bedded in the mortar. Bricks loosened after the mortar has taken its set shall be removed, cleaned, and relaid with fresh mortar. Do not use broken or chipped bricks in the face. Do not use spalls or bats except where necessary to shape around irregular openings or edges. Place full bricks at ends or corners where possible. Use the bats in the interior of

the course. In making closures, do not use bricks shorter than the width of a whole brick. Use only whole brick as headers.

463.03.03 Joints. Slush all joints with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Lay exterior faces in advance of backing. Back plaster or parge exterior faces with a coat of mortar at least 3/8 in. thick before the backing is laid up. Prior to parging, cut flush all joints on the back of face courses. Joints shall be 1/4 to 1/2 in. wide. Uniformly maintain whatever width is adopted throughout the work.

463.03.04 Pointing. Tool all exterior head and bed joints with a round tool, slightly larger than the joint, pressed tight against the plastic mortar for a concave finish. When nails or line pins are used, plug the holes with mortar and point them immediately upon removal.

463.03.05 Cleaning. Upon completion of the work, clean all exterior surfaces by scrubbing and washing down with water. If necessary, clean with a 5 percent solution of muriatic acid, which shall be rinsed off with liberal quantities of clean fresh water.

463.03.06 Curing. After the work has been laid up and pointed, cure the exposed surfaces using one of the following methods:

- (a) Cover with two layers of burlap and keep wet for three days.
- (b) Apply a nonasphalt colorless liquid curing compound using an approved hand or motor driven spray operated at a pressure of 40 to 60 psi. Apply uniformly at a rate of 27 yd²/gal. Ensure that the surface is completely coated and sealed in one application. Where there is evidence of insufficient coating, apply additional material as directed.

463.03.07 Cold Weather Protection. Do not perform brick masonry work and pointing when there is frost in the brick or when the air temperature is below 50 F, unless suitable housing and heating devices are provided as necessary to keep the atmosphere surrounding the masonry at a temperature of at least 50 F for the curing period.

463.03.08 Backfill. Do not backfill before seven days after completion of the section.

463.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all sample panels, dove tail anchors, curing, and for

all material, labor, equipment, tools, and incidentals necessary to complete the work.

463.04.01 Brick Masonry for Structures will be measured and paid for at the Contract unit price per square foot.

463.04.02 Brick Masonry for Structures will be measured and paid for at the Contract unit price per cubic yard.

463.04.03 Brick Masonry for Structures will not be measured but will be paid for at the Contract lump sum price.

463.04.04 Brick Masonry Facing will be measured and paid for at the Contract unit price per square foot.

463.04.05 Brick Masonry Facing will be measured and paid for at the Contract lump sum price.

SECTION 464 — EPOXY PROTECTIVE COATINGS FOR CONCRETE

464.01 DESCRIPTION. Furnish and apply epoxy protective coatings to concrete surfaces.

464.02 MATERIALS.

Sand	901.01
Epoxy Protective Coatings	917.01

464.03 CONSTRUCTION. Coatings shall not be applied until 30 days after removal of the forms. Abrade all surfaces to be coated by abrasive blasting, water blasting, or other mechanical means to provide a surface profile for improved adhesion. Ensure that the surface is sound, clean, thoroughly dry, and free of oil, grease, curing compound, and other foreign matter before applying the first epoxy protective coating. Apply two coats to the specified areas of the structure. Each application shall follow a dry weather period of at least two consecutive days and be within the time frame recommended by the manufacturer. Mask adjacent areas not to be coated or otherwise protect to prevent staining.

464.03.01 Mixing and Application. Mix and apply according to the manufacturer's recommendations. Apply by brush or roller. Do not

apply to piers and abutments until the structural steel masonry plates are in place.

464.03.02 Coating Requirements. Sprinkle an excess of sand on the second epoxy coating on the top surfaces of the piers and abutment bridge seat areas between beam pads while it is still wet. When it has hardened sufficiently to resist marring, remove sand not adhering to the coatings. Coat the following areas:

- (a) For abutments under a transverse joint, apply the coatings to the entire horizontal surface of the bridge seat areas (between and around the beam pads) and all exposed surfaces of the beam pads, and the entire contiguous vertical faces of the backwalls and cheek walls.
- (b) For piers under a transverse joint, apply the coatings to the entire horizontal surface of bridge seat areas (between and around the beam pads), and all exposed surfaces of the beam pads.

464.03.03 Material Precautions. Use the manufacturer's Material Safety Data in handling and use of the material.

464.03.04 Repairs. Repair all damage to the structure resulting from the coating operations, including damage to the epoxy protective coating. Perform epoxy protective coating repairs according to the manufacturer's recommendations.

464.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for both coats and all material, labor, equipment, tools, and incidentals necessary to complete the work.

464.04.01 Epoxy protective coatings for concrete for which no specific item is included will not be measured but the cost will be incidental to other pertinent items.

464.04.02 Epoxy protective coatings for concrete will not be measured but will be paid for at the Contract lump sum price for the pertinent Epoxy Protective Coating item.

464.04.03 Epoxy protective coatings for concrete will be measured and paid for at the Contract unit price per square foot for the pertinent Epoxy Protective Coating item.

SECTION 465 — FUSION BONDED POWDER COATINGS FOR METAL

465.01 DESCRIPTION. Furnish and apply electrostatically applied fusion bonded powder coatings to metal surfaces.

465.02 MATERIALS.

Epoxy Powder Coating	917.02 except creep test will not be required
Polyester Powder Coating	917.03

Use polyester powder coating unless otherwise specified.

465.03 CONSTRUCTION. Apply the coating in an environmentally controlled plant that is fully enclosed. The coating system shall have the capabilities of preheating and post baking.

Ensure that the surface is free of oil and mill coatings.

Grit blast the surface to white metal according to SSPC-SP 5 using a mixture of steel shot and grit. Protect cleaned surfaces from high humidity, rainfall, and surface moisture. Surfaces shall not flash rust before coating. Provide a uniform, angular anchor blast profile having a height of 2 to 5 mils. Check anchor pattern with an approved surface profile gauge.

Apply and cure the material as specified by the coating manufacturer. Neither the metal surface nor the oven temperature shall exceed 500 F during any part of the curing process.

Ensure that the cured coating has a uniform color, gloss, and thickness, and is free of blisters, fish eyes, sags, runs, and any other irregularity.

Ensure that the finished coating thickness is 10 ± 2 mils when tested according to SSPC PA-2, except the balls and sockets on steel sheet piling may have a lesser thickness of coating.

Similarly coat new bolts, nuts, and washers to a thickness of 4 to 7 mils. The nuts shall have oversize threads and fit the bolts after both are coated. Restrain the bolt heads from turning during torquing operations.

The coater shall be responsible for all quality control checking including visual inspection and thickness measurements and shall keep the results of each inspection in a form suitable to the Engineer.

The Engineer shall have access to each part of the process and have the right and opportunity to witness or perform any of the quality control tests on a random sampling basis.

Touch Up. Provide a compatible touch up system for repair of defects, all areas damaged during erection, and all visible open areas. Apply touch up as follows:

- (a) **Surface Preparation.** The surface shall be clean, dry, and free of rust and scale. Blast clean to National Association of Corrosion Engineers (NACE) Near White where possible. Use suitable solvents to remove grease, oil, and other contaminants. Apply coating directly to the cleaned surface before oxidation occurs.
- (b) **Mixing.** Mix ratio of Part A to Part B shall be as recommended by the manufacturer. Thoroughly mix the two parts until a uniform color is achieved. If thinning is required, thin each part separately using a thinner recommended by the manufacturer. Discard material not used within the recommended pot life.

465.03.01 Material Precautions. Use the manufacturer's Material Safety Data in handling and use of this material. Refer to 421.03.04 for handling and protection.

465.04 MEASUREMENT AND PAYMENT. Fusion bonded powder coatings for metal will not be measured but the cost will be incidental to the pertinent items specified.

SECTION 466 THRU 468 — RESERVED

SECTION 469 — POROUS BACKFILL

469.01 DESCRIPTION. Furnish and place porous backfill material, reinforced concrete base, and pipe drains at the rear of abutments, wing walls, retaining walls, and other locations.

469.02 MATERIALS.

Porous Backfill, Size No. 57, Aggregate	901.01
Concrete Mix No. 1	902.10
Pipe Drains	905
Reinforcement Steel	908.01
Geotextile, Class as specified	921.09

469.03 CONSTRUCTION. Place porous backfill material in layers in conjunction with the adjacent fill. Any fill material removed for placing the porous backfill material shall be at no additional cost to the Administration. When a form is used between the porous backfill material and the earth backfill, completely remove the form from the completed fill.

Slope concrete base to drain to points of discharge.

469.04 MEASUREMENT AND PAYMENT. Porous backfill will not be measured but will be paid for at the Contract lump sum price for the pertinent Porous Backfill item. The payment will be full compensation for all excavation, concrete, reinforcement, geotextiles, drains, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

If no item for porous backfill appears in the Contract Documents, the work will not be measured but the cost will be incidental to other items specified.

SECTION 470 — UTILITIES ON STRUCTURES

470.01 DESCRIPTION. Place utility markers to identify utilities when they are newly installed, replaced, or relocated. Place the identification markers as specified herein and as approved.

470.02 MATERIALS. Use decals or stencil high quality black or white print onto the pipe or carrier. Lettering height shall be 1/3 the pipe diameter but not less than 1 in. or more than 4 in. Markers shall include the name of the utility and a description of the contents as shown in the Contract Documents or as directed.

Submit a sample of the proposed markers.

470.03 CONSTRUCTION. Place identification markers within the first and last 50 ft of the structure, and at intervals not to exceed 100 ft.

Ensure that the surface to receive the marker is properly cleaned and prepared prior to the application. Orient the markings for best visibility.

470.04 MEASUREMENT AND PAYMENT. The application of utility markers on structures will not be measured but the cost will be incidental to the pertinent items.

SECTION 471 THRU 494 — RESERVED

SECTION 495 — APPLICATION OF BRIDGE/STRUCTURE NUMBERS

495.01 DESCRIPTION. Apply Bridge/Structure Numbers to all completed structures.

495.02 MATERIALS. Select a paint that is suitable for the particular application, subject to the approval of the Engineer.

495.03 CONSTRUCTION. Apply the Number as a last order of work. Refer to the pertinent details included in the Contract Documents for the size, location, etc. Ensure that completed work has sharp edges differentiating all coatings and the previous substrate. Properly prepare surfaces according to the paint manufacturer's recommendations. Do not apply paint to wet or moist surfaces.

On rehabilitation projects repaint the Number if it is faded, removed, or otherwise deemed necessary by the Engineer.

495.04 MEASUREMENT AND PAYMENT. Application of Bridge/Structure Numbers will not be measured but the cost will be incidental to the pertinent items specified.

SECTION 496 THRU 498 — RESERVED

SECTION 499 — WORKING DRAWINGS

499.01 DESCRIPTION. Schedule and distribute working drawings, which are described in TC-1.03 and specified in TC-4.01. Working drawings shall exhibit good drafting practices and represent the original work of the Contractor, fabricator, or supplier. Duplicated portions of the Plans will not be accepted. When requested by the Administration or consultant, submit calculations or other information deemed necessary to backup working drawings. Calculations and other backup material shall be signed and sealed by a professional engineer registered in the State of Maryland.

499.02 MATERIALS. Not applicable.

499.03 CONSTRUCTION.

499.03.01 Schedule. As a first order of work, prepare and submit a schedule for the submission of the working drawings as specified in 499.03.02 or 499.03.03. Coordinate the schedule with and in full accord with the Progress Schedule submitted to the procurement officer as specified in GP-8.04 and TC-5.02.

The schedule shall include each type of working drawings (e.g. form plans, structural steel, etc.), approximate number of drawings to be reviewed, estimated date of first submission, and estimated rate of submission of drawings (e.g. 5/wk). Where possible, submit the most crucial drawings first with sufficient time for review so as to minimize delays during construction.

499.03.02 Consultant Engineering Firm. When the Contract Documents specify that a consultant engineering firm is to review the working drawings for the structure, send all working drawings to that firm.

To expedite the checking and distribution of working drawings, fabricators or suppliers may send prints directly to the appropriate consultant engineering firm with copies of all correspondence to the Contractor, Director - Office of Bridge Development, and the District Engineer. If the Contractor requests that all plans be routed through the Contractor's office, then the establishment of that procedure should be the first order of work so as to avoid possible misunderstandings as to the processing. Be advised that this plan of action will delay the turn around time and will not constitute grounds for complaint or a time extension.

The Contractor, fabricator, or supplier shall furnish to the consultant engineering firm 10 prints each of all working drawings, etc., for primary review.

Once primary review is complete, the Contractor, fabricator, or supplier shall furnish to the consultant engineering firm additional prints (number to be furnished by primary reviewer) for stamping and forwarding to the Administration's Office of Bridge Development for secondary review and distribution.

All working drawings for the structures will not be considered accepted until they bear the acceptance stamps of both the consultant engineering firm and the Administration's Office of Bridge Development.

499.03.03 Office of Bridge Development. When no consultant engineering firm is specified, send all working drawings for the structures to the Director - Office of Bridge Development.

To expedite the checking and distribution of working drawings, fabricators or suppliers may send prints directly to the Director with copies of all correspondence to the Contractor and the District Engineer. If the Contractor requests that all drawings be routed through the Contractor's office, then the establishment of that procedure should be the first order of work so as to avoid possible misunderstandings as to the processing. Be advised that this plan of action will delay the turn around time and will not constitute grounds for complaint or a time extension.

The Contractor, fabricator, or supplier shall furnish to the Director 10 prints each of all working drawings, etc., for primary review.

Once primary review is complete the Contractor, fabricator, or supplier shall furnish to the Director additional prints (number to be furnished by primary reviewer) for final review and distribution.

499.03.04 Revisions and Substitutions. All modifications, regardless of whether or not the Contract includes a consultant engineering firm, shall be sent to the Director - Office of Bridge Development for acceptance. Any modifications implemented, without written acceptance from the Director - Office of Bridge Development, will be subject to the requirements of GP-5.02.

499.04 MEASUREMENT AND PAYMENT. This work will not be measured but the cost will be incidental to other pertinent items.

CATEGORY 500 PAVING

SECTION 501 — AGGREGATE BASE COURSES

501.01 DESCRIPTION. Construct base courses using one of the following:

- (a) Graded aggregate without a stabilizing agent.
- (b) Plant mixed graded aggregate with a portland cement stabilizing agent.
- (c) Bank run gravel.
- (d) Sand aggregate.

501.02 MATERIALS.

Graded Aggregate for Base Course	901.01
Bank Run Gravel for Base Course	901.01
Sand Aggregate Base Course	
Coarse Aggregate	901.01, Size No. 57
Fine Aggregate	916.01.01
Portland Cement	902 Type I or IA
Emulsified Asphalt	904.03
Production Plant	915
Water	921.01
Moisture and Dust Control Agents	921.02

501.03 CONSTRUCTION. At least 30 days prior to the start of constructing the base course, submit the proposed plants, equipment, and material sources for approval.

Protect the subgrade and base against damage from all causes. Repair or replace damaged areas.

Limit excavation for widening to an area that can be backfilled the same working day using graded aggregate base. Refer to Standard No. 104.01-28 for the area to be backfilled. Maintain the temporary graded aggregate base wedge with a 4:1 or flatter fill slope. Compact the material as directed. Leave the graded aggregate base wedge in place until placement of the hot mix asphalt base.

501.03.01 Equipment. All equipment, including the production plant and on-site equipment, is subject to approval. Have the plant ready for inspection at least 48 hours prior to the start of construction operations.

501.03.02 Weather Restrictions.

- (a) **Temperature and Surface Conditions.** Place graded aggregate stabilized with portland cement when the ambient air and surface temperatures are at least 40 F and rising. Place graded aggregate, bank run gravel, and sand aggregate base when the ambient air and surface temperatures are at least 32 F and rising. Do not place material on a frozen subgrade.
- (b) **Cold Weather Protection.** Protect the plant mixed graded aggregate stabilized base from freezing during the seven-day curing period.
- (c) **Precipitation.** Do not place material during precipitation. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. If precipitation occurs during placement, placement of material enroute from the plant to the job site shall be at the Contractor's risk.

501.03.03 Subgrade Preparation. Before beginning base course construction, complete the approved subgrade to final line and grade at least 500 ft ahead. Construct the foundation as specified in Sections 204 and 208. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, distribute the loading over the entire width of the course to aid in obtaining uniform and thorough compaction. Remove rutting by reshaping and recompacting the affected area as specified in Section 204.

501.03.04 Stabilized Graded Aggregate Base Mix. Use the amount of portland cement determined per MSMT 321.

501.03.05 Bank Run Gravel Base Mix. Mixing or blending of materials using approved chemical additives will be permitted.

501.03.06 Sand Aggregate Base Mix. Provide a mixture containing 35 to 40 percent coarse material as measured by dry weight of the total mix.

501.03.07 Transportation. Handle and transport mixed base materials in a manner that minimizes segregation and loss of moisture. Cover all loads in accordance with State laws unless hauling is off road and is approved. Unless approved, do not dump material into piles, haul over the completed base course, or stockpile the material on the job site.

501.03.08 Spreading. Spread the base material uniformly and in layers of approximately equal thickness, to provide the specified planned depth. Avoid segregation of coarse and fine particles. Build shoulders or berms at least 2 ft wide on each side of the base and to the top elevation of each uncompacted layer, except when placing the base against concrete curbs or gutters.

501.03.09 Grade or Finished Surface Control. Shape the surface of the base material to the specified line, grade, and cross section. Set grades longitudinally and transversely with fixed controls spaced no greater than 25 ft. Compact and smooth the surface over its full width using a smooth faced steel-wheeled roller, or if rolling is not feasible, by mechanical tampers and vibratory compactors, as approved. Maintain the finished grade within 1/2 in. from the established grade.

501.03.10 Compaction. Immediately after placement, compact the material to the required density. During compaction operations, maintain the moisture content of the material to within 2 percent of optimum moisture. Determine the optimum moisture content and maximum dry density as follows:

- (a) Sand Aggregate Base and Bank Run Gravel Base per T 180.
- (b) Graded Aggregate Base and Graded Stabilized Aggregate Base per MSMT 321.

Compact graded aggregate base, bank run gravel base, and sand aggregate base to at least 97 percent of the maximum dry density. Compact graded stabilized aggregate base to at least 95 percent of the maximum dry density. Measure in place density per MSMT 350 or 352.

Begin compaction operations, except on superelevated curves, at the sides of the course. Overlap the shoulder or berm at least 1 ft and progress toward the center parallel to the center line of the roadway. On superelevated curves, begin compaction at the low side and progress toward the high side. Continue compaction operations until all compaction marks are removed.

501.03.11 Graded Stabilized Aggregate Base Protection and Curing. Complete the spreading, compacting, and shaping within three hours after the mixing water, cement, and aggregate come in contact. Reconstruct any section not conforming to these requirements. Maintain the surface in a moist condition until the emulsified asphalt seal coat is applied. Apply the emulsified asphalt using distributing equipment as specified in 503.03.01 at the rate of 0.2 gal/yd². Avoid ponding of the emulsified asphalt. If ponding occurs, use a sand blotter or an equivalent method as approved.

Allow the material to cure for a period of seven days. During this period, close the base course to all traffic. Repair damaged portions of the base course seal coat.

501.03.12 Moisture and Dust Control Agents. When specified, add calcium or magnesium chloride at the plant or apply it to the surface of the material at the project site. Apply calcium chloride at the rate of 1 lb/yd². Apply magnesium chloride at the rate of 1 lb/yd² or as a solution at the rate of 1/2 gal/yd².

501.03.13 Maintenance. During construction and after completion of the base course, maintain the base until the surface course is placed. When unacceptable work cannot be repaired, replace it for the full depth of the base.

501.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all aggregate, furnishing, hauling, placing, curing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

501.04.01 Graded Aggregate Base Course, Graded Aggregate Base Course Stabilized with Cement, Bank Run Gravel Base Course, and Sand Aggregate Base Course will be measured and paid for at the Contract unit price per square yard.

Surface area measurements will be based on the specified width of the base and the actual length measured along the center line of the base surface.

The temporary graded aggregate base wedge constructed in conformance with Standard No. MD 104.01-28, maintaining the 4:1 or flatter slope, compaction, and removal of the material, will not be measured but the cost will be incidental to the Graded Aggregate Base Course item.

501.04.02 The portland cement stabilizing agent and the emulsified asphalt for seal coat will not be measured but the cost will be incidental to the Graded Aggregate Base Course Stabilized with Cement item.

501.04.03 Bank Run Gravel Base. Material manipulation or addition of chemical additives will not be measured but the cost will be incidental to the Bank Run Gravel Base Course item.

501.04.04 Calcium or Magnesium Chloride will be measured and paid for at the Contract unit price per square yard or per ton as specified.

SECTION 502 — SOIL-CEMENT BASE COURSE

502.01 DESCRIPTION. Construct soil-cement base course using a combination of soil and portland cement, uniformly mixed, moistened, compacted, shaped, and sealed. Unless otherwise specified, the soil, cement, and water may be either plant mixed or mixed in place.

502.02 MATERIALS.

Portland Cement	902
Emulsified Asphalts	904.03
Production Plant	915
Soil	916.01.01 or 916.01.02
Water	921.01

502.03 CONSTRUCTION. At least 30 days prior to the start of constructing the base course, submit the proposed production plants, location of plants with respect to project site, equipment, and material sources for approval.

Protect the subgrade and base against damage from all causes. Repair or replace damaged subgrade and base.

502.03.01 Equipment. All equipment, including the production plant and on-site equipment, is subject to approval. Have the production plant ready for inspection at least 48 hours before the start of construction operations.

502.03.02 Weather Restrictions.

- (a) **Temperature and Surface Conditions.** Place soil-cement base course when the ambient air and surface temperatures are at least 40 F and rising. Do not place material on a frozen subgrade.
- (b) **Cold Weather Protection.** Protect the completed base from freezing during the seven-day curing period.
- (c) **Precipitation.** Do not place material during precipitation. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. If precipitation occurs during placement, placement of material en route from the plant to the job site shall be at the Contractor's risk.

502.03.03 Subgrade Preparation. Complete the subgrade to final line and grade at least 500 ft ahead before beginning base course construction.

Construct the foundation as specified in Sections 204 and 208. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, distribute the loading over the entire width of the course to aid in obtaining uniform and thorough compaction. Remove rutting by reshaping and recompacting the affected area as specified in Section 204.

502.03.04 Design Mix. At least 45 days prior to the start of constructing the base course, submit samples of the soil and portland cement from the proposed material sources. Sample the materials as specified in the Materials Manual. The Engineer will determine the exact proportions of soil and portland cement, and the optimum moisture content based on these samples. Proportions may be revised during construction to provide for changing conditions as directed. Plant mixed material shall be sampled at the plant. Mixed in place material shall be sampled from a 100 ft long control strip constructed on the site.

502.03.05 Transportation. Handle and transport mixed materials in a manner that minimizes segregation and loss of moisture. Cover all loads in accordance with State laws, unless hauling is off road and approved. Unless approved, do not dump material into piles, haul over the completed base course, or stockpile the material on the job site.

502.03.06 Spreading of Plant Mix Material. Spread the base material uniformly in layers of approximately equal thickness, to provide the specified planned depth. Avoid segregation of coarse and fine particles. Build shoulders or berms at least 2 ft wide on each side of the base and to the top elevation of each uncompacted layer, except when placing the base against concrete curbs or gutters.

502.03.07 Mixed In Place Construction. Pulverize the soil base material to ensure that, at the completion of moist mixing, 100 percent passes a 1 in. sieve and at least 80 percent passes a No. 4 sieve. Limit any variation in the moisture content of the soil at the time of cement application to 2 percent from optimum. Then spread portland cement on the soil at the approved spread rate. In the presence of the Engineer, use an accurate scale to verify the spread rate. Then thoroughly mix the pulverized soil and cement. Immediately after completing the mixing operation, use a pressurized distributor to spray water on the mixture at the approved rate. Mix the soil/cement/water combination until it is uniform.

502.03.08 Grade or Finished Surface Control. Shape the surface of the base material to the specified line, grade, and cross section. Set grades longitudinally and transversely with fixed controls spaced no more than 25 ft. Compact and smooth the surface over its full width using a smooth faced steel-wheeled roller, or if rolling is not feasible, by

mechanical tampers and vibratory compactors, as approved. Maintain the finished grade within 1/2 in. from the established grade.

502.03.09 Finishing. Shape the surface of the base material to the specified line, grade, and cross section.

502.03.10 Compaction. Immediately after placement, compact the soil-cement base to a density of at least 100 percent of the maximum density as determined by T 134. Measure the in place density per MSMT 350. Furnish a compaction block as specified in 204.03.04.

At the start of compaction, maintain the moisture in the mixture to within 2 percent of the specified optimum moisture. Begin compaction operations, except on superelevated curves, at the sides of the course. Overlap the shoulder or berm at least 1 ft and progress toward the center parallel to the center line of the roadway. On superelevated curves, begin compaction at the low side and progress toward the high side. Continue compaction operations until all compaction marks are removed.

502.03.11 Construction Joints. At the end of each day's construction, create a straight transverse construction joint by cutting back into the completed work to form a vertical face. Build the base for large, wide areas as a series of parallel lanes of convenient length and width, complete with longitudinal joints, as approved.

502.03.12 Protection and Curing. Complete all spreading, compacting, and shaping within three hours after the mixing water, cement, and soil come in contact. Reconstruct any section not meeting these requirements. Maintain the surface of the base course in a moist condition until the emulsified asphalt is applied. Use distributing equipment conforming to 503.03.01 to apply the emulsified asphalt at the rate of 0.2 gal/yd². Avoid ponding of the emulsified asphalt. If ponding occurs, use a sand blotter or an equivalent method as approved.

Allow the soil cement base course to cure for a period of seven days. During this period, close the base course to all traffic. Repair damaged areas.

502.03.13 Maintenance. During construction and after completion of the base course, maintain the base course until the surface course is placed. When unacceptable work cannot be repaired, replace it for the full depth of the base.

502.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for control strip, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

502.04.01 Soil-Cement Base Course will be measured and paid for at the Contract unit price per square yard.

Surface area measurements will be based on the specified width of the base and the actual length measured along the center line of the base surface.

502.04.02 Portland Cement for Soil-Cement Base Course will be measured and paid for at the Contract unit price per ton.

SECTION 503 — CHIP SEAL SURFACE TREATMENT

503.01 DESCRIPTION. Apply one or two seal coats or a prime coat followed by one or two seal coats as specified. The seal coat consists of emulsified asphalt followed by an application of aggregate. The prime coat, when required, consists of preparing and treating an existing surface with emulsified asphalt.

503.02 MATERIALS.

MATERIAL	SECTION	APPLICATION	SIZE OR GRADE	SPREAD RATE lb/yd ²	SPRAY TEMP F	SPRAY RATE SINGLE COAT OR FIRST COAT gal/yd ²	SPRAY RATE FOR SECOND COAT (Double) gal/yd ²
Aggregate	901	Single or First Coat	No. 7	25-50	—	—	—
		Second (Double Coat)	No. 8	20-35	—	—	—
Emulsified Asphalts	904.03	Seal Coat	CRS-1	—	70-140	0.3-0.5	0.2-0.4
			CRS-2	—	140-160	0.3-0.5	0.2-0.4
			RS-1	—	70-140	0.3-0.5	0.2-0.4
			RS-2	—	140-160	0.3-0.5	0.2-0.4

503.03 CONSTRUCTION. At least 30 days prior to the start of placement of the chip seal surface treatment, submit a proposed plan, including equipment and material sources, for approval.

Protect the treated pavement against damage from all causes. Repair or replace damaged areas as directed.

503.03.01 Equipment. All equipment is subject to approval.

- (a) **Asphalt Distributing Equipment.** This equipment shall be inspected and calibrated by the Administration prior to use and shall bear a current Administration inspection and calibration tag. A calibration chart showing the total capacity in gallons of the distributor tank, and the fractional capacity for each 1/4 in. of tank depth, shall be carried in the unit. The unit shall be capable of uniformly applying the specified material on variable widths of surface at the rates specified in 503.02. In addition, the equipment shall include the following:
- (1) A fifth wheel tachometer for maintaining uniform speed.
 - (2) A thermometer graduated in 2 F increments to determine the specified temperature ranges.
 - (3) Heaters for uniformly heating the materials to the proper temperatures.
 - (4) Full circulation spray bars that are laterally and vertically adjustable, plus a hand spray.
 - (5) A calibrated tank to determine the quantity of asphalt in each load and the amount used.
 - (6) A valve or petcock built into the equipment for sampling the asphalt.
 - (7) A motor driven pump with pressure gauges to deliver the material to the spray bars. When a variable speed pump and metering system is used, provide charts prepared by the manufacturer for selecting the proper pump speed for each application.
- (b) **Aggregate Spreader.** Use equipment that is either self-propelled or attached to a truck tailgate.
- (c) **Rollers.** Refer to 504.03.01(c).

503.03.02 Weather Restrictions. Place when the ambient air and surface temperatures are at least 50 F and rising and the pavement is clean and dry. When weather conditions differ from these limits, placement of material en route from the plant to the job site shall be at the Contractor's risk. When the Engineer stops placement of the material, dispose of all material en route at no additional cost to the Administration.

503.03.03 Foundation Preparation. Construct the foundation as specified. When paving over existing pavement, repair ruts and potholes

to provide a smooth surface for the application of the chip seal surface treatment.

503.03.04 Prime Coat. Prior to the application, clean the surface of all loose and foreign materials. Uniformly apply the prime coat to the surface at the application rate specified in 503.02. Remove pooled material before applying the next coat.

503.03.05 First Seal Coat.

- (a) No sooner than 24 hours after the application of the prime coat, spray emulsified asphalt on the surface at the application rate specified in 503.02.
- (b) Immediately following this asphalt application, spread a dry, dust free aggregate on the surface at the application rate specified in 503.02. Remove excess aggregate, and correct all areas containing insufficient aggregate.

503.03.06 Rolling. Immediately following the aggregate application, roll the surface until the aggregate is uniformly embedded into the asphalt. Discontinue rolling if the aggregate begins to crush.

503.03.07 Second Seal Coat. When specified, after the first seal coat has cured at least 24 hours, apply a second seal coat to the surface, omitting the prime coat. Apply emulsified asphalt and aggregate at the application rate specified in 503.02. Remove excess aggregate and correct all areas containing insufficient aggregate. Roll the surface as specified in 503.03.06.

503.03.08 Traffic. Close completed sections to traffic until the final seal coat has completely cured. Maintain the treated surface after it has been opened to traffic until final acceptance.

503.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for the foundation preparation, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Chip Seal Surface Treatment will be measured and paid for at the Contract unit price for one or more of the items listed below.

503.04.01 No. 7 Aggregate for Single Coat Chip Seal Surface Treatment per ton.

503.04.02 No. 8 Aggregate for Second Coat Chip Seal Surface Treatment per ton.

503.04.03 Emulsified Asphalt for Seal Coat per gallon.

The actual number of gallons of emulsified asphalt distributed will be corrected to the corresponding volume at 60 F as determined by use of conversion tables furnished by the Administration.

SECTION 504 — HOT MIX ASPHALT PAVEMENT

504.01 DESCRIPTION. Construct hot mix asphalt (HMA) pavement.

504.02 MATERIALS.

Performance Graded Asphalt Binders	904.02
Tack Coat	904.03
Hot Mix Asphalt Mixes	904.04
Crack Filler	911.01
Production Plant	915

504.03 CONSTRUCTION.

Quality Control Plan. At least 30 days prior to the placement of any HMA pavement, submit a Plant Quality Control Plan to the Office of Materials Technology (OMT) and a Field Quality Control Plan to the District_Engineer's representative for approval. The Quality Control Plans shall contain a statistically based procedure of random sampling and shall show how the Contractor proposes to control the equipment, materials, production, and paving operations to ensure conformance with these Specifications. A master Plant and Field Quality Control Plan shall be submitted for this prior to approval. When a master Field Quality Control Plan is submitted and approved, an addendum shall be submitted for each specific Contract. The Contractor shall discuss the QC plan requirements in the pre-construction, pre-pave and progress meetings.

The Field Quality Control Plan shall contain:

- (a) Production plants, location of plants with respect to the project site, personnel qualifications, inspection and record keeping methods, and minimum frequencies of sampling and testing as specified in MSMT 735, Table 2.
- (b) Corrective actions that will be taken for unsatisfactory construction practices and deviations from the material Specifications.

- (c) A Quality Control Plan for the plant, which addresses all elements necessary for quality control.

Plan Administrator and Certified Technicians. The Quality Control Plan shall designate a Plan Administrator, who shall have full authority to institute any action necessary for the successful operation of the Plan. The Plan Administrator may supervise the Quality Control Plan on more than one project, if that person can be in contact with the job site within one hour after being notified of a problem.

As identified in the Mid-Atlantic Region Technician Certification Program (MARTCP) and the Maryland Technician Certification Program, the Quality Control Plan shall also designate a Certified HMA Plant Technician – Level 2, a Certified HMA Field Technician, a Certified Inertial Profiler Operator, and if used, a Certified HMA Plant Technician – Level 1, a Certified HMA Materials Tester/Field Technician or any Trainee Technicians. A Certified Plant Technician shall be present at the plant during production and shipment of HMA for the Administration, unless otherwise approved in the Field Quality Control Plan. The technician shall perform the quality control sampling, testing and documentation in conformance with the approved quality control plan and Contract Documents.

A Certified Field Technician shall be present at the job site unless otherwise approved in the Field Quality Control Plan. The certified technician shall be responsible for the required field quality control sampling and testing in conformance with the approved quality control plan and contract documents. Any deviation from the approved quality control plan, shall be cause for immediate suspension of the production and paving operations.

In addition to quality control testing, the Contractor's or Producer's technician certified by the Administration shall perform sampling for quality control, sampling for quality assurance, sampling for acceptance, and sampling for verification. Submit quality control test results to the Engineer when requested. When a certified technician is deficient in their duties as defined in MSMT 731 and the Mid-Atlantic Region Technician Certification Program policy manual, the technician's certification will be rescinded. Replace the deficient technician with another certified technician before resuming production and paving operations for the Administration.

Records. Maintain and make available to the Engineer upon request complete records of sampling, testing, actions taken to correct problems, and quality control inspection results. Provide copies of the reports when requested.

The Contractor shall maintain linear control charts or may elect to use other types of control charts such as standard deviation or range. Control charts may be maintained by production, by mix, or by mix per project. Current control charts shall be maintained in the quality control laboratory in a manner satisfactory to the Engineer. As a minimum, the control charts shall identify the mix design number, each test result, and the upper and lower Specification limits applicable to each test.

Quality Assurance (QA). The Administration will perform QA by conducting independent sampling, testing and inspection activities separate from the Contractor and Producer. The Engineer will perform the following to assure the quality of the HMA pavement:

- (a) Periodically observe tests performed by the Producer or Contractor,
- (b) Monitor required control charts,
- (c) Direct the producer or contractor to take mix samples behind the paver prior to compaction,
- (d) Direct the producer or contractor to take mix samples at the plant site,
- (e) Direct the producer or contractor to take core samples from the compacted pavement,
- (f) Monitor conformance with the approved quality control plan(s), and;
- (g) Evaluate quality control sampling and testing procedures and quality control sampling and testing equipment by an Independent Assurance (IA) program.

Protect the pavement against damage from all causes. Repair or replace damaged pavement.

504.03.01 Equipment. All equipment including the production plant and paving equipment shall be subject to approval. Have the plant ready for inspection at least 48 hours prior to the start of construction operations.

- (a) **Hauling Units.** Refer to 915.02(f).
- (b) **Pavers.** Inspection and approval will be based upon the manufacturer's specification manual (copy to be provided by the Contractor on request). The paver shall be equipped with means of preventing the segregation of the coarse aggregate particles when moving the mixture from the paver hopper to the paver augers. The means and methods used shall be in accordance with the paver manufacturer's instructions and may consist of chain curtains, deflector plates, or other such devices, or any combination of these. The Contractor shall demonstrate to the Engineer prior to use that the modifications to the paving equipment have been implemented on all pavers to be used on the project. For mainline paving, use a Highway Class, 25,000 pounds or greater, self-contained, self-propelled unit. For non-mainline paving, a paver less than 25 000 pounds may be used. The paver shall:
- (1) Produce a finished surface of the required smoothness and texture without tearing, shoving, or gouging the mixture.
 - (2) Be operated in a manner which delivers a homogeneous mixture the full width of the pavement.
 - (3) Have automatic controls capable of maintaining the grade and transverse slope within the required tolerances set forth in the contract documents.

When screed extensions are used, use auger extensions to maintain a distance no greater than 18 in. from the end of the auger to the end gate.

Manual operation will be permitted to make grade changes, in the construction of irregularly shaped and minor areas.

Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the workday as directed.

Provide reference lines or other approved markings to control the horizontal alignment.

(c) **Rollers.** All rollers shall be inspected by the Contractor and approved by the Engineer before use. Rollers shall be self-propelled, reversible, and steel wheeled or pneumatic tired. The roller shall be operated:

- (1) In conformity with the manufacturer's recommendations.
- (2) In a manner that does not damage the mat.
- (3) In a manner that delivers the optimal combination of densification requirements and ride requirements.

504.03.02 Weather Restrictions. Place HMA mixtures used as the final surface when the ambient air and surface temperatures are at least 40 F. Place mixtures used as intermediate and base layers when the ambient air and surface temperatures are at least 32 F, and place polymer-modified surface mixes when the ambient air and surface temperatures are at least 50 F. The pavement surfaces shall be clean, dry, and approved by the Engineer before HMA paving begins. When weather conditions differ from these limits, or when it begins raining while the work is underway, the Contractor is allowed to use material en route from the plant at the Contractor's risk. The Engineer reserves the right to perform any testing necessary to ensure the quality of the pavement. All testing and associated cost, including maintenance of traffic, will be at the Contractor's expense.

If the Engineer stops placement of the material, all material en route shall be wasted at no additional cost to the Administration.

Do not place HMA on a frozen graded aggregate base.

504.03.03 Foundation Preparation. Prior to placement of paving material, the foundation shall be constructed as specified. When paving over existing pavement, remove all excess crack filling and patch material. All spalls and potholes shall be cleaned, tack coated, filled with HMA, and tamped before placement of paving material. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as directed.

504.03.04 Tack Coat. Prior to applying the tack coat, remove all loose and foreign materials from the surface. Apply using full circulation spray bars that are laterally and vertically adjustable and that provide triple fanning and overlapping action. The resulting coating shall be residual asphalt uniformly applied at a rate of 0.01 to 0.05 gal/yd², as directed.

504.03.05 Hot Mix Asphalt Placement. Delivery of the mixture by the hauling units and placement should be continuous. At the time of placement, the temperature of the mixture shall be at least 225 F, or as identified in the approved Quality Control Plan for Field Operations. HMA shall be placed by the paver. Do not broadcast loose mixture over the new surface.

504.03.06 Compaction. Immediately following placement of the HMA, roll the mixture to compact to the proper in-place density and ride smoothness requirement. Incentive or disincentive price adjustment for density will be as specified in 504.04.02. Incentive or disincentive price adjustment for ride smoothness will be as specified in the Contract Documents. Use steel wheel rollers for the first rolling of all joints and edges, the initial breakdown rolling, and the finish rolling.

When base widening is too narrow to permit the use of conventional rollers, use a power driven trench roller. When the trench must be excavated wider than the proposed width of the widening, form an earth berm or shoulder against the loose HMA as soon as it is placed. Roll and compact the two materials simultaneously. Roller marks shall not be visible after rolling operations.

After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to less than 140 F.

504.03.07 Joints. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Stagger transverse joints by the length of the paver. Stagger longitudinal joints at least 6 in., and arrange so that the longitudinal joint in the top course is within 6 in. of the line dividing the traffic lanes. Construct joints in a manner to provide a continuous bond between the old and new surfaces. When constructing longitudinal joints adjacent to existing HMA pavements overlap the existing pavement 1-inch to 1.5-inches. The initial longitudinal roller pass shall be on the un-compacted hot mat and 6-inches to 1-foot from the joint. The successive roller pass shall compact the overlapped material and the 6-inch to 1-foot material simultaneously.

Apply tack coat to joints as directed. When placing a surface course, cut back the edge of the existing pavement for its full depth at transverse joints to expose a fresh surface, and apply tack coat material as directed. Before placing the mixture against curbs, gutters, headers, manholes, etc., apply tack coat to all contact surfaces.

504.03.08 Edge Drop-off. Where HMA paving is being applied to highways carrying traffic, all compacted pavement courses exceeding 2-1/2 in. in depth shall be matched with the abutting lane or shoulder on the same working day. Where compacted pavement courses of 2-1/2 in. or less are placed, the Contractor shall have the option of paving the abutting lane or shoulder on alternate days. Pave the abutting lane or shoulder prior to weekends and temporary shutdowns, regardless of the depth of the compacted pavement course. When uneven pavement joints exist, place advance warning traffic control devices in conformance with the Contract Documents.

504.03.09 Tie-In. When HMA paving is being applied to the traveled way carrying traffic with a posted speed ≤ 40 mph, construct a temporary tie-in at least 4 ft in length for each 1 in. of pavement depth. When HMA paving is being applied to the traveled way carrying traffic with a posted speed >40 mph, construct a temporary tie-in at least 10 ft in length for each 1 in. of pavement depth. Construct temporary tie-ins before traffic is allowed to cross the transverse joint. Construct temporary tie-ins 10ft or greater using a paver meeting the requirements of section 504.03.01.

At the final tie-in point, remove a transverse portion of the existing pavement to a depth so the design thickness of the final surface course is maintained. Construct the final tie-in to a length equal to the posted speed per 1 in. depth of the design thickness of the final course, with a length of at least 25 ft per 1 in. depth and a maximum length of 50 ft per 1 in. depth.

504.03.10 Sampling & Testing for Mixture. Quality Control (QC) sampling and testing shall be the responsibility of the Producer or Contractor. The Field QC Plan shall identify the QC sampling location (plant site or project site). Quality Assurance (QA) sampling shall be performed by the Contractor as directed and witnessed by the Administration. QA samples shall be obtained behind the paver prior to compaction. QA testing shall be the responsibility of the Administration.

- (a) **QC Sampling for Mixture at the Plant Site.** Plant site mixture sampling shall be completed in conformance with MSMT 451, Method A. The samples shall be obtained randomly. At least one mixture sample per day's shipment per mix or one per 1000 tons of shipment per mix, whichever yields a higher frequency, shall be obtained. The producer shall sample the mixture at the plant site. The sample shall be obtained or witnessed by the Certified Technician. QC plant site mixture sample results shall not be used in the pay factor calculation.

- (b) **QC Sampling for Mixture at the Project Site.** Project site mixture sampling shall be completed in conformance with MSMT 457. The samples shall be obtained randomly and independent of QA mixture samples. QC and QA samples shall not be split samples. At least one mixture sample per paving day per mix or one per 1000 tons of paving per mix, whichever yields a higher frequency, shall be obtained. The Contractor's Certified Technician shall sample the mixture at the project site. A mixture subplot size should not exceed 1000 tons. A subplot size up to 200 tons can be combined with the previous 1000 ton subplot placed on the same day. A mix lot constitutes all sublots of a mix created during the production of required tonnage for a lot as defined herein. A new lot number for a mix will be given when there is a change in the approved job mix formula. QC project site mixture sample results may be used in the pay factor calculation.
- (c) **QA Sampling for Mixture at the Project Site.** Project site mixture sampling shall be completed in conformance with MSMT 457. The samples shall be obtained randomly. At least one mixture sample per paving day per mix or one per 1000 tons of paving per mix, whichever yields a higher frequency, shall be obtained from behind the paver prior to compaction. The Contractor's Certified Technician shall sample the mixture at the project site as witnessed by the Administration. The Administration will immediately take possession of the QA mixture sample and deliver the sample to the Laboratory for testing. A mixture subplot size should not exceed 1000 tons. A subplot size up to 200 tons can be combined with the previous 1000 ton subplot placed on the same day. A mix lot constitutes all sublots of a mix created during the production of required tonnage for a lot as defined herein. A new lot number for a mix will be given when there is a change in the approved job mix formula.

Mixture Acceptance Determination. An HMA mixture acceptance lot size is approximately equal to 6000 tons of a mix per project. A mix acceptance lot ends on the day when 6000 tons is reached. A mixture subplot size should not exceed 1000 tons. A subplot size up to 200 tons can be combined with the previous 1000 ton subplot placed on the same day. A mix lot constitutes all sublots of a mix created during the production of required tonnage for a lot as defined herein. A new lot number for a mix will be given when there is a change in the approved job mix formula. The Administration will test at least three behind the paver mixture

samples per acceptance lot in conformance with MSMT 735 for asphalt content and gradation. When QC samples are taken randomly from behind the paver, the QC results and QA results from behind the paver will be compared based on the analysis in conformance with MSMT 733 (F test and t test method) for each pay factor property in MSMT 735. When F test and t test method results indicate a QC and QA pay factor property is not from different populations, QC and QA results will be combined to calculate the mix pay factor property in accordance with MSMT 735 and 504.04.02. When F test and t test method indicate a QC and QA pay factor property is from different populations, the pay factor property will be determined using QA results only. The Administration will determine the acceptance evaluation procedure when less than three QA behind the paver samples are obtained for an acceptance lot. The Administration's Laboratory will make the results of the individual days paving available to the Engineer and the HMA Producer within five working days.

504.03.11 Sampling & Testing for Density Determination. Quality Control (QC) sampling and testing shall be the responsibility of the Producer or Contractor. Quality Assurance (QA) sampling shall be performed by the Contractor as directed and witnessed by the Administration. QA testing shall be the responsibility of the Administration. The Engineer will select at random the core sampling locations for each subplot in conformance with MSMT 459. The Contractor shall sample the QC and QA cores in conformance with MSMT 458 as witnessed by the Engineer. A minimum of 10 cores per day's paving per mix or two per 500 tons of paving per mix, whichever yields the higher frequency of cores, shall be taken. A density lot is defined as a day's paving per mix. A subplot shall not exceed 500 tons. The Engineer will designate one core sample for QC and one for QA for each subplot. A paving day shall begin with a new lot and sublots. Control strips shall be divided into five equal sublots. The diameter of the cores shall be 6 in., except that a 4 in. core may be used for mixes smaller than 25 mm. The Engineer will note any density waivers on the daily field density forms with remarks for the waivers.

- (a) **Quality Control (QC) for Density.** The Contractor shall obtain and test one core per subplot for Quality Control. The QC Laboratory will test core samples in conformance with MSMT 452. The density of the core samples will be expressed as a percentage of the maximum specific gravity of the mixture for each lot's placement. The maximum specific gravity will be determined in accordance with T 209 and the core's percent density will be expressed to the nearest 0.1%. When more than one mixture sample is obtained per day's placement, an average of all maximum

specific gravity tests for the day will be used for the determination of percent density of each core sample. The QC Laboratory will make results of individual days paving available to the Engineer and the Contractor no later than the next working day. The Contractor shall retain core samples until notified of the results of the F& t test.

- (b) **Quality Assurance (QA) for Density.** The Administration shall obtain and test one core per subplot for Quality Assurance. The Engineer will take immediate possession of the core samples and deliver the cores to the Administration's Laboratory for testing. The Laboratory will test core samples in conformance with MSMT 452. The density of the core samples will be expressed as a percentage of the maximum specific gravity of the mixture for each lot's placement. The maximum specific gravity will be determined in accordance with T 209 and the core's percent density will be expressed to the nearest 0.1 percent. When more than one mixture sample is obtained per day's placement, an average of all maximum specific gravity tests for the day will be used for the determination of percent density of each core sample. The Laboratory will make results of individual days paving available to the Engineer and the HMA Producer within five working days.
- (c) **Acceptance.** Each HMA density lot will be evaluated for compliance using the Engineer's quality assurance test data and the Contractor's QC data. The QC and QA core specific gravity data will be analyzed in conformance with MSMT 733 (F test and t test method). When test results are determined to be from the same population, QC and QA subplot results will be averaged to calculate the density pay factor in accordance with and 504.04.02. When results are determined not from the same population, the pay factor will be calculated using QA subplot results only. The average QC maximum specific gravity test results and the average project site behind the paver QA maximum specific gravity test results shall be compared. When QC results and QA results compare within 0.026, the average of the combined QC and QA results shall be used to calculate each core density. When they do not compare within 0.026, QA maximum specific gravity results shall be used to determine each core density. Sublot density and lot density shall be between 92.0 and 97.0 percent. Pay reduction or incentive for the pavement compaction lot will be calculated in conformance with 504.04.02. The process for determining statistical outliers will be in conformance with MSMT 734. An HMA density lot size shall equal one paving day's production per mix. A lot shall be divided into a minimum of five equal sublots. A subplot shall not be greater than 500 tons. When a

paving day's production per mix is greater than 2500 tons, then each subplot size shall be 500 tons or fraction thereof. On Contracts requiring less than 500 tons of HMA or when HMA is used in nontraffic areas or on bridge decks, acceptance will be determined by the use of a thin layer density gauge tested in conformance with the manufacturer's recommendations.

504.03.12 Thin Lifts and Wedge/Level Courses. Pavement density shall be determined by using density gauge readings. When the HMA course is determined by the Engineer to be a thin lift in accordance with the "Thin Lift Mix Design Identification Table" in Section 904.04.03, construct a 400 to 500 ft control strip on the first day of paving. Readings shall be taken in five (5) random locations with a thin layer density gauge in accordance with the manufacturer's recommendations to determine roller patterns and the number of coverages to obtain optimum density. Optimum density is defined as when the average density does not change by more than 1.0 percent between successive coverages and the percent density is between 90.0 and 97.0. This optimum density shall be used to determine HMA acceptance after approval by the Engineer. Any lot average 2.0 percent or more below optimum density shall require a new control strip to be constructed, tested, and approved before paving continues. Readings shall be taken in a minimum of 10 random locations per day's paving per mix or two per 500 tons of paving per mix, whichever yields the higher frequency of locations. A density lot is defined as a day's paving per mix. A subplot shall not exceed 500 tons. A paving day shall begin with a new lot and sublots.

Wedge/Level courses placed at variable thicknesses shall be tested and accepted in accordance with this Thin Lift specification.

504.03.13 Control Strip. When mixes are not determined to be Thin Lifts, the Contractor may opt to construct a control strip for guidance in determining roller patterns to achieve optimum density. When a control strip is constructed, it shall be placed on the first workday in which HMA is placed and shall be between 400 and 500 ft in length. Based on the Contractor's evaluation of the initial control strip, paving may continue at the Contractor's risk.

The Contractor will not be assessed a density pay adjustment for the amount of material required for construction of the control strips. Should the removal of any control strip be necessary, the Contractor shall remove it at no additional cost to the Administration.

The Engineer may require the Contractor to construct a control strip any time during placement of HMA based on the evaluation of compaction results.

504.03.14 Pavement Surface Checks. Have an approved 10 ft straightedge available at all times. After final compaction of each course, the surface of each pavement course shall be true to the established line and grade and shall be sufficiently smooth so that when tested with the straightedge placed upon the surface parallel with the center line, the surface does not deviate more than 1/8 in. The transverse slope of the finished surface of each course when tested with the straightedge placed perpendicular to the center line, shall not deviate more than 3/16 in.

Check transverse joints using the straightedge immediately after the initial rolling. When the surface of each course varies more than 1/8 in. from true, make immediate corrections so that the finished joint surface is within tolerance.

Areas that are tested and reported in accordance with the Pavement Surface Profile Specification are not applicable to 504.03.14.

504.03.15 Curbs, Gutters, Etc. Where permanent curbs, gutters, edges, and other supports are planned, they shall be constructed and backfilled prior to placing the HMA.

504.03.16 Shoulders. Shoulders abutting the HMA surface course of any two-lane pavement that is being used by traffic shall be completed as soon as possible after completion of the surface course on that lane. Construct shoulders as specified.

504.03.17 Pavement Profile. Refer to the Pavement Surface Profile requirements specified in the Contract Documents.

504.04 MEASUREMENT AND PAYMENT. Hot Mix Asphalt Pavement will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for furnishing, hauling, placing all materials including anti-stripping additive, tack coat, control strip, pot hole and spall repairs, setting of lines and grades where specified, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Temporary Tie-Ins. Placement and removal of the temporary tie-in where hot mix asphalt is being applied to the traveled way carrying traffic will not be measured but the cost will be incidental to the pertinent Hot Mix Asphalt item.

Removal of the existing pavement or structure for the final tie-in will be measured and paid for at the Contract unit price for the pertinent items used. The hot mix asphalt for the final tie-in will be measured and paid for at the Contract unit price for the pertinent Hot Mix Asphalt item.

Adjustments. Adjustment of existing visible manholes, valve boxes, inlets, or other structures will not be measured but the cost will be incidental to the Hot Mix Asphalt item.

Adjustment of existing manholes, valve boxes, inlets, or other structures that are encountered below the existing grade will be considered for payment in conformance with GP-4.07.

Removal of Existing Raised/Recessed Pavement Markers. Removal of existing raised/recessed pavement markers will not be measured but the cost will be incidental to the Hot Mix Asphalt item.

Removal of existing raised/recessed pavement markers that are encountered below the existing pavement will be considered for payment in conformance with GP-4.07.

504.04.01 Price Adjustment for Asphalt Binder. An adjustment will be made to the final Contract unit price for Hot Mix Asphalt if the price of asphalt binder fluctuates significantly from the prevailing price as quoted in the Contract Documents to the date of placement. This includes HMA patching material converted to tons. The Contract unit price will be adjusted by the amount of fluctuation above 5 percent for Contracts scheduled to be paved during more than one construction season or having an estimated mix quantity of 10 000 tons or more. For Contracts completed within one construction season and having an estimated mix quantity of less than 10 000 tons, the adjustment will be based upon the amount of fluctuation above 15 percent. Only the differential percent change beyond the above noted 5 and 15 percent will be used.

For the purpose of making these calculations, a monthly price index will be maintained by the Administration.

The adjusted Contract unit price for Hot Mix Asphalt will be computed monthly by using the following formula:

$$F = ((PP - P_b) / P_b) \times 100$$

where:

F = Percent price increase/decrease of asphalt binder.

PP = Index price of asphalt binder per ton at placement date.

Pb = Prevailing index price of asphalt binder per ton as specified in the Invitation for Bids.

Adjusted Contract unit price due Contractor when price of asphalt binder increases:

$$A = B + (D \times T \times Pb)$$

Adjusted Contract unit price due Administration when price of asphalt binder decreases:

$$A = B - (D \times T \times Pb)$$

where:

A = Adjusted Contract unit price per ton of Hot Mix Asphalt.

B = Contract unit price per ton of Hot Mix Asphalt.

D = Differential percentage expressed as a decimal (F – 5 percent or F – 15 percent as defined above).

T = Design target asphalt content expressed as a decimal.

Pb = Prevailing index price of asphalt binder per ton as specified in the Invitation for Bids.

504.04.02 Price Adjustment for Hot Mix Asphalt Mixture and Pavement Density. A price adjustment will be made as specified in GP-5.02 when the hot mix asphalt properties or pavement density does not conform to Specifications. The Contract unit price will be adjusted for noncompliance with HMA properties and pavement density in conformance with these procedures. A pay reduction or incentive payment adjustment for pavement density will be based on individual subplot core test data for a given lot and the lot average density as specified in this section. Pay adjustment due to noncompliance with the density requirements or incentive pay adjustment will be made against the adjusted Contract unit price for Hot Mix Asphalt in conformance with Table 504A. Price adjustment will be waived for that portion of the pavement where the Engineer determines that inadequate density is due to a poor foundation.

TABLE 504A		
Dense Graded HMA Mixes – Percent of Maximum Density		
Lot Average % Minimum	No Individual Sublot Below %*	Pay Factor %
94.0	94.0	105.0
93.8	93.7	104.5
93.6	93.4	104.0
93.4	93.1	103.5
93.2	92.8	103.0
93.0	92.5	102.5
92.8	92.2	102.0
92.6	91.9	101.5
92.4	91.6	101.0
92.2	91.3	100.5
92.0	91.0	100.0
91.8	90.8	99.0
91.6	90.6	98.0
91.4	90.4	97.0
91.2	90.2	96.0
91.0	90.0	95.0
90.8	89.8	94.0
90.6	89.6	93.0
90.4	89.4	92.0
90.2	89.2	91.0
90.0	89.0	90.0
89.8	88.8	89.0
89.6	88.6	88.0
89.4	88.4	87.0
89.2	88.2	86.0
89.0	88.0	85.0
88.8	87.8	84.0
88.6	87.6	83.0
88.4	87.4	82.0
88.2	87.2	81.0
88.0	87.0	80.0
Less than 88.0	87.0	75.0 or rejected by Engineer

Note 1: When any test data is above 97.0, the lot may be rejected per the Engineer. When not rejected, the lot will receive a pay adjustment in accordance with the following:

- (a) When the density lot average is above 97.5, the pay factor = 75%
- (b) When 3 subplot densities are above 97.0, the pay factor = 95%
- (c) When 4 or more subplot densities are above 97.5, the pay factor = 75%

Note 2: Pay incentive or pay disincentive will not be paid for placements identified as wedge/level courses or thin lift courses.

*Note 3: When the Contractor's core specific gravity data does not compare with the Administration's core specific gravity data, only the Administration's single subplot values and lot average value will be used in acceptance decision.

*Note 4: The average subplot values and the lot average will be used in acceptance decision.

Acceptance of a mixture lot will be in conformance with Sections 904, 915, and MSMT 735. A composite pay factor (CPF) for asphalt content and gradation, will be based on the total estimated percent of the lot that is within Specification limits as computed using the quality level analysis in conformance with MSMT 735.

The Lot payment for in-place density will be computed using the following formula:

$$\text{LPipd} = (\text{CP}) \times (\text{DF}) \times (\text{TL})$$

where:

LPipd	=	Lot payment in-place density
CP	=	Contract unit price
DF	=	Density pay factor from Table 504A
TL	=	Tonnage per lot.

The Lot payment for asphalt content and gradation will be computed using the following formula:

$$\text{LPmd} = (\text{CP}) \times (\text{MF}) \times (\text{TL})$$

where:

LPmd	=	Lot payment for mix design
CP	=	Contract unit price
TL	=	Tonnage per lot
MF	=	Mixture pay factor (refer to MSMT 735 for CMPWSL):
MF = 55 + 0.5 CMPWSL		

An in-place density lot containing material with a pay factor of less than 1.0 may be accepted at the reduced pay factor, provided the pay

factor for density is at least 0.80 and there are no isolated defects identified by the Engineer.

A mixture lot containing material with a pay factor of less than 1.0 may be accepted at the reduced pay factor, provided the composite pay factor for asphalt content and grading is at least 0.75 and there are no isolated defects identified by the Engineer.

An in-place density lot containing nonconforming material that fails to obtain at least a 0.80 pay factor and a mixture lot containing nonconforming material that fails to obtain at least 0.75 pay factor for asphalt content and gradation, will be evaluated by the Engineer to determine its acceptance. When the Engineer determines to reject a lot, the lot shall be replaced at no additional cost to the Administration.

When less than five Quality Control or Quality Assurance samples per in-place density lot have been obtained, the lot will not be evaluated for incentive payment.

When less than three mix samples have been obtained at the time of the acceptance sampling or at the time a lot is terminated, the Engineer will determine if the material in a shortened lot will be considered a part of the previous lot, or will be accepted based on the individual test data.

504.04.03 Control Strip Price Adjustment. The cost of the control strip, if constructed, will not be measured but the cost will be incidental to the pertinent Hot Mix Asphalt item.

504.04.04 Dispute Resolution. This is a general procedure to resolve conflicts resulting from discrepancies between test results from the Engineer and Contractor, and non-test related disputes of sufficient magnitude to impact payment. When a dispute arises, the producer or Engineer will file a written complaint to the Chief Engineer describing the nature of the dispute along with the pertinent information. The Chief Engineer will appoint a panel of three members to resolve the conflict. The panel will include a member selected by the asphalt industry. The panel will make recommendations to the Chief Engineer. The Chief Engineer will decide the disposition of the dispute based on the panel's recommendations. A written report from the panel describing all subsequent actions and final disposition of the dispute shall be included in the project records.

If subsequent disputes arise on the same issue, the written report will be included as a resource during the resolution process.

SECTION 505 — HOT MIX ASPHALT PATCHES

505.01 DESCRIPTION. Repair rigid, flexible, or composite pavements by removing part or all of the section of the existing pavement and replacing the removed materials using hot mix asphalt (HMA) paving material. The locations and extent of the repairs will be as specified or as directed.

Partial Depth Patching (PDP). PDP consists of the removal of areas of unsound pavement material up to a 50 percent of the pavement thickness, and replacement with HMA. The pavement thickness is defined as the thickness of all bound materials in the pavement structure including HMA, portland cement concrete (PCC), and any other asphalt or cement modified materials.

Full Depth Patching (FDP). FDP consists of the removal of the full thickness of the pavement sections to the top of the aggregate base material and replacement with HMA. Construct FDP whenever more than 50 percent of the pavement thickness requires repair.

505.02 MATERIALS.

Graded Aggregate Base	901.01
Aggregates for HMA	901.01
Aggregates for Superpave Mixes	901.01 and MP2
Performance Graded Asphalt Binders and Hot Mix Asphalt	904
Crack Filler	911.01
Production Plant	915

505.03 CONSTRUCTION. Keep disturbance to the base material to a minimum. The faces of the remaining pavement shall be square and vertical without ragged edges. Do not use equipment that could damage the existing pavement.

505.03.01 Weather Restrictions. Section 504.

505.03.02 Existing Pavement. Each day complete all repairs for which excavation has been completed. Do not leave open excavated areas at the end of the work day.

Removal of Pavement for PDP. Remove existing pavement by milling, grinding, or saw cutting and removal to the specified depth. Maintain square vertical faces after removal. Where concrete is encountered, limit

the depth of the patch to the top elevation of the PCC. Prior to application of the patch, remove all loose and foreign materials. For PDP of composite pavements, protect the PCC from damage during removal of the HMA. Before placing the patch, treat all spalled cracks and joints by tack coating and filling and tamping with HMA. When the material at the bottom of the PDP is determined to be unsuitable, remove additional material until sound material is encountered. When PCC is encountered in a composite pavement and is determined to be unsuitable, follow the removal and replacement procedures for a FDP.

Removal of Pavement for FDP. Make a perpendicular saw cut full depth around the perimeter and remove the existing pavement to the top of the aggregate base. Refer to the applicable portions of 522.03.03 for the concrete portion of a composite pavement. Maintain square vertical faces after saw cutting.

505.03.03 Base and Subgrade Preparation. The Engineer will evaluate the aggregate base of the FDP area to determine if it is suitable. When it is determined to be unstable, compact it as specified in 501.03.10. When no aggregate base is present, construct the subgrade foundation as specified in Section 208 or as directed. When the aggregate base or subgrade material is unsuitable, replace the material with graded aggregate base conforming to Section 501. This operation is defined as the removal of unsuitable material and refill. Compact the replacement aggregate material in layers no greater than 4 in. depth. Immediately remove and dispose of the existing pavement materials.

Protect the aggregate base or subgrade after preparation. No payment will be made for removal and replacement of subgrade that was not protected.

505.03.04 Subgrade Drains. The Engineer may direct that subgrade drains be constructed in areas of wet underlying subgrade or areas where there may be a future drainage problem. For construction, refer to Section 306.

505.03.05 Emergency Filler. Have sufficient approved cold patch material readily available to fill the void of the repair area. Place and compact the material when directed. At the beginning of the next day's work, completely remove the material.

505.03.06 Steel Plates. Have readily available on site an ample supply of 12 x 14 ft by 1 in. thick steel plates to cover the emergency filler.

505.03.07 Patch Construction. Complete patch construction as specified in the applicable portions of Section 504. Manual operation will be permitted for placement of the HMA. Cores, control strip, and

pavement profile measurements are waived. Furnish equipment and perform placement, compaction, and quality control procedures as approved.

505.03.08 Patch Placement. Prior to placing the HMA, thoroughly clean and tack coat the exposed vertical surface of adjacent pavement as specified in 504.03.04. Spread the HMA mixture by shovel, rake, or other approved method approved. Do not place HMA on a frozen base.

Maintain lift thickness in conformance with the following:

HMA SUPERPAVE LIFT THICKNESS		
MIX DESIGNATION (mm)	MINIMUM (in.)	MAXIMUM (in.)
9.5	1.0	2.0
12.5	1.5	2.5
19.0	2.0	3.0
25.0	3.0	4.0
37.5	4.0	5.0

505.03.09 Testing and Acceptance. Acceptance will be determined by in place density gauge test data witnessed by the Engineer. Calibrate the density gauge per the manufacturer's recommendation. Take one test from each lift of each patch. Randomly select test locations within the patch.

In place density gauge test data shall be expressed as a percentage of the maximum specific gravity determined for each day's production. An in place density of 92.0 to 97.0 percent is required for each patch.

Compliance will be determined for each patch separately by averaging all density tests performed within each specific patch.

505.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for saw cutting, milling, grinding, removal, disposal, trimming of the existing pavement, subgrade preparation, placing all materials including tack coat, steel plates, emergency filler, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

After removal, steel plates and emergency filler will remain the property of the Contractor.

505.04.01 Partial Depth Patching and Full Depth Patching will be measured and paid for at the Contract unit price per square yard or per ton as specified. The payment will be full compensation for furnishing, hauling, placing all material, additional removal of pavement above the aggregate base, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

505.04.02 Removal of Unsuitable Material and Refill will be measured and paid for at the Contract unit price per cubic yard. The payment will also include excavation and disposal of unsuitable material, backfilling with aggregate, and compaction.

SECTION 506 — HOT MIX ASPHALT GAP-GRADED

506.01 DESCRIPTION. Place hot mix asphalt gap-graded surface (HMAGG). HMAGG shall conform to Section 504, except as specified herein.

506.02 MATERIALS.

Hot Mix Asphalt Gap-Graded	904.05
Production Plant	915

506.03 CONSTRUCTION.

506.03.01 Demonstration. Before proceeding with the actual work, demonstrate to the Engineer that a satisfactory mix can be produced, placed, and the compactive effort determined. Place at least 100 tons of HMAGG outside the project limits for the demonstration. A new strip will be required if a project carries over to a new season. For paver and rollers requirements, refer to 504.03.01. A material transfer vehicle may be used in placing the demonstration strip.

506.03.02 Hauling Units. Dry soap powder, as approved, may be used with the release agent specified in 915.02(f). Raise truck beds to drain excess water before loading.

A light dusting of No. 10 aggregate coated with 1 percent asphalt may be used in lieu of the liquid release agent.

Limit the time between plant mixing and shipment to one hour. Storage time may vary depending upon gradation, type of binder, and stabilizer. Storage material shall consistently have results of no less quality than mixtures discharged directly into hauling vehicles.

Completely cover each load with a full tarp extending at least 6 in. over each side of the truck body and fasten securely.

506.03.03 Weather Restrictions. Place HMAGG when the ambient and surface temperatures are at least 50 F and rising.

506.03.04 Material Transfer Vehicle (MTV). Place the final surface course using a material transfer vehicle. Use an MTV that performs additional mixing of the gap-graded material and then deposits the mixture into the paver at a uniform temperature and consistency.

506.03.05 Mix Temperature. The minimum temperature of the mixture required at the time of placement shall be established as part of the mix design procedure.

506.03.06 Pavement Thickness. Place the pavement to the specified thickness.

506.03.07 Tack Coat. Refer to 504.03.04, except apply tack coat so that the resulting residual asphalt coating is applied at a rate of 0.03 to 0.05 gal/yd².

506.03.08 Compaction. Start rolling immediately after placement using at least three static steel-wheeled rollers, each weighing 10 to 12 tons, following within 500 ft of the paver. For in place density refer to 504.03.11(c), except that the density requirement is 94 to 97 percent of maximum density. Perform sampling and testing as specified in 504.03.10, .11, and .12.

Use rollers equipped with a watering or soapy watering system that prevents material from sticking to the rollers.

Do not use the vibratory mode without written approval. Maintain a roller speed of between 1.0 and 3.0 mph. Complete compaction before the mix cools below 240 F. Do not use pneumatic wheeled rollers on HMAGG.

506.03.09 Control Strip. Prior to starting paving, construct a full lane width control strip on the finished grade at least 500 ft in length. The control strip will be used by to evaluate the application of the tack coat and to determine the compactive effort. If compaction is not obtainable using rollers in static mode, high frequency vibratory rollers may be used for breakdown rolling with the approval of the Engineer. After the control strip is complete, do not deviate from the approved rolling pattern without constructing a new control strip. Density requirements will not be waived. As determined by the Engineer, remove and dispose of any unacceptable control strip at no additional cost to the Administration.

506.03.10 Pavement Profile. Refer to the Pavement Surface Profile requirements specified in the Contract Documents.

506.03.11 Sampling and Testing for Density and Mixture. Refer to 504.03.10, .11, and .12.

506.04 MEASUREMENT AND PAYMENT. Hot Mix Asphalt Gap-Graded will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for furnishing, hauling, placing all materials, material transfer vehicle, antistripping additive, tack coat, control strips, setting of lines and guides where specified, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Material produced for the demonstration will not be measured but the cost will be incidental to the item Hot Mix Asphalt Gap-Graded.

506.04.01 Price Adjustment for Hot Mix Asphalt Mixture and Pavement Density. Refer to 504.04 except as follows:

HOT MIX ASPHALT GAP GRADED MIXES		
PERCENT OF MAXIMUM DENSITY		
LOT AVERAGE	NO INDIVIDUAL SUBLOT BELOW	PAY FACTOR %
95.0 – 97.0	95.0	105
95.0 – 97.0	94.0	104
94.0 – 97.0	94.0	103
94.0 – 97.0	93.0	100
93.0 – 97.0	92.0	95
92.0 – 97.0	91.0	90
91.0 – 97.0	90.0	85
Less than 91.0	—	75.0 or rejected per Engineer

Note 1: When any test data is above 97.0, additional pay reduction or reject per the Engineer.

Note 2: For Option A (Section 504), when the Contractor's core density data does not compare with the Administration's density data, only the Administration's single subplot values and lot average value will be used in the acceptance decision.

Note 3: For Option B (Section 504), the average subplot values and the lot average will be used in the acceptance decision.

506.04.02 Dispute Resolution. Refer to 915.02.01(e).

SECTION 507 — SLURRY SEAL

507.01 DESCRIPTION. Construct a slurry seal course using a slurry seal (SS), or a latex modified slurry seal (LMSS).

507.02 MATERIALS.

Mineral Filler	901.01
Water	921.01
Aggregate	923.01
Emulsified Asphalt	923.03
Latex Modified Emulsion	923.04

507.03 CONSTRUCTION.

507.03.01 Weather Restrictions. Place slurry seal when the air and surface temperatures are at least 50 F, when it is not raining, and when the local weather forecast does not predict precipitation or the temperature to fall below 40 F within 24 hours from the time the mixture is placed.

Cease placement when the surface or air temperature falls below the specified limits. Any further placement is at the Contractor's risk.

507.03.02 Mixing Equipment. Use a self-propelled, front feed, continuous loading mixing machine. The unit shall proportion and deliver the materials to a revolving, multi-blade, shafted mixer; and discharge it continuously and uniformly.

The mixer shall have devices that control the proportioning of each material at all times. Either calibrate the mixer for the mix design in the presence of a representative of the Administration, or submit certified calibration documents for approval of the Engineer. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, additives, and water to maintain an adequate supply of the materials for the proportioning controls. The proper amount of mineral filler shall be added to the aggregate before introduction into the mixer.

Use mixing machines equipped with water pressure systems and nozzle spray bars to provide a water spray ahead of and outside the spreader box when required.

Truck mounted machines with positive, nonslipping aggregate delivery systems, but without a front feed continuous loading feature, may be used on project segments of less than 15 000 yd² or for spot repairs.

When truck mounted machines are used, have at least two units on the project prior to construction.

507.03.03 Spreading Equipment. Spread the slurry seal uniformly by means of a mechanical squeegee box attached to the mixer and equipped with paddles mounted on an adjustable shaft to continuously agitate and distribute the materials. Use equipment that provides sufficient turbulence to prevent the mix from setting in the box or causing excessive side buildup or lumps. Attach flexible seals where the box contacts the road, front and rear, to prevent loss of the mixture. Do not spray additional water into the spreader box.

507.03.04 Surface Preparation. Apply the tack coat and slurry seal to surfaces that are clean, dry, and free of all objectionable materials.

Apply tack coat consisting of one part asphalt emulsion to three parts water to all surfaces. Use the same emulsion type and grade as used in the slurry seal, applied at a rate of 0.05 to 0.10 gal/yd².

507.03.05 Application. Spread slurry seal to repair slight irregularities and to achieve a uniform, skid resistant surface without skips, lumps, or tears.

Use squeegees and lutes to spread the mixture in areas that are inaccessible to the spreader box and areas that require hand spreading.

When hand spreading is necessary, additives may be used to provide slower setting time. Pour the slurry seal in a small windrow along one edge of the surface to be covered, and then spread the material uniformly. Construct a smooth, neat seam where two passes meet. Remove excess material immediately from the ends of each run.

- (a) **Slurry Seal.** Apply SS at the rate of 16 ± 2 lb/yd² for Type II Mix and 20 ± 2 lb/yd² for Type III Mix, based on the dry aggregate weight, unless otherwise specified.
- (b) **Latex Modified Slurry Seal.** Apply LMSS in one or two coats as directed.

For roadways specified to receive one application, apply LMSS at the rate of 16 ± 2 lb/yd² for Type II Mix and 22 ± 2 lb/yd² for Type III Mix, based on the dry aggregate weight, unless otherwise specified. When two applications are specified, apply the material

at the combined rate of 28 ± 2 lb/yd² for Type II Mix and 32 ± 2 lb/yd² for Type III Mix.

507.03.06 Certification. Furnish certified weight tickets to the Engineer for the emulsion, latex emulsion, aggregate, and mineral filler. The weight tickets will be used to determine in place application rates.

507.03.07 Sampling and Testing. Sample the mixtures at least once daily during paving. Place each sample in a 1-gallon container. Submit the samples to the Regional Laboratory for testing. Residual asphalt content, gradation, stability, and flow will be determined per T 30, T 164 and T 245, Modified.

507.03.08 Tie-Ins for Entrances and Connecting Roads. Make tie-ins at entrances and connecting roads as directed.

507.03.09 Traffic. The cure rate for permitting traffic on the pavement without damaging the surface shall be within two hours for SS and one hour for LMSS. Repair traffic damaged slurry seal at no additional cost to the Administration.

507.04 MEASUREMENT AND PAYMENT. Slurry Seal and Latex Modified Slurry Seal will be measured and paid for at the Contract unit price per square yard for one or more of the pertinent items listed below. The payment will be full compensation for furnishing and placing the aggregate, tack coat, tie-ins to entrances and connecting roads, mineral filler, emulsion, latex emulsion, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

507.04.01 Slurry Seal Using Type II Mix (One Coat).

507.04.02 Slurry Seal Using Type III Mix (One Coat).

507.04.03 Latex Modified Slurry Seal Using Type II Mix (One Coat).

507.04.04 Latex Modified Slurry Seal Using Type III Mix (One Coat).

507.04.05 Latex Modified Slurry Seal Using Type II Mix (First Coat).

507.04.06 Latex Modified Slurry Seal Using Type III Mix (Second Coat).

507.04.07 Price Adjustment. Material not conforming to these Specifications may be accepted at a reduced price if the Engineer determines that it is not detrimental to the work. The following price adjustment will apply:

- (a) The residual asphalt content of samples will be averaged for each day's production per lift and will be compared to the submitted mix design. The Contract unit price per square yard will be reduced 1 percent for each 0.10 percent the asphalt content is out of tolerance.
- (b) The Contract unit price per square yard will be reduced 0.5 percent for each gram per square foot of Wet Track Abrasion Test loss between 75 and 100 grams per MSMT 403. Material having a loss greater than 100 grams will be rejected.
- (c) For applications less than the specified rate, the Contract unit price per square yard will be reduced 3 percent for each pound per square yard below the specified rate. This adjustment will be determined by comparing the certified delivery tickets with the project Specifications. For applications at more that the specified rate, no increase to the Contract Unit price will be considered.

SECTION 508 — MILLING HOT MIX ASPHALT PAVEMENT

508.01 DESCRIPTION. Mill hot mix asphalt (HMA) pavement.

508.02 MATERIALS.

Hot Mix Asphalt (HMA)

904

508.03 CONSTRUCTION. Perform roadway patching before the milling operation. Additional roadway patching may be required after the milling operation. Refer to Section 505.

508.03.01 Equipment. Use a power operated planing machine or grinder capable of removing, in one pass, a layer of asphalt pavement at the specified depth and at least half the lane width. The machine shall be capable of accurately establishing profile grade control and have a positive means for controlling slope elevation. The machine shall be capable of preventing dust from escaping into the atmosphere. The resultant surface shall be true to the established grade and be skid resistant. Furnish an approved 10 ft straightedge for testing the transverse and longitudinal surface after milling operations. Maintain a tolerance of $\pm 1/8$ in.

508.03.02 Pavement Milling. Mill one lane at a time. If the milling depth exceeds 2-1/2 in. on highways carrying traffic, mill the abutting lane or shoulder on the same day. Mill the abutting lane or shoulder,

regardless of depth, prior to weekends or temporary shutdowns. Otherwise, if the milling depth is 2-1/2 in. or less, the abutting lane or shoulder may be milled on alternate days. Where uneven pavement joints exist, provide adequate advance warning devices in conformance with the Contract Documents.

When HMA paving is being applied to the traveled way carrying traffic with a posted speed ≤ 40 mph, construct a temporary tie-in at least 4 ft in length for each 1 in. of pavement depth. When HMA paving is being applied to the traveled way carrying traffic with a posted speed >40 mph, construct a temporary tie-in at least 10 ft in length for each 1 in. of pavement depth. Construct temporary tie-ins before traffic is allowed to cross the transverse joint. Construct temporary tie-ins 10ft or greater using a paver meeting the requirements of section 504.03.01.

In addition to any other equipment required to remove debris from behind the milling operation, use a vacuum equipped street sweeper to remove the dust prior to returning the area to traffic.

After the milling operation is complete, fill all depressions, potholes, and other irregularities using HMA. Construct an HMA wedge at existing water valves, meters, manhole covers, etc.

508.04 MEASUREMENT AND PAYMENT.

508.04.01 Milling Hot Mix Asphalt Pavement will be measured and paid for at the Contract unit price per square yard. The square yard measurement will be computed from the actual width and length measurements of the milled area. The payment will be full compensation for milling, the disposal of milled material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

508.04.02 Hot mix asphalt for filling depressions and potholes, and for wedging manholes, valve boxes, inlets, or other structures, will be measured and paid for as specified in 106.04.

508.04.03 Hot mix asphalt patches will be measured and paid for as specified in 505.04.

SECTION 509 — GRINDING HOT MIX ASPHALT PAVEMENT

509.01 DESCRIPTION. Grind hot mix asphalt (HMA) pavement.

509.02 MATERIALS. Hot Mix Asphalt (HMA) 904

509.03 CONSTRUCTION. Perform roadway patching before the grinding operation. Additional roadway patching may be required after the grinding operation. Refer to Section 505.

509.03.01 Equipment. Use grinding equipment that has a cutting mandrel with carbide tipped cutting teeth and designed specifically for grinding asphalt surfaces to close tolerances. The equipment shall accurately establish slope elevations and profile grade controls.

Follow immediately behind the grinding machine with a vacuum equipped street sweeper, capable of removing all loose material from the roadway without causing dust to escape into the air.

509.03.02 Control Strip. Grind a control strip at least 500 ft in length with a uniformly textured surface and cross section as approved.

Provide a final pavement surface with a transverse pattern of 0.2 in. center to center of each strike area and with the difference between the high and low of the matted surface not exceeding 1/16 in.

509.03.03 Pavement Grinding. Use the same procedures, settings, speed, and requirements as those used in the control strip.

When necessary to maintain an adequate cross slope for drainage, grind the pavement adjacent to the ground pavement. Grinding will not be required on bridge decks.

Grind one lane at a time. If the grinding depth exceeds 2-1/2 in. on highways carrying traffic, grind the abutting lane or shoulder on the same day. Grind the abutting lane or shoulder, regardless of depth, prior to weekends or temporary shutdowns. Otherwise, if the grinding depth is 2-1/2 in. or less, the abutting lane or shoulder may be ground on alternate days. Where uneven pavement joints exist, provide adequate advance warning devices in conformance with the Contract Documents.

Furnish an approved 10 ft straightedge for testing the transverse and longitudinal surface after grinding operations. Correct all areas showing high spots greater than 1/8 in. within 10 ft by additional grinding at no additional cost to the Administration. Straightedge requirements apply to areas across joints and repaired cracks but are not applicable to areas outside the ground area.

After the grinding operation is complete, fill all depressions, potholes, and other irregularities using HMA. Construct an HMA wedge at existing water valves, meters, manhole covers, etc.

509.04 MEASUREMENT AND PAYMENT. Grinding Hot Mix Asphalt Pavement will be measured and paid for at the pertinent Contract unit price per square yard. The square yard measurement will be computed from the actual width and length measurements of the area that has been ground. The payment will be full compensation for grinding, removal and disposal of ground material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

509.04.01 Hot mix asphalt for filling depressions and potholes, and for wedging manholes, valve boxes, inlets, or other structures will be measured and paid for as specified in 106.04.

509.04.02 Hot mix asphalt patches will be measured and paid for as specified in 505.04.

SECTION 510 — FILLING CRACKS IN HOT MIX ASPHALT PAVEMENTS

510.01 DESCRIPTION. Clean and fill cracks 1/8 to 1-3/4 in. wide. Cracks less than 1/8 in. wide do not need to be filled. Repair distressed areas as specified herein. Cracks more than 1-3/4 in. wide and map, edge, or alligator cracks requiring major repairs are not included in this work (Section 505).

510.02 MATERIALS.

Performance Graded Asphalt Binders and	
Hot Mix Asphalt (HMA)	904.04
Crack Filler	911.01
Aggregate	M 43, No. 10
Tack Coat	M 140

Ensure that all materials for crack filling are inspected, tested, and approved before incorporating them into the work.

510.03 CONSTRUCTION. All cracks to be filled will be designated by the Engineer.

Crack Cleaning and Preparation. Remove existing deteriorated filler using equipment capable of removing the material to the required depth without damaging the sides of the pavement within the crack. Do not use equipment that creates a “V” shaped groove. Repair damage done to sound pavement resulting from construction operations.

Clean cracks by using high pressure water blasting, abrasive blasting, oil free air blowing, a heat lance, or a combination thereof, as approved. The Engineer may suspend operations when weather conditions might create a hazard to the traveling public.

Before filling, completely dry the cracks using an approved method.

The Engineer will inspect the prepared cracks for debris, adherent dust, and dryness prior to filling. Reclean and dry cracks as directed.

Cracks varying in width up to 1-3/4 in. shall be divided into segments for repair. Portions of cracks having widths ranging from over 1 in. and up to 1-3/4 in. shall be sawn to the full depth of the crack and 1/8 in. wider than the maximum width of the crack. Clean the crack of all debris as specified above, and apply tack coat to the sides of the crack. Repair the crack as specified in Section 505 using an approved surface mix. Select an appropriate asphalt content and mixing temperature.

Crack Filling. Perform crack filling when the ambient and pavement surface temperatures are least 45 F and rising, unless otherwise recommended by the manufacturer and approved by the Engineer.

For cracks from 1/8 to 1 in. in width, heat the hot applied filler material as recommended by the manufacturer, in a double boiler, indirect heating kettle using oil as a heat transfer medium, or other approved equipment. The kettle shall have a mechanically operated agitator, recirculation pumps, and a positive thermostatic temperature control. Insulate the applicator wand and all connecting hoses. Do not overheat the filler or apply direct heating.

Withdraw and waste all filler that has been overheated, heated more than four hours, or that remains in the applicator at the end of the day's operation. Prior to the start of each day's operation, withdraw and waste at least 1 gallon of filler through the applicator wand.

Fill prepared and approved cracks until the material is 1/16 in. below or level with the pavement surface. If after two hours any filled crack is not in conformance with this requirement, refill the crack as directed.

If cracks can not be filled due to filler drainage into a large void, repair the crack by plugging the void with HMA Superpave 4.75 mm or other approved material. Complete filling the crack as specified above.

Remove excess filler from the surface of the pavement.

Submit field prepared flow panels of hot applied crack filler to the Office of Materials Technology for the flow test at least twice daily, or as directed.

Fill cracks the same day they are prepared. If cracks are not filled on the same day they are prepared, reclean and dry them prior to filling.

Do not allow traffic on the filled pavement until the crack filler has cured.

Filler that pulls loose within 96 hours after opening the pavement to traffic shall be repaired at no additional cost to the Administration.

510.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing, hauling, and placing of all materials, crack shaping, crack filling, the removal and disposal of old filler and debris, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment will not be made for wasted material.

510.04.01 Filler Removal, Saw Cutting, Crack Shaping, and Crack Filler will be measured and paid for at the Contract unit price per linear foot.

510.04.02 Patching Material for Cracks will be measured and paid for per linear foot regardless of the width or depth of the crack.

SECTION 511 THRU 519 — RESERVED

SECTION 520 — PLAIN AND REINFORCED PORTLAND CEMENT CONCRETE PAVEMENTS

520.01 DESCRIPTION. Construct plain and reinforced portland cement concrete pavements.

520.02 MATERIALS.

Portland Cement Concrete and Related Products	902
Reinforcement Steel	908
Joint Materials	911
Portland Cement Concrete Plant	915.03
Epoxy Coating for Reinforcement	917.02

Reinforcement, including load transfer assemblies, tie bars, deformed steel bars, and longitudinal tie devices shall meet Section 908 and be epoxy coated.

520.03 CONSTRUCTION. Within 30 days prior to the start of paving operations, submit a proposed paving plan for approval. Include the production plants, location of the plants with respect to project site, equipment, proposed material sources, and indicate whether the fixed form method or slip form method is proposed.

Protect the pavement against damage from all causes. Repair or replace damaged pavement.

Mix, place, and finish concrete when natural light is sufficient, or with an approved artificial lighting system.

520.03.01 Equipment. All equipment, including the production plant and paving equipment, is subject to approval. The plant, including central mixers, batching plant, truck mixers, and hauling equipment shall meet Section 915. Have the plant ready for inspection at least 48 hours prior to the start of construction operations. Have the paving equipment on the job site and ready for inspection at least 24 hours prior to the start of construction operations.

Slip form pavers shall be self-propelled on crawler tracks. No other tractive force shall be applied. The paver shall be capable of being automatically controlled for both alignment and grade.

The equipment and methods used shall provide a means to obtain the prescribed weights within the allowable tolerances, to obtain the consistency specified with a minimum amount of water, to achieve proper placement of the mixture in a condition of maximum density with no segregation, and to finish and cure the pavement as specified herein.

520.03.02 Weather Restrictions.

- (a) **Temperature and Surface Conditions.** Begin concrete placement when the ambient air and surface temperatures are at least 40 F and rising. Discontinue placement whenever the temperature falls below 40 F. These requirements may be waived for incidental concrete construction. Do not place concrete on a frozen base.
- (b) **Precipitation.** Have sufficient approved material on hand to cover freshly placed concrete as protection against precipitation.
- (c) **Wind.** Cease placement when the Engineer determines that wind conditions may have a detrimental effect on the work.

When weather conditions differ from these limits, placement of material en route is at the Contractor's risk.

If the Engineer for any other reason stops placement, dispose of enroute material at no additional cost to the Administration.

520.03.03 Foundation. Construct the foundation as specified. Construct the total width of the foundation to the width of the pavement plus at least 4 in. outside the base of the fixed form or the outermost edge of the slip form paver track or wheel. No additional payment will be made for the extended width. Ensure that the foundation is approved prior to the installing fixed forms or the use of slip forms.

520.03.04 Forms. Use steel side forms having a thickness of at least 7/32 in. and a depth equal to the edge thickness of the pavement. Forms shall have a base equal to the height, a flat-flanged tread or top surface not less than 2 in. wide, and be of sufficient strength to resist all loads applied during the paving process. Do not use built up forms or warped forms. Use form sections that are at least 10 ft long except for installation along curves with a radius of less than 200 ft. For a curve radius less than 200 ft, use form sections that are no more than 6 ft long or use curved forms. All form sections shall have stake sockets that will accommodate a 1 in. diameter steel stake. Sections 10 ft or greater in length shall have at least three sockets. Sections less than 10 ft long shall have at least two sockets.

Fasten keyways rigidly to the form. Provide holes through both the form and the keyway to accommodate tie bars or dowels.

Place the forms to a tolerance of 1/8 in. in 10 ft for the top, and 1/4 in. in 10 ft for the face. Provide a means for locking the ends of abutting sections. Forms shall be clean and coated with an approved form release compound. Remove or repair forms that are bent, deformed, or broken.

Set grade controls at intervals of no more than 25 ft. Set the forms at least 400 ft ahead of concrete placement. When the foundation has been disturbed subsequent to the forms being set to the correct grade, make corrections as approved. Check the alignment and grade for conformance with the Contract Documents. Use an approved device such as a scratchboard and make any necessary corrections prior to concrete placement.

Wooden forms may be approved for use in exceptional cases, such as for curves of very short radius or when a nonstandard length of straight form is required.

520.03.05 Slip Form Paving. Unless otherwise approved, the minimum width of slip form paving shall be 24 ft. The total foundation width shall be graded using machine methods.

Set grade controls using string lines at intervals of no more than 25 ft. Construct the foundation as specified in 520.03.03; completed and approved at least 1000 ft ahead of the paver before paving begins. Stop paving whenever the paving machine comes to within 200 ft from the end of the approved foundation, and install a bulkhead construction joint. When paving adjacent to an existing pavement, the portion of the equipment supported by the existing pavement shall have wheels with rubber tires or crawler treads on protective pads. Maintain a clearance of at least 1 ft from the inner edge of the paver track or wheel to the edge of the existing pavement.

Slip forms shall be spaced and braced in a vertical position at a uniform and constant width, and of a length sufficient to prevent slumping or sagging of the sides and top edges of the pavement slab. Slip form equipment shall be capable of placing and securing embedded tie bars and keyways in proper position in the plastic concrete before the edge of the pavement slab is free of the slip form.

520.03.06 Reinforcement. Reinforcement shall be as specified. Maintain the reinforcement in a clean condition, free from foreign material that may prevent proper bonding of the concrete. Secure all reinforcement to prevent displacement or movement.

- (a) Install dowel bars at joints on the approved foundation parallel to the foundation grade, sufficiently ahead of the placement of slab reinforcement and concrete. Coat each dowel bar with an approved water insoluble lubricant. Dowel bars may be machine placed or set on approved chairs or prefabricated assemblies. Maintain proper alignment, depth, and spacing.

- (b) Tie bars for longitudinal construction joints may be placed on chairs or machine placed so that upon the initial set of the concrete they are at the proper alignment, depth, and spacing, and at right angles to the center line of the pavement. Prior to use, submit chairs and machine placement devices for approval.
- (c) Furnish fabric and mat reinforcement in flat sheets. Keep the material flat during placement. Maintain the specified reinforcement clearance.
- (d) When using slip forms, the tied reinforcement bars or prefabricated mats may be installed ahead of the placement of concrete by being supported on chairs. Reinforcement installed in this manner shall be in place at least 500 ft ahead of the paver or a two-hour run of the paver before any paving may begin. Stop paving whenever it comes to within 100 ft of the end of the steel placement, and install a bulkhead construction joint.

520.03.07 Concrete Placement. Prior to placement of the concrete, ensure that the foundation is in a moist condition. In addition, if the concrete is exposed to the direct rays of the sun and the ambient temperature is 70 F and rising, sprinkle the forms and reinforcement with cool water just before placement of the concrete. Once deposited within the forms, keep any rehandling to a minimum.

Where concrete is to be placed adjoining a previously constructed lane of pavement, mechanical spreading and finishing equipment may be operated upon the existing lane of pavement only after the existing concrete has reached a compressive strength of 3000 psi in conformance with 902.10.03. Wheels that rest on the previously completed concrete shall be flat without flanges, at least 3 in. wide, and located far enough from the edge of the slab to preclude spalling or damage. Perform sampling for control testing at the time of concrete placement and as specified in 902.10.08.

Deposit the total depth of the slab in a single layer except as otherwise specified herein or approved. For pavement constructed using bar mat or wire fabric reinforcement, place the concrete in two layers, unless it is demonstrated that the bar mat or wire fabric can be properly supported on approved devices.

Single Layer Placement. Set the reinforcement on chairs capable of maintaining the stability and proper elevation of the reinforcement. Welding of reinforcement to the chairs in lieu of wire ties will be permitted, except welding for epoxy-coated reinforcement will be permitted only if the epoxy coating is applied after the welding. Repair damage to epoxy coating using materials specified in 917.02.

Two Layer Placement. Place the concrete and bar mats or wire fabric reinforcement in a continuous operation. First, place the concrete to the specified depth of reinforcement. Then place the reinforcement on the freshly deposited concrete; follow immediately with the second layer of concrete.

520.03.08 Consolidation of Concrete.

Fixed Form Paving. Consolidate the concrete by using immersion type vibrators. Vibrators shall advance with the paving equipment and be set at the spacing and depth necessary to clear reinforcement by 1/2 in. Maintain the amplitude required to obtain thorough consolidation within the slab, along the faces of the forms, and at the joint assemblies. Avoid excessive vibration that results in segregation, and any vibrator contact with the side forms, joint assemblies, or underlying material. The consolidation system and settings are subject to approval.

Slip Form Paving. Concrete consolidation systems shall be incorporated in the paving equipment. Submit the systems for approval.

520.03.09 Finishing.

Machine Finishing. The machine shall be equipped with two transverse screeds with provision for adjustment to ensure that the concrete is at the specified crown and grade. Following the transverse screeds, the concrete shall be screeded longitudinally. The width of the working face of the screeds shall be at least 6 in. Use a chevron ("V" type) nonreciprocating finishing float or other approved type. The float shall be suspended from a frame that does not ride directly on the forms. Following the finishing float, use a long handled scraping straightedge 10 ft long to bring the pavement to the correct grade. When the finishing machine is operated over concrete that has partially set, make provisions to prevent damage to the concrete by the machine wheels.

Hand Finishing. With approval, hand finishing may be substituted for machine finishing. Do not use rakes for handling concrete.

520.03.10 Slab Surface and Thickness Checks.

Surface Check. After finishing, and before texturing of the concrete, check the entire surface by using an approved 10 ft long metal straightedge. Limit the surface deviation from a straight line or vertical curve transversely or longitudinally to 1/8 in. in 10 ft.

Thickness Check. After the pavement is placed and before final acceptance, cut cores by which the Engineer will check the thickness. Perform coring per MSMT 552. Locate cores every 1000 ft for each lane

unless otherwise specified or directed. Fill core holes at no additional cost to the Administration. Pavement deficient in thickness by more than 1 in. will be unacceptable. Remove and replace the full pavement section. Deficiencies up to 1 in. will be subject to reduced payment as specified in 520.04.

520.03.11 Texturing and Edging.

Texturing. Following concrete finishing and surface check, apply a transverse texture to the roadway surface using a device that produces corrugations 1/8 in. wide by 1/8 in. deep and variably spaced between 5/8 and 7/8 in. Maintain a 2 in. space between passes of the texturing device and a 3 in. space between the last corrugation and the center line of all transverse joints. Begin texturing when the concrete surface is plastic enough to allow texturing to the depth specified but dry enough to prevent the plastic concrete from flowing back into the grooves. Avoid overlaps and the tearing of the concrete. On open sections, apply texturing uniformly for the full width of pavement. On closed sections, leave the last 12 in. of the roadway adjacent to the curb untextured, to facilitate drainage. The completed textured finish shall be uniform in appearance.

Edging. After texturing the surface, and when the concrete has taken its initial set, edge transverse and longitudinal slabs using a 1/4 in. radius edging tool.

520.03.12 Curing. Following texturing and edging, cure the concrete for at least 72 hours. Whenever the ambient air temperature falls below 40 F during the curing period, use insulated blankets to maintain the concrete temperature above 40 F. Use insulated blankets in addition to any curing material that is used. Provide a sufficient number of high/low thermometers to monitor the temperature of the concrete. Cure the concrete using one of the following methods:

- (a) **Liquid Membrane Forming Compound.** Use a liquid membrane forming compound that is in conformance with 902.07.03. Apply the material to the surface as soon as the free water has disappeared. Use an approved spraying machine having drive wheels that straddle the freshly placed concrete. Have standby equipment on site in the event of failure of the spraying machine. The spraying machine shall be equipped with an adequate wind guard and be capable of producing a fine spray of material that covers the surface with a uniform continuous film. Apply the compound in two applications, each at a rate of 1/2 gal/200 ft². Maintain the film free of pin holes, checks, cracks, peelings, and other imperfections. Correct discontinuities in the film by the application of an additional coat to the affected area

within 30 minutes of the original coat. If sprayed surfaces are subjected to damaging rainfall within three hours after the second application, respray the surface at no additional cost to the Administration.

Use rope or other approved masking methods to keep the vertical surfaces of longitudinal and transverse joints free of curing compound. Protect the sprayed surfaces to maintain the continuity of the membrane. Application of compound by hand operated spraying equipment in irregular areas shall be as directed.

- (b) **Burlap Curing.** Place burlap conforming to 902.07.01 on the freshly placed concrete as soon as practical, without damaging the concrete. Overlap the burlap to provide a double thickness on the entire surface. Saturate the burlap with water before placement and keep it continuously wet during the curing period.
- (c) **Cotton Mat Curing.** Place cotton mats conforming to 902.07.04 on the freshly placed concrete as soon as practical, without damaging the concrete. Saturate the mats with water before placement and keep them continuously wet during the curing period.
- (d) **Sheet Materials.** Place sheet materials conforming to 902.07.02 on the freshly placed concrete as soon as practical without damaging the concrete. Overlap the material at least 1 ft and extend it outside the slab. Secure all laps and edges in place to provide continuous contact of the sheet with the pavement surface.

520.03.13 Form Removal of Fixed Form Paving. Unless otherwise directed, leave forms in place until the concrete has set at least 12 hours. If the sides of the slab show no damage, continue curing for the remaining 60 hours of the 72 hour curing period. Repair damaged or honeycombed areas and then cure for an additional 72 hours.

520.03.14 Joints. Construct joints in conformance with the details specified, perpendicular to the finished grade of the pavement, and sealed as specified in Section 523. Transverse expansion and contraction joints shall be straight and continuous from edge to edge of the pavement.

- (a) **Transverse Construction Joints.** Place a transverse construction joint at the end of each day's placing operations and at any other points within a paving lane where concrete placement is interrupted for 30 minutes or longer. Locate these joints at a planned joint except in the case of an equipment breakdown. When concrete placement cannot be continued, the transverse construction joint may be located within the slab unit but not less

than 10 ft from a planned transverse joint. Dowel transverse construction joints as specified, and saw the joints in conformance with in (c)(1).

- (b) **Expansion Joints.** Form expansion joints by placing a preformed filler material conforming to 911.02. Use approved metal supports to hold the filler securely in position. Leave the metal supports in the pavement. Install a removable metal channel cap bar to hold the parts of the joint in proper position and to protect the filler from damage during concreting operations. Remove the cap bar without damaging the pavement to provide a space for sealing the joint. Fit adjacent sections of filler tightly together, and extend them across the full width of the paving lane to prevent concrete from entering the expansion space. Use a joint filler of the specified type, thickness, and width to form expansion joints around structures and features that project through, into, or against the pavement.
- (c) **Contraction Joints.** Construct longitudinal and transverse contraction joints by sawing. If gravel aggregate is used, tool the joint, or form it by using an approved insert.
- (1) **Sawed Joints.** Sawcut to the specified depth using a 1/8 in. blade. Base the time of sawing on current and anticipated weather conditions and to prevent uncontrolled cracking of the pavement. Start the sawing operation as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. Respray damaged membrane cured surfaces as soon as the surface is dry. After completion of the curing period, widen the upper portion of the groove by sawing to the specified width and depth. The saw blades may be single or gang type, with one or more blades mounted in tandem. Do not sawcut into load transfer devices. Immediately after sawing the joint, thoroughly flush the saw cut and adjacent concrete surface with water to remove all waste.
- (2) **Insert Type Contraction Joints.** Construct insert type contraction joints by installing a preformed insert in the plastic concrete to form a weakened plane to induce cracking. Use a machine equipped with a vibratory bar for cutting a groove in the plastic concrete for placement of the insert and for vibrating the insert into place. Arrange vibration units to distribute vibration uniformly throughout the bar. The intensity of vibration shall be adjustable as necessary to form a groove of proper size for the filler, to force the insert into the plastic concrete, and to consolidate the concrete around the

insert. Immediately following final machine finishing, install the insert at the specified location and required depth for the full width of the paving lane. Ensure that there are no more than two joint spacings between the finishing machine and the inserter. For concrete placed by slip form pavers, support the edges of the plastic concrete to prevent slumping during the vibration and placement of the inserts. Join adjacent sections of the joint inserts within each slab securely together, and thoroughly consolidate the concrete against the full depth of the insert. Maintain the insert perpendicular to the finished grade of the pavement and straight in alignment. Keep the top of the insert flush or not more than 1/8 in. below the pavement surface. Following placement of the insert, use the vibratory float in lieu of hand floating and troweling. Perform any additional straightedge and texturing operations without disturbing the insert.

After the completion of the curing period, remove the top portion of fiberboard fillers or sawable preformed inserts by sawing with a power saw as approved.

520.03.15 Pavement Profile. Refer to pavement surface profile requirements specified.

520.03.16 Opening to Traffic. The pavement may be opened to vehicular traffic after having attained a compressive strength of 3000 psi. Field samples will be tested per T 23.

520.04 MEASUREMENT AND PAYMENT. Plain and reinforced portland cement concrete pavements will be measured and paid for at the Contract unit price per square yard for the pertinent Portland Cement Concrete Pavement item. The square yard measurement will be computed on the basis of plan width and as-built length measured along the pavement center line. The payment will be full compensation for all concrete, forms, reinforcement steel, chairs, epoxy coating, finishing, curing, joints, joint construction, saw cutting and joint sealing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

520.04.01 Pavement Thickness Price Adjustment. Payment for areas that are accepted at a reduced price for deficient thickness will be adjusted by the factors shown in the following table. Deficiencies will be determined by procedures specified in 520.03.10. There will be no additional payment for excess thickness.

PAVEMENT THICKNESS PRICE ADJUSTMENT	
DEFICIENCY IN INCHES	PERCENT OF PAYMENT CONTRACT UNIT PRICE
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00 *See 520.03.10	0*

SECTION 521 — CONTINUOUSLY REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

521.01 DESCRIPTION. Construct continuously reinforced portland cement concrete pavement on a prepared subgrade.

521.02 MATERIALS. Refer to 520.02 and the following:

Reinforcement. Section 908 for reinforcement, load transfer assemblies, tie bars, deformed steel bars, and longitudinal tie devices, except that all materials shall be epoxy coated. Select the type of reinforcement from one of the following:

- (a) Deformed steel bar mats as specified in 908.07. Use No. 5, Grade 60 longitudinal bars, and No. 4, Grade 60 transverse bars.
- (b) Loose deformed steel bars as specified in 908.01. Use No. 5, Grade 60 longitudinal bars with a length of at least 40 ft, and No. 4, Grade 60 transverse bars.
- (c) Welded deformed steel wire fabric as specified in 908.06.

521.03 CONSTRUCTION. Refer to 520.03 except as modified herein.

521.03.01 Placing Reinforcement. Preset the reinforcement on chairs or chair bars with the transverse members placed below the longitudinal members. Place the longitudinal bars within the tolerances specified.

Before placing the concrete, remove rust, mud, oil, or other detrimental coatings. Place the mat and fabric reinforcement flat and free from distortions. Furnish loose steel bars that are free from kinks or bends that prevent them from being properly assembled or installed.

Furnish approved chairs or chair bars designed to support the reinforcement in position without deflection or displacement during the placing and consolidation of the concrete. Use chair bases designed with sufficient bearing to prevent overturning or penetration into the subgrade, and that will not impede placement of the concrete. Chairs may be welded to the transverse bars prior to epoxy coating.

If the support system does not hold the reinforcement within the specified tolerances, increase the number of chairs or take other steps to maintain proper positioning of the steel.

521.03.02 Placing Concrete. Place the concrete in one lift, vibrated internally over its full width and depth by immersion vibrators mounted at intervals of not more than 30 in. center to center across the full width of the slab. The vibrators shall have variably controlled frequencies. Operate the vibrators at the frequency and amplitude necessary to be perceptible on the surface of the concrete more than 1 ft in any direction. Mount the vibrators as a group advancing longitudinally with the paving machinery, hinge mounted to facilitate riding over obstructions, and set to clear the reinforcement by approximately 1/2 in.

Stop all screeding and vibrating operations immediately whenever forward motion of the paving machinery is stopped.

521.03.03 Joints. Do not place transverse expansion or contraction joints in continuously reinforced portland cement concrete pavement. Construct a transverse bulkhead joint whenever concreting operations are stopped for more than 30 minutes and at the end of any working period. Form the joints using an approved header board in conformance with the cross section of the pavement, placed at right angles to the center line, and perpendicular to the surface. Furnish and install additional bars as specified. Finish the pavement flush with the header board without edging. Complete the joints accurately and keep the bulkhead clean. Extend the roadway reinforcement continuously through the joint. Support the reinforcement extending through the joint securely on chairs or wooden sills to prevent deflection.

Resume paving operations when the Engineer determines that the concrete has sufficiently set. Before resuming concrete placement, remove the bulkhead and debris and clean the joint.

Seal all joints as specified in Section 523.

521.03.04 Terminal Joints. Construct terminal joints as specified.

521.03.05 Thickness Check. Refer to 520.03.10

521.03.06 Pavement Profile. Refer to the pavement surface profile requirements in the Contract Documents.

521.04 MEASUREMENT AND PAYMENT. Continuously Reinforced Portland Cement Concrete Pavement will be measured and paid for at the Contract unit price per square yard. The square yard measurement will conform to 520.04. The payment will be full compensation for all concrete, forms, reinforcement steel, chairs, epoxy coating, finishing, curing, joints, joint construction, saw cutting and joint sealing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

521.04.01 Pavement Thickness Price Adjustment. Refer to 520.04.01.

521.04.02 Terminal Joints. Terminal Joints will be measured and paid for at the Contract unit price per linear foot. The payment will be full compensation for all steel beams, stiffener plates, end plates, drilled holes, welding, cutting, styrofoam, joint filler, concrete, reinforcement, bond breaker, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 522 — PORTLAND CEMENT CONCRETE PAVEMENT REPAIRS

522.01 DESCRIPTION. Repair plain, conventionally reinforced, or continuously reinforced portland cement concrete pavement. Repairs are either Type I, 6 ft to less than 15 ft in length; or Type II, 15 ft and greater in length.

522.02 MATERIALS. Refer to 520.02 except as follows:

Graded Aggregate for Base Course	901.01
Crusher Run Aggregate CR-6	901.01
High Range Water Reducing Admixture	902.06.03
Nonshrink Grout	902.11(c)

Epoxy Grout	902.11(d)
Epoxy Adhesive	921.04

522.02.01 Concrete Mix Design (Modified Mix No. 6). Use Mix No. 6 concrete as specified in 902.10.03, except with a cement factor of at least 800 lb/yd³, a high range water reducing admixture, and a compressive strength of at least 2500 psi in 12 hours. Testing shall be as specified in 902.10.08, except that cylinders shall be left in the molds until tests are conducted.

522.02.02 Field Control. Field control will be by compressive strength, cement content, slump, water/cement ratio, and air entrainment. Acceptance will be based on a minimum compressive strength of 3000 psi in 24 hours. If test results fall below the specified value, prepare a new mix design as directed.

522.02.03 Polyester Grout. A polyester grout may be used in lieu of epoxy grout providing the grout conforms to 902.11(d). Identify cartridge type systems by batch or lot number.

522.02.04 Epoxy Adhesives. Refer to 921.04. Use water insensitive materials classified as Type IV, Grade 3, Class B and C.

522.02.05 Reinforcement. Section 908 for reinforcement, including load transfer assemblies, tie bars, deformed steel bars, and longitudinal tie devices, except all material shall be epoxy coated.

522.03 CONSTRUCTION. The Engineer will determine the areas to be repaired and the type of repair. Prior to the start of repairs, submit a proposed repair plan, including equipment, methods, and procedures. Protect the repair area against damage from all causes. Repair or replace any part of the repaired pavement that is damaged. Make repairs in only one lane at a time for each roadway.

522.03.01 Equipment. Refer to 520.03.01.

522.03.02 Weather Restrictions. As specified in 520.03.02, except perform this work only during the months of April through October, unless otherwise permitted in writing. When the range in daily temperature is expected to exceed 15 F, concrete may be placed in the late afternoon after the existing pavement has achieved its maximum expansion, unless otherwise directed.

Cold weather protection shall conform to 520.03.12, except use insulated blankets when the ambient air temperature is less than 70 F.

522.03.03 Saw Cuts and Removal of Existing Pavement. Make all saw cuts perpendicular using a diamond saw blade. Remove concrete slabs by the lift out method in large sections. No other method of slab removal shall be used unless approved. Complete all repairs within the same working day on which the pavement is removed.

Repair adjacent slab damage caused by the removal operations.

Perform saw cutting and pavement removal as follows:

- (a) **Plain and Conventionally Reinforced Portland Cement Concrete Pavement.** Make full depth sawcuts for the full slab width and at least 2 in. from and parallel to longitudinal joints. When the repair is on only one side of an existing transverse joint, extend removal into the adjacent slab a sufficient distance to remove existing dowels. Remove the concrete slab within one week after making the saw cuts. Complete the repairs in a continuous operation.
- (b) **Continuously Reinforced Portland Cement Concrete Pavement.** Locate the boundaries of the repair at least 18 in. from the nearest transverse tight crack for normally spaced tight cracks, and at least 6 in. from the nearest transverse crack when they are closely spaced. Make at least a 2 in. depth saw cut for the full width of the lane at the boundaries of the repair. Do not cut the steel reinforcement. Make a full depth saw cut across the full width of the slab at least 22 in. inside each boundary saw cut. Make additional full depth saw cuts along all longitudinal edges not bounded by construction joints. Remove the concrete to its full depth within the boundaries of the repair area within 72 hours after making the saw cuts. Do not bend existing reinforcement bars.

Use no more than a 60 lb jackhammer and hand tools to remove concrete in the areas between each 2 in. and full depth saw cut. Trim the existing pavement edge neatly and vertical. Leave at least 22 in. of reinforcement exposed on each side of the repair. The Engineer will require the removal of any pavement breaking equipment from the project that could damage the adjacent concrete pavement.

When saw cuts close due to temperature, make narrowly spaced, full depth, and full width saw cuts to relieve the pressure. Remove the material between the narrowly spaced saw cuts and between the longitudinal joint and the 2 in. minimum offset longitudinal cut using the equipment specified above. Cut tie bars protruding from the longitudinal offset flush with the existing concrete. Remove

all waste material immediately from the repair site. Seal any saw cuts that extend into adjacent slabs, curbs, or gutters as specified in Section 523.

522.03.04 Base and Subgrade Preparation. Refer to 505.03.03, except moisten the subgrade for all types of repairs.

522.03.05 Subgrade Drains. If directed, construct subgrade drains as specified in section 306.

522.03.06 Forms. Use forms conforming to 520.03.04. Overlap existing pavement at least 1 ft on each side of the patch and securely fasten to prevent movement. Excavate the adjacent shoulder the width of the form plus 6 in. to provide space for the forms. After removing the form, repair the excavated shoulder area using the same type of material as used in the original shoulder.

522.03.07 Reinforcement. Refer to 520.03.06 and as specified herein. Place the doweled joint at the slab face closest to the original doweled joint location.

Drill holes 1/4 in. larger than the dowels, load transfer tie bars, and longitudinal tie devices into the face of the existing slab at mid depth. Blowout the holes and allow to dry. Grout or epoxy the dowels, load transfer tie bars, and longitudinal tie devices into place. Align reinforcement in the direction of the pavement and parallel to the surface.

Place a plastic grout retention disk, conforming to the Contract Documents, on each dowel to prevent loss of the bonding material.

For continuously reinforced portland cement concrete pavement, use reinforcement steel bars of the same size and spacing as the existing bars. Splice the reinforcement to the existing steel by lapping, welding, or approved mechanical device. For lap splices, lap at least 22 in. and secure using tie wires. Place the longitudinal steel reinforcement bars continuous for the full length of the repair. Place an amount of steel at least equal to the amount of steel in the existing pavement. Support the reinforcement steel bars on chairs or as approved.

For plain and conventionally reinforced pavement, coat the protruding ends of the dowel bars with an approved water insoluble lubricant.

522.03.08 Joints. Refer to 520.03.14. Seal all joints as specified in Section 523.

522.03.09 Concrete Placement. Refer to 520.03.07. Prior to placing concrete, clean the adjacent vertical surfaces.

For weather requirements refer to 520.03.02. The temperature of the concrete at placement shall be 50 to 90 F.

The air temperature shall be at least 40 F and rising. When the range in daily temperature is expected to exceed 15 F, concrete may be placed in the late afternoon after the existing pavement has achieved maximum expansion, unless otherwise directed.

Construct both plain and continuously reinforced concrete pavement repairs in one full depth operation. Construct conventionally reinforced concrete pavement repairs by placing two equal lifts with the wire mesh laid on the surface of the first lift. Vibrate all concrete.

522.03.10 Finishing. Following concrete placement, strike off the surface to the finished grade using an adjustable steel or wooden template and float the surface. Screed the repair longitudinally to provide uniformity of ride to adjacent pavement. Match the contour of the existing roadway. Perform surface checks as specified in 520.03.10.

522.03.11 Curing. Cure the concrete as specified in 520.03.12, except continue curing for 12 hours after concrete placement or until the repair is put into service.

522.03.12 Emergency Filler. Have sufficient crusher run aggregate CR-6 readily available to fill the void of the repair area. Place and compact the material, and cover it with a steel plate. At the beginning of the next day's work, completely remove the material using procedures that will not disturb the subgrade, dowels, load transfer tie bars, load transfer assemblies, or reinforcement placed previously.

522.03.13 Steel Plates. Have an ample supply of 12 x 14 ft x 1 in. thick steel plates available on the project to cover emergency filler and to protect the patch area until the concrete has developed sufficient strength to carry traffic.

522.03.14 Unacceptable Repairs. Remove and replace repairs that are not in conformance with the Contract Documents and repairs damaged by traffic or other causes.

522.04 MEASUREMENT AND PAYMENT. Portland cement concrete pavement repairs will be measured in place and paid for at the Contract unit price per square yard for the pertinent type Plain Portland Cement Concrete Pavement Repair, Conventionally Reinforced Portland Cement Concrete Pavement Repair, and Continuously Reinforced

Portland Cement Concrete Pavement Repair item. The payment will be full compensation for saw cuts, furnishing, hauling, placing of all materials, removal and disposal of old concrete, grout, drilled holes, chairs, all tie devices, reinforcement, epoxy coating, steel plates, emergency filler, joint sealing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Emergency filler and steel plates will remain the property of the contractor at the completion of the project.

522.04.01 Removal of Unsuitable Material and Refill per cubic yard. The payment will also include excavation and disposal of unsuitable material, backfilling with aggregate, and compaction.

522.04.02 Subgrade drains will be measured and paid for as specified in the applicable portions of Section 306.

522.04.03 Shoulder Repairs per square yard. Repairs to existing shoulders necessitated by the placement of forms are also included.

SECTION 523 — JOINT SEALING OF PORTLAND CEMENT CONCRETE PAVEMENTS

523.01 DESCRIPTION. Clean and seal portland cement concrete pavement joints.

523.02 MATERIALS.

Joint Sealers	911.01
Preformed Joint Fillers	911.02

Backer Rod. Use backer rod that is flexible, compressible, nonshrinkable, has a surface that will not bond with the joint sealer, and is capable of uniformly containing the sealer within the desired shape factor. Do not use hard rubber or materials that swell when wet or deform at sealer application temperatures.

523.03 CONSTRUCTION. Seal joints the same day they are shaped and prepared, and complete the joints prior to opening the roadway to traffic, unless otherwise directed. If joints are not sealed the same working day, reclean and dry the joints as specified in 523.03.02 prior to sealing.

523.03.01 Joint Construction. As specified in 520.03.14. If the joint is tooled, do not use preformed joint fillers.

523.03.02 Joint Preparation. Clean joints by one of the following methods as approved:

- (a) High pressure water blasting.
- (b) Abrasive blasting.
- (c) Oil free air blowing at a minimum of 90 psi.

Ensure that all joint walls and surfaces to which the joint material is to adhere are dry prior to installing the joint filler.

Ensure that all prepared joints are inspected and approved prior to sealing.

523.03.03 Sealing. Install preformed joint filler in conformance with the manufacturer's recommendations and the Contract Documents. Insert the backer rod as specified.

Install silicone sealer in conformance with the manufacturer's recommendations.

Backer rods are not required in longitudinal joints.

Apply sealer when the ambient air and pavement temperatures are at least 45 F and rising.

Heat hot applied sealer in accordance with the manufacturer's recommendations in a kettle or other equipment acceptable to the Engineer. Use kettles that have mechanically operated agitators, recirculation pumps, and positive thermostatic temperature controls. The applicator wand and all connecting hoses shall be insulated. Do not overheat or apply direct heat to the sealer.

Withdraw and waste all filler that has been overheated, heated more than four hours, or that remains in the applicator at the end of the day's operation. Prior to the start of each day's operation, withdraw and waste at least 1 gallon of filler through the applicator wand.

Fill joints with sufficient material that the final surface of the sealer is recessed 1/4 in. below the pavement surface. Reseal the joint if within two hours after sealing, the sealer is recessed more than 5/16 in. below the pavement surface.

Use an approved tool to apply a parabolic shape to the surface of the sealer. Ensure that the deepest point at the center of the joint is 5/16 in. below the pavement surface. Remove any excess sealer from the surface of the pavement.

Curing time for silicone material varies with temperature and humidity, and may delay opening the pavement to traffic. Traffic is not allowed on the pavement surface until the sealer has cured. Refer to the manufacturer's recommendations for curing time.

Any sealer that pulls loose from the joint or shows excessive bubbling within one week after opening the pavement to traffic shall be replaced.

523.04 MEASUREMENT AND PAYMENT. Joint Sealing of Portland Cement Concrete Pavement will be measured and paid for at the Contract unit price per linear foot of joint unless otherwise specified. The payment will be full compensation for cleaning existing joints, furnishing, hauling, placing all materials including preformed joint filler, joint sealer, backer rod, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Joint construction and sealing will not be measured but the cost will be incidental to the Contract unit price for the pertinent Portland Cement Concrete Pavement item.

SECTION 524 THRU 548 RESERVED

SECTION 549 — PAVEMENT MARKINGS

549.01 DESCRIPTION. Apply durable and nondurable pavement markings (line markings, letters, numbers, arrows and symbols) to various surfaces at locations and patterns as specified or as directed.

549.02 MATERIALS.

Durable and Nondurable Pavement Markings

Refer to Contract Documents

549.03 CONSTRUCTION.

549.03.01 Quality Control/Quality Assurance. At least 30 days prior to the prestripping meeting, submit in writing a proposed Quality Control Plan (QCP).

Address procedures for random sampling as specified in MSMT 729, and show how the equipment and material will be controlled to ensure conformance with the Specifications. Include the material manufacturer's application recommendations, personnel certifications, inspection and record keeping procedures, and minimum frequencies of sampling and testing as specified in MSMT 729. Detail when and how corrective action will be taken for unsatisfactory construction practices and deviations from the Specifications. Any deviation from the QCP shall be cause for immediate suspension of the marking operation. Operations shall not resume without approval.

- (a) **Placement.** Do not begin placement operations until the QCP is approved and a walkthrough has been performed to approve the layout with the Engineer, Contractor, and pavement marking foreman.

Widths. The traveled way lane widths and width of longitudinal lines shall be as specified. Lane widths shall be measured from center to center of the lane lines once a control line is established for the lane configuration of the roadway. When measurements are taken from existing longitudinal lines, the point of reference shall be the center of the single line or the center of the space between dual lines. The traveled way lane widths are in compliance when they have an acceptable appearance and are within 2 in. from the proposed lane width.

Alignment. Place markings in a straight and uniform manner. Lane lines are in compliance when they have an acceptable appearance and are visually in alignment, with no more than a 3/8 in. variation in any 40 ft section of traveled way. Maintain longitudinal alignment through all intersections and breaks, even though the lines themselves may discontinue. Do not apply pavement line markings over longitudinal joints; Offset the markings 2 in.

Layout Markings. Remove layout markings that detract from the overall appearance or function of the final markings as determined by the Engineer at no additional cost to the Administration.

- (b) **Certified Technicians.** Provide Administration certified technicians to perform quality control testing and sampling. The technicians shall demonstrate that they have a thorough knowledge of sampling and testing procedures as specified in MSMT 729. Perform quality control during the marking operations in conformance with the approved QCP. Identify the location of quality control tests. Should a certified technician be delinquent in any of their duties (i.e., fail to have all the proper test equipment on

the site, fail to perform tests, fail to submit documents to the Engineer at the end of the day, report information that varies substantially from the Administration's results, etc.), then the technician's certification shall become invalid and a recertification shall be required. All pavement marking operations shall be suspended until the Contractor provides a certified replacement technician.

- (c) **Records.** Maintain complete records of quality control inspection results, including actions taken to correct problems. Submit a copy of the QC results, signed by the certified technician, daily. Identify the location of the following quality control tests:

- (1) Ambient temperature.
- (2) Pavement surface temperature.
- (3) Material temperature.
- (4) Material thickness.
- (5) Retroreflectivity.
- (6) Alignment.
- (7) Color.

- (d) **Quality Assurance.** The Administration will provide quality assurance by:

- (1) Conducting independent sampling and testing.
- (2) Periodically observing testing performed by the Contractor.
- (3) Directing the Contractor to take additional samples and perform additional tests at any time and at any location.
- (4) Monitoring Contractor conformance with the Quality Control Plan.
- (5) Evaluation of quality control results and testing performed by the Administration will provide the basis for final acceptance.

The Administration will perform independent assurance audits to confirm and assure that both the quality control personnel's test methods and quality control test equipment are in reasonable conformity with Administration specifications.

549.03.02 Cleaning Pavement Surfaces. Pavement surfaces shall be dry and free of oil, dirt, grease, and other contaminants prior to application of pavement markings. Clean nonconforming surfaces to a width 4 to 6 in. wider than the markings.

549.03.03 Quality Control Test Strip. As specified, or as directed, place a 200 to 300 ft cumulative quality control test strip of pavement marking material that conforms to the Contract Documents at a location determined by the Engineer. Place additional control strips as directed. Authorization to proceed will be given when the quality control test strip conforms to the Contract Documents.

549.03.04 Marking Removal. Remove existing pavement markings that conflict with new or altered traffic patterns. Use an approved method and ensure that the pavement surface is not damaged by the process. Repair or replace damaged pavement at no additional cost to the Administration. Refer to (565) in the Contract Documents.

549.03.05 Curing. Protect the markings until dry or cured by placing warning devices as specified in the MdMUTCD and as approved. If a vehicle damages uncured markings, reapply the markings and remove marks left on the pavement by the vehicle at no additional cost to the Administration.

549.03.06 Observation Period. The Contractor shall be responsible for any defects in materials and workmanship of the pavement markings for a period of 180 days for durable and 60 days for nondurable materials from the date the pavement is opened to traffic.

Time charges will not be assessed during the observation period provided all other work on the Contract is complete. At the end of the observation period, the Engineer will inspect the pavement markings for durability, color, and retroreflectivity, and inform the Contractor of pavement markings that have failed and that require corrective action. Pavement markings will be failed for any of the following conditions:

- (a) More than 5 percent of the substrate is exposed in any 2000 ft section of longitudinal marking.
- (b) Retroreflectance values have dropped below the minimum retroreflectivity specified.
- (c) Marking is discolored when compared visually with the color chips.

Remove and replace all failed markings within 30 days of receiving written notification from the Engineer.

549.04 MEASUREMENT AND PAYMENT. The payment for furnishing and applying the pavement marking (line markings, letters, numbers, arrows and symbols) will be made under the pertinent pavement markings items. Quality control will not be measured but the cost will be incidental to the other pertinent items specified.

549.04.01 Removal, Replacement, or Corrective Actions. Corrective actions for markings unsatisfactorily installed as determined by the Engineer or that fail during the observation period, shall be at no additional cost (including Maintenance of Traffic) to the Administration. In addition, the current road user fee will be applied when traffic disruption occurs during corrective actions.

CATEGORY 600 SHOULDERS

SECTION 601 — EARTH SHOULDERS

601.01 DESCRIPTION. Construct shoulders using earth.

601.02 MATERIALS. Section 204.

601.03 CONSTRUCTION. Refer to 204.03 and 208.03.

601.04 MEASUREMENT AND PAYMENT. Earth shoulders will not be measured but the cost will be incidental to the Contract unit price for the pertinent Excavation item.

SECTION 602 — CURB, COMBINATION CURB AND GUTTER, AND MONOLITHIC MEDIAN

602.01 DESCRIPTION. Construct concrete curb, concrete combination curb and gutter, concrete curb openings, concrete monolithic median, and hot mix asphalt (HMA) curb.

602.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
Aggregate	901.01, Size No. 57
Curing Materials	902.07
Form Release Compound	902.08
Concrete Mix No. 3	902.10
Hot Mix Asphalt	904
Tack Coat	904.03
Reinforcement Steel	908.01
Joint Sealer	911.01
Preformed Joint Filler	911.02
Borrow Excavation	916.01

602.03 CONSTRUCTION.

602.03.01 Concrete Curb, Combination Curb and Gutter, and Monolithic Median.

- (a) **Excavation.** Excavate to the specified depth and to the width required to install and brace the forms. Compact the subgrade to 92 percent density per T 180, Method C, and trim to the proper shape and required grade. Remove all soft and unsuitable material and replace with approved material.
- (b) **Forms.**
- (1) **Fixed Form Method.** Ensure that all forms are properly designed and acceptable. Use full depth steel forms that are at least 10 ft in length. When installing forms where the radius of the curb face is less than 200 ft, use flexible or curved steel or wooden forms that are no more than 6 ft in length. Securely fasten and brace forms to prevent buckling, warping, or any other movement during the placing of concrete. Place the forms to a tolerance in grade and alignment of 1/4 in. in 10 ft. Thoroughly clean and coat the forms with a form release compound each time they are used.
- (2) **Slip-Form Method.** Refer to 603.03.01(b)(2).
- (c) **Concreting.** Mix according to 915.03.04. Volumetric batching and continuous mixing will be permitted. Before placing concrete, moisten the subgrade with as much water as it can absorb. Consolidate the concrete in the forms by spading or other approved method. Remove curb face forms as soon as the concrete will retain its shape. Keep other forms in place for at least 12 hours.
- (d) **Depressed Curbs.** Construct depressed curbs at entrances and sidewalk ramps.
- (e) **Openings.** Provide an outlet for rainspouts and other drainage by constructing insert openings within the curb.
- Construct curb openings as specified.
- (f) **Finishing.** Strike off the concrete to the specified cross section. finish, float, and apply a broom finish. For matching adjacent

concrete surfaces, other methods of finishing may be permitted. Do not use plastering. Use a 1 in. radius edging tool on the face edge of the curb. Finish all other exposed edges with a 1/4 in. edging tool. Limit any deviation from grade and alignment of the face and top surface of curbs and medians to no more than 1/4 in. in 10 ft. Immediately after removal of the forms, repair all honeycombed and damaged areas.

(g) Joints.

(1) Fixed Form Method. Use 10 ft spacing between joints, except where a lesser spacing is necessary for closures and for matching expansion and contraction joints in contiguous concrete pavements. Do not use joint spacings less than 4 ft. Form the joints by using plate steel templates 1/8 to 3/16 in. thick that have a width and depth equal to the unit cross section. Do not use intermediate templates or sections of templates. Set the templates perpendicular to the line and grade of the unit. At stationary structures such as bridges and inlets, construct an expansion joint using 1/2 in. preformed expansion joint filler. Construct expansion joints at points of curves, tangents, at locations coinciding with adjoining pavement joints, and as specified or as directed. Extend the expansion joint material to the full depth of the unit cross section. Apply sealer to the entire gutter portion and 1 in. up the face of all joints. In addition, seal the entire expansion joint of monolithic medians.

(2) Slip-Form Method. Refer to 604.03.01(b), except use 602.03.01(g)(1) for joint spacing.

(h) Cold Weather Construction and Curing. Refer to 520.03.02 and .12.

(i) Backfill. After curing for at least 72 hours, use approved material to backfill the front and back of the curb, combination curb and gutter, and median to the required elevations. Complete the backfilling before rolling the adjacent roadway.

602.03.02 HMA Curb. Unless otherwise approved, use a self-propelled machine to place HMA curb. The machine shall form curbing that is uniform in texture, shape, and density, and to the specified template.

Place the curb on a clean, dry, and stable base. Apply tack coat using asphalt of the type and amount as directed.

When required, backfill the curb after it has sufficiently hardened to prevent damage. Consolidate the backfill by tamping or rolling.

602.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all concrete, hot mix asphalt, forms, excavation, backfill, disposal of excess material, drainage openings, joint sealer, tack coat, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

The removal and disposal of unsuitable material will be measured and paid for at the Contract unit price for Class 2 Excavation, which price includes the cost of using suitable excavation as replacement material. When Borrow or Selected Backfill is authorized as replacement material, payment will be made at the Contract unit price bid for the respective items.

When existing curb or combination curb and gutter is removed and replaced with new curb or combination curb and gutter, the cost of the removal will be incidental to the Contract unit price for the new item.

602.04.01 Curb, Combination Curb and Gutter, and Monolithic Median will be measured and paid for at the Contract unit price per linear foot. Hot Mix Asphalt Curbs, Concrete Curbs, and Concrete Combination Curb and Gutter will be measured along the front face of the curb. Monolithic Concrete Median will be measured along the center line of the finished top of median.

602.04.02 Concrete Curb Opening and Curb Opening for Concrete Combination Curb and Gutter will be measured and paid for at the Contract unit price per each.

SECTION 603 — SIDEWALKS

603.01 DESCRIPTION. Construct hot mix asphalt (HMA) or concrete sidewalks and sidewalk ramps. Ensure that the sidewalks and sidewalk ramps are constructed in accordance with the most recent accessibility guidelines of the Americans with Disabilities Act (ADA).

603.02 MATERIALS.

Curing Materials	902.07
Form Release Compound	902.08
Concrete Mix No. 3	902.10
Hot Mix Asphalt (HMA)	904
Welded Wire Fabric	908.05
Joint Sealer	911.01
Preformed Joint Fillers	911.02

603.03 CONSTRUCTION.**603.03.01 Concrete Sidewalks.**

- (a) **Excavation.** Refer to 602.03.01(a).
- (b) **Forms.**
- (1) **Fixed Form Method.** Use full depth steel or wood forms. Use forms that are straight, free from warp, and of sufficient strength to resist the pressure of the concrete. Brace and stake the forms so that they remain in both horizontal and vertical alignment. Thoroughly clean and coat forms with form release compound each time they are used. Allow the concrete to set for at least 12 hours before removing the forms.
- (2) **Slip-Form Method.** Refer to 604.03.01(b), except use 603.03.01(e) for joint construction.
- (c) **Concreting.** Before placing concrete, moisten the subgrade with as much water as it can absorb. Mix the concrete according to 915.03.04. Volumetric batching and continuous mixing will be permitted. Deposit the concrete on the prepared subgrade in successive batches to the full width of the sidewalk. Thoroughly spade along the edges and tamp the entire surface area to eliminate voids. Strike off and screed the concrete to the top of the forms.
- (d) **Finishing.** Float the surface and apply a broom finish. Do not plaster the surface. Use a 1/4 in. edging tool on all outside edges and all joints.

- (e) **Joints.** Place joints as specified. Tool or saw dummy joints a minimum of 3/4 in. deep.

Match adjacent joints in curb or pavement. Place expansion joint material to the full depth of the concrete.

- (f) **Cold Weather Protection and Curing.** Refer to 520.03.02 and .12. Do not allow pedestrian and vehicular traffic during the curing period.

- (g) **Expansion Joint Sealing.** Prior to sealing, clear dirt and other foreign material from the expansion joints. Ensure that joint walls and all surfaces to which the sealing material is to adhere are surface dry for at least three hours prior to sealing. Do not seal the joints until they are acceptable to the Engineer. Ensure that the surface of the sealing compound is not more than 1/8 in. below the sidewalk surface.

603.03.02 HMA Sidewalks.

- (a) **Excavation.** Complete excavation, subgrade preparation, and form placement when required, as specified in 603.03.01(a) and (b).
- (b) **Placement.** Place HMA as specified in 504.03.05. When the sidewalk is not placed in forms, use acceptable backfill material to form an 18 in. wide shoulder for the HMA or as specified.
- (c) **Compaction.** Use an approved roller. In areas inaccessible to a roller, a vibrating plate compactor or hand tamping may be used. In any case, the HMA shall be uniformly compacted. Start compactive effort as soon as the HMA can be compacted without displacement and continue until the material is thoroughly compacted and all marks have been removed.

603.03.03 Backfill. After the forms have been stripped and repairs are satisfactorily completed, backfill the spaces in front and back of the sidewalk to the required elevations using approved material.

603.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, backfill, disposal of excess or unsuitable material, forms, reinforcement when specified, joints, sealer,

compaction, curing, finishing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

The removal and disposal of unsuitable material will be measured and paid for at the Contract unit price for Class 2 Excavation, which price includes the cost of using suitable excavation as replacement material. When Borrow or Selected Backfill is authorized as replacement material, payment will be made at the Contract unit price bid for the respective items.

When the existing sidewalk is removed and replaced with a new sidewalk, the cost to remove the existing sidewalk will be incidental to the Contract unit price for sidewalk.

603.04.01 Concrete Sidewalks will be measured and paid for at the Contract unit price per square foot of finished surface including sidewalk ramps.

603.04.02 Hot Mix Asphalt Sidewalks will be measured and paid for at the Contract unit price per ton for the mixture placed.

SECTION 604 — CONCRETE TRAFFIC BARRIERS

604.01 DESCRIPTION. Construct concrete traffic barriers.

604.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
Aggregate	901.01, Size No. 57
Curing Materials	902.07
Form Release Compound	902.08
Concrete Mix No. 3	902.10
Concrete Mix No. 6	902.10
PVC Pipe	905
Reinforcement Steel	908
Preformed Joint Fillers	911.02
Borrow Excavation	916.01
Geotextile	921.09
Reflective Delineators	QPL

Use concrete mix No. 6 to construct all concrete traffic barriers, end transitions, and footers unless otherwise specified. Before beginning work, construct a sample panel approximately 2 ft x 2 ft x 3 in. using the proposed concrete mix design. After 28 days, the concrete shall match Federal Standard No. 595, Color 37722 or lighter. Submit the panel and mix design to the Office of Materials Technology for approval. Keep the approved sample panel at the construction site to be used by the Engineer to compare the color of the concrete barrier to the sample panel for adjustments and approval.

Submit a sample panel for each source of supply.

604.03 CONSTRUCTION. Use cast-in-place construction. Excavate to the required depth and to a width that will permit the installation and bracing of forms where necessary. Remove all soft and unsuitable material, and replace it with suitable material. Properly shape the subgrade and compact it as specified in Section 208.

604.03.01 Concrete Barriers. Forming of the footer or concrete barrier may be by either the fixed form or the slip-form method. Do not construct the footer and the barrier section monolithically.

- (a) **Fixed Form Method.** Use steel forms with a tolerance in grade and alignment of 1/4 in. in 10 ft. For bifurcated and transition sections, other forming materials may be used as directed.

Thoroughly clean and coat the forms with form release compound each time they are used.

Mix and place concrete as specified in 915.03.04 and Section 420, respectively. Volumetric batching and continuous mixing will be permitted. Vibrate concrete using an approved immersion type mechanical vibrator.

Saw or form construction and contraction joints at 20 ft intervals with a minimum of 10 ft. For saw time requirements, refer to 520.03.14(c)(1). Place expansion joints where specified or as directed. Ensure that all joints in footers and walls align.

Finish concrete as specified in 604.03.03 except apply a broom finish to the surface when forms are stripped in less than 24 hours. Remove the face forms for finishing as soon as the concrete can retain its shape.

After removing the forms, immediately repair all honeycombed and damaged areas.

- (b) Slip-form Method.** Use approved slip-form equipment. The equipment shall have internal vibrating capability and automatic guidance controls to follow line and grade references. On vertical and horizontal curves, set an additional intermediate support in the field to establish an acceptable reference line. Do not use ski or shoe sensors. This method shall not be used within 5 ft. of either side of a utility junction box. Use the fixed form method.

Mix concrete as specified in 915.03.04. Ensure that the consistency of the concrete after extrusion will maintain the shape of the barrier without support. Provide surfaces that are free of pits larger than 3/16 in. diameter and that require no further finishing other than a broomed finish.

Whenever a tear occurs during the operation of the slip-form equipment, repair it immediately or remove and replace as directed.

Saw or form construction and contraction joints at 20 ft intervals in the barrier and footer with a minimum of 10 ft, except in the area of miscellaneous structures 6 ft will be permitted. Saw the joints 1/8 in. wide and at least 2 in. deep. Place expansion joints as specified or as directed.

604.03.02 Curing. Cure and protect concrete as specified in Section 420.

604.03.03 Finished Surface. Finish concrete as specified in Section 420. The completed barriers shall be within 1/4 in. in 10 ft from the specified horizontal and vertical lines. The barrier shall present a smooth, uniform appearance.

604.03.04 Reflective Delineators. Install reflective delineators on the concrete traffic barrier as specified.

604.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all test panels, excavation, removal of existing hot mix asphalt, disposal of excess or unsuitable material, reinforcement, drilled holes, drainage appurtenances, geotextile, No. 57 aggregate, conduit, boxes and fittings, backfilling, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

The removal and disposal of unsuitable material will be measured and paid for at the Contract unit price for Class 2 Excavation, which price includes the cost of using suitable excavation as replacement material. When Borrow or Selected Backfill is authorized as replacement material, payment will be made at the Contract unit price for the respective items.

The removal of existing concrete traffic barriers will not be measured unless specified elsewhere in the Contract Documents.

604.04.01 Concrete Traffic Barriers will be measured and paid for at the Contract unit price per linear foot. Measurement will be along the center line of the top of the barrier.

604.04.02 Concrete Traffic Barrier End Transitions will be measured and paid for at the Contract unit price per each.

604.04.03 Reflective Delineators will be measured and paid for at the Contract unit price per each.

SECTION 605 — METAL TRAFFIC BARRIERS

605.01 DESCRIPTION. Construct metal traffic barriers.

605.02 MATERIALS.

Brown Polyester Coating	917.03
W Beam	918.01
Metal Posts	918.02
Traffic Barrier Hardware	918.03
Timber Posts	918.04
Wood Offset Blocks	918.04
Wire Rope	918.05
Rub Rail	A 36, Galvanized, A 123

Thrie Beam Reflective Delineators	M 180, Class A, Type 2 As approved by the Office of Traffic and Safety
Recycled Composite Material Offset Blocks	As specified by the manufacturer

605.03 CONSTRUCTION.

605.03.01 Post Installation. Drive all posts, unless otherwise approved. Use a method of driving that will not batter or distort the posts. If posts are not driven, set them in holes of sufficient diameter to allow tamping of the backfill. Backfill with approved material. Place backfill in horizontal layers not exceeding 6 in. loose depth and thoroughly compact. When it is necessary to place posts in existing paving, remove all loose material and replace the paving. Prior to installing rail or cable elements, properly align the posts to within 1/4 in. of line and grade. Install all posts plumb.

When rock is encountered at a depth less than the specified footing depth, drill a 12 in. diameter hole 20 in. into the rock or to the planned footing depth, whichever is less. If the 20 in. depth is reached prior to the planned depth, cut the post to the appropriate length. Paint the cut edge with approved galvanizing repair paint. Set the post and backfill with an approved material. Do not use concrete or grout material. Place the backfill in horizontal layers not exceeding 6 in. loose depth and thoroughly compact.

605.03.02 Rail Assembly. Furnish rail elements as specified. Ensure a smooth continuous installation, with laps in the direction of traffic flow. Ensure that all bolts are drawn tight.

605.03.03 Offset Blocks. When installing new traffic barrier W beam, use either wood or recycled composite offset blocks. Do not mix different types of manufactured composite blocks or mix composite and wood blocks. All offset blocks shall be routed or grooved to prevent them from rotating.

When an existing steel offset bracket is damaged, replace it with a steel bracket.

605.03.04 Brown Polyester Coated Traffic Barrier W Beam Using 6 Foot Post or 8 Foot Post. Ensure that all components are padded and handled with nylon slings during loading, unloading, and installation.

Preserve the integrity of the polyester coating. If the polyester coating is chipped, scratched, blistered, or otherwise separated from the base metal, repair the damaged areas using the manufacturer's repair kit. Complete all repairs to the satisfaction of the Engineer or replace the damaged material at no additional cost to the Administration.

605.03.05 W Beam Barrier Reflective Delineators. Install reflective delineators as specified.

605.03.06 Remove and Reset Existing Traffic Barrier. When removing and resetting an entire run or a portion of a run of traffic barrier, replace the metal offset brackets with either wood or recycled composite offset blocks. When removing and resetting an entire run, use 8 in. offset blocks. When removing and resetting only a portion of a run, use 6 in. offset blocks. Ensure that the holes in the blocks match the holes in the existing posts. Move the posts at least 1 ft in either direction from the existing location. When resetting the rail, measure the height of the rail to ensure that it conforms to the current height shown on the Standards. Unless otherwise directed, maintain the existing offset distance from the edge of the roadway.

605.03.07 Remove and Reset Existing Median Traffic Barrier W Beam. Refer to 605.03.06.

605.03.08 End Treatments. Section 606.

605.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all rock excavation, restoration of grassed or paved areas, drilled post holes and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

605.04.01 Traffic Barrier W Beam Using 6 Foot Post or 8 Foot Post will be measured and paid for at the Contract unit price per linear foot. When a bottom W beam panel is specified for the Traffic Barrier W Beam item it will be measured and paid for at the Contract unit price per linear foot for Traffic Barrier W Beam Panel.

605.04.02 Traffic Barrier W Beam Median Barrier will be measured and paid for at the Contract unit price per linear foot.

605.04.03 Traffic Barrier Thrie Beam will be measured and paid for at the Contract unit price per linear foot.

605.04.04 Replacing 6 or 8 foot posts, installing additional 6 or 8 foot posts, splice joints, and replacing W beam panels will be measured and paid for at the Contract unit price as specified in the Contract Documents.

605.04.05 Removal and Disposal of Existing Traffic Barrier W Beam will be measured and paid for at the Contract unit price per linear foot.

605.04.06 Remove and Reset Existing Traffic Barrier will be measured and paid for at the Contract unit price per linear foot. Offset blocks will not be measured but the cost will be incidental to the item.

605.04.07 Remove and Reset Existing Median Traffic Barrier W Beam will be measured and paid for at the Contract unit price per linear foot. Offset blocks will not be measured but the cost will be incidental to the item.

605.04.08 Traffic Barrier W Beam Median Barrier with Bottom Panel will be measured and paid for at the Contract unit price per linear foot.

605.04.09 Remove and Reset Existing Median Traffic Barrier W Beam with Bottom Panel will be measured and paid for at the Contract unit price per linear foot.

605.04.10 W Beam Barrier Reflective Delineators will be measured and paid for at the Contract unit price per each.

605.04.11 The application of fusion bonded brown polyester coating to Traffic Barrier W Beam, as well as all special handling and touch up will not be measured but the cost will be incidental to the item to which the coating is applied.

SECTION 606 — PERMANENT TRAFFIC BARRIER END TREATMENTS

606.01 DESCRIPTION. Furnish, and install permanent traffic barrier end treatments.

606.02 MATERIALS. Refer to 605.02 and the following:

End Treatments and Spare Parts Packages	As specified by the manufacturer
Hazard Marker	QPL
Plastic Barrels	QPL

Sand	901.01
Graded Aggregate Base	901.01
Bank Run Gravel Base	901.01
Common Borrow	916.01.04
Topsoil	920.01
Concrete Mix 2 and 6	902.10

606.03 CONSTRUCTION.

606.03.01 End Treatments.

- (a) **Type A System.** Bury the ends of the traffic barrier, the end anchorage terminal, and the rub rail when required, in a cut slope. Excavate the slope to install these components. Upon installation, backfill the area to match the adjacent slope, compact, seed, mulch, and install soil stabilization matting as directed. For single rail systems, use 6 ft posts throughout the entire end treatment. For double rail systems, use 8 ft posts, except for the last three posts buried in the cut slope.

Construct the end anchorage terminal using either option 1 or 2 from the Standard.

Install traffic barrier W beam as specified in 605.03.

- (b) **Type B System.** Install according to the manufacturer's recommendations.
- (c) **Type C, D, E, and F.** Install these systems in a straight line, unless otherwise specified by the manufacturer and approved by the Engineer. Refer to the manufacturer's recommendations for installation methods and procedures.
- (d) **Nose Section.** Reflectorize as approved by the Office of Traffic and Safety.
- (e) **Finish Coat.** Traffic barrier end treatments shall have the same finish coat as the W beam traffic barrier to which they are attached.
- (f) **Sand Filled Plastic Barrels (SFPB).** Provide the components and assemble, place in the required configuration, and fill each barrel

according to the manufacturer's recommendations or as specified in the Contract Documents. Ensure that each SFPB is watertight and separated from other SFPB by a distance of 3 in. Place the last row of SFPB 12 in. from the shielded object.

Reflectorize the first barrel of the SFPB configuration as specified. Ensure that all sand is dry and loose. Do not use bags of sand. Add an antifreeze agent to the sand according to the manufacturer's recommendations.

606.03.02 Surface Adjustment. When surface adjustment is required for installation of Type B, C, D, E, and F end treatments, use any class of excavation available on the project. When excavation is not available on the project, use crusher run aggregate CR-6, bank run gravel subbase, borrow, topsoil, or asphalt milling and grindings. Complete the surface adjustment within 48 hours.

606.03.03 Transitions to Existing Structures. When transitions to existing structures or traffic barriers are required, perform the work as recommended by the manufacturer.

606.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, removal of the existing end treatment to be replaced, fabrication of all component parts, transitions to barriers, reflectorization, backfill, compaction, restoration of grassed or paved areas, seed and mulch, soil stabilization matting, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

606.04.01 Type A End Anchorage Terminal Either Option will be measured and paid for at the Contract unit price per each.

606.04.02 Type B through H, J, and K Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each. Type L Traffic Barrier Anchorage will be measured and paid for at the Contract unit price per each.

606.04.03 Surface adjustment for Types B, C, D, E, and F end treatments will be measured and paid for at the Contract unit price per cubic yard for the Surface Adjustment for Traffic Barrier End Treatment item. The payment will also include full compensation for furnishing, adjusting, and compacting embankment or aggregate material.

606.04.04 Permanent Crash Cushion Sand Filled Plastic Barrels will be measured and paid for at the Contract unit price per barrel. The payment will also include full compensation for furnishing and placing sand and antifreeze agent.

606.04.05 Repairs.

- (a) Traffic Barrier End Treatment Spare Parts Package furnished and installed will be measured and paid for at the Contract unit price per each for the type specified. The payment will also include full compensation for the clearing and removal of debris and damaged unsalvageable parts.
- (b) When spare parts packages are furnished by the Administration, Repairing Traffic Barrier End Treatments will be measured and paid for at the Contract unit price per each for the type specified. The payment will also include full compensation for all transportation, reconnection to fixed objects where necessary, and clearing and removal of debris and damaged unsalvageable parts.
- (c) Payment will not be made for spare parts packages used for end treatments damaged due to the Contractor's operations.

606.04.06 The application of fusion bonded brown polyester coating, as well as all special handling, will not be measured but the cost will be incidental to the item to which the coating is applied.

SECTION 607 — CHAIN LINK FENCE

607.01 DESCRIPTION. Construct chain link fence.

607.02 MATERIALS.

Concrete Mix No. 2	902.10
Fence Fabric	914.01
Tie Wires, Line Post Clips, Tension Wires and Tension Wire Clips	914.02
Posts, Braces, Fittings and Hardware	914.03
Gates	914.04
Barbed Wire	914.05

607.02.01 Type. Install the height and type of fence specified. When the type of fence is not specified, one of the following types may be used:

- (a) Galvanized steel and malleable iron components.
- (b) Galvanized steel fabric utilizing galvanized steel posts or aluminum line posts.
- (c) Aluminum coated steel fabric utilizing galvanized steel line posts.
- (d) Aluminum coated steel fabric utilizing aluminum line posts.
- (e) Bonded vinyl coated fabric utilizing galvanized steel or galvanized bonded vinyl coated steel line posts and fittings.
- (f) Bonded vinyl coated fabric utilizing aluminum line posts.

607.03 CONSTRUCTION.

607.03.01 General Requirements. Confine all activities and operations to the area immediately adjacent to the right-of-way lines and within the right-of-way. The Engineer may grant permission to perform normal construction activities through lands owned by or under control of the Administration.

In areas where privately owned fence or other property is within the Administration's right-of-way, remove the items and place them on the owner's property as directed by the Engineer. The Contractor shall be responsible for any damage to privately owned items removed.

Fence lines specified in the Contract Documents are only a guide. The exact location of the fence will be determined in the field by the Engineer.

Install all posts plumb. Maintain, as uniform as practicable, the spacing specified, with a tolerance of minus 2 ft.

Use post lengths that accommodate the fabricated width of the fence fabric without stretching or compressing the fabric and that provide the required spacing below the bottom of the fabric.

Install terminal posts at all ends, abrupt changes in grade, and at changes in horizontal alignment greater than 15 degrees. Install terminal posts at a spacing not exceeding 500 ft.

Install horizontal brace rails with diagonal truss rods and turn buckles at all terminal posts. Supply sufficient braces to provide complete bracing of each terminal post to the adjacent line posts.

Install post caps on all round line, terminal, and corner posts.

Place the bottom of the fabric a approximately 1 in. above the groundline. A maximum clearance of 6 in. will be permitted for a maximum horizontal distance of 8 ft, except for special conditions specified in the Contract Documents.

Any excavation or backfill required to comply with the above clearance will require approval. Place fence fabric on the side of the post nearest to the roadway. For storm water management ponds, place the fabric on the side farthest from the pond. The fence shall be true and taut.

Run a tension wire continuously between terminal posts near the top and bottom of the fabric. Attach the wire to the fabric with hog ring fasteners at 18 in. intervals.

Tie the fabric to the brace rails at intervals not exceeding 2 ft and to posts at intervals not exceeding 12 in. Attach stretcher bars to terminal posts by connectors equally spaced at not more than 16 in. centers. Place top and bottom connectors as close as possible to the ends of the fabric.

607.03.02 Anchorage for Line Posts and Terminal Posts. Where rock is encountered at a depth less than that specified for the footing, drill a hole 1 in. larger than the greatest dimension of the post to a depth of 12 in. or the planned footing depth, whichever is less. After the post has been set, fill the remainder of the drilled hole with grout composed of one part portland cement and two parts mortar sand by dry loose volume. Fill the space above the rock with concrete. Do not use the drive anchor method in rock areas.

Select the type of anchorage system from the following, except use the concrete method in rock areas.

Concrete Method. Place posts in the center of concrete footings. Thoroughly compact the concrete around the post by rodding or vibrating. Trowel the top surface to a smooth finish slightly above the groundline and uniformly sloped to drain away from the post. Do not disturb the post within the 72 hours after the individual post footing is completed.

Do not use hand mixed concrete unless approved. When permitted, limit the size of the hand mixed batch to 1/2 yd³.

Drive Anchor Blade Method. A drive anchor blade unit consists of two steel blades driven diagonally through galvanized steel fittings attached to opposite sides of the post. The drive anchor unit shall hold the post rigidly upright. Ensure that the spread of the blades at their full depth is approximately 39 in. Install the device so that its top is at least 3 in. below the finished grade. The anchor unit device and procedure shall be as approved.

Anchor each line post using one of these units. Anchor each terminal post using two units spaced approximately 6 in. apart. At terminal posts, drive each anchor blade unit in the direction that offsets the stresses caused by the tension of the fence.

607.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. The removal of privately owned fence or other property from within the Administration's right-of-way will not be measured but the cost will be incidental to the Contract lump sum price for Clearing and Grubbing.

When an item for Clearing and Grubbing is not specified in the Contract Documents, clearing and grubbing will not be measured but the cost will be incidental to the Contract unit price for the pertinent Chain Link Fence item.

607.04.01 Chain Link Fence will be measured and paid for at the Contract unit price per linear foot for the actual number of linear feet measured to centers of end posts.

607.04.02 Terminal Posts (End, Pull, and Corner Post) will be measured and paid for at the Contract unit price per each for the size and type specified.

607.04.03. Gates will be measured and paid for at the Contract unit price per each as complete units of the size and type specified.

SECTION 608 — WHEEL STOPS

608.01 DESCRIPTION. Furnish and install preformed wheel stops.

608.02 MATERIALS.

Concrete Mix No. 2	902.10
Reinforcement Steel	908.01
Recycled Composite Material Wheel Stops	As specified by the manufacturer

Recycled Composite Material. Wheel stops manufactured of recycled composite material shall be as specified by the manufacturer and be insect resistant.

The manufacturer shall furnish certification as specified in TC-1.03.

608.03 CONSTRUCTION. Locate and secure wheel stops in place as specified. Only one type of wheel stop is permitted for each project.

608.04 MEASUREMENT AND PAYMENT. Wheel Stops will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 609 — SHOULDER EDGE DROP OFF GRADING ADJUSTMENT

609.01 DESCRIPTION. Construct the area adjacent to the outside edge of the shoulder to eliminate the shoulder edge drop off.

609.02 MATERIALS.

Crusher Run Aggregate CR-6	901.01
Bank Run Gravel Subbase	901.01

Select Borrow	916.01.01
Common Borrow	916.01.04
Topsoil	920.01
Hot Mix Asphalt Millings or Grindings	Size of individual particles shall be less than 2 in. as determined visually.

609.03 CONSTRUCTION. When the outside edge of the shoulder is greater than 2 1/2 in. above the existing groundline, place a wedge of material graded to a slope of 4:1 or as directed. Compact the material as specified or as directed. Complete the grading adjustment by the end of the day that the drop off is created and prior to opening to traffic.

The material, lines and grades, and the cross section shall be as specified.

609.04 MEASUREMENT AND PAYMENT. Crusher Run Aggregate CR-6, Bank Run Gravel Subbase, Select Borrow, Common Borrow, Topsoil, and Hot Mix Asphalt Millings or Grindings for Shoulder Edge Drop Off will be measured and paid for at the Contract unit price per ton, cubic yard, or square yard, as specified in the Contract Documents. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 610 — SHOULDER RUMBLE STRIPS

610.01 DESCRIPTION. Grind or mill depressions into existing hot mix asphalt or portland cement concrete to form rumble strips.

610.02 MATERIALS. Not applicable.

610.03 CONSTRUCTION. Place rumble strips as specified.

Grind or mill the rumble strips into hot mix asphalt (HMA) at a rate of at least 4000 strips per hour. Grind into portland cement concrete at a rate of at least 1000 strips per hour.

Equipment. The equipment shall have rotary type cutting heads with a length of 16 in. and an outside diameter not greater than 24 in. The cutting heads shall have the cutting tips arranged in a pattern providing a relatively smooth cut (approximately 1/16 in. between peaks and valleys).

The cutting heads shall be mounted on their own suspension, independent of the power unit, to allow the tool to self-align with the slope of the shoulder and any irregularities in the shoulder surface.

The cutting tool shall be equipped with guides to provide consistent alignment of each cut in relation to the roadway and to provide uniformity throughout the project. The Engineer will randomly check the pattern edge alignment.

Control Strip. Grind a control strip at least 100 ft. in length to demonstrate that the speed of operation, dimensions, and texture are acceptable.

Clean up. Sweep or vacuum the work area before reopening the roadway to traffic. Do not sweep the material to the side of the road.

610.04 MEASUREMENT AND PAYMENT. Rumble Strips will be measured and paid for at the Contract unit price per linear foot as measured along the shoulder or center line where the rumble strips are actually placed. Payment will be full compensation for all installation of rumble strips, cleaning and disposal of waste material, control strips, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 611 — DETECTABLE WARNING SURFACES

611.01 DESCRIPTION. Furnish and install detectable warning surfaces. Ensure that the detectable warning surface is in accordance with the most recent accessibility guidelines of the Americans with Disabilities Act (ADA).

611.02 MATERIALS.

Detectable Warning Surfaces

925

Select the detectable warning surface from the prequalified list maintained by the Office of Materials Technology. Ensure that detectable warning surface materials meet certification requirements prior to use. Submit the proposed source of supply and the specific product for approval.

611.03 CONSTRUCTION. The detectable warning system may be either surface applied or cast in place. However, use only Type I, III, or IV detectable warning systems for new or replacement concrete installations. Install the system according to the manufacturer's recommendations. Unless specifically addressed in the manufacturer's recommendations, remove the existing surface texturing by grinding or other means. At a minimum, prepare the concrete surface in accordance with SSPC-SP 13. Remove all old adhesives and sealants.

The detectable warning surface shall be 24 in. wide in the direction of pedestrian travel and installed for the full width of the curb ramp, landing, or blended transition. Do not bridge or overhang cracks or expansion joints.

Ensure that the vertical edges of the installed system are not more than 0.50 in. above the adjacent surfaces. Place a 2:1 or flatter bevel on edges that are more than 0.25 in. above the adjacent surface. The same edge requirements apply to cut material.

611.04 MEASUREMENT AND PAYMENT. Detectable Warning Surfaces will be measured and paid for at the Contract unit price per square foot. The payment will be full compensation for removal and disposal of old treatments, including adhesives and sealants, reapplying, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

The sidewalk on which the detectable warning surface is placed will be measured and paid for at the Contract price for the pertinent Sidewalk item.

CATEGORY 700

LANDSCAPING

SECTION 701 — TOPSOIL AND SUBSOIL

701.01 DESCRIPTION. Salvage, furnish, and place topsoil and subsoil.

701.02 MATERIALS.

Salvaged Topsoil	920.01.01
Furnished Topsoil	920.01.02
Salvaged Subsoil	920.01.03
Furnished Subsoil	920.01.04
Limestone	920.02.01
Sulfur	920.02.02
Gypsum	920.02.04
Compost	920.02.05

701.03 CONSTRUCTION.

701.03.01 General.

- (a) **Schedule.** Perform topsoil and subsoil operations when soil moisture and weather conditions are suitable. Cease operations when conditions are unsuitable.
- (b) **Nutrient Management Plan (NMP).** Soil testing will be performed and a NMP will be developed by the Administration. Apply fertilizer and soil amendments as specified in the NMP.
- (c) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

701.03.02 Salvaging Topsoil and Subsoil.

- (a) **Evaluation of Weeds.** Refer to 920.01.01. Topsoil and subsoil will be inspected and shall be free of prohibited weeds before salvaging operations. Prevent the spread of these weeds as directed.

- (b) **Removal.** Mow or remove vegetation from the areas where soil is to be salvaged. Remove topsoil and subsoil to the depth as specified or directed. Transport soils separately and keep them apart from other materials.
- (c) **Storage.** Construct storage areas on well drained land, away from streams, drainage areas, and floodplains as specified in Section 308.

Install and maintain silt fence around the edge of the stockpile areas as specified in 308.03.29 before placing stockpiles.

Maintain topsoil and subsoil separately, in neat stockpiles away from other material. Apply temporary mulch or temporary seed immediately after final shaping as specified in Section 704.

- (d) **Excess.** Topsoil and subsoil are Administration property. Do not remove soils without written approval.

701.03.03 Placing Salvaged Topsoil and Subsoil.

- (a) **Reevaluation of Weeds.** Soils that contain prohibited weeds will be reevaluated. Do not remove surface debris or transport soil from stockpiles before the reevaluation is completed.
- (b) **Debris Removal.** Remove grass, weeds, brush, and other objectionable material from the surface of stockpiles before transporting soil.
- (c) **Site Preparation.** Ensure the site is uniformly graded true to line and cross section in preparation for placing topsoil or subsoil.
- (d) **Placing, Spreading, and Compacting Subsoil.** Place, spread, and compact subsoil in layers up to 8 in. thickness to provide a firm and uniform subsoil base.

Track slopes 4:1 to 2:1 with cleated track equipment operated perpendicular to the slope.

Check subsoil thickness, lines, grades, and elevations to ensure the completed work is as specified. Remove stones and other debris with a length or width greater than 4 in. from the surface of the subsoil before placing and spreading topsoil.

- (e) **Placing and Spreading Topsoil.** Place and spread topsoil over the designated areas to the specified depth.

When topsoil can be blended with the substrate, till and mix the topsoil into the substrate.

When topsoil cannot be blended with the substrate, roughen the surface of the substrate to provide a bond for the topsoil layer.

- (f) **Grading Topsoil.** Grade the soil to provide a uniform surface true to depth, line, cross section, and elevation to ensure the completed work is as specified after settlement.

Track slopes 4:1 to 2:1 with cleated track equipment operated perpendicular to the slope.

Remove stones and other debris with a length or width greater than 3 in. from the surface of the topsoil when grading is completed.

- (g) **Amending Topsoil and Subsoil.** Apply soil amendments (limestone, sulfur, gypsum, compost) to salvaged topsoil and salvaged subsoil as specified in the NMP.

701.03.04 Placing Furnished Topsoil and Subsoil. Refer to 701.03.03 and the following:

- (a) **Responsibility.** Make arrangements and assume responsibility for consents, agreements, and payments with property owners who provide, prepare, or transport soils.
- (b) **Storage.** Construct storage areas and maintain stockpiles as specified in 701.03.02(c).

701.03.05 Inspection and Acceptance. Submit a request for Acceptance when operations are completed. Inspection will be conducted to verify that operations were completed as specified. Acceptance will be granted at that time.

701.04 MEASUREMENT AND PAYMENT. Topsoil and subsoil will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

701.04.01 Salvaging Topsoil will not be measured but the cost will be incidental to the Contract unit price for Class 1 Excavation.

701.04.02 Salvaging Subsoil will not be measured but the cost will be incidental to the Contract unit price for Class 1 Excavation.

701.04.03 Placing Salvaged Topsoil will be measured and paid for at the Contract unit price per square yard for the specified depth.

701.04.04 Placing Salvaged Topsoil for Grading Adjustment will be measured and paid for at the Contract unit price.

701.04.05 Placing Salvaged Subsoil will be measured and paid for at the Contract unit price per cubic yard.

701.04.06 Placing Furnished Topsoil will be measured and paid for at the Contract unit price per square yard for the specified depth.

701.04.07 Placing Furnished Topsoil for Grading Adjustment will be measured and paid for at the Contract unit price.

701.04.08 Placing Furnished Subsoil will be measured and paid for at the Contract unit price per cubic yard.

SECTIONS 702 — 703 RESERVED

SECTION 704 — TEMPORARY SEED AND TEMPORARY MULCH

704.01 DESCRIPTION. Apply temporary seed and temporary mulch.

704.02 MATERIALS.

Fertilizer	920.03.01
Straw Mulch	920.04.01
Wood Cellulose Fiber	920.04.02
Seed	920.06
SHA Temporary Seed Mix	920.06.07
Water	920.09.01

704.03 CONSTRUCTION.**704.03.01 General.**

- (a) **Schedule.** Apply temporary seed and temporary mulch any time of the year to areas that are not ready for permanent stabilization.
- (b) **Nutrient Management Plan (NMP).** The fertilizer application rate specified in 704.03.02(c) shall be the NMP rate for temporary seeding unless the Administration develops a substitute NMP.
- (c) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

704.03.02 Temporary Seed. Prepare the soil and apply seed, fertilizer, mulch, and wood cellulose fiber to areas that will remain undisturbed for 2 to 12 months.

- (a) **Soil Preparation.** Complete grading and shaping operations as directed. Loosen soil surfaces before seeding.
- (b) **Application Equipment.** Refer to 705.03.05.
- (c) **Application Rates.** Apply materials according to the following table. Do not apply fertilizer if the area was fertilized within the previous 3 months.

APPLICATION RATES - TEMPORARY SEED		
MATERIAL	LB PER 1000 FT²	LB PER ACRE
SHA Temporary Seed Mix	2.9	125
Fertilizer (15-30-15)	10.3	450
Straw Mulch	91.8	4000
Wood Cellulose Fiber	17.2	750

(d) Seeding.

- (1) **Hydroseeders.** Apply seed and fertilizer mixtures within two hours of mixing.
- (2) **Mechanical Seeder.** Incorporate seed and fertilizer to a depth of 1/8 to 1/4 in.

- (3) **After Seeding.** Immediately apply straw mulch.
- (e) **Mulching.** Mulch shall cover 90 percent of the soil surface when applied as follows:
 - (1) **Blower.** Apply mulch to a loose depth of 3/4 to 2 in.
 - (2) **Manually.** Apply mulch to a loose depth of 1-1/2 to 3 in.
- (f) **Securing Mulch.** Immediately after applying mulch secure with wood cellulose fiber. Do not displace the mulch.

704.03.03 Temporary Mulch. Apply straw mulch and wood cellulose fiber to areas that will be redisturbed in within 2 months.

- (a) **Soil Preparation.** Do not disturb or till soil.
- (b) **Application Equipment.** Refer to 705.03.05.
- (c) **Application Rates.** Apply materials as follows:

APPLICATION RATES - TEMPORARY MULCH		
MATERIAL	LB PER 1000 FT ²	LB PER ACRE
Straw Mulch	91.8	4000
Wood Cellulose Fiber	17.2	750

- (d) **Mulching.** Refer to 704.03.02(e).
- (e) **Securing Mulch.** Refer to 704.03.02(f).

704.03.04 Repairing Defective Areas. Repair Temporary Seed or Temporary Mulch that is defective. Complete repairs before Acceptance.

704.03.05 Acceptance. Submit a request for Acceptance when operations are completed. Inspection will be conducted to verify completion. Acceptance will be granted when at least 90 percent of the soil surface is covered with secured mulch.

704.03.06 Repairs after Acceptance. Repair or replace Temporary Seed or Temporary Mulch, when directed after Acceptance, at the Contract unit price as additional work.

704.04 MEASUREMENT AND PAYMENT. Temporary Seed and Temporary Mulch will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

704.04.01 Temporary Seed will be measured and paid for at the Contract unit price per pound of seed.

704.04.02 Temporary Mulch will be measured and paid for at the Contract unit price per square yard.

SECTION 705 — TURFGRASS ESTABLISHMENT

705.01 DESCRIPTION. Prepare soil and establish turfgrass.

705.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Gypsum	920.02.04
Compost	920.02.05
Fertilizer	920.03.01
Straw Mulch	920.04.01
Wood Cellulose Fiber	920.04.02
Soil Stabilization Matting	920.05.01
Fasteners	920.05.02
Seed	920.06
SHA Turfgrass Seed Mix	920.06.07(a)
SHA Special Purpose Seed Mix	920.06.07(b)
SHA Temporary Seed Mix	920.06.07(c)
Water	920.09.01

705.03 CONSTRUCTION.

705.03.01 General.

(a) Regional Areas. Maryland is divided into Regions by counties as follows:

Region 1. Garrett, Allegany, and Washington (West of Clear Spring, MD).

Region 2. Washington (East of Clear Spring, MD), Frederick, Carroll, Baltimore, Harford, Cecil, Howard, Montgomery, and Baltimore City.

Region 3. Anne Arundel, Prince George’s, Calvert, Charles, St. Mary’s, Kent, Queen Anne’s, Talbot, Caroline, Dorchester, Wicomico, Worcester, and Somerset.

(b) Seeding Seasons and Seed Mixes. Perform turfgrass establishment when the temperature is above 32 F and the soil is not frozen according to the following schedule:

SEEDING SEASONS AND SEED MIXES				
REGION	SEEDING SEASON - MONTH/DAY			
	Spring	Summer	Fall	Late Fall
	SHA Turfgrass Seed Mix			
1	4/1 to 6/15	6/16 to 7/31	8/1 to 10/1	10/2 to 11/1
2	3/1 to 5/15	5/16 to 7/31	8/1 to 10/20	10/21 to 11/20
3	3/1 to 5/1	5/2 to 7/31	8/1 to 10/31	11/1 to 11/30
1, 2, and 3	–	Plus Additive A or B	–	Plus Additive C
	Plus Additive D when seeding: <ul style="list-style-type: none"> • Areas 30 ft and greater from the pavement edge • Slopes 4:1 and steeper 			
	When seeding areas within 4 miles of a State airport: Areas flatter than 4:1 - Use no Additives Slopes 4:1 and steeper - Use SHA Special Purpose Seed Mix in lieu of SHA Turfgrass Seed Mix			
	<p style="text-align: center;">Additives</p> <p>A = Weeping Lovegrass C = SHA Temporary Seed Mix B = Foxtail Bristlegrass D = Sericea Lespedeza</p>			

- (c) **Nutrient Management Plan (NMP).** Soil testing will be performed and a NMP will be developed by the Administration. Replace application rates of 705.03.06 as required by the NMP.

When a NMP is not available, 1000 lb. per acre of 20-16-12 (83% UF with MAP & SOP) fertilizer shall be the NMP rate for turfgrass establishment.

- (d) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

705.03.02 Grade Repair. Ensure that soil meets specified grades. Repair any gullies, washes, or disturbed areas that develop before preparing soil or seedbed.

705.03.03 Preparing Soil. Loosen the soil as follows:

- (a) **Topsoiled Areas 4 in. Thickness and Greater.** Loosen topsoil immediately before seeding by disking, raking, or rototilling to a depth of at least 3 in.
- (b) **Topsoiled Areas 2 in. Thickness.** Loosen topsoil as specified in (a) to a depth of 2 in.
- (c) **Nontopsoiled Areas.** Loosen subsoil as specified in (a) to a depth of 1 in.
- (d) **Slopes 4:1 to 2:1.** Refer to 701.03.03(f).
- (e) **Serrated Cut Slopes.** Do not loosen soil.

705.03.04 Preparing Seedbed. Till the seedbed so that it conforms to the specified finished grade and provides a uniform and porous surface that is free of weed and plant growth.

- (a) **Areas Flatter than 4:1.** Remove cleat marks and debris from the soil surface as follows:
- (1) **Within 15 ft of Pavement Edge.** Remove clods, stones, and debris with a length or width greater than 1-1/2 in.

(2) **Near Commercial or Residential Property.** As in (1), above.

(3) **All Other Areas.** Remove stones and debris with a length or width greater than 2-1/2 in.

(b) **Slopes 4:1 and Steeper.** Remove clods, stones, and debris with a length or width greater than 3.0 in. from the soil surface.

705.03.05 Application Equipment. Use hydroseeders, spreaders, drills, mulch blowers, or other approved machinery. Calibrate equipment before application. Apply materials accurately and uniformly to avoid misses and overlaps.

Hydroseeders shall be equipped with an agitation system able to keep solids in suspension, and have a gauge to show fill levels and tank capacity. Operate hydroseeders and spinner spreaders during non-windy weather. Do not allow materials to blow onto sensitive areas or structures.

Direct hydroseeding mixtures so the droplets produce a uniform spray. Do not allow materials to runoff or cause erosion. Mechanical seeders shall be capable of placing seed and other materials at the specified rate.

705.03.06 Application Rates. Refer to 705.03.01(b) and include seed additives as specified. Apply materials as follows:

APPLICATION RATES		
MATERIAL	LB PER 1000 FT ²	LB PER ACRE
LIMESTONE Regions 1 and 2: Limestone Region 3: Dolomitic Limestone	0 to 200 ^a 0 to 185 ^a	0 to 8700 ^a 0 to 8050 ^a
SULFUR All Areas	0 to 30 ^a	0 to 1300 ^a
GYPSUM All Areas except Serrated Cut Slopes	0 to 92 ^a	0 to 4000 ^a
COMPOST All Areas except Serrated Cut Slopes	0 to 1.4 yd ³ compost per 24 yd ³ of topsoil ^a	
SEED MIXES		
SHA Turfgrass Seed Mix Areas less than 30 ft from the pavement edge flatter than 4:1, and at facilities	4.6	200
SHA Turfgrass Seed Mix & Sericea Lespedeza Areas 30 ft and more from the pavement edge, and slopes 4:1 and steeper SHA Turfgrass Seed Mix Sericea Lespedeza	2.3 0.46	100 20
SHA Special Purpose Seed Mix Slopes 4:1 and steeper within four miles of a State airport	4.6	200
ADDITIVE SEED		
A = Weeping Lovegrass	0.046	2
B = Foxtail Bristlegrass	0.23	10
C = SHA Temporary Seed Mix	0.57	25
D = Sericea Lespedeza	0.46	20
FERTILIZER AT SEEDING		
Topsoiled Areas		
20-16-12 (83% UF with MAP & SOP)	23.0 ^a	1000 ^a
38-0-0 (UF)	0 to 9.2 ^{a,b}	0 to 400 ^{a,b}
0-0-50 (SOP)	0 to 5.7 ^{a,b}	0 to 250 ^{a,b}
Nontopsoiled Areas		
20-16-12 (83% UF with MAP & SOP)	23.0 ^a	1000 ^a
38-0-0 (UF)	8.0 to 17.2 ^{a,b}	350 to 750 ^{a,b}
0-0-50 (SOP)	0 to 5.7 ^{a,b}	0 to 250 ^{a,b}
MULCH		
Straw Mulch Secured with Wood Cellulose Fiber	92	4000
Wood Cellulose Fiber	34	1500
MULCH BINDER Wood Cellulose Fiber	17	750
REFERTILIZING		
5-20-20	4.6	200
38-0-0 (UF)	11.5	500

Note: UF = Ureaform MAP = Monoammonium Phosphate SOP = Sulfate of Potash

^a The NMP will specify the application rate.

^b When application of 20-16-12 is below 1000 lb. per acre, apply 38-0-0 and 0-0-50 per NMP.

705.03.07 Incorporating Soil Amendments. Incorporate amendments (limestone, sulfur, gypsum, compost) into the soil as follows:

(a) Topsoiled Areas Flatter than 4:1.

(1) Topsoil Depth of 2 in. Incorporate to a 2 in. depth.

(2) Topsoil Depth 4 in. and Greater. Incorporate to 3 in. depth.

(b) Topsoiled Areas 4:1 and Steeper. Apply limestone, sulfur, and gypsum immediately before or after tracking. Incorporate compost into topsoil in a separate operation before spreading topsoil.

(c) Nontopsoiled Areas and Serrated Cut Slopes. Apply the amendments to the soil surface after completing soil loosening operations.

Fertilizer may be incorporated into the soil with soil amendments.

705.03.08 Fertilizing and Seeding. Apply fertilizer and seed to previously prepared areas. On slopes 4:1 and steeper, including serrated cut slopes, apply seed, fertilizer, and mulch in 15 ft maximum vertical increments.

(a) Hydraulic Seeding. Apply fertilizer and seed mixtures within two hours after mixing.

Inoculate sericea lespedeza seed with 10 times the amount of inoculant specified on the inoculant package label for dry seeding. Apply seed within one hour of inoculation, or reinoculate and apply seed within one hour of reinoculation.

(b) Mechanical Seeding. Incorporate seed and fertilizer to a depth of 1/8 to 1/4 in. below the soil surface.

Dampen sericea lespedeza seed with water, and add the amount of inoculant specified on the package label before mixing with other seed. Apply seed within 24 hours of inoculation, or reinoculate and apply seed within 24 hours of reinoculation.

705.03.09 Mulching. Apply mulch immediately after seeding in all seasons except as allowed in (b) and (c).

(a) **Mulch Cover.** Cover at least 90 percent of the soil surface with mulch as follows:

(1) **Mulch Blower.** Apply mulch to a loose depth of 3/4 to 2 in.

(2) **By Hand.** Apply mulch to a loose depth of 1-1/2 to 3 in.

(b) **Wood Cellulose Fiber.** Wood cellulose fiber may be approved as a replacement for straw mulch on slopes 1-1/2:1 and steeper where straw application equipment is impractical.

Apply at least 70 percent of the wood cellulose fiber mulch after and separately from the seed and fertilizer during the Summer Seeding Season.

(c) **Summer Seeding Season.** In medians flatter than 4:1 open to traffic, install Type A Soil Stabilization Matting in lieu of straw mulch over seed and fertilizer as specified in Section 709. Keying-in shall not be performed within curbed medians.

705.03.10 Securing Mulch. Secure straw immediately after the completion of mulching operations by applying wood cellulose fiber uniformly without displacing the mulch.

705.03.11 Seeding Phase Acceptance. Submit a request for Seeding Phase Acceptance when operations are completed. Inspection will be conducted to verify completion. Seeding Phase Acceptance will be granted at that time.

705.03.12 Establishment Phase. The Establishment Phase will begin upon Seeding Phase Acceptance.

705.03.13 Overseeding and Reseeding. When turfgrass establishment is not acceptable, perform overseeding and reseeding as directed. Do not apply additional fertilizer or soil amendments unless directed.

(a) **Overseeding Thin Turf.** Overseeding consists of seeding and mulching areas where turfgrass coverage is 40 to 94 percent.

(1) **Methods.** Cut the turfgrass to a height of 3 to 4 in. and remove debris that will interfere with seeding. Do not apply herbicide or till soil. Apply seed mixtures, seed additives, mulch, and secure mulch as specified in 705.03.01 and 705.03.05 thru .10.

(2) **Coverage.** Ensure at least 90 percent of the soil surface is covered with mulch or turfgrass when overseeding is completed.

(b) **Reseeding Failed Turf.** Reseeding consists of tilling, seeding and mulching areas where turfgrass coverage is less than 40 percent.

Grade, prepare soil and seedbed, seed, mulch, and secure as specified in 705.03.01 thru .10.

705.03.14 Final Acceptance. The Engineer and the Landscape Operations Division will complete an Inspection Report of turfgrass height, color, and percent coverage. When it is not possible to perform the Inspection, Final Acceptance will be delayed until Inspection is possible.

The Inspection Report will be included in the Punch List requirements for the project. Complete the Punch List requirements as directed.

Final Acceptance will be granted when the turfgrass seedlings have grown at least 4 in., exhibit dark green color, and percent coverage as follows:

TURFGRASS ESTABLISHMENT COVERAGE		
AREAS	SHA TURFGRASS SEED MIX or SHA SPECIAL PURPOSE SEED MIX	OTHER DESIRABLE VEGETATION
	Seedling Coverage	
Areas flatter than 4:1; and slopes 4:1 and steeper not tracked with cleated equipment	at least 95% *	up to 5%
Slopes 4:1 and steeper tracked with cleated equipment	at least 50% *	up to 50%

* Includes coverage of additive seed species when included.

705.03.15 Mowing. Mow as specified in the Integrated Vegetation Management Manual for Maryland Highways and as follows:

MOWING HEIGHT				
AREAS	TRACTOR CUTTING		HAND CUTTING	
	Max Height Before Mowing In.	Height of Cut In.	Max Height Before Mowing In.	Height of Cut In.
General Areas	18	4 - 5	10	3 - 4
In Medians or Adjacent to Commercial or Residential Areas	12	4 - 5	8	3 - 4

705.03.16 Refertilizing. Apply 5-20-20 and 38-0-0 (UF) fertilizer 4 to 12 months after seeding as directed.

REFERTILIZING TURFGRASS AREAS			
AREAS	REGIONS	NUMBER OF APPLICATIONS	TIMING
Topsoiled	1 and 2	1	April or September
Nontopsoiled and Serrated Cut Slopes	1 and 2	1	April or September
	3	2	April and September

705.04 MEASUREMENT AND PAYMENT. Turfgrass establishment will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

705.04.01 Turfgrass Establishment. Turfgrass Establishment including preparing soil, preparing seed bed, applying fertilizer, seed mixes, seed additives, overseeding, reseeding, mulching, securing mulch, and repairing unacceptable areas will be measured and paid for at the Contract unit price per square yard.

(a) Payment Schedule. Payments will be made according to the following Schedule when construction requirements are met:

PAYMENT SCHEDULE		
CONSTRUCTION REQUIREMENTS	PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
705.03.01 thru .11	80	At Seeding Phase Acceptance
705.03.12 thru .14	20	At Final Acceptance
Total Payment	100%	

(b) Forfeiture. Failure to complete operations as required in conformance with the Payment Schedule will result in forfeiture of that percentage of payment.

705.04.02 Applying Limestone to Salvaged Topsoil and Nontopsoiled Areas per ton.

705.04.03 Applying Sulfur to Salvaged Topsoil and Nontopsoiled Areas per ton.

705.04.04 Applying Gypsum to Salvaged Topsoil and Nontopsoiled Areas per ton.

705.04.05 Applying Compost to Salvaged Topsoil and Nontopsoiled Areas per cubic yard.

705.04.06 Applying 38-0-0 Ureaform Fertilizer to Nontopsoiled Areas per pound.

705.04.07 Refertilizing per pound.

705.04.08 Tractor and Hand Mowing per hour.

705.04.09 Amending furnished topsoil and furnished subsoil will not be measured but the cost will be incidental to the Contract unit price for Placing Furnished Topsoil and Placing Furnished Subsoil.

SECTION 706 — SHRUB SEEDING

706.01 DESCRIPTION. Perform shrub seeding.

706.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Compost	920.02.05
Fertilizer	920.03.01
Straw Mulch	920.04.01
Wood Cellulose Fiber	920.04.02
Meadow Forb Seed	920.06 and 920.06.06(d)
Meadow Grass, Sedge and Rush Seed	920.06 and 920.06.06(e)
Shrub Seed	920.06 and 920.06.06(g)
SHA Special Purpose Seed Mix	920.06 and 920.06.07(b)
SHA Temporary Seed Mix	920.06 and 920.06.07(c)
Water	920.09.01

706.03 CONSTRUCTION.

706.03.01 General.

(a) **Regional Areas.** Refer to 705.03.01(a).

(b) **Seeding Seasons.** Perform shrub seeding when the temperature is above 32 F and the soil is not frozen according to the following schedule:

SEEDING SEASONS AND SEED				
REGIONS	SEASON - MONTH/DAY			
	Spring	Summer	Fall	Late Fall
	Shrub Seed			
1	3/1 to 6/15	6/16 to 7/31	8/1 to 10/1	10/2 to 11/1
2	2/15 to 5/15	5/16 to 7/31	8/1 to 10/20	10/21 to 11/20
3	2/1 to 5/1	5/2 to 7/31	8/1 to 10/31	11/1 to 11/30
1, 2, and 3	Plus Additive A and C	Plus Additive A, B and C	Plus Additive A and C	Plus Additive A, B and C
	Additives A = SHA Special Purpose Seed Mix C = Upland Meadow Seed or B = SHA Temporary Seed Mix Lowland Meadow Seed			

- (c) **Nutrient Management Plan (NMP).** Soil testing will be performed and a NMP will be developed by the Administration. Replace application rates of 706.03.04 as required by the NMP.

When a NMP is not available, 600 lb. per acre of 20-16-12 (83% UF with MAP & SOP) fertilizer shall be the NMP rate for shrub seeding.

- (d) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the SHA Nutrient Management Reporting Form. Submit the Form to the Engineer within 24 hours after applying fertilizer.

706.03.02 Preparing Soil. Refer to 705.03.03.

706.03.03 Seed Delivery, Weighing, and Mixing.

- (a) **Delivery.** Shrub seed shall be delivered unmixed.
- (b) **Weighing and Mixing.** Test seed as specified in 920.06.05 before weighing and mixing.

Use a scale with 0.01 oz accuracy to verify application rates and quantities of seed.

Mix and apply seed separately or with other specified seed.

706.03.04 Application Rates. Refer to 706.03.01(b) and include seed additives as specified. Apply materials as follows:

TABLE 1 - APPLICATION RATES		
MATERIAL	LB PER 1000 FT²	LB PER ACRE
LIMESTONE	0 to 50 ^a	0 to 2,000 ^a
SULFUR	0 to 13 ^a	0 to 550 ^a
COMPOST	0 to 1.4 yd ³ Compost per 24 yd ³ of Topsoil ^a	
SHRUB SEED		
Upland Shrub Seed	Refer to Table 2 Upland Shrub Seed	Refer to Table 2 Upland Shrub Seed
Lowland Shrub Seed	Refer to Table 3 Lowland Shrub Seed	Refer to Table 3 Lowland Shrub Seed
ADDITIVE SEED		
SHA Special Purpose Seed Mix	0.5	22
SHA Temporary Seed Mix	1.1	50
Upland Meadow Seed Include With Upland Shrub Seed	Refer to 707.03.07, Table 2 Upland Meadow Seed	Refer to 707.03.07, Table 2 Upland Meadow Seed
Lowland Meadow Seed Include With Lowland Shrub Seed	Refer to 707.03.07, Table 3 Lowland Meadow Seed	Refer to 707.03.07, Table 3 Lowland Meadow Seed
FERTILIZER AT SEEDING		
20-16-12 (83% UF with MAP & SOP)	13.8 ^a	600 ^a
38-0-0 (UF)	0 to 3.0 ^{a,b}	0 to 130 ^{a,b}
11-52-0 (MAP)	0 to 6.0 ^{a,b}	0 to 270 ^{a,b}
0-0-50 (SOP)	0 to 5.0 ^{a,b}	0 to 220 ^{a,b}
MULCH		
Straw Mulch	66	3000
Wood Cellulose Fiber Mulch Binder	23	1000
REFERTILIZING		
5-20-20	2.3	100
38-0-0 (UF)	5.7	250

Note: UF = Ureaform MAP = Monoammonium Phosphate SOP = Sulfate of Potash

^a The NMP will specify the application rate.

^b When application of 20-16-12 is below 600 lb per acre, apply 38-0-0, 11-52-0, and 0-0-50 per NMP.

TABLE 2 - UPLAND SHRUB SEED					
SPECIES Select 6 Marked 'x'	SEEDING RATE		REGION		
	Oz per 1000 Ft²	Lb per Acre	1	2	3
black chokeberry	0.37	1.0	x	x	x
bristly locust *	0.92	2.5	x		
chokecherry	1.10	3.0	x	x	
fragrant sumac	1.10	3.0	x		
gray dogwood	1.10	3.0	x	x	
mapleleaf viburnum	0.55	1.5		x	x
nannyberry	1.10	3.0	x	x	x
red elderberry	0.18	0.5	x		
smooth sumac	1.10	3.0	x	x	x
spicebush	1.10	3.0		x	x
staghorn sumac	1.10	3.0	x	x	x
witch hazel	1.10	3.0		x	x

TABLE 3 - LOWLAND SHRUB SEED					
SPECIES Select 6 Marked 'x'	SEEDING RATE		REGION		
	Oz per 1000 Ft²	Lb per Acre	1	2	3
American cranberrybush	1.10	3.0	x	x	
American black elderberry	0.92	2.5	x	x	x
common buttonbush	1.29	3.5	x	x	x
common winterberry	1.10	3.0	x	x	
desert false indigo *	1.10	3.0		x	x
inkberry	1.29	3.5		x	x
ninebark	0.37	1.0	x	x	
red chokeberry	0.73	2.0	x	x	x
redosier dogwood	1.29	3.5	x	x	
silky dogwood	0.73	2.0		x	x
southern arrowwood	1.29	3.5	x	x	x
steeplesh	0.37	1.0		x	x
swamp Rose	0.55	1.5		x	x

*Apply seed with inoculant labeled for use with the species.

706.03.05 Application Equipment. Refer to 705.03.05.

706.03.06 Fertilizing and Seeding. Apply seed and fertilizer only to previously prepared sites. Apply up to 150 pounds per acre of wood cellulose fiber mulch binder with seed and fertilizer mixtures.

Apply fertilizer and seed mixtures within two hours after mixing. Inoculate bristly locust and desert false indigo with 10 times the quantity of inoculant required for dry seeding. Apply seed within one hour of inoculation, or reinoculate and apply seed within one hour of reinoculation.

On slopes 4:1 and steeper, including serrated cut slopes, apply seed, fertilizer and mulch in 15 ft maximum vertical increments.

706.03.07 Mulching. Refer to 707.03.11.

706.03.08 Securing Mulch. Secure straw mulch immediately after application by applying wood cellulose fiber uniformly without displacing the mulch.

706.03.09 Seeding Phase Acceptance. Submit a request for Seeding Phase Acceptance when operations are completed. Inspection will be conducted to verify completion. Seeding Phase Acceptance will be granted at that time.

706.03.10 Establishment Phase. The Establishment Phase will begin upon Seeding Phase Acceptance.

706.03.11 Final Acceptance. The Engineer and the Landscape Operations Division will complete an Inspection Report of seedling height, color, and percent coverage. When it is not possible to perform the Inspection, Final Acceptance will be delayed until Inspection is possible.

The Inspection Report will be included in the Punch List requirements for the project. Complete the Punch List requirements as directed.

Final Acceptance will be granted when the seedlings have grown at least 4 in., exhibit dark green color, and percent coverage as follows:

SHRUB SEEDING COVERAGE		
AREAS	SHA SPECIAL PURPOSE SEED MIX, SHA TEMPORARY SEED MIX, SHRUB SEED, and MEADOW SEED	TOTAL VEGETATION COVER
	Seedling Coverage	
Areas flatter than 4:1; and slopes 4:1 and steeper not tracked with bulldozer	at least 70%	at least 95%
Slopes 4:1 and steeper tracked with bulldozer	at least 45%	at least 95%

706.03.12 Refertilizing. Apply 5-20-20 and 38-0-0 (UF) fertilizer 4 to 12 months after seeding as directed.

706.04 MEASUREMENT AND PAYMENT. Shrub Seeding will be measured and paid for at the Contract unit price for one or more of the Specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

706.04.01 Upland Shrub Seeding. Upland Shrub Seeding, including preparing soil, applying fertilizer, shrub seed, additive seed, mulch, and securing mulch will be measured and paid for at the Contract unit price per square yard.

Payment Schedule. Payments will be made according to the following Schedule when construction requirements are met:

PAYMENT SCHEDULE			
CONSTRUCTION REQUIREMENTS		PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
706.03.01 thru .09	Seeding Phase	80	At Seeding Phase Acceptance
706.03.10 and .11	Establishment Phase and Final Acceptance	20	At Final Acceptance
Total Payment		100%	

Forfeiture. Failure to complete operations as required or directed in conformance with the Payment Schedule will result in forfeiture of that percentage of payment.

706.04.02 Lowland Shrub Seeding. Lowland Shrub Seeding, including preparing soil, applying fertilizer, shrub seed, additive seed, mulch, and securing mulch will be measured and paid for at the Contract unit price per square yard.

Payment Schedule. Refer to 706.04.01.

Forfeiture. Refer to 706.04.01.

706.04.03 Applying Limestone to Salvaged Topsoil and Nontopsoiled Areas per ton.

706.04.04 Applying Sulfur to Salvaged Topsoil and Nontopsoiled Areas per ton.

706.04.05 Applying Compost to Salvaged Topsoil and Nontopsoiled Areas per cubic yard.

706.04.06 Refertilizing per pound.

706.04.07 Amending furnished topsoil and furnished subsoil will not be measured but the cost will be incidental to the Contract unit price for Placing Furnished Topsoil and Placing Furnished Subsoil.

SECTION 707 — MEADOW ESTABLISHMENT AND WILDFLOWER SEEDING

707.01 DESCRIPTION. Perform meadow establishment and wildflower seeding.

707.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Compost	920.02.05
Fertilizer	920.03.01
Straw Mulch	920.04.01
Wood Cellulose Fiber	920.04.02
Meadow Forb Seed	920.06 and 920.06.06(d)
Meadow Grass, Sedge and Rush Seed	920.06 and 920.06.06(e)
Wildflower Seed	920.06 and 920.06.06(f)
SHA Special Purpose Seed Mix	920.06 and 920.06.07(b)

Water	920.09.01Seed
Carrier	920.09.02
Pesticides	920.09.03

707.03 CONSTRUCTION. Complete 707.03.01 thru .14 when performing meadow establishment. Complete 707.03.15 thru .26 when performing wildflower seeding.

707.03.01 Meadow Establishment - General.

- (a) **Regional Areas.** Refer to 705.03.01.
- (b) **Seeding Seasons.** Perform seeding when the temperature is above 32 F and the soil is not frozen according to the following schedule:

SEEDING SEASONS - MONTH/DAY		
REGION	SPRING	FALL
1	3/1 to 4/31	8/15 to 9/30
2	2/15 to 4/15	9/1 to 10/15
3	2/1 to 3/31	9/15 to 10/31

- (c) **Pesticide Application.** Refer to 710.03.01(c).
- (d) **Pesticide Application Reporting.** Refer to 710.03.01(d).
- (e) **Nutrient Management Plan (NMP).** Soil testing will be performed and a NMP will be developed by the Administration. Replace application rates of 707.03.08 as required by the NMP.

When a NMP is not available, 400 lb. per acre of 20-16-12 (83% UF with MAP & SOP) fertilizer shall be the NMP rate for meadow establishment.

- (f) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

707.03.02 Submittals. Submit the following items:

- (a) **Seeding Schedule.** Develop a Schedule that provides dates for completing major operations of the Contract, including nonselective herbicide application, mowing, tilling, and seeding.

Submit the written Schedule at least 14 days before beginning operations. The Schedule will be reviewed by the Engineer and Landscape Operations Division for completeness and feasibility, and will be approved or returned for correction.

- (b) **IPM Program and Establishment Schedule.** Develop an IPM Program that includes methods of pest monitoring for weed control, pesticide selection, application rates, and scheduling. The Establishment Schedule shall include dates for meadow maintenance operations such as mowing.

Submit the IPM Program and Establishment Schedule when seeding operations are completed. The Program and Schedule will be forwarded to the Landscape Operations Division for review and comment before approval is granted.

707.03.03 Marking. Mark areas to be seeded, and obtain approval before applying herbicide, mowing, or beginning seeding operations.

707.03.04 Non-Selective Herbicide Application. Apply non-selective herbicide to eliminate undesirable vegetation when directed. Apply herbicide in water with wetting agent and dye in conformance with the IPM Program at least 10 days before seeding as follows:

NONSELECTIVE HERBICIDE APPLICATION	
MATERIAL	RATE PER ACRE
Glyphosate Herbicide	5 lb of active ingredient
Marking Dye	6 to 15 oz
Water	40 to 50 gal

707.03.05 Mowing. Mow vegetation to a height less than 4 in. before seeding when directed by the Engineer. Do not perform mowing within 10 days of non-selective herbicide application. Disperse or dispose of excessive clippings prior to seeding.

707.03.06 Preparing Soil Before Seeding.

- (a) **Broadcast Seeding.** Rototill the soil to a depth of 1 in. and remove stones and other debris with a length or width greater than 2-1/2 in. from the soil surface.
- (b) **Drill Seeding.** When using a drill seeder, no soil preparation is required.

707.03.07 Seed Delivery, Weighing, and Mixing.

- (a) **Delivery.** Seed shall be delivered unmixed.
- (b) **Weighing and Mixing.** Test seed as specified in 920.06.05 before weighing and mixing.

Use a scale with 0.01 oz accuracy to verify application rates and quantities of seed. Mix and apply seed separately or with other specified seed.

707.03.08 Application Rates. Apply materials as follows:

TABLE 1 - MEADOW ESTABLISHMENT APPLICATION RATES		
MATERIAL	LB PER 1000 FT²	LB PER ACRE
LIMESTONE	0 to 50 ^a	0 to 2,000 ^a
SULFUR	0 to 13 ^a	0 to 550 ^a
COMPOST	1.4 yd ³ Compost per 24 yd ³ of Topsoil ^a	
UPLAND MEADOW SEED	Refer to Table 2 Upland Meadow Seed	Refer to Table 2 Upland Meadow Seed
LOWLAND MEADOW SEED	Refer to Table 3 Lowland Meadow Seed	Refer to Table 3 Lowland Meadow Seed
WET MEADOW SEED	Refer to Table 4 Wet Meadow Seed	Refer to Table 4 Wet Meadow Seed
SHA SPECIAL PURPOSE SEED MIX Include with Upland & Lowland Meadow Seed	0.50	25
SEED CARRIER	2 to 6	85 to 260
FERTILIZER		
20-16-12 (83% UF with MAP & SOP)	9.2 ^a	400 ^a
38-0-0 (UF)	0 to 3.0 ^{a,b}	0 to 130 ^{a,b}
11-52-0 (MAP)	0 to 6.0 ^{a,b}	0 to 270 ^{a,b}
0-0-50 (SOP)	0 to 5.0 ^{a,b}	0 to 220 ^{a,b}
MULCH		
Straw Mulch	66	3000
Wood Cellulose Fiber Mulch Binder	23	1000

Note: UF = Ureaform MAP = Monoammonium Phosphate SOP = Sulfate of Potash

^a The NMP will specify the application rate.

^b When application of 20-16-12 is below 400 lb per acre, apply 38-0-0, 11-52-0, and 0-0-50 per NMP.

TABLE 2 - UPLAND MEADOW SEED					
FORBS	PURE LIVE SEED *		GRASSES	PURE LIVE SEED *	
	Oz per 1000 Ft²	Lb per Acre		Oz per 1000 Ft²	Lb per Acre
Select 8			Include All		
blackeyed Susan	0.18	0.5	Broomsedge	0.36	1.0
browneyed Susan	0.18	0.5	Deertongue	0.73	2.0
eastern purple coneflower	0.44	1.2	Little Bluestem	0.73	2.0
gray goldenrod	0.07	0.2	Purpletop	0.73	1.0
lanceleaf tickseed	0.51	1.4	Note: Seed Upland Meadow Seed with SHA Special Purpose Seed Mix * Seeding rates shall be calculated on the basis of Pure Live Seed per 1000 ft ² or acre.		
Maryland senna	0.11	0.3			
partridge pea	0.44	1.2			
smooth blue aster	0.07	0.2			
sundial lupine	0.51	1.4			
talus slope penstemon	0.07	0.2			
wild bergamot	0.07	0.2			

TABLE 3 - LOWLAND MEADOW SEED					
FORBS	PURE LIVE SEED *		GRASSES	PURE LIVE SEED *	
	Oz per 1000 Ft²	Lb per Acre		Oz per 1000 Ft²	Lb per Acre
Select 8			Include All		
common boneset	0.04	0.1	big bluestem	2.0	0.73
eastern purple coneflower	0.44	1.2	gamagrass	2.0	0.73
evening primrose	0.07	0.2	Indiangrass	2.0	0.73
lanceleaf tickseed	0.55	1.5	switchgrass	1.0	0.36
Maximilian sunflower	0.18	0.5	Note: Seed Lowland Meadow Seed with SHA Special Purpose Seed Mix * Seeding rates shall be calculated on the basis of Pure Live Seed per 1000 ft ² or acre.		
New England aster	0.07	0.2			
New York ironweed	0.07	0.2			
showy tickseed	0.04	0.1			
stiff goldenrod	0.11	0.3			
swamp verbena	0.26	0.7			
trumpetweed or spotted trumpetweed	0.07	0.2			

TABLE 4 - WET MEADOW SEED					
FORBS	PURE LIVE SEED *		GRASSES, SEDGES and RUSHES	PURE LIVE SEED *	
	Oz per 1000 Ft ²	Lb per Acre		Oz per 1000 Ft ²	Lb per Acre
Select 8			Include All		
Allegheny monkeyflower	0.07	0.2	common rush	0.29	0.8
crimsoneyed rose mallow	0.07	0.2	fox sedge	0.18	0.5
flat-top goldenrod	0.07	0.2	longhair sedge	0.11	0.3
king of the meadow	0.07	0.2	rattlesnake mannagrass	0.18	0.5
New York Aster	0.07	0.2	shallow sedge	0.11	0.3
New York Ironweed	0.07	0.2	woolgrass	0.11	0.3
seedbox	0.07	0.2	* Seeding rates shall be calculated on the basis of Pure Live Seed per 1000 ft ² or acre.		
swamp milkweed	0.04	0.1			
swamp sunflower	0.11	0.3			
swamp verbena	0.26	0.7			
trumpetweed or spotted trumpetweed	0.07	0.2			

707.03.09 Seeding Equipment. Use approved drill seeders equipped with 3 seed boxes, or broadcast seeders.

707.03.10 Seeding Methods. Operate seeders as follows:

- (a) **Drill Seeding.** Mix and place seed in the seed boxes A (small seed), B (medium seed), or C (fluffy seed) as recommended by the seeder manufacturer, or as specified or directed. Seed carrier may be mixed with seed.

Drill seed into the soil to a 1/4 in. depth. When soil is disturbed to a greater depth or is not in a firm condition at the time of seeding, firm the soil with a roller. Rollers shall weigh approximately 40 lb per ft of width.

- (b) **Broadcast Seeding.** Uniformly mix seed with seed carrier. Spread seed and carrier in two directions at right angles, and then lightly rake or drag seed into the soil to a 1/4 in. depth before firming the soil with a roller as described above.

707.03.11 Mulching. Immediately after seeding, apply mulch over bare soil to cover at least 90 percent of the surface. Do not apply mulch after operating a drill seeder through dead vegetation. Apply mulch as follows:

- (a) **Mulch Blower.** Apply mulch to a loose depth of 1/2 to 1-1/2 in.
- (b) **By Hand.** Apply mulch to a loose depth of 1 to 2 in.

707.03.12 Securing Mulch. Secure mulch immediately after application by applying wood cellulose fiber uniformly without displacing the mulch.

707.03.13 Seeding Phase Acceptance. Submit a request for Seeding Phase Acceptance when operations are completed, and provide the IPM Program and Establishment Phase Schedule as specified in 707.03.02(a). Inspection will be conducted to verify completion. Seeding Phase Acceptance will be granted at that time.

707.03.14 Establishment Phase. The Establishment Phase begins upon Seeding Phase Acceptance as follows:

- (a) **Period of Maintenance.** Maintain meadows for 12 months after seeding.
- (b) **Weed Control.** Monitor and promptly implement the IPM Program to control weeds in conformance with the IPM Program, or when notified of problems in consultation with the Landscape Operations Division. Remove dead weeds over 18 in. tall.
- (c) **Inspection.** Meadow establishment will be inspected by the Engineer on or about the 15th of January, March, May, July, September, and November.

707.03.15 Final Acceptance. The Engineer and the Landscape Operations Division will complete an Inspection Report of seedling height, color, and percent coverage. When it is not possible to perform the Inspection, Final Acceptance will be delayed until Inspection is possible.

The Inspection Report will be included in the Punch List requirements for the project. Complete the Punch List requirements as directed.

Final Acceptance will be granted when the seedlings have grown at least 4 in., exhibit dark green color, and percent coverage as follows:

MEADOW ESTABLISHMENT COVERAGE		
AREAS	SHA SPECIAL PURPOSE SEED MIX, SHA TEMPORARY SEED MIX, and MEADOW SEED	TOTAL VEGETATION COVER
	Seedling Coverage	
Areas flatter than 4:1; and slopes 4:1 and steeper not tracked with bulldozer	at least 70%	at least 95%
Slopes 4:1 and steeper tracked with bulldozer	at least 45%	at least 95%

707.03.16 Wildflower Seeding.

- (a) **Regional Areas.** Refer to 705.03.01(a).
- (b) **Seeding Seasons.** Refer to 707.03.01(b).
- (c) **Pesticide Application.** Refer to 710.03.01(c).
- (d) **Pesticide Application Reporting.** Refer to 710.03.01(d).
- (e) **Nutrient Management Plan (NMP).** Refer to 707.03.01(e).
- (f) **Nutrient Management Reporting.** Refer to 707.03.01(f).

707.03.17 Seeding Schedule. Develop a Schedule that provides dates for completing major operations of the Contract, including non-selective herbicide application and seeding.

Submit the proposed Schedule at least 14 days before beginning operations. The Schedule will be reviewed by the Engineer and Landscape Operations Division for completeness and feasibility, and will be approved or returned for correction.

707.03.18 Marking. Mark areas to be seeded, and obtain approval before applying herbicide, mowing, or beginning seeding operations.

707.03.19 Non-Selective Herbicide Application. Refer to 707.03.04.

707.03.20 Mowing. Refer to 707.03.05.

707.03.21 Seed Delivery, Weighing, and Mixing.

- (a) **Delivery.** Wildflower seed shall be delivered unmixed.
- (b) **Weighing and Mixing.** Refer to 707.03.22 Table 6. Test seed as specified in 920.06.05 before weighing and mixing.

Weigh wildflower seed before uniformly pre-mixing and placing it into the seed boxes of the seeder. Use a scale with 0.01 oz accuracy to verify application rates and quantities of seed.

Mix and apply seed separately or with other specified seed.

707.03.22 Application Rates. Apply materials as follows:

TABLE 5 - WILDFLOWER SEEDING APPLICATION RATES		
MATERIAL	LB PER 1000 FT ²	LB PER ACRE
LIMESTONE	0 to 50 ^a	0 to 2,000 ^a
SULFUR	0 to 13 ^a	0 to 550 ^a
COMPOST	0 to 1.4 yd ³ Compost per 24 yd ³ of Topsoil ^a	
WILDFLOWER SEED	Refer to Table 6 Wildflower Seed	Refer to Table 6 Wildflower Seed
SEED CARRIER	2 to 6	85 to 260
FERTILIZER		
20-16-12 (83% UF with MAP & SOP)	0 to 6.9 ^a	0 to 400 ^a
38-0-0 (UF)	0 to 3.0 ^b	0 to 130 ^b
11-52-0 (MAP)	0 to 6.0 ^b	0 to 270 ^b
0-0-50 (SOP)	0 to 5.0 ^b	0 to 220 ^b
MULCH		
Wood Cellulose Fiber Mulch Binder	23	1000

Note: UF = Ureaform MAP = Monoammonium Phosphate SOP = Sulfate of Potash

^a The NMP will specify the application rate.

^b When application of 20-16-12 is below 400 lb. per acre, apply 38-0-0, 11-52-0, and 0-0-50 per NMP.

TABLE 6 - WILDFLOWER SEED						
SPECIES	SMALL SEED		MEDIUM SEED		FLUFFY SEED	
	Oz per 1000 Ft ²	Lb per Acre	Oz per 1000 Ft ²	Lb per Acre	Oz per 1000 Ft ²	Lb per Acre
blackeyed Susan	0.18	0.5				
corn poppy	0.37	1.0				
golden tickseed	0.37	1.0				
lemon beebalm	0.18	0.5				
Moroccan toadflax	0.18	0.5				
Siberian wallflower	0.55	1.5				
doubtful knight's-spur			0.18	0.5		
garden cornflower			0.37	1.0		
garden cosmos 'Sensation'			0.11	0.3		
sulphur cosmos 'Bright Lights'			0.11	0.3		
firewheel					0.18	0.50

707.03.23 Seeding Equipment. Use approved drill seeders equipped with 3 seed boxes.

707.03.24 Seeding Methods. Refer to 707.03.10(a).

707.03.25 Mulching and Securing Mulch. Refer to 707.03.11 and .12.

707.03.26 Seeding Phase Acceptance. Submit a request for Seeding Phase Acceptance when operations are completed. Inspection will be conducted to verify completion. Seeding Phase Acceptance will be granted at that time.

707.03.27 Establishment Phase. The Establishment Phase will begin upon Seeding Phase Acceptance.

707.03.28 Final Acceptance. The Engineer and the Landscape Operations Division will complete an Inspection Report of seedling color and percent coverage at 90 to 120 days after seeding. When it is not possible to perform the Inspection, Final Acceptance will be delayed until Inspection is possible.

The Inspection Report will be included in the Punch List requirements for the project. Complete the Punch List requirements as directed.

Final Acceptance will be granted when the seedlings exhibit dark green color and percent coverage as follows:

WILDFLOWER SEEDING COVERAGE		
AREAS	WILDFLOWER SPECIES	TOTAL VEGETATION COVER
	Seedling Coverage	
Areas flatter than 4:1; and slopes 4:1 and steeper not tracked with bulldozer	at least 70%	at least 95%
Slopes 4:1 and steeper tracked with bulldozer	at least 45%	at least 95%

707.03.29 Mowing. Mow meadow or wildflower foliage to a height of 6 to 8 in. when directed by the Engineer in consultation with the Landscape Operations Division.

707.04 MEASUREMENT AND PAYMENT. Meadow Establishment and wildflower seeding will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

707.04.01 Upland Meadow Establishment. Upland Meadow Establishment, including preparing soil, applying fertilizer, meadow seed, SHA Special Purpose Seed Mix, mulch, and securing mulch will be measured and paid for at the Contract unit price per square yard.

(a) Payment Schedule. Payments will be made according to the following Schedule when construction requirements are met:

MEADOW ESTABLISHMENT PAYMENT SCHEDULE			
CONSTRUCTION REQUIREMENTS		PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
707.03.01 thru .13	Seeding Phase and Seeding Acceptance	80	At Seeding Phase Acceptance
707.03.14 and .15	Establishment Phase Weed Control and Final Acceptance	20	Pro-Rated at Each Bi-Monthly Inspection and Final Acceptance
Total Payment		100%	

(b) Forfeiture. Failure to complete operations as required in conformance with the Payment Schedule will result in forfeiture of that percentage of payment.

707.04.02 Lowland Meadow Establishment. Lowland Meadow Establishment, including preparing soil, applying fertilizer, meadow seed, SHA Special Purpose Seed Mix, mulch, and securing mulch will be measured and paid for at the Contract unit price per square yard.

Payment Schedule. Refer to 707.04.01(a).

Forfeiture. Refer to 707.04.01(b).

707.04.03 Wet Meadow Establishment. Wet Meadow Establishment, including preparing soil, applying fertilizer, meadow seed, mulch, and securing mulch will be measured and paid for at the Contract unit price per square yard.

Payment Schedule. Refer to 707.04.01(a).

Forfeiture. Refer to 707.04.01(b).

707.04.04 Wildflower Seeding. Wildflower Seeding, including applying fertilizer, wildflower seed, and mulch will be measured and paid for at the Contract unit price per square yard. Payment will be made according to the Payment Schedule when construction requirements are met.

Payment Schedule. Payments will be made according to the following schedule when construction requirements are met:

WILDFLOWER SEEDING PAYMENT SCHEDULE			
CONSTRUCTION REQUIREMENTS		PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
707.03.16 thru .26	Seeding Phase and Seeding Acceptance	80	At Seeding Phase Acceptance
707.03.27 thru .28	Establishment Phase and Final Acceptance	20	At Final Acceptance
Total Payment		100%	

Forfeiture. Refer to 707.04.01(b).

707.04.05 Non Selective Herbicide Application per square yard.

707.04.06 Tractor and Hand Mowing per hour.

707.04.07 Selective Grass Herbicide Application per square yard.

707.04.08 Selective Broadleaf Herbicide Application per square yard.

707.04.09 Applying Limestone to Salvaged Topsoil and Nontopsoiled Areas per ton.

707.04.10 Applying Sulfur to Salvaged Topsoil and Nontopsoiled Areas per ton.

707.04.11 Applying Compost to Salvaged Topsoil and Nontopsoiled Areas per cubic yard.

707.04.12 Amending furnished topsoil and furnished subsoil will not be measured but the cost will be incidental to the Contract unit price for Placing Furnished Topsoil and Placing Furnished Subsoil.

SECTION 708 — TURFGRASS SOD ESTABLISHMENT

708.01 DESCRIPTION. Prepare soil and establish turfgrass sod.

708.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Gypsum	920.02.04
Compost	920.02.05
Fertilizer	920.03.01
Turfgrass Sod	920.04.06
Fasteners	920.05.02
Water	920.09.01

708.03 CONSTRUCTION.**708.03.01 General.**

- (a) **Regional Areas.** Refer to 705.03.01(a).
- (b) **Installing Season and Sod Species.** Install sod from August 15 to May 31 when the sod is not frozen.

Install tall fescue sod in Region 1 and Region 2. Install tall fescue or Bermudagrass sod in Region 3 as specified.

- (c) **Nutrient Management Plan (NMP).** Soil testing will be performed and a NMP will be developed by the Administration. Replace application rates of 708.03.05 as required by the NMP.

When a NMP is not available, 1000 lb. per acre of 20-16-12 (83% UF with MAP & SOP) fertilizer shall be the NMP rate for turfgrass establishment.

- (d) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

708.03.02 Grade Repair. Ensure that soil meets specified grades. Repair any gullies, washes, or disturbed areas that develop before preparing soil, incorporating soil amendments, or placing turfgrass sod.

708.03.03 Preparing Soil. Immediately before installing turfgrass sod, loosen the soil with rototillers, disks, rakes or other approved equipment to a depth of 3 in. Amendments may be incorporated into the soil during this operation.

When soil preparation is completed, remove clods, stones, and debris with a length or width greater than 1-1/2 in. and ensure the soil provides a uniform and porous surface, conforms to the specified grade, and is free of weed and plant growth.

708.03.04 Application Equipment. Use spreaders or other approved machinery that is calibrated before application. Apply materials accurately and uniformly to avoid misses and overlaps.

Operate spinner spreaders during non-windy weather. Do not allow materials to blow onto sensitive areas or structures.

708.03.05 Application Rates.

APPLICATION RATES		
MATERIAL	LB PER 1000 FT ²	LB PER ACRE
LIMESTONE	0 to 200 ^a	0 to 8700 ^a
SULFUR	0 to 30 ^a	0 to 1300 ^a
GYPSUM	0 to 92 ^a	0 to 4,000 ^a
COMPOST	0 to 1.4 yd ³ Compost per 24 yd ³ of Topsoil ^a	
FERTILIZER		
20-16-12 (83% UF with MAP & SOP)	23.0 ^a	1000 ^a
38-0-0 (UF)	0 to 9.2 ^{a,b}	0 to 400 ^{a,b}
0-0-50 (SOP)	0 to 5.7 ^{a,b}	0 to 250 ^{a,b}

Note: UF = Ureaform MAP = Monoammonium Phosphate SOP = Sulfate of Potash

^a The NMP will specify the application rate.

^b When application of 20-16-12 is below 1000 lb per acre, apply 38-0-0 and 0-0-50 per NMP.

708.03.06 Incorporating Soil Amendments. Mix soil amendments into the upper 3 in. of soil after application.

708.03.07 Transporting and Handling. Transport and install turfgrass sod within 48 hours after harvest. Handle sod without excessive breaking, tearing, or loss of soil.

708.03.08 Placing. Place turfgrass sod with closed joints. Do not overlap or leave gaps between strips.

(a) **Slopes 2:1 and Steeper.** Place sod strips with the long edges following the contour, not up and down the slope. Begin at the bottom of the slope and stagger the joints between strips.

(b) Ditches. Place sod strips with the long edges following the flow of water, not across the ditch. Center the lowest strip on the centerline of the ditch.

708.03.09 Securing. Secure turfgrass sod in ditches and slopes 2:1 and steeper with at least two fasteners per strip spaced no more than 2 ft apart. Drive the fasteners through the sod and firmly into the soil below so there is no gap at the top of the fastener.

708.03.10 Firming. Tamp or roll turfgrass sod after placing and stapling to tighten the joints between the sod strips, and to press the sod firmly into the soil. Hand tampers shall weigh approximately 15 lb with a flat surface of approximately 100 in². Rollers shall weigh approximately 40 lb per ft of width.

708.03.11 Initial Watering. Perform the first watering within four hours after placing turfgrass sod. Wet the soil to a depth at least 3 in. below the sod.

708.03.12 Installation Acceptance. Submit a request for Installation Phase Acceptance when operations are completed. Inspection will be conducted to verify completion. Installation Phase Acceptance will be granted at that time.

708.03.13 Establishment Phase. The Establishment Phase will begin upon Installation Phase Acceptance. Monitor the soil moisture and water needs of the sod. Promptly provide water when needed or when directed.

708.03.14 Final Acceptance. The Engineer and the Landscape Operations Division will complete an Inspection Report of turfgrass sod height, color, and coverage. When it is not possible to perform the Inspection, Final Acceptance will be delayed until Inspection is possible.

The Inspection Report will be included in the Punch List requirements for the project. Complete the Punch List requirements as directed.

Final Acceptance will be granted when the turfgrass sod has grown at least 4 in., exhibits dark green color, has at least 99 percent coverage, and is firmly rooted into the soil.

708.04 MEASUREMENT AND PAYMENT. Turfgrass Sod Establishment will be measured and paid for at the Contract unit price for

one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

708.04.01 Turfgrass Sod Establishment. Turfgrass Sod Establishment, including preparing soil, applying fertilizer, placing sod and fasteners, and initial watering will be measured and paid for at the Contract unit price per square yard.

- (a) **Payment Schedule.** Payments will be made according to the following schedule when construction requirements are met:

PAYMENT SCHEDULE		
CONSTRUCTION REQUIREMENTS	PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
708.03 thru 708.03.12	80	At Installation Phase Acceptance
708.03.13 and 708.03.14	20	At Final Acceptance
Total Payment	100	

- (b) **Forfeiture.** Failure to complete operations as required or directed in conformance with the Payment Schedule will result in forfeiture of that percentage of payment.

708.04.02 Applying Limestone to Salvaged Topsoil and Nontopsoiled Areas per ton.

708.04.03 Applying Sulfur to Salvaged Topsoil and Nontopsoiled Areas per ton.

708.04.04 Applying Gypsum to Salvaged Topsoil and Nontopsoiled Areas per ton.

708.04.05 Applying Compost to Salvaged Topsoil and Nontopsoiled Areas per cubic yard.

708.04.06 Amending furnished topsoil and furnished subsoil will not be measured but the cost will be incidental to the Contract unit price for Placing Furnished Topsoil and Placing Furnished Subsoil.

SECTION 709 — SOIL STABILIZATION MATTING

709.01 DESCRIPTION. Install soil stabilization matting (SSM) in conjunction with seeding.

709.02 MATERIALS.

Topsoil	920.01
Soil Stabilization Matting	920.05.01
Fasteners	920.05.02
Water	920.09.01

709.03 CONSTRUCTION.

709.03.01 Soil Preparation and Seeding. Perform operations for the SSM type as follows:

- (a) **Type A and B.** Prepare soil and perform Turfgrass Establishment as specified in Section 705, but do not apply mulch. Install SSM immediately after seeding as specified in 709.03.02 thru .05.
- (b) **Type C.** Install Type C SSM as specified in 709.03.02 thru .05. Infill with soil and immediately perform Turfgrass Establishment as specified in Section 705, but do not till or apply mulch. Complete matting installation over seeded area as specified in 709.03.06.
- (c) **Type D.** Prepare soil and perform seeding as specified. Install Type D SSM immediately after seeding as specified in 709.03.02 thru .05.

709.03.02 Unrolling. Unroll SSM in the direction of the flow of water. Lay matting smoothly in firm, uniform contact with the soil surface, without stretching or tenting.

709.03.03 Overlapping. Overlap SSM with the upslope portion on top. Overlap edges at least 2 in., and ends at least 6 in.

709.03.04 Keying-in. Keying-in consists of the following operations:

- (a) **Trenching.** Trench into the soil perpendicular to the flow of water to at least 6 in. depth.

AREAS OF MATTING TO KEY-IN	
MATTING TYPE	AREA OF MATTING
A, B	Uppermost or leading-edge.
A, B	Edges adjacent to catch basins and structures.
B	Lowermost or toe-edge.
C, D	All edges
C	Folds of matting perpendicular to water flow every 20-25 ft.

- (b) **Fastening.** Install fasteners through SSM into the bottom of the trench.

- (c) **Backfilling.** Backfill the trench with firmly tamped soil.

709.03.05 Fastening. Refer to 920.05.02 and secure SSM with fasteners driven perpendicular to the soil grade, and flush with the surface of the matting as follows:

- (a) **Fastener Selection.** Use fasteners of the shape and length approved for the matting type as follows:

FASTENER SELECTION					
MATTING TYPE	FASTENER SHAPE	APPROVED FASTENERS			
		6 in. Length	8 in. Length	12 in. Length	18 in. Length
A	U-Shaped Staple	X	X		
	Circle-Top Pin	X	X		
	Round Head Pin	X	X		
	T-Head Pin	X			
	Wood Peg	X			
B, C, D	U-Shaped Staple		X	X	
	Fabric Pin			X	X

- (b) **Placement of Fasteners.** Install fasteners at the specified distance apart as required for the area of matting and the matting type as follows:

FASTENER PLACEMENT		
AREA OF MATTING	MATTING TYPE	MAXIMUM DISTANCE BETWEEN FASTENERS In.
Uppermost or Leading-Edge of Matting	A, B, C, D	6
Overlapping Edges of Matting	A, B, C, D	18
Center of Ditch	A, B, C, D	18
Lowermost or Toe-Edge of Matting	A, B, C, D	18
Throughout Matting	A, B, C, D	24
In Folds Every 20 to 25 ft	C	12

709.03.06 Infilling and Seeding Type C SSM. Perform the following operations after installing Type C SSM.

- (a) **Infilling.** Infill the matting with topsoil to provide a depth equal to twice the thickness of the matting, and sufficient for a graded 24 in. tapered area beyond the outside edges of the matting.
- (b) **Seeding.** Firm the soil with a roller as specified in 708.03.10 and perform Turfgrass Establishment over the infilled matting and tapered area.
- (c) **Covering.** Install Type B SSM immediately after seeding to cover the seeded area. Secure the matting with 12 in. U-shaped staples, or 12 in. or 18 in. fabric pins.

709.03.07 Watering. Gently water SSM with a sprinkler or water-breaker nozzle within 48 hours of installation to bond the matting to the soil. Apply water at the rate of 300 gal per 1000 ft² to wet the soil to a minimum 2 in. depth below the matting.

709.03.08 Installation Phase Acceptance. Inspection will be conducted to verify that operations were completed as specified. Installation Phase Acceptance will be granted at that time.

709.03.09 Establishment Phase. The Establishment Phase will begin upon Installation Phase Acceptance.

709.03.10 Final Acceptance. Final Acceptance will be granted when the SSM is secure and the turfgrass or other vegetation seedlings have grown at least 4 in., exhibit dark green color and minimum percent coverage.

Turfgrass establishment will be accepted as specified in 705.03.14. Other vegetation seeding will be accepted as specified.

When turfgrass establishment or other vegetation seeding is not acceptable, remove Type A, B, or D SSM. Remove Type C matting when directed.

Prepare soil, reseed, and install new matting unless the original matting is approved for reuse. Apply additional fertilizer or soil amendments as directed.

709.04 MEASUREMENT AND PAYMENT. Soil stabilization matting will be measured and paid for at the Contract unit price per square yard for one or more of the specified items. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

(a) Payment Schedule. Payments will be made according to the following schedule when construction requirements are met:

PAYMENT SCHEDULE		
CONSTRUCTION REQUIREMENTS	PERCENT OF TOTAL CONTRACT PRICE	PAYMENT FOR COMPLETED WORK
709.03.01 thru .08	80	At Installation Phase Acceptance
709.03.09 and .10	20	At Final Acceptance
Total Payment	100	

(b) Forfeiture. Failure to complete operations as required in accordance with the Payment Schedule will result in forfeiture of that percentage of payment.

709.04.01 Type A Soil Stabilization Matting per square yard.

709.04.02 Type B Soil Stabilization Matting per square yard.

709.04.03 Type C Soil Stabilization Matting per square yard.

709.04.04 Type D Soil Stabilization Matting per square yard.

SECTION 710 — TREE, SHRUB, AND PERENNIAL INSTALLATION AND ESTABLISHMENT

710.01 DESCRIPTION. Install and establish trees, shrubs, perennials, vines, and grasses.

710.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Iron Sulfate	920.02.03
Compost	920.02.05
Fertilizer	920.03.01
Shredded Hardwood Bark (SHB) Mulch	920.04.03
Plant Materials	920.07
Marking and Staking Materials	920.08
Water	920.09.01
Pesticides	920.09.03
Marking Dye	920.09.04
Spray Adjuvant and Wetting Agent	920.09.05

710.03 CONSTRUCTION.

710.03.01 General.

(a) **Planting Seasons.** Install plants during the following Planting Seasons unless a Modification Request is approved:

PLANTING SEASONS					
SEASON	DECIDUOUS TREES, SHRUBS, VINES		EVERGREEN TREES, SHRUBS, VINES		PERENNIALS, GRASSES
	Balled & Burlapped, Bare Root	Container Grown	Balled & Burlapped	Container Grown	Container Grown
Spring	2/15 – 4/30	3/1 – 6/15	3/15 – 4/30	3/15 – 6/15	4/15 – 6/30
Fall	10/15 – 12/15	8/15 – 12/15	9/1 – 11/15	8/15 – 11/15	9/1 – 10/30

(b) **Modification Request.** Submit a written Modification Request to perform installation out-of season, or to install plants of different species, cultivars, sizes, growth habits, or planting stock type.

The Engineer and Landscape Operations Division will evaluate the Request. If granted, a Notice of Approved Modification will be returned within 14 days afterwards.

- (c) **Pesticide Application.** Apply pesticides in conformance with the Maryland Pesticide Applicator's Law, the Administration's Integrated Vegetation Management Manual for Maryland Highways, and the manufacturer's recommendations.

The Contractor shall possess a Maryland Department of Agriculture Commercial Pesticide Business License and a Pesticide Applicator Certificate for the pertinent pesticide application Category: (2) Forest; (3-A) Ornamental Plant Exterior; (3-C) Turf; (5) Aquatic; (6) Right-of-Way and Weed.

Pesticides shall be applied by a Maryland Certified Pesticide Applicator, or by a Registered Pesticide Applicator under the supervision of a Certified Pesticide Applicator.

- (d) **Pesticide Application Reporting.** Record the location, acreage treated, pesticide name and quantity applied on the Pesticide Application Reporting Form. Submit the Form within 24 hours after applying pesticide.
- (e) **Nutrient Management Plan (NMP).** The specified application rates of 14-14-14, 20-10-5, and 20-20-20 fertilizers shall be the NMP rates unless the Administration develops a substitute NMP. Replace application rates of 710.03.04 and .05 as required by the NMP.
- (f) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

- (g) **Plant Storage and Handling.** Refer to 920.07.05.

710.03.02 Submittals and Inspection. Submit the following items:

- (a) **Breakdown List of Contract Prices.** Refer to 710.04.01 and develop a Breakdown List of Contract Prices for each plant in the Contract. Include the cost of all installation and establishment operations in the per plant price.

Submit the written Breakdown List within 14 days after Award of Contract. The Breakdown List will be reviewed by the Engineer and Landscape Operations Division for completeness and balance, and will be approved or returned for correction.

- (b) **Installation Phase Schedule.** Develop a Schedule with dates for completing 710.03.01 thru .15, including:

OPERATIONS IN INSTALLATION PHASE SCHEDULE	
1	Layout, utilities review and marking.
2	Undesirable vegetation removal and herbicide application.
3	Planting pit excavation, soil preparation, and plant installation.
4	Planting beds rototilling and soil preparation, applying shredded hardwood bark (SHB) mulch, and plant installation.
5	Applying fertilizer solution after installation, and cleanup.

Submit the written Schedule at least 30 days before beginning landscape work. The Schedule will be reviewed by the Engineer and Landscape Operations Division for completeness and feasibility, and will be approved or returned for correction.

- (c) **Plant Material Inspection and Approval.** The Inspection will be conducted by the Landscape Operations Division as specified in 920.07.03.

- (d) **Establishment Phase Schedule & IPM Program.** Develop a Schedule with dates for completing 710.03.22. Include an Integrated Pest Management (IPM) Plan with methods of pest monitoring (weeds, diseases, insects, mammals, etc.), pesticide selection, application rates, and scheduling.

Submit the written Establishment Phase Schedule & IPM Program at the Installation Phase Inspection.

The Schedule will be reviewed by the Engineer and the Landscape Operations Division, and will be approved or returned for correction.

710.03.03 Utilities Marking, Layout, and Inspection. Refer to Section 875 when included in the Contract Documents.

- (a) **Utilities Marking.** Contact ‘Miss Utility’ or another approved service to identify and mark utilities in the rights-of-way. Contact the District Utilities Engineer to mark utilities on Administration property.
- (b) **Conflicts.** Notify the Administration of conflicts that may involve design changes. Conflicts will be reviewed by the Landscape Operations Division and resolved within 14 days after notice.
- (c) **Planting Layout.** Provide the necessary materials and lay out the locations of planting pits and planting beds specified in the Contract Documents, or as adjusted by the Landscape Operations Division.
- (d) **Inspection.** At least 7 days notice will be required to schedule each stage of a layout inspection in consultation with the Landscape Operations Division. Proceed with operations after layout approval.

710.03.04 Preparing Planting Pits. Perform the following operations when preparing planting pits for individual plants:

- (a) **Undesirable Vegetation.** Eliminate undesirable vegetation as follows:
 - (1) **Non-Selective Herbicide.** Apply non-selective herbicide in water with wetting agent and dye at least 14 days before plant installation as follows:

NON-SELECTIVE HERBICIDE APPLICATION	
MATERIAL	RATE PER ACRE
Glyphosate Herbicide	5 lb of active ingredient
Marking Dye	6 to 15 oz
Water	40 to 50 gal

Cut and remove dead vegetation or debris that interferes with soil preparation, plant installation or future maintenance.

- (2) **Manual Vegetation Removal.** Remove undesirable vegetation within Bioretention Facilities manually without the use of herbicides.
- (b) **Excavation.** Excavate planting pits to the depth required for the placement of root collars as specified in 710.03.09(c). Retain the

excavated soil for preparation as backfill soil. Remove excess soil from the site, or spread it as directed.

- (c) **Pit Diameter, Compost, and Water.** Use the following table to determine the diameter of the planting pit based upon the container or root ball diameter, the volume of compost or peat moss to be mixed into the backfill soil, and the amount of water to be used per watering event.

PREPARING PLANTING PITS AND BACKFILL SOIL						
Container or Root Ball Diameter In.	ANSI Z60 Container Size	Planting Pit Diameter In.	Compost or Peat Moss Ft. ³	14-14-14 Granular Fertilizer Oz.	20-10-5 Tablet Fertilizer Each	Water per Event Gal.
3	#SP3	6	0.02	0.10	-	0.15
5	#SP4	10	0.02	0.12	-	0.2
6	#SP5 or #1	12	0.03	0.18	-	0.3
8	#2	17	0.09	0.30	-	0.5
10	#3	21	0.18	0.55	-	1.0
12	#5	24	0.28	0.75	-	1.5
14	#7	28	0.44	1.0	1	2.3
16	#10	32	0.65	1.3	1	3.5
18	#15	36	0.94	1.6	1	5.0
20	#20	40	1.27	2.0	1	6.8
24	#25	48	2.20	3.0	2	12
30	-	60	4.30	4.5	3	23
36	#45	72	7.40	6.5	5	40
42	#65	84	11.80	8.8	7	60

- (1) **Container Grown (CG) and Balled and Burlapped (BB).** Add 14-14-14 or 20-10-5 fertilizer to each planting pit during installation unless other rates are specified in the NMP.

- (2) **Bare Root (BR).** Excavate planting pits to accommodate roots when spread in natural position. Add 14-14-14 fertilizer to each planting pit during installation based upon the pit diameter unless other rates are specified in the NMP.

- (d) **Compost or Peat Moss.** Mix compost into the backfill soil as specified in 710.03.04(c) when installing all plants except Ericaceous species, which shall be amended with the same volume of peat moss.

- (e) **pH Adjustment.** Adjust soil pH to pH 6.0 to 6.5 for all plants except Ericaceous species, which shall be adjusted to pH 5.0 to 5.5. Use limestone to raise soil pH and iron sulfate to lower soil pH as specified in the NMP.
- (f) **Fertilizer.** At the time of installation, mix 14-14-14 fertilizer into the backfill soil of trees, shrubs, vines, perennials and grasses, or place 20-10-5 fertilizer into the backfill soil near the mid-point depth of the planting pit of trees, shrubs and vines in lieu of 14-14-14 fertilizer.

Use a scale with 0.01 oz accuracy to calibrate measures and verify application rates of 14-14-14 fertilizer.

710.03.05 Preparing Planting Beds. Perform the following operations when preparing planting beds:

- (a) **Undesirable Vegetation.** Eliminate undesirable vegetation as specified in 710.03.04(a). Cut or mow dead vegetation to a height of 1 in. and remove the debris.
- (b) **Fertilizer and Soil Amendments.** Uniformly apply fertilizer and soil amendments (limestone, iron sulfate, compost, peat moss) at rates specified in 710.03.04(c) unless other rates are specified in the NMP. Mix 14-14-14 fertilizer or place 20-10-5 fertilizer into the backfill soil of each planting pit within the planting bed. Refer to 710.03.04(f) and the following:
 - (1) **Areas Flatter than 4:1.** Apply compost to the soil surface of the bed to a 2 in. depth.
 - (2) **Slopes 4:1 and Steeper.** Mix compost or peat moss into the backfill soil of each planting pit within the bed.
- (c) **Rototilling.** Rototill the soil of the bed as follows:
 - (1) **Areas Flatter than 4:1.** Rototill to a depth of 6 in. to thoroughly mix compost and specified fertilizer or soil amendments into the soil.
 - (2) **Slopes 4:1 and Steeper.** Do not rototill.
 - (3) **Bioretention Soil Mixture.** Do not rototill.

- (d) **Debris Removal.** Remove debris, stones, and soil clods with a length or width greater than 2 in. that are uncovered during rototilling.
- (e) **Leveling.** Level the soil surface after rototilling, and leave it in a condition ready for shredded hardwood bark (SHB) mulching and plant installation.

710.03.06 Plant Acclimation. Ensure that container grown plants are acclimated to prevailing weather conditions before installing. Install bare root plants while dormant when soil and air temperatures are above freezing.

710.03.07 Plant Care. Begin plant care at the time each plant is installed, and continue until Installation Phase Acceptance is granted.

710.03.08 Pruning. Prune to preserve the natural appearance of trees and shrubs. Remove water sprouts manually with pruners.

Remove damaged or undesirable wood of deciduous trees taller than 6 ft before installation. Prune deciduous trees and shrubs 6 ft or shorter at the time of installation.

710.03.09 Installing. Install plants vertically in planting pits and beds prepared as specified in 710.03.04 and .05, and as follows:

- (a) **Removing Containers, Burlap, Wire Baskets.** Remove synthetic fabric, plastic, and metal containers before installing plants.

Remove twine and natural burlap from the tops of root balls to a depth at least 6 in. below the surface of the backfilled planting pit.

Cut and remove the tops of wire baskets from the upper half of the rootball.

- (b) **Preparing Roots.** Carefully remove the containers of container grown plants, and loosen the soil mass to eliminate girdling roots.

Spread the roots of bare root plants in a natural position, and work amended soil around the roots.

- (c) **Placing Root Collar.** Place the root collar of plants at or above the average soil surface grade outside the planting pit as follows:

ROOT COLLAR PLACEMENT	
SOIL CONDITIONS	HEIGHT OF ROOT COLLAR
Normal, Well Drained	Place collar at same level to 1 in. above average surface grade.
Compacted	Place collar at 1 to 2 in. above average surface grade.
Poorly Drained or Wet	Place collar as needed to ensure 25% of root mass is above average surface grade.

- (d) Backfilling.** Remove clods, stones and other foreign material with a length or width greater than 2 in. from soil used for backfilling.

Place backfill soil that has been fertilized and amended as specified in 710.03.04 and .05 under and around roots to stabilize plants in upright position and restore the grade.

Lightly compact backfill soil to reduce air pockets. Avoid excessive compaction of Bioretention Soil Mixture (BSM).

710.03.10 Soil Berming. Form a 4 in. high berm of backfill soil around planting pits and planting beds as follows:

- (a) Planting Pits.** On areas flatter than 4:1, form the berm around the entire planting pit.

On slopes 4:1 and steeper, take soil from the upslope rim of the pit and place it on the downslope rim to form the berm.

- (b) Planting Beds.** On slopes 4:1 and steeper, form the berm as a shoulder at the lower edge of the bed.

Berm individual trees and shrubs installed within beds on slopes 4:1 and steeper as described in (a) above.

710.03.11 Edging. Cut edging at a steep angle into the mulched area to a 3 in. depth into the soil. On slopes 4:1 and steeper, cut edging outside of the bermed area on the lower edge of berm. Remove and discard excess soil.

- (a) Planting Pits.** Edge entirely around all planting pits except planting pits within planting beds.

- (b) Planting Beds.** Smoothly cut edging around all planting beds to the shapes specified.

710.03.12 Staking and Guying. Stake and guy trees the same day they are installed.

- (a) **Installation.** When two or three stakes are specified for trees, install two stakes parallel to the direction of traffic, or as directed. Drive stakes vertically to a depth of 10 in. below the bottom of the pit, and 5 to 8 in. away from roots as follows:

STAKING AND GUYING				
TREE TYPE	CALIPER In.	HEIGHT Ft	SUPPORT	
			No. of Stakes	Length, ft
Shade	Under 1	6 and 8	2	6
	1 to 2	—	2	8
	2-1/2 to 3-1/2	—	3	10
	4 and over	—	—	3 guy wires attached to tree anchors
Flowering	3/4 to 2-1/2	—	2	5-8
	3 and over	—	—	3 guy wires attached to tree anchors
Evergreen	—	5 and 6	2	5-6
	—	7, 8 and 9	3	7-8
	—	10 and over	—	3 guy wires attached to tree anchors

- (b) **Maintenance.** Promptly straighten trees that become crooked after installation. Repair or replace stakes, guys, and other support materials as needed.

710.03.13 Mulching. Spread SHB mulch uniformly over the soil surface to a 3 in. depth. Promptly repair damage caused by washouts or construction activities.

- (a) **Planting Pits.** Spread SHB mulch the same day that plants are installed. Mulch around the base of each plant to cover the soil of the planting pit to its outside edge, including the soil berm. Do not allow mulch to touch the bark or main stem of the plant.
- (b) **Planting Beds.** SHB mulch may be spread before or after installing plants. Spread mulch over the entire bed and rake it to an even surface, including berms and shoulders. Ensure that mulch does not cover plants.
 - (1) **Rototilled Beds.** Spread mulch the same day after rototilling.

- (2) **Non-Rototilled Beds.** Spread mulch within 3 days after plant installation.

When installation is completed, ensure that mulch uniformly covers the soil to a uniform 2 in. depth.

710.03.14 Fertilizing and Watering after Installation.

- (a) **Application Equipment.** Fertilizer and watering equipment shall consist of sprinklers or hoses equipped with water breaker nozzles so the materials are applied with care to prevent damage to plants and minimize disturbance to SHB mulch.
- (b) **Fertilizer Solution.** Fertilizer solution shall consist of 5 lb of 20-20-20 water soluble fertilizer per 100 gal of water, applied as follows:
- (1) **Planting Pits.** Apply fertilizer solution as specified in 710.03.04(c) to each installed plant.
- (2) **Planting Beds.** Apply 300 gal of fertilizer solution per 1000 ft² to the entire bed area.
- (c) **Nutrient Management Reporting.** Refer to 710.03.01(f).
- (d) **Follow-Up Watering.** Monitor and apply water during the Installation Phase to supply plant needs. Do not mix fertilizer with the irrigation water during the Installation Phase after the initial watering unless directed.

710.03.15 Cleanup. Remove growers tape, plant stakes, pot markers, field tags, and similar materials at the time of installation. Ensure that the Administration's Material Inspection Approval Seals and plant tags remain on trees and shrubs until the end of the Establishment Phase.

Keep turfgrass areas, paved surfaces, and sidewalks clean. Promptly remove excess and waste materials. Take precautions to avoid damage to existing structures, plants, and turfgrass. Repair damage caused to surrounding areas during installation, and fill ruts and reestablish turfgrass as necessary.

710.03.16 Relocating Plants. Begin plant relocation operations within 7 days after notice to relocate, and continue until work is completed.

Remove plants installed in undesirable locations as directed by the Engineer, and reinstall these plants as specified in herein.

710.03.17 Abandoned Planting Pits. Backfill abandoned planting pits when directed with excavated soil or approved backfill. Compact the backfill in 8 in. layers to the finished grade. Establish turfgrass as specified in Section 705.

710.03.18 Unacceptable Plants and Replacement Plants. Promptly remove and replace plants that are unacceptable at any time during the Installation Phase as specified in 920.07, or when requested.

Plants that are determined to be missing, dead, dying, damaged, diseased, deformed, underdeveloped, damaged by pesticides, or not true to species, cultivar, size or quality shall be replaced.

Refer to GP-5.09 regarding removal of defective work and materials, and GP-7.16 regarding Contractor responsibility for work, theft, damage, and loss.

(a) Criteria. The following criteria will be used to identify unacceptable plants:

CRITERIA FOR UNACCEPTABLE PLANTS			
Item	Plant Type	Condition	Unacceptable
1	Tree, Shrub, Vine, Perennial Grass	Death or Absence	Any dead or missing plant, any cause.
2	Tree, Shrub, Vine, Perennial Grass	Defoliation	More than 25% of leaf area dead, lost or dropped.
3	Tree, Shrub, Vine	Bark Wound	More than 15% of bark circumference or 2 in. length.
4	Shrub or Vine	Height Die-back	More than 25% of the shrub or vine height.
5	Tree	Leader Die-back	More than 10% of tree height.
6	Tree	Branch Die-back	More than 6 in. on 75% of branches.

(b) Replacement Plants. Replacement plants shall be true to species, cultivar, size, and quality as specified in the Contract Documents unless a Substitution Request is approved.

Install replacement plants as soon as feasible during the current Planting Season, or if between Planting Seasons, during the next Planting Season.

Promptly submit a Modification Request as specified in 710.03.01(b) when it is not possible to obtain plants that meet specifications.

Replacement plants shall meet the specifications of 920.07, and be installed and established as specified in Section 710 for 12 months, until Final Acceptance.

710.03.19 Installation Phase Inspection. Submit a request for Installation Phase Inspection when operations are completed, and provide the Establishment Phase Schedule as specified in 710.03.02(d).

The Installation Phase Inspection will be scheduled by the Engineer at the project with the Contractor and the Landscape Operations Division to verify completion. At least 14 days notice will be provided before the scheduled Inspection so that it may be completed in the company of the Contractor.

710.03.20 Installation Phase Punch List. The Engineer in consultation with the Contractor and the Landscape Operations Division will develop the Installation Phase Punch List and list of plants to be replaced. Complete the Punch List requirements and replace plants as required.

710.03.21 Installation Phase Acceptance. Re-inspection will be performed as needed. Installation Phase Acceptance will be granted when the Punch List and all Installation Phase requirements are completed.

The following list includes key Installation Phase requirements:

REQUIREMENTS FOR INSTALLATION PHASE ACCEPTANCE		
Item	Requirement	Section
a	Submittals are accepted and Inspections are completed.	710.03.01(b), 710.03.02, 920.07
b	Damaging pests are controlled.	710.03.02(c)
c	Layouts are inspected and approved.	710.03.03
d	Fertilizer and soil amendments are applied.	710.03.04 and 710.03.05
e	Planting pits and planting beds are weed free.	710.03.04(a) and 710.03.05(a)
f	Trees and shrubs are pruned.	710.03.08
g	Trees are installed vertically and straightened.	710.03.09
h	Planting pits and beds are bermed and edged.	710.03.10 and 710.03.11
i	Staking and guying are repaired or replaced.	710.03.12
j	SHB mulch is uniformly spread to the specified depth.	710.03.13
k	Washouts in planting pits and beds are repaired.	710.03.13
l	Plants are watered and fertilized.	710.03.04 and 710.03.14
m	Clean up is completed, plant tags and ribbons are removed.	710.03.15
n	Plants are relocated to approved locations.	710.03.16
o	Abandoned planting pits are filled and seeded.	710.03.17
p	Unacceptable plants are replaced.	710.03.18
q	Damage repairs and Installation Punch List is completed.	710.03.20
r	Pesticide Application and Nutrient Management Reporting Forms are completed.	710.03.01(d) and (f)
s	Plants are properly installed and successfully transplanted.	710.03.01 thru .18
t	Establishment Phase Schedule & IPM Program is accepted.	710.03.02 (e) and 710.03.21

710.03.22 Establishment Phase. The Establishment Phase begins upon Installation Phase Acceptance. Maintain plants as specified in 710.03.01 thru 0.21, and as follows:

- (a) **Period of Maintenance.** Maintain plants for 12 months after installation, until Final Acceptance.
- (b) **Plant Watering.** Monitor the soil moisture and water needs of plants. Promptly apply water as specified in 710.03.04(c) to planting pits, and 600 gal of water per 1000 ft² to planting beds when needed or when directed.
- (c) **Pest Management.** Monitor and promptly control weeds, insects and other pests in conformance with the IPM Program, or when requested. Control weeds in mulched areas in preparation for inspection on or about the 15th of each month from March 15th to November 15th. Remove dead weeds taller than 6 in. Refer to

710.03.01(d) and complete the Pesticide Application Reporting Form.

- (d) **Unacceptable Plants and Replacement Plants.** Refer to 710.03.18. Promptly remove and replace plants that have become unacceptable during the Establishment Phase as needed or as directed.
- (e) **End-of-Season Foliage Removal.** Remove the aboveground parts of perennials and grasses that have declined during the months of November and March respectively, or as directed.
- (f) **Refertilizing.** Apply 20-20-20 fertilizer solution as specified in 710.03.14 in the final 60 days of the Establishment Phase.
- (g) **Removing Supports and Seals.** Remove tree supports, hoses wires, guys and Material Inspection Approval Seals in the final 30 days of the Establishment Phase. Pull stakes from the soil or cut them to ground level.
- (h) **Establishment Phase Inspection and Punch List.** 710.03.19 and .20. The Inspection will be scheduled and the Establishment Phase Punch List will be developed. Perform repairs, replacements and other work as specified in the Contract Documents and Punch List.

710.03.23 Final Acceptance. Refer to 710.03.21. Final Acceptance will be granted when the Punch List and all Establishment Phase requirements are completed.

The following list includes key establishment requirements:

REQUIREMENTS FOR ESTABLISHMENT PHASE & FINAL ACCEPTANCE		
Item	Requirement	Section
1	Water sprouts are manually pruned and removed.	710.03.08
2	Trees are straightened.	710.03.09
3	Staking and guying are repaired or replaced.	710.03.12
4	Washouts in planting pits and beds are repaired.	710.03.13
5	Plants are relocated to approved locations.	710.03.16
6	Abandoned planting pits are filled and seeded.	710.03.17
7	Plants are successfully established for 12 months.	710.03.22(a) and (b)
8	Damaging pests are controlled.	710.03.22(c)
9	Planting pits and planting beds are weed free.	710.03.22(c)
10	Unacceptable plants are replaced.	710.03.22(d)
11	Annual foliage dieback of perennials and grasses is cut and removed.	710.03.22(e)
12	Plants are refertilized.	710.03.22(f)
13	Pesticide Application and Nutrient Management Reporting Forms are completed.	710.03.01(d) and (f)
14	Staking, guying, and Material Inspection Seals are removed.	710.03.22(g)
15	Damage repairs and Establishment Punch List are completed.	710.03.22(h)

710.04 MEASUREMENT AND PAYMENT. Tree, Shrub, and Perennial Installation and Establishment will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all plants, material, labor, equipment, tools, and incidentals necessary to complete the work.

710.04.01 Tree, Shrub, and Perennial Installation and Establishment. Tree, Shrub, and Perennial Installation and Establishment shall include the cost of trees, shrubs, perennials, vines, and grasses, layout, marking, pruning, planting pit excavation, fertilizer, soil amendments, backfilling, staking, guying, berming, edging, watering, pest management, plant maintenance, and all operations related to the Installation and Establishment Phases of each plant, until Final Acceptance.

Tree, Shrub, and Perennial Installation and Establishment will be paid for in monthly pro-rated payments based upon the approved Breakdown List of Contract Prices.

Refer to 710.03.02(a). In the event of change in the quantities required, payment adjustments will be based on the approved Breakdown List of Contract Prices.

- (a) **Payment Schedule.** Payments will be made according to the following schedule when construction requirements are met;

PAYMENT SCHEDULE			
INSTALLATION AND ESTABLISHMENT PHASE COMPLETION		PERCENT OF TOTAL CONTRACT PRICE	PRO-RATED MONTHLY FOR COMPLETED WORK
710.03.01 thru .21	Installation Phase	70	Duration of Installation Phase
710.03.22(a) thru (d)	Establishment Phase Care & Maintenance	20	At Each Monthly Inspection
710.03.22(e) thru (h)	Establishment Phase Removal & Replacement and Final Acceptance	10	At Final Acceptance
Total Payment		100	

- (b) **Forfeiture.** Failure to complete operations as required or directed in conformance with the Payment Schedule will result in forfeiture of that percentage of payment based upon the Breakdown List of Contract Prices.

710.04.02 Constructing Planting Beds. Constructing Planting Beds will be measured and paid for at the Contract unit price per square yard. The price shall include the cost of layout, marking, fertilizer, soil amendments, rototilling, berming, edging, applying 3 in. of SHB mulch, and all operations related to construction of the planting bed.

Mulching individual planting pits of trees, shrubs, perennials, vines, and grasses within planting beds will not be measured but the cost will be incidental to 710.04.01.

710.04.03 Relocating Plants. Relocating Plants will be measured and paid for at the Contract unit price per cubic foot of planting pit volume excavated as specified in 710.03.04(c).

Refer to the following Table to determine planting pit volume based upon planting pit diameter:

RELOCATING PLANTS			
PIT DIAMETER In.	PIT VOLUME Ft ³	PIT DIAMETER In.	PIT VOLUME Ft ³
3	0.1	16	10
5	0.3	18	14
6	0.5	20	19
8	1.2	24	35
10	2.4	30	65
12	4.0	36	110
14	5.7	42	175

710.04.04 Abandoned Planting Pits. Abandoned Planting Pits will be measured and paid for at the Contract unit price per cubic foot of excavated planting pit as specified in to 710.04.03.

710.04.05 Additional Mulching. Additional Mulching will be measured and paid for at the Contract unit price per square yard of 1.0 in. depth of shredded hardwood bark (SHB) mulch over designated areas.

710.04.06 Composted Wood Chip Mulch. Composted Wood Chip (CWC) Mulch will be measured and paid for at the Contract unit price per square yard at 1.0 in. depth over designated areas.

SECTION 711 — ANNUALS AND BULBS INSTALLATION AND ESTABLISHMENT

711.01 DESCRIPTION. Install and establish annuals and bulbs.

711.02 MATERIALS.

Limestone	920.02.01
Sulfur	920.02.02
Iron Sulfate	920.02.03
Compost	920.02.05
Fertilizer	920.03.01
Shredded Hardwood Bark (SHB) Mulch	920.04.03
Plant Materials	920.07
Marking and Staking Materials	920.08

Water	920.09.01
Pesticides	920.09.03

711.03 CONSTRUCTION.

711.03.01 General.

- (a) **Regional Areas.** Refer to 705.03.01(a).
- (b) **Planting Seasons.** Install plants during the following Planting Seasons unless a Modification Request is approved:

PLANTING SEASONS				
SEASON	PLANTS	INSTALLATION DATE		
		Region 1	Region 2	Region 3
Spring	Container Grown Summer Annuals	5/20 – 6/20	5/10 – 6/10	5/01 – 6/01
Fall	Container Grown Winter Annuals	9/01 – 10/20	9/10 – 10/31	9/20 – 11/10
	Spring Flowering Bulbs	9/01 – 11/30	9/10 – 12/31	9/20 – 12/31

- (c) **Modification Request.** 710.03.01(b).
- (d) **Pesticide Application.** 710.03.01(c).
- (e) **Pesticide Application Reporting.** 710.03.01(d).
- (f) **Nutrient Management Plan (NMP).** 710.03.01(e).
- (g) **Nutrient Management Reporting.** 710.03.01(f).
- (h) **Plant Storage and Handling.** 920.07.05.

711.03.02 Submittals and Inspection. Submit the following items as indicated:

- (a) **Breakdown List of Contract Prices.** Refer to 710.03.02(a).
- (b) **Installation Phase Schedule.** Refer to 710.03.02(b) and submit the Schedule with dates for completing 711.03.02 thru .12.

(c) Plant Material Inspection and Approval. The Inspection will be conducted by the Landscape Operations Division as specified in 920.07.01.

(d) Establishment Phase Schedule & IPM Program. Refer to 710.03.02(d) and submit the Schedule with dates for completing 711.03.17.

711.03.03 Utilities Marking, Layout, and Inspection. Refer to 710.03.03.

711.03.04 Preparing Planting Beds and Planting Areas.

(a) Planting Beds. Refer to 710.03.05 for preparing beds and planting holes for container grown annuals and bulbs. Dig holes for bulbs to the depth and width recommended for the species or variety by the grower.

(b) Planting Areas for Naturalized Daffodils. Dig planting holes to 3.0 diameter and to a 5 in. depth. Mix 0.20 oz of 14-14-14 fertilizer into the backfill soil of each bulb, or as specified in the NMP. Firmly cover each bulb with backfill soil to the level of the surrounding grade.

Omit 711.05.05 thru .10 when installing naturalized daffodils.

711.03.05 Soil Berming. Refer to 710.03.10.

711.03.06 Edging. Refer to 710.03.11.

711.03.07 Mulching. Refer to 710.03.13.

711.03.08 Plant Acclimation. Refer to 710.03.06.

711.03.09 Plant Care. Refer to 710.03.07.

711.03.10 Installing. Handle annuals and bulbs with care to avoid damage or bruising. Refer to 710.03.09 and the following:

(a) Foliage Removal. Remove dead foliage of annuals and other unwanted vegetation from the previous season without damaging or disturbing perennials or other desirable vegetation.

- (b) **Mulch.** Remove and conserve SHB mulch at sites where annuals or bulbs will be installed before digging the planting hole. Replace mulch to a depth of 2 in. over bulbs and around the stems of annuals.

711.03.11 Fertilizing and Watering After Installation.

- (a) **Application Equipment.** Refer to 710.03.14(a).
- (b) **Fertilizer Solution.** Refer to 710.03.14(b).
- (c) **Nutrient Management Reporting.** Refer to 710.03.01(f).
- (d) **Follow-Up Watering.** Refer to 710.03.14(d).

711.03.12 Cleanup. Refer to 710.03.15.

711.03.13 Unacceptable Plants and Replacement Plants. Refer to 710.03.18, 920.07 and replace unacceptable plants as specified in Section 711 for the remainder of the growing season until Final Acceptance.

711.03.14 Installation Phase Inspection. Refer to 710.03.19.

711.03.15 Installation Phase Punch List. Refer to 710.03.20.

711.03.16 Installation Phase Acceptance. Refer to 710.03.21 and provide the Establishment Phase Schedule as specified in 711.03.02(e).

Installation Phase Acceptance will be granted when the Punch List and all Installation Phase requirements are completed.

The following list includes key Installation Phase requirements:

REQUIREMENTS FOR INSTALLATION PHASE ACCEPTANCE		
Item	Requirement	Section
a	Submittals are accepted and Inspections are completed.	710.03.01(b), 711.03.02, 920.07
b	Dead foliage in existing beds is removed.	711.03.10(a)
c	Fertilizer and soil amendments are applied.	711.03.04
d	Planting pits and planting beds are bermed and edged.	710.03.10 and 710.03.11
e	SHB mulch is uniformly spread to the specified depth.	710.03.13 and 711.03.10(c)
f	Plants are watered and fertilized.	711.03.04 and 711.03.11
g	Damaging pests are controlled.	711.03.02(c)
h	Cleanup is completed, plant tags and ribbons are removed.	710.03.15
i	Washouts in and around planting beds are repaired.	710.03.13
j	Unacceptable plants are replaced as needed or required.	710.03.18
k	Damage repairs and Installation Punch List are completed.	710.03.20
l	SHA Pesticide Application and Nutrient Management Reporting Forms are completed.	710.03.01(d) and (f)
m	Plants are properly installed and successfully transplanted.	711.03.01 thru .13
n	Establishment Phase Schedule & IPM Program is accepted.	710.03.02(e) and 711.03.16

711.03.17 Establishment Phase. The Establishment Phase for annuals and bulbs planted in beds begins upon Installation Phase Acceptance. Maintain all plants except naturalized daffodils as specified in 711.03.01 thru 0.16 and as follows:

- (a) **Period of Maintenance.** Plants shall be maintained for one Planting Season, until Final Acceptance.
- (b) **Plant Watering.** Refer to 710.03.22(b).
- (c) **Pest Management.** Refer to 710.03.22(c).
- (d) **Unacceptable Plants and Replacement Plants.** Refer to 710.03.18. Promptly remove and replace plants that have become unacceptable during the Establishment Phase as needed, or at the request of the Engineer.
- (e) **End-of-Season Foliage Removal.** Remove the foliage of annuals that have declined in late summer or fall, as directed by the Engineer. Remove the foliage and flower stems of bulbs planted in beds after they have declined at the end of their growing season in June.

- (f) **Establishment Phase Inspection and Punch List.** Refer to 710.03.19 and .20. The Inspection will be scheduled and the Establishment Phase Punch List will be developed. Perform repairs, replacements and other work as specified in the Contract Documents and Punch List.
- (g) **Final Acceptance.** Refer to 710.03.21. Final Acceptance will be granted when the Punch List and all Establishment Phase requirements are completed.

The following list includes key establishment requirements:

REQUIREMENTS FOR ESTABLISHMENT PHASE & FINAL ACCEPTANCE		
Item	Requirement	Section
1	Washouts in and around planting beds are repaired.	710.03.13
2	Plants are watered as needed and refertilized as requested.	710.03.14(d) and 710.03.22(b)
3	Damaging pests are controlled.	710.03.22(c)
4	Planting beds are weed free.	710.03.22(c)
5	Pesticide Reporting and Nutrient Management Fertilizer Reporting Forms are completed.	710.03.01(d) and (f)
6	Unacceptable plants are replaced as requested.	711.03.17(d)
7	End-of-season foliage removal is completed.	711.03.17(e)
8	Damage repairs and Establishment Punch List are completed.	711.03.17(f)

711.04 MEASUREMENT AND PAYMENT. Annuals and Bulbs Installation and Establishment Installation and Establishment will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all plants, material, labor, equipment, tools, and incidentals necessary to complete the work.

711.04.01 Annuals and Bulbs Installation and Establishment. Annuals and Bulbs Installation and Establishment shall include the cost of plants, layout, marking, pruning, planting pit excavation, fertilizer, soil amendments, backfilling, berming, edging, watering, pest management, plant maintenance, and all operations related to the Installation and Establishment Phases of each plant, until Final Acceptance.

Annuals and Bulbs Installation and Establishment will be paid for in monthly pro-rated payments based upon the approved Breakdown List of Contract Prices and the following Payment Schedule.

Refer to 711.03.02(a). In the event of change in the quantities required, payment adjustments will be based on the approved Breakdown List of Contract Prices.

(a) Payment Schedule. Payments will be made according to the following schedule when construction requirements are met;

PAYMENT SCHEDULE					
INSTALLATION AND ESTABLISHMENT PHASE COMPLETION		PERCENT OF TOTAL CONTRACT PRICE			PRO-RATED MONTHLY FOR COMPLETED WORK
		Annuals in Beds	Bulbs in Beds	Naturalized Bulbs	
711.03.0 thru .16	Installation Phase	70	80	100	Duration of Installation Phase
711.03.17(a) thru (d)	Establishment Phase In-Season Maintenance	20	10	–	At Each Monthly Inspection
711.03.17(e) thru (g)	End-of-Season Maintenance, Removal & Replacement, and Final Acceptance	10	10	–	At Final Acceptance
Total Payment		100	100	100	

(b) Forfeiture. Failure to complete operations as required or directed in conformance with the Payment Schedule will result in forfeiture of that percentage of payment based upon the Breakdown List of Contract Prices.

711.04.02 Constructing Planting Beds. Refer to 710.04.02

711.04.03 Refertilizing. Refertilization authorized after the Engineer grants Installation Phase acceptance will be measured and paid for at the Contract unit price per 1000 gallons.

711.04.04 Additional Mulching. Refer to 710.04.05.

SECTION 712 — TREE BRANCH PRUNING

712.01 DESCRIPTION. Prune tree branches.

712.02 MATERIALS. Not applicable.

712.03 CONSTRUCTION.

712.03.01 General.

(a) **Permits.** Obtain a Roadside Tree Permit from the Maryland Department of Natural Resources - Forest Service.

(b) **Tree Preservation Program (TPP).** Adhere to the requirements of the TPP when developed by the Administration.

712.03.02 Breakdown List of Contract Prices. Refer to 712.04 and develop a Breakdown List of Contract Prices for each tree in the Contract. Include costs for pruning and completing all operations per tree.

Submit the written Breakdown List within 14 days after Notice of Award. The Breakdown List will be reviewed by the Engineer and Landscape Operations Division for completeness and balance, and will be approved or returned for correction.

712.03.03 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the Operations in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

712.03.04 Meetings. Meet with the Engineer, the LTE, and the LOD to review areas, Operations, and the approved Breakdown List of Contract Prices before beginning Operations.

712.03.05 Marking. Identify trees to be pruned, and obtain approval before beginning Operations.

712.03.06 Equipment. Equipment and tools shall conform to accepted arboricultural practices.

712.03.07 Notice. Notify the Engineer at least 10 days before beginning Operations.

712.03.08 Operations. The Contract Documents will indicate the trees to be selectively pruned or the dimensions or goals to be achieved by pruning. Meet ANSI A300 standards for Tree Care Operations. Tree branch pruning shall conform to one or more of the following Operations, as specified:

- (a) **Cleaning.** To remove dead, diseased, and broken branches.
- (b) **Thinning.** To reduce the density of live branches.
- (c) **Raising.** To provide vertical clearance to a height of 15 ft, or as specified in the Contract Documents.
- (d) **Reducing.** To decrease the height or spread.
- (e) **Specialty Pruning.** To meet the needs of young trees, at planting, once established, pollarding, for restoration, to maintain vistas, or to accommodate utilities.

712.03.09 Wood Chipping. Chip wood and disperse or dispose of chips as directed.

712.03.10 Cleanup and Restoration. Promptly disperse or remove and dispose of wood debris and other waste materials as directed.

Avoid damage to existing structures, plants, and turfgrass. Keep turfgrass areas, paved surfaces, and sidewalks clean. Restore ruts and damaged turfgrass areas by seeding as specified in Section 705 before beginning any new landscape operations.

712.03.11 Damage Repair. Do not injure vegetation to be preserved.

Injuries to bark, trunks, or limbs shall be repaired by cutting, smoothing, and tracing the bark in accordance with ANSI A300 Standards for Tree Care Operations.

712.03.12 Damage Compensation. Monetary compensation for damage or loss of trees will be calculated and assessed in conformance with the Guide for Plant Appraisal of the Council of Tree & Landscape Appraisers.

712.04 MEASUREMENT AND PAYMENT. Tree Branch Pruning will not be measured, but will be paid for at the Contract lump sum price based upon the Breakdown List of Contract Prices.

The payment will be full compensation for all labor, material, equipment, tools, and incidentals necessary to complete the work. If the Administration requests a change, the units and payment will be adjusted on the basis of the approved Breakdown List of Contract Prices.

SECTION 713 — BRUSH REMOVAL

713.01 DESCRIPTION. Remove brush as specified.

713.02 MATERIALS.

Herbicide	920.09.03(a)
Marking Dye	920.09.04

713.03 CONSTRUCTION.

713.03.01 General.

- (a) **Permits.** Obtain a Roadside Tree Permit from the Maryland Department of Natural Resources - Forest Service.
- (b) **Tree Preservation Program (TPP).** Adhere to the requirements of the TPP when developed by the Administration.
- (c) **Pesticide Application.** Refer to 710.03.01(c).
- (d) **Pesticide Application Reporting.** Refer to 710.03.01(d).

713.03.02 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the Operations in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

713.03.03 Meetings. Meet with the Engineer, the LTE, and the Landscape Operations Division to review areas and Operations before beginning Operations.

713.03.04 Marking. Mark areas where brush is to be removed. Identify trees and shrubs to be preserved and protected. Ensure that marking and identification is completed and approved before beginning Operations.

713.03.05 Equipment. Equipment and tools shall conform to accepted arboricultural practices.

713.03.06 Notice. Notify the Engineer at least 10 days before beginning Operations.

713.03.07 Operations. Brush removal shall involve cutting, herbicide treatment, and debris removal of areas of living or dead vegetation. Do not injure vegetation identified for preservation.

One or more of the following Operations will be specified:

(a) **Operation 1 - Brush Removal.** Cut vegetation to a height of no more than 1 in. above the soil surface. Remove wood debris.

(b) **Operation 2 - Brush Removal with Stump Treatment.** Cut vegetation as in Operation 1. Immediately treat the cambium layer and exposed bark of live stumps with an approved herbicide solution and marking dye. Remove wood debris.

713.03.08 Wood Chipping. Chip wood and disperse or dispose of chips as directed.

713.03.09 Cleanup and Restoration. Promptly remove, disperse, or dispose of wood debris and other waste materials as directed.

Avoid damage to existing structures, plants, and turfgrass. Keep turfgrass areas, paved surfaces, and sidewalks clean. Restore ruts and damaged turfgrass areas by seeding as specified in Section 705 before beginning any new landscape operations.

713.03.10 Damage Repair. Do not injure vegetation to be preserved.

Injuries to bark, trunks, or limbs shall be repaired by cutting, smoothing, and tracing the bark in accordance with ANSI A300 Standards for Tree Care Operations.

713.03.11 Damage Compensation. Monetary compensation for damage

or loss of trees will be calculated and assessed in conformance with the Guide for Plant Appraisal of the Council of Tree & Landscape Appraisers.

713.04 MEASUREMENT AND PAYMENT. Brush removal will be measured and paid for at the Contract unit price per square yard, as specified. The payment will be full compensation for all labor, material, equipment, tools, and incidentals necessary to complete the work.

SECTION 714 — TREE FELLING

714.01 DESCRIPTION. Fell trees as specified.

714.02 MATERIALS.

Furnished Topsoil	920.01.02
Herbicide	920.09.03(a)
Marking Dye	920.09.04

714.03 CONSTRUCTION.

714.03.01 General.

- (a) **Permits.** Obtain a Roadside Tree Permit from the Maryland Department of Natural Resources - Forest Service.
- (b) **Tree Preservation Program (TPP).** Adhere to the requirements of the TPP when developed by the Administration.
- (c) **Pesticide Application.** Refer to 710.03.01(c).
- (d) **Pesticide Application Reporting.** Refer to 710.03.01(d).

714.03.02 Breakdown List of Contract Prices. Refer to 714.04 and develop a Breakdown List of Contract Prices for each tree in the Contract. Include costs for felling and completing all operations per tree.

Submit the written Breakdown List within 14 days after Notice of Award. The Breakdown List will be reviewed by the Engineer and Landscape Operations Division for completeness and balance, and will be approved or returned for correction.

714.03.03 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the Operations in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

714.03.04 Meetings. Meet with the Engineer, the LTE, and the LOD to review areas, Operations, and the Breakdown List of Contract Prices before beginning Operations.

714.03.05 Utilities and Tree Marking. Refer to Section 875 when included in the Contract Documents.

- (a) **Utilities Marking.** Contact ‘Miss Utility’ or another approved service to identify and mark utilities in the rights-of-way. Contact the District Utilities Engineer to mark utilities on Administration property.
- (b) **Tree Marking.** Mark trees to be felled. Obtain approval before beginning Operations.

714.03.06 Equipment. Equipment and tools shall conform to accepted arboricultural practices.

714.03.07 Notice. Notify the Engineer at least 10 days before beginning Operations.

714.03.08 Operations. Tree felling shall involve cutting, stump removal, stump grinding, herbicide treatment, and debris removal of selected living or dead trees.

When trees cannot be felled as a unit without danger to traffic or injury to other plants or property, remove the top sections until the tree can be safely felled.

One or more of the following Operations will be specified:

- (a) **Operation 1 - Felling and Stump Removal.** Fell trees and remove the stumps or grind them to a depth at least 8 in. below the soil surface. Remove wood debris and stump grindings. Within 24 hours after removal or grinding, backfill the stump holes with topsoil to the surrounding soil level. Seed as specified in Section 705.
- (b) **Operation 2 - Felling and Stump Treatment.** Fell trees and

remove wood debris. Cut stumps to a height of no more than 4 in. above the soil surface. Treat with herbicide as specified in 713.03.07(b).

(c) Operation 3 - Felling and Removal. Fell trees and remove wood debris. Cut stumps to a height of no more than 4 in. above the soil surface.

(d) Operation 4 - Felling and Delimiting. Fell trees and cut stumps to a height of no more than 12 in. above the soil surface. Branches of felled trees that extend higher than 3 ft above the soil surface shall be cut or delimited to a height of no more than 3 ft above the soil surface. Do not remove wood debris.

714.03.09 Wood Chipping. Chip wood and disperse or dispose of chips as directed.

714.03.10 Cleanup and Restoration. Promptly remove, disperse, or dispose of wood debris and other waste materials as directed.

Avoid damage to existing structures, plants, and turfgrass. Keep turfgrass areas, paved surfaces, and sidewalks clean. Restore ruts and damaged turfgrass areas by seeding as specified in Section 705 before beginning any new landscape operations.

714.03.11 Damage Repair. Do not injure vegetation to be preserved.

Injuries to bark, trunks, or limbs shall be repaired by cutting, smoothing, and tracing the bark in accordance with ANSI A300 Standards for Tree Care Operations.

714.03.12 Damage Compensation. Monetary compensation for damage or loss of trees will be calculated and assessed in conformance with the Guide for Plant Appraisal of the Council of Tree & Landscape Appraisers.

714.04 MEASUREMENT AND PAYMENT. Tree Felling will not be measured, but will be paid for at the Contract lump sum price based upon the Tree Felling Size Classes and the Breakdown List of Contract Prices specified in 714.03.02.

The payment will be full compensation for all labor, material, equipment, tools, and incidentals necessary to complete the work. Felled trees shall be classed according to the following table of Tree Felling

Size Classes, and be paid as per their Size Class:

TREE FELLING SIZE CLASSES			
TREE DIAMETER AT BREAST HEIGHT IN.	TREE PAY CLASS	TREE DIAMETER AT BREAST HEIGHT IN.	TREE PAY CLASS
Under 10+	A	31 to 35+	F
10 to 15+	B	36 to 39+	G
16 to 20+	C	40 to 45+	H
21 to 25+	D	46 to 50+	I
26 to 30+	E	Over 51	J

If the Administration requests a change, the units and payment will be adjusted on the basis of the Tree Felling Size Classes and the Breakdown List of Contract Prices.

SECTION 715 — TREE ROOT PRUNING

715.01 DESCRIPTION. Prune tree roots as specified.

715.02 MATERIALS.

Salvaged Topsoil	920.01.01
Furnished Topsoil	920.01.02

715.03 CONSTRUCTION.

715.03.01 General.

- (a) **Permits.** Obtain a Roadside Tree Permit from the Maryland Department of Natural Resources - Forest Service.
- (b) **Tree Preservation Program (TPP).** Adhere to the requirements of the TPP when developed by the Administration.

715.03.02 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the Operations in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

715.03.03 Meetings. Meet with the Engineer, the LTE, and the Landscape Operations Division before beginning Operations.

715.03.04 Utilities Marking and Conflicts. Refer to Section 875 when included in the Contract Documents.

- (a) **Utilities Marking.** Contact ‘Miss Utility’ or another approved service to identify and mark utilities in the rights-of-way. Contact the District Utilities Engineer to mark utilities on Administration property.
- (b) **Conflicts.** Notify the Administration of conflicts that may affect operations. Conflicts will be reviewed by the Landscape Operations Division and resolved within 14 days after notice.

715.03.05 Marking. Mark areas to be root pruned, and obtain approval before beginning Operations.

715.03.06 Equipment. Use a vibratory knife or other equipment and tools that conform to accepted arboricultural practices.

715.03.07 Notice. Notify the Engineer at least 10 days before beginning Operations.

715.03.08 Operations. Meet ANSI A300 standards for Tree Care Operations. Cleanly cut tree roots to a depth of 24 in. along the approved line, and immediately backfill trenches with excavated soil.

715.03.09 Cleanup and Restoration. Promptly remove, disperse, or dispose of wood debris and other waste materials as directed.

Avoid damage to existing structures, plants, and turfgrass. Keep turfgrass areas, paved surfaces, and sidewalks clean. Restore ruts and damaged turfgrass areas by seeding as specified in Section 705 before beginning any new landscape operations.

715.03.10 Damage Repair. Do not injure vegetation to be preserved. Injuries to bark, trunks, or limbs shall be repaired by cutting, smoothing, and tracing the bark in accordance with ANSI A300 Standards for Tree Care Operations.

715.03.11 Damage Compensation. Monetary compensation for damage or loss of trees will be calculated and assessed in conformance with the Guide for Plant Appraisal of the Council of Tree & Landscape Appraisers.

715.04 MEASUREMENT AND PAYMENT. Tree Root Pruning will be measured and paid for at the Contract unit price per linear foot. The payment will be full compensation for all labor, material, equipment, tools, and incidentals necessary to complete the work.

SECTION 716 — TREE FERTILIZING

716.01 DESCRIPTION. Fertilize trees as specified.

716.02 MATERIALS.

Fertilizer 920.03 and as specified in the TPP.

716.03 CONSTRUCTION.

716.03.01 General.

- (a) **Permits.** Obtain a Roadside Tree Permit from the Maryland Department of Natural Resources - Forest Service.
- (b) **Tree Preservation Program (TPP).** Adhere to the requirements of the TPP when developed by the Administration.
- (c) **Nutrient Management Reporting.** Record the fertilizer analysis, the square yards covered, and the pounds of fertilizer applied on the Nutrient Management Reporting Form. Submit the Form within 24 hours after applying fertilizer.

716.03.02 Maryland Licensed Tree Expert (LTE). A LTE shall perform or directly supervise the Operations in conformance with the Maryland Roadside Tree Law, the Forest Conservation Act, and accepted arboricultural practices.

716.03.03 Meetings. Meet with the Engineer, the LTE, and the Landscape Operations Division before beginning Operations.

716.03.04 Marking. Identify trees to be fertilized, and obtain approval before beginning Operations.

716.03.05 Equipment. Equipment and tools shall conform to accepted arboricultural practices.

716.03.06 Notice. Notify the Engineer at least 10 days before beginning Operations.

716.03.07 Operations. Meet ANSI A300 standards for Tree Care Operations. One or more of the following Operations will be specified:

- (a) **Operation 1 - Broadcast Fertilizing.** Apply fertilizer uniformly over the soil surface.
- (b) **Operation 2 - Injection Fertilizing.** Inject fertilizer solution through a pressurized probe, at points 2 to 3 ft apart, to a depth of 8 to 10 in.
- (c) **Operation 3 - Drill Fertilizing.** Place fertilizer into 1 to 3 in. diameter drilled holes, at points 2 to 3 ft apart, to a depth of 8 to 10 in.

716.03.08 Cleanup and Restoration. Avoid damage to existing structures, plants, and turfgrass. Keep turfgrass areas, paved surfaces, and sidewalks clean. Restore ruts and damaged turfgrass areas by seeding as specified in Section 705 before beginning any new landscape operations.

716.03.09 Damage Repair. Do not injure vegetation to be preserved.

Injuries to bark, trunks, or limbs shall be repaired by cutting, smoothing, and tracing the bark in accordance with ANSI A300 Standards for Tree Care Operations.

716.03.10 Damage Compensation. Monetary compensation for damage or loss of trees will be calculated and assessed in conformance with the Guide for Plant Appraisal of the Council of Tree & Landscape Appraisers.

716.04 MEASUREMENT AND PAYMENT. Tree fertilizing will be measured and paid for at the Contract unit price for one or more of the specified items. The payment will be full compensation for all labor, material, equipment, tools, and incidentals necessary to complete the work.

716.04.01 Tree Broadcast Fertilizing per square yard.

716.04.02 Tree Injection Fertilizing per square yard.

716.04.03 Tree Drill Fertilizing per square yard.

CATEGORY 800

TRAFFIC

SECTION 801 — CONCRETE FOUNDATIONS

801.01 DESCRIPTION. Construct concrete foundations for installing traffic signals, highway lighting, and signs.

801.02 MATERIALS.

Curing Materials	902.07.03
Concrete Mix No. 3	902.10
Corrugated Metal Pipe	905
Reinforcement Steel	908.01
Anchor Bolts	909.08
Conduit	921.07
Galvanizing for Hardware	A 153

801.03 CONSTRUCTION.

801.03.01 Excavation. Excavate to the dimensions specified. Ensure that all excavation work is inspected and approved before proceeding with construction.

801.03.02 Galvanized parts that have been cut or chipped to bare metal shall be repaired per A 780.

801.03.03 Concrete Placement. Place concrete against undisturbed earth wherever possible. However, where the existing ground shows a tendency to cave in or otherwise will not retain its shape during or after excavation provide, install, and leave in place a corrugated steel pipe.

Mix, place, and test concrete as specified in Section 420. Construct footings, including reinforcement and bolt circle data, as specified in the Contract Documents and in conformance with the approved working drawings. Use suitable and accurately placed templates to set the anchor bolts plumb. Leave the templates in place until the concrete attains initial set.

Apply a level trowel finish to the top of the foundation. Apply a liquid membrane forming compound to all exposed surfaces.

801.03.04 Unusual Soil Conditions. When unexpected subsurface conditions are encountered, modify the excavation depth as directed. If

rock or boulders cannot be removed by ordinary means, remove them to the levels and dimensions specified, or to a depth necessary to obtain the required stability.

801.03.05 Backfill. Use material that is free of topsoil, organic, frozen, and other undesirable materials. Keep spaces to be backfilled free of trash. Clean the space before placing backfill. Use suitable material from the excavation or other sources conforming to Section 204. Place in layers not more than 8 in. loose thickness. Use mechanical or vibratory compaction equipment to obtain at least 92 percent of maximum density at a moisture content within 2 percent of the optimum per T 180, Method C.

801.04 MEASUREMENT AND PAYMENT. Concrete foundations for installing traffic signals, highway lighting, and signs will be measured and paid for at the Contract unit price per cubic yard for the pertinent Concrete Foundation item. The payment will be full compensation for all concrete, excavation, corrugated metal pipe or forms, reinforcement steel, anchor bolts, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Where concrete barrier transitions, grounding, and conduit are required, they will be measured and paid for as specified in Sections 604, 804, and 805 respectively.

SECTION 802 — GALVANIZED STEEL BEAM SIGN POSTS

802.01 DESCRIPTION. Furnish and install galvanized steel beam sign posts.

802.02 MATERIALS.

Bolts, Nuts and Washers	909.07
Galvanizing for Beams	A 123
Galvanizing for Hardware	A 153
Steel Beams	A 709

802.03 CONSTRUCTION. Stake each location for approval. Upon approval, submit working drawings. Show the highest elevation of the traveled roadway and the shoulder elevation at each post location. Upon approval of the working drawings, materials may be ordered.

Galvanized parts that have been cut or chipped to bare metal shall be repaired per A 780.

Install posts plumb and to the lateral orientation specified.

802.04 MEASUREMENT AND PAYMENT. Galvanized Steel Beam Sign Posts will be measured and paid for at the Contract unit price per linear foot for the various sizes of posts specified. The payment will be full compensation for stakeout, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Breakaway Base Support Systems will be measured and paid for as specified in Section 821.

SECTION 803 — OVERHEAD SIGN STRUCTURES

803.01 DESCRIPTION. Furnish and install overhead sign structures and appurtenances. Sign panels, electrical work, luminaires, and foundations are excluded.

803.02 MATERIALS.

Bolts, Nuts and Washers	909.07
Overhead Sign Structures	950.04

803.03 CONSTRUCTION. Do all fabrication in the shop as specified in Section 430, except do welding in accordance with ANSI/AWS D1.1, Tubular Structures.

Design and manufacture all assemblies and tubular members as specified in A 385 to permit hot dip galvanizing. Make all holes required in the supports before galvanizing. Protect the surfaces during transportation and handling.

The structure shall be free from sharp edges, irregularities, misfits, and structural deficiencies. After installation and before final acceptance, repair or replace all damaged surfaces.

Stake each location for approval by the Engineer. Upon approval, submit working drawings. Show the highest elevation of the traveled roadway and the shoulder elevation at each support location. Upon approval of the working drawings, materials may be ordered.

803.04 MEASUREMENT AND PAYMENT. Overhead Sign Structures will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all stakeouts, sign and luminaire supports, nuts and washers, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 804 — GROUNDING

804.01 DESCRIPTION. Furnish and install grounding systems.

804.02 MATERIALS.

Ground Wire and Rods

950.06.04

804.03 CONSTRUCTION. The grounding system shall conform to the latest editions of the NEC and NESC. Grounding of overhead communication cable messenger cable attached to a utility company owned pole shall also conform to the utility company's requirements.

804.03.01 Equipment Grounding System. This system shall consist of the ground wire, electrically continuous metallic conduit system, span wire, steel poles, grounding conductors, communications cable steel spans, ground rods, steel span wire back guying, steel span wire pole to pole guying, and steel span wire slack spans and terminations.

Grounding for overhead communications cable shall be to all of the following when present: at the telephone and CATV cables support span wires, at the ground wire of a multigrounded system, at the neutral wire of a multigrounded system, and at the ground of a secondary circuit with approved span wire grounding clamps. Grounding to the overhead communication cable support span at utility company owned poles shall be with a vise type body clamp equipped with jaws having teeth to pierce the insulation, without stripping the jacket on the overhead communications cable span wire, and operated by a single hexagonal head bolt.

804.03.02 Grounding Conductors. Furnish and install grounding conductors of the size and type specified.

804.03.03 Ground Rods. Install ground rods as specified. Measure the ground resistance of each rod before connecting the rod to the grounding conductor. If the measured resistance exceeds 25 ohms, exothermically weld a 10 ft extension rod to the top of the first rod and drive to its full depth. Measure the earth resistance again. If it still exceeds 25 ohms, contact the Engineer for instructions.

Where rock is encountered and acceptable earth grounds cannot be accomplished by driving as described above, the Engineer may direct the use of a grounding grid. In a grounding grid, direct buried rods are exothermically welded end to end to bond lighting standards and structures in continuous series to some point where an acceptable earth ground can be obtained.

804.03.04 Continuity. Maintain continuity of the equipment grounding system throughout the project.

804.03.05 Terminations. Connection to equipment grounding system shall be made with suitable lugs at all grounding bushings specified in Section 805, and at the ground lugs in lighting structure access holes or in a breakaway base. Make connections to ground rods as specified in the Contract Documents. Connections to neutral grounding systems shall be made with lugs as specified in Section 805.

Overhead communication cable shall be made with connectors installed at the first attachment on a utility company owned pole in the following method: at the last attachment on the pole; at every fifth attachment between the first and last attachment on the pole; at each attachment where power, CATV, and telephone cables continue onto differing poles; at each attachment where power, CATV, and telephone cables converge onto the same pole; at attachments on poles equal to 1/4 mile or more; and at where more than one separate attachment or guy is on the same pole. Grounding connectors shall be installed to the overhead communications cable, to the telephone and CATV cables support span wires when present, to the ground wire of a multigrounded system, to the neutral wire of a multigrounded system, and to the ground of a secondary circuit. The ground wire between clamps shall be stapled every 12 in.

804.03.06 Testing. Section 820.

804.04 MEASUREMENT AND PAYMENT. Ground Rods will be measured and paid for at the Contract unit price per each 10 ft length. The payment will be full compensation for lugs and welding, excavation, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Ground wire will be measured and paid for as specified in 810.04.01.

SECTION 805 — ELECTRICAL CONDUIT AND FITTINGS

805.01 DESCRIPTION. Furnish and install electrical conduit and fittings.

805.02 MATERIALS.

Concrete	902.10
Metallic Conduit and Fittings	921.07.01
Nonmetallic Conduit and Fittings	921.07.02
Flexible Conduit and Fittings	921.07.02
PVC Coated Metallic Conduit and Fittings	921.07.03

805.03 CONSTRUCTION.

805.03.01 Bends. Unless otherwise specified, use manufactured bends or field bends to make changes in direction. Maintain an 18 in. trade radius.

805.03.02 Connections. Make conduit runs with as few couplings as standard length will permit. Rigid steel conduit connections shall be threaded. Paint field cut threads of galvanized conduit with approved galvanizing repair paint prior to assembly. Connect nonmetallic conduit using a solvent welding process. Use watertight cast ferrous compression type fittings for electrical metallic tubing (EMT).

805.03.03 Conduit Terminations. Use pull boxes or conduit bodies at conduit terminations. Conduits terminating in cast iron junction boxes shall be threaded into hubs, with bonding screws furnished and installed on the interior of the box. Conduits terminating in junction boxes without hubs shall be secured with two lock nuts with an insulated grounding bushing installed. Conduits terminating at concrete foundations, manholes, or hand holes shall be secured as specified in the Contract Documents. Cap all ends of unused conduit.

805.03.04 Cleaning and Capping. Prior to installing conductors, remove all obstructions and debris by pulling a mandrel type device through each conduit run and all fittings in the presence of the Engineer. Cap conduit ends by using a manufactured cap or plug. Prior to the installation of wiring, remove manufactured caps or plugs and install an insulated bonding bushing on galvanized rigid conduit; install bell end fittings on PVC conduit.

805.03.05 Pull Wire. Install a pull wire or cord in all conduits left empty. Pull wire and cord shall be corrosion resistant material with a breaking strength of at least 200 lb.

805.03.06 Exposed Conduit. Exposed conduit runs shall be parallel or at right angles to walls, slabs, girders, etc. Locate conduit to minimize accumulation of dirt and to provide accessibility for painting. Attach conduit to steel, concrete, masonry, or timber using straps, clamps, or hangers of an approved type made of stainless steel or galvanized malleable iron. Space the attachments as specified. When specified, paint all exposed rigid steel conduit surfaces to match the color of adjacent material. Prepare all galvanized surfaces as specified in Section 435 before the application of approved paint.

805.03.07 Expansion Joints. Where conduits cross expansion joints in the structure, or where otherwise specified, use expansion fittings of a type that ensures electrical continuity across the joint.

805.03.08 Buried Conduit (Trenched). Conduits shall be sloped to drain and have a cover of at least 24 in.

805.03.09 Encased Conduit (Slotted or Trenched). Place the conduit accurately, and secure it rigidly to maintain position during concrete placement.

805.03.10 Conduit Installation Under Existing Paved Areas (Bored). Do not cause any disturbance to the existing roadway.

805.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, backfill, encasement concrete, hot mix asphalt, paint, pull wires, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

805.04.01 Electrical conduit and electrical conduit attached to Bridges will be measured and paid for at the Contract unit price per linear foot measured along the center line of the conduit from end to end.

805.04.02 Electrical hand holes, manholes, pull and junction boxes will be measured and paid for as specified in Section 811.

805.04.03 Electrical conduit, fittings, and junction boxes constructed into concrete structures will not be measured but the cost will be incidental to the pertinent Concrete Traffic Barrier, Concrete Parapet, or other pertinent Concrete items specified in the Contract Documents.

SECTION 806 — LUMINAIRES AND LAMPS

806.01 DESCRIPTION. Furnish and install luminaires and lamps.

806.02 MATERIALS.

Luminaires and Lamps	950.12
Photoelectric Controls	950.13.02

806.03 CONSTRUCTION. Attach a safety cable to access doors that face downward and that support the weight of all or part of the ballast. The safety cable shall restrict the amount the door may swing open to 90 degrees. The cable shall be attached to the door by spring clips that can be removed without the use of tools, to allow the door to be easily removed.

806.03.01 Arm Mounted Luminaires. Adjust socket positions to provide the required photometric performance. Provide an individual photocell on each luminaire when specified.

806.03.02 Bridge Underpass Luminaires. Adjust socket positions to provide the required photometric performance.

806.03.03 Cleaning. Prior to the 30-day performance test, clean refractors and reflectors with a product approved by the manufacturer.

806.03.04 Installation. Furnish and install all luminaires and lamps in conformance with the manufacturer's recommendations or as specified in the Contract Documents.

806.03.05 Luminaire Photometric Data and Calculations. Submit the following data with the catalog cut for the luminaire.

- (a) **Photometric Data.** A photometric file for the luminaire selected, in standard IES electronic format. Clearly indicate the name of the file on the catalog cut.
- (b) **Photometric Calculations.** Printouts of the predicted lighting levels for the areas indicated in the Contract Documents. If no areas are indicated, select a typical section of the project for each type of luminaire. Assume a maintenance factor of 0.64 for the calculations.

Calculations for roadway luminaires shall show predicted horizontal footcandle values and veiling luminance ratios for the section selected.

For pedestrian luminaires, show calculations for a typical section of walkway. If any of the walkway is adjacent to a roadway, select a section adjacent to the roadway. The printouts shall show predicted horizontal footcandles for the section of walkway selected, and horizontal footcandles and veiling luminance ratios for the roadways adjacent to the walkway. If roadway lighting also illuminates the adjacent walkway, include the roadway lighting luminaires in the calculations.

For proposed changes to luminaire models during the course of the Contract, or if the manufacturer changes specifications for the luminaire during the Contract, submit photometric calculations and diskette for each change.

All calculated lighting levels for roadway lighting shall be at least the levels specified in the Contract Documents. When no levels are specified, the calculated lighting levels shall be at least those specified in IES RP-8-00 American Standard Practice for Roadway Lighting.

All calculated lighting levels on pedestrian walkways lighting shall be at least the levels specified in the Contract Documents. When no levels are specified, the calculated levels shall conform to IESN.A. In all cases, the maximum calculated veiling luminance ratios on the traveled roadway adjacent to the walkway shall not exceed 0.4.

All roadway and pedestrian luminaires shall conform to the following criteria:

- (a) **Fixed Aim Luminaires.** Fixed aim luminaires, such as cobra-head or post top luminaires, shall have an IES Type 3 distribution pattern or as specified in the Contract Documents. The luminous intensity shall not exceed 100 candelas per 1000 lamp lumens for any point 80 degrees, or higher, above nadir.
- (b) **Adjustable Aim Luminaires.** Adjustable aim luminaires, such as floodlights, shall have an IES Type 3 distribution pattern or as specified in the Contract Documents. The luminous intensity shall not exceed 100 candelas per 1000 lamp lumens for any point 80 degrees, or higher, above nadir; or exceed 25 candelas per 1000 lamp lumens for any point 90 degrees, or higher above nadir; when the aiming point is nadir.

- (c) **High Mast Luminaires.** High mast luminaires shall have an IESNA Type 4 distribution pattern or as specified in the Contract Documents. The luminous intensity shall not exceed 100 candelas per 1000 lamp lumens for any point 80 degrees, or higher, above nadir; or exceed 25 candelas per 1000 lamp lumens for any point 90 degrees, or higher above nadir.

Testing. Submittal and approval of photometric data and calculations shall not remove the responsibility to perform the photometric testing required by Section 820, or to correct or replace lighting where field measurements do not conform to Administration or IES requirements.

806.04 MEASUREMENT AND PAYMENT. Luminaires will be measured and paid for at the Contract unit price per each. The payment will be full compensation for photocell, when required, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

806.04.01 Photometric calculations, and photometric data, will not be measured but the cost will be incidental to other pertinent items included in the Contract Documents.

SECTION 807 — ELECTRICAL SERVICE EQUIPMENT

807.01 DESCRIPTION. Furnish and install electrical service equipment necessary for the utility company to connect the electrical power supply. This work includes coordinating the connection with the local utility company.

807.02 MATERIALS.

Control and Distribution Equipment

950.13

807.03 CONSTRUCTION. Electrical service equipment consists of the equipment necessary to connect a utility company service to a traffic signal controller cabinet, lighting control cabinet, traffic monitoring station cabinet, or other traffic control device cabinet. Provide electrical service equipment at the phasing and amperage specified in the Contract Documents.

807.03.01 Embedded Metered Service Pedestal. Install a galvanized steel post including a 200 amp double pole main circuit breaker for service disconnect, branch circuit breakers, and integral meter socket.

The post shall be designed for embedment into the soil at least 18 in. and have a stabilizer shoe. Pour a concrete collar around the post as shown in the Contract Documents. The post and meter socket shall meet NEMA 3R. Provide the means to padlock the post closed and to install a utility company seal on the meter.

Provide branch circuit breakers as specified.

Embedded metered service pedestals shall be UL listed Suitable for Service Equipment, and be acceptable to the local utility companies for use as a service connection.

807.03.02 Base Mounted Metered Service Pedestal. Install a base-mounted aluminum pedestal including a 200 amp double pole main circuit breaker for service disconnect, branch circuit breakers, and integral meter socket. The pedestal shall have the option of being ordered with the meter socket facing to the front or back, as shown in the Contract Documents. Extend all conduit stub-outs 6 in. beyond the edge of the foundation and arranged as shown in the contract documents.

The pedestal shall be designed for pad mounting using 18 in. anchor bolts. The pedestal shall measure 16 in. wide, 17 in. deep, and 48 in. tall, and meet NEMA 3R. Provide a means to padlock the customer service side door closed and to install a utility company seal on the meter. The meter shall be protected by a hinged hood.

Main circuit breakers shall consist of an industrial grade, F-frame style circuit breaker. Branch circuit breakers shall consist of industrial grade, QC-style circuit breakers mounted on nonenergized clips. Internal cables between the terminal block and the breakers shall be No. 4 AWG THHN.

Provide branch circuit breakers as specified.

Base mounted metered service pedestals shall be UL508 listed Suitable for Service Equipment, and be acceptable to the local utility companies for use as a service connection.

807.03.03 Electrical Service Distribution Cabinet. Where an electrical service distribution cabinet is specified, furnish and install an equipment enclosure, meter socket, disconnect switch, panel boards, transformers, circuit breakers, thermostats, fans, lightning arresters, conduit, wiring and wiring devices, and all other equipment necessary to provide a complete functioning electrical service distribution cabinet. Protect all electrical outlets with ground fault circuit interrupters (GFCI).

807.03.04 Meter Sockets. Provide either ringed or ringless type meter sockets as required by the utility company. If a meter is not required, provide a ringless socket with suitable shunts and a metallic cover plate. Provide hardware for attaching the meter socket to a cabinet, wood post, or other structure.

807.03.05 Disconnect Switch. Include all hardware for attaching the disconnect switch to a cabinet, wood post, or other structure.

807.03.06 Service Cable. Electric service cable for traffic signals, intersection control beacons, hazard identification beacons, and luminaires mounted on traffic signal structures shall have three individual type THWN wires. Each wire shall be at least 19 strands. Electric service cable color identification by spray paint, tape, heat shrink tubing, or any other post-manufacturing method is prohibited.

807.03.07 Utility Connection. Before any control equipment or material is ordered, arrange a meeting with the utility company representatives, Traffic Operations Division representatives, the Engineer, and the District Utility Engineer to establish a schedule for utility connections.

Do not disconnect, de-energize, reconnect, tamper with, or otherwise handle any of the utility company's facilities. Make the utility service connection to the point of service supplied by the utility company.

Make the necessary arrangements with the utility companies to ensure having needed utilities available at the time of turn on. Delays due to utility energization, connection, or disconnection will not be a basis for time extension. Report any difficulties in securing utility company services to the Engineer as soon as possible.

807.04 MEASUREMENT AND PAYMENT.

807.04.01 Electrical Utility Service Equipment will be measured and paid for at the Contract unit price per each at the phasing and amperage specified. The payment will be full compensation for the disconnect switch, meter socket, meter, shunts, cover plate, lightning arresters, wiring, conduit risers, wiring trough, conduit nipples and adapters, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

807.04.02 Embedded Metered Service Pedestal will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all enclosures, panel boards, circuit breakers, internal wiring, wiring devices, concrete collar, meter sockets, meter, shunts, cover plates, wiring, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

807.04.03 Base Mounted Metered Service Pedestal will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all enclosures, concrete foundation, panel boards, circuit breakers, internal wiring, wiring devices, meter sockets, meter, shunts, cover plates, wiring, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

807.04.04 Electrical Service Distribution Cabinet will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all enclosures, concrete foundation, disconnect switches, lightning arresters, panel boards, circuit breakers, internal wiring, ground fault interrupter outlets, conduits, wiring devices, meter sockets, meter, shunts, cover plates, wiring, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

807.04.05 Meter Socket will be measured and paid for at the Contract unit price per each. The payment will be full compensation for attachment hardware, meter, shunts, cover plate, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. When an item for this work is not included in the Contract documents, this work will not be measured, but the cost will be incidental to other pertinent items.

807.04.06 Disconnect Switch will be measured and paid for at the Contract unit price per each. The payment will be full compensation for attachment hardware, fuses, switch, and for all material, labor, equipment, tools and incidentals necessary to complete the work. When an item for this work is not included in the Contract Documents, this work will not be measured, but the cost will be incidental to other pertinent items.

807.04.07 Underground conduit will be measured and paid for as specified in 805.04.

807.04.08 Service lateral cable will be measured and paid for as specified in 810.04.

807.04.09 Utility connection coordination with the utility company will not be measured, but the cost will be incidental to other pertinent items.

807.04.10 Utility company energization, connection, and disconnection costs will be the responsibility of the Administration.

SECTION 808 — LIGHTING STRUCTURES

808.01 DESCRIPTION. Furnish and install steel and aluminum lighting poles, bracket arms, and fittings.

808.02 MATERIALS.

Cast Iron	909.04
Hardware	909.10
Conduit	921.07
Lighting Structures	950.07
Galvanization	A 123
Stainless Steel Hardware	A 167, Type 302
Aluminum Castings	B 26 or B 108, alloy 356-T6
Anchor Base Plate for Aluminum Structures	B 209, 6000 series alloy

808.03 CONSTRUCTION. Refer to Section 801 for concrete foundations.

Perform all fabrication and welding as specified in Section 430. After forming and welding, the pole shall have a smooth finish with only one longitudinal weld and no transverse welds. When fully assembled, install each lighting structure so that the pole is plumb.

Use a metallic arc consumable electrode inert gas shielded process for all welding for aluminum poles. After welding, the entire assembly shall be precipitation heat treated to the T-6 temper by an approved method and rotary sand finished.

All aluminum poles shall be furnished with internal vibration dampening devices.

Bracket Arms. Secure bracket arms to the poles as specified in the manufacturer's recommendations. Install each bracket arm perpendicular to the travel lane, unless otherwise specified.

808.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

808.04.01 Lighting Structures will be measured and paid for at the Contract unit price per each pole height, bracket arm length, and material type.

808.04.02 Concrete foundations will be measured and paid for as specified in 801.04.

808.04.03 Breakaway base support systems, when specified in the Contract Documents, will be measured and paid for as specified in 821.04.

808.04.04 Bracket arms for signal structures or wood poles will be measured and paid for at the Contract unit price per each for the pertinent Bracket Arm item.

SECTION 809 — TRENCHING AND BACKFILLING

809.01 DESCRIPTION. Excavate trenches for the installation of underground conduit, wire, or duct cable for traffic control devices.

809.02 MATERIALS.

Backfill	950.05
Conduit Detection Tape	950.11

809.03 CONSTRUCTION. Excavate trenches as specified.

In areas where conduit or cable is trenched, place a detector tape 6 in. below the finished grade. The tape shall be red and imprinted with a continuous warning message that reads "**CAUTION: ELECTRICAL LINE BURIED BELOW**", repeated every 36 in. The tape shall be inductively and conductively traceable using a standard pipe and cable locating device.

Cable Treatment. Bed the duct cable and direct buried wires into the special backfill material as specified.

Backfill. Backfill and compact the trench as specified in 801.03.05 and restore to its original condition. Replace topsoil, reseed, and resod, where directed.

809.04 MEASUREMENT AND PAYMENT. Trenching and backfilling will not be measured but the cost will be incidental to the Contract unit price for the installation of the pertinent Conduit, Wire, or Duct Cable.

SECTION 810 — ELECTRICAL CABLE, WIRE, AND CONNECTORS

810.01 DESCRIPTION. Furnish and install loop detector wires and leads, electrical cable, cable ducts, wire, micro-loop probe sets, communication cable, and associated connectors.

810.02 MATERIALS.

Micro-Loop Probe	QPL
Sealer for Loop Detector	911.06
Conduit	921.07
Electrical Cable and Wire	950.06
Communication Cable	950.06.08
Cable and Wire Connectors	950.14

810.03 CONSTRUCTION. All conductors shall be copper. Unless specified, no cable splicing will be permitted. When specified, lighting cable splices and loop detector lead in cable splices will be permitted only in pull and junction boxes, manholes, and hand holes. Do not install cable until the entire related raceway, including manhole, hand hole, and foundation system is in place. Provide 6 ft of cable slack, neatly tied, coiled, and positioned in the bottom of manholes, hand holes, and cabinets. Provide 8 in. drip loops at all overhead entrance points into structures. Install insulated spade type terminal ends on all wiring placed on terminal blocks.

810.03.01 Direct Burial Cable. Install to the depth of cover specified. Install backfill as specified in 801.03.05.

810.03.02 Cable in Conduits. Install by method in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the other protective covering. Seal the ends of all cables until ready for connection. When installing more than one wire or cable in a single duct or conduit, pull them into the conduit by hand or power winch with the use of cable grips or pulling eyes. Pulling tension shall be governed by recommended standard procedures for straight pulls or bends. Use a lubricant compatible with the cable insulation.

810.03.03 Preassembled Cable Duct. Prior to installation, pay out the cable duct while moving the reel alongside and parallel to the trench. Do not pull cable duct off a reel located in a stationary position. Install the cable using a cable grip in a manner that will not stress or damage conductors, insulation, or sheath wall.

After backfilling, demonstrate that the conductors move freely within the duct by pulling the conductors out at least 2 ft. Pulling tensions shall conform to 810.03.02. Then pull the cable back to its original position. Completely seal cable duct ends using a waterproof removable sealing compound, a molded plastic device, or a rubber device.

810.03.04 Cable in Lighting Structures. Support the cable at each luminaire with a suitable clamp as an integral part of the luminaire or a device approved by the Engineer for the application.

810.03.05 Identification Tags. Furnish and install circuit wiring identification tags in all manholes, hand holes, junction boxes, and control cabinet and service pedestals. Use a nylon self-clinching type nonconductive band with an adequate sized tab for labeling. Mark each band using 1/4 in. minimum lettering dies, engraving device, or other approved permanent marking process. Indicate the circuit number, the terminal block position for loop detector cables, and the traffic signal phase for all other signal cables.

810.03.06 Loop Detector Wire and Loop Detector Lead-in. Prior to the installation of loop wires, the saw cut area shall be dry and free of saw cut debris. Twist the loop detector wire five turns per foot from the loop itself to the terminal point. Use a blunt instrument to seat the loop detector wire at the bottom of the saw cut. Splice the loop detector wire to the loop detector lead-in as specified.

810.03.07 Grounding Wire. Section 804.

810.03.08 Connector Kits. Furnish and install connector kits as required for the types of cables specified in the Contract Documents and in conformance with the manufacturer's recommendations.

810.03.09 Micro-Loop Probes. Furnish and install Micro-loop probe sets as specified. Terminate all leads in the controller cabinet.

810.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all overhead communication cable attachments, trench excavation, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

810.04.01 Electrical Cable, Cable Ducts, Loop Detector Wire, Loop Detector Lead-in Cable, Grounding Wire, and Communication Cable will be measured and paid for at the Contract unit price per linear foot for the type and sizes specified.

810.04.02 Connector Kits will be measured and paid for at the Contract unit price per each type.

810.04.03 Micro-Loop Probe Sets will be measured and paid for at the Contract unit price per each set. The payment will be full compensation for all sealant, PVC conduit, hole drilling, installation of lead-in cable, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Saw cuts for loop detector wire and micro-loop probe sets will be measured and paid for as specified in 815.04.

SECTION 811 — ELECTRICAL HAND HOLES, MANHOLES, PULL AND JUNCTION BOXES

811.01 DESCRIPTION. Furnish and install electrical hand holes, manholes, pull and junction boxes.

811.02 MATERIALS.

811.02.01 Hand holes.

No. 57 Coarse Aggregate	901.01
Concrete Mix No. 2	902.10
Brick	903.02
Bolts	A 276, Type 304
Frames and Covers	AISC 1020 Steel
Precast Concrete	M 199

811.02.02 Manholes.

No. 57 Coarse Aggregate	901.01
Reinforced Concrete Pipe	905
Cast Iron Manhole Covers	909.04
Polyethylene (PE)	921.10
Precast Concrete	M 199

811.02.03 Pull and Junction Boxes.

Steel Plate	909.02
Cast Iron	909.04

811.03 CONSTRUCTION.

811.03.01 Hand Holes and Manholes. Install hand holes and manholes flush to drain with the finished grade. Mix, place, and test concrete as specified in Section 420. Install aggregate drain as specified. Excavate and backfill in accordance with Section 809. When installing hand holes

and manholes in sidewalks, remove and reinstall the sidewalk to the nearest joint. Fill or patch spaces between conduit and the hand hole and manhole wall with concrete or other sealer as directed.

Set hand hole and manhole frames in a mortar or concrete bed as shown in the Contract Documents.

811.03.02 Pull and Junction Boxes. The conduit entrance shall have a hub or boss of sufficient thickness that five full threads of the conduit engage the threaded holes in the box.

811.04 MEASUREMENT AND PAYMENT. Electrical Hand Holes, Manholes, Pull and Junction Boxes will be measured and paid for at the Contract unit price per each unless otherwise specified in the Contract Documents. The payment will be full compensation for all excavation, aggregate drain, concrete, bolts, bricks, pipes, backfill, sealer, frames and covers, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 812 — WOOD SIGN SUPPORTS

812.01 DESCRIPTION. Furnish and install wood sign supports.

812.02 MATERIALS.

Wood	921.05
Preservatives	921.06

Wood supports shall be No. 1 dense grade.

812.03 CONSTRUCTION. Auger or dig holes using methods approved by the Engineer. Place supports in a plumb position and to the specified depth and lateral orientation. Backfill using suitable excavation material, and compact in place. Do not drive or hammer supports into undisturbed earth.

When specified, wood sign supports shall have drilled holes conforming to the breakaway requirements specified in AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, or as shown in the Contract Documents.

812.04 MEASUREMENT AND PAYMENT. Wood Sign Supports will be measured and paid for at the Contract unit price per linear foot for the length and size specified. The payment will be full compensation for all excavation, backfill, drilled holes, and for all

material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 813 — SIGNS

813.01 DESCRIPTION. Furnish and install signs as specified. Refer to Sections 802, 803, and 812 for sign supports.

813.02 MATERIALS.

Sign Panel Supports and Hardware	909.07, 921.05, 921.06, 950.04, A 123, A 153 and A 709
Reflective and Nonreflective Sheeting	950.03
Sign Materials	950.08

Provide all hardware not provided by the Administration. Hardware shall be stainless steel. The Administration will supply traffic signal related signs and their mounting hardware for span wire, mast arm, and signal pole mounted applications.

813.03 CONSTRUCTION. Use demountable copy or direct applied copy on extruded aluminum. Use direct applied or silk screen copy on sheet aluminum.

The signs will be inspected after sign installation is complete. If specular reflection is apparent on any sign, reposition the sign as directed.

Inspect each new sign location to determine if clearing is required to provide for good sight distance. Complete all clearing and disposal as specified in Section 101. Remove any tree limbs protruding within the limits of clearing as specified in Section 712. The limits of clearing for each location will be as specified.

813.04 MEASUREMENT AND PAYMENT.

813.04.01 Signs will be measured and paid for at the Contract unit price per square foot of area of the vertical front face of the completed sign with no deduction for required shaping. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

813.04.02 Administration furnished signs and mounting hardware will be measured and paid for at the Contract unit price per square foot for the

completed sign installed. The payment will be full compensation for all transportation, drilling holes as specified, installation, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

813.04.03 Clearing for signing will not be measured but the cost will be incidental to the Contract unit price for furnishing and installing the signs.

SECTION 814 — SIGNAL HEADS

814.01 DESCRIPTION. Furnish and install vehicle traffic control signal heads and pedestrian traffic control signal heads.

814.02 MATERIALS.

Traffic Signal Heads	950.15
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814.03 CONSTRUCTION.

Aiming. Aim signal heads to be visible in conformance with the minimum requirements of the MdmUTCD.

814.04 MEASUREMENT AND PAYMENT. Aluminum, Polycarbonate, and Optically Programmed Signal Heads and Pedestrian Signal Heads furnished and installed will be measured and paid for at the Contract unit price per each section of signal head type and size as specified in the Contract Documents. The payment will be full compensation for all lenses, mounting hardware, assembly, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 815 — SAW CUTS FOR TRAFFIC CONTROL DEVICES

815.01 DESCRIPTION. Saw cut and seal the saw cuts for traffic control devices.

815.02 MATERIALS.

Sealer	911.06
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815.03 CONSTRUCTION.

815.03.01 Saw Cut. Prior to sawcutting, drill holes at all turns. Saw cut using a water quenched process. Do not saw cut curbs and gutter. Maintain the specified saw cut width.

815.03.02 Saw Cut Sealing. Sealing shall not be performed until the electrical testing is completed as specified in Section 820. Apply sealer as specified in the manufacturer’s recommendations into washed, cleaned, and dried saw cuts. Sealer shall not be poured when the roadway surface temperature is below 35 F or during any precipitation.

815.04 MEASUREMENT AND PAYMENT. Saw Cuts for Traffic Control Devices will be measured and paid for at the Contract unit price per linear foot. The payment will be full compensation for all drilled holes, sealing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 816 — TRAFFIC CONTROL DEVICE CABINETS AND EQUIPMENT

816.01 DESCRIPTION. Install Administration furnished traffic signal controllers and cabinets, furnish and install traffic signal controllers and cabinets, furnish and install Intelligent Transportations Systems control cabinets, and furnish and install lighting control cabinets for highway and sign lighting.

816.02 MATERIALS.

Conduit	902.10, 921.07.01, 921.07.03, and 950.11
Control and Distribution Equipment	950.13
Anchor Bolts, Hardware, Cabinets and Controllers	Furnished by, or as approved by the Office of Traffic and Safety

All materials, equipment and installations shall be new, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.

816.03 CONSTRUCTION.

816.03.01 Base Mounted Traffic Signal Cabinets. Mount cabinets on concrete foundations conforming to Section 801. Furnish and install conduit as specified in Section 805.

816.03.02 Pole Mounted Traffic Signal Cabinets. Install cabinets as specified. Furnish and install conduit as specified in Section 805.

816.03.03 Base Mounted Lighting Cabinets. Furnish and install the equipment enclosure, panel boards, transformers, circuit breakers, lighting contactor, relay, photoelectric controls, thermostats, selector switches, fans, lightning arresters, conduit, wiring and wiring devices, and all other equipment necessary to provide a complete functioning lighting cabinet as specified. Protect all electrical outlets with ground fault circuit interrupters (GFCI).

816.03.04 Pole Mounted Lighting Cabinets. Furnish and install a NEMA 4X, stainless enclosure with hardware for attaching the unit to a utility pole, wood post, or traffic control device structure. Include a 60 amp, double pole main circuit breaker; a 60 amp, double pole electrically held lighting contactor; four double pole circuit breakers at the amperage specified in the Contract Documents; photoelectric control; lightning arrester; and all incidentals necessary to provide a complete lighting control unit.

816.04 MEASUREMENT AND PAYMENT.

816.04.01 Installing Administration furnished signal controllers and cabinets will be measured and paid for at the Contract unit price per each for the pertinent Install Traffic Signal Controllers and Cabinets item. Installing Contractor furnished traffic signal controllers and cabinets will be measured and paid for at the Contract unit price per each for the pertinent Traffic Signal Controllers and Cabinets item. The payment will be full compensation for pickup, transportation, and installation of the controller or cabinet when applicable, furnishing and installing the controller or cabinet when applicable, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

816.04.02 Concrete foundations will be measured and paid for as specified in 801.04.

816.04.03 Conduit will be measured and paid for as specified in 805.04.

816.04.04 Ground rods will be measured and paid for as specified in 804.04.

816.04.05 Lighting Control Cabinets will be measured and paid for at the Contract unit price per each of the type and size specified. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 817 — PUSH BUTTONS AND PUSH BUTTON SIGNS

817.01 DESCRIPTION. Furnish and install pedestrian push button assemblies and push button signs.

817.02 MATERIALS.

Retroreflective Sheeting (Type II)	950.03.01
Push Button Sign	950.08
Push Buttons	A 319

The push button assembly shall be weather-tight and tamper proof. The assembly shall be designed to prevent an electrical shock under any weather condition and have provisions for grounding in conformance with the NEC.

- (a) The push button assembly shall be fabricated from aluminum ingot and have an anodized finish.
- (b) The push button plunger shall be chrome plated, 2 in. diameter, and have a spring with operative force not to exceed 5 lb.
- (c) The push button switch shall have single-pole momentary, normally-open, single-throw contacts and spade-type terminals.
- (d) The switch assembly shall have an operating force of approximately 0.5 lb, but not more than 1 lb.
- (e) The switch assembly shall be UL approved and electrically rated to carry 25 amps at 120 volts AC.

817.03 CONSTRUCTION. Locate push buttons in positions that clearly indicate to the pedestrian which crosswalks are actuated by each push button.

Furnish all mounting hardware, and drill holes to provide cable and wire entrances.

817.04 MEASUREMENT AND PAYMENT. Push buttons and push button signs will be measured and paid for at the Contract unit price per each for the pertinent Push Button and Sign item. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 818 — SIGNAL STRUCTURES

818.01 DESCRIPTION. Pickup and install Administration furnished signal structures. The grommets and miscellaneous hardware will be furnished by the Administration.

818.02 MATERIALS.

Signal Structures Hardware	Furnished by the Administration
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818.03 CONSTRUCTION. Install the signal structure on a concrete foundation conforming to Section 801.

Breakaway base support systems, when specified, shall conform to Section 821.

Repair any finish on the signal structures and mounting hardware damaged during transportation and installation to match the original finish as approved by the Engineer at no additional cost to the Administration.

818.04 MEASUREMENT AND PAYMENT.

818.04.01 Installation of Administration furnished signal structures will be measured and paid for at the Contract unit price per each for the type and size specified. The payment will be full compensation for the pickup, transportation and installation of all steel poles, mast arms, twin mast arms, triple mast arms, strain poles, and pedestal poles, breakaway base support systems, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

818.04.02 Concrete foundations will be measured and paid for as specified in 801.04.

SECTION 819 — STEEL SPAN WIRE

819.01 DESCRIPTION. Furnish and install steel span wire for signal head or sign mountings, interconnect runs, and for tethering purposes.

819.02 MATERIALS.

Steel Span Wire	950.09
Galvanizing	A 153

Steel messenger rings shall be the specified size and be mechanically or hot dip galvanized after fabrication.

819.03 CONSTRUCTION. Attach the span wire to poles by wrapping two full turns of the span wire around the pole at the specified height leaving a free end of 2 ft.

Secure the free end to the traversing span wire using a three-bolt clamp and serving sleeve as specified.

Space messenger rings 8 in. apart.

819.04 MEASUREMENT AND PAYMENT. Steel Span Wire will be measured and paid for at the Contract unit price per linear foot for the size of wire installed. The payment will be full compensation for all hardware, material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 820 — GENERAL ELECTRICAL WORK AND TESTING

820.01 DESCRIPTION. Test all electrical items referred to in Category 800.

820.02 MATERIALS. All materials and equipment installed as part of the permanent installation shall be new, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes applicable to the area of installation.

820.03 CONSTRUCTION.

820.03.01 General. All installations shall meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work. All electrical work shall be under the direct supervision of a master electrician licensed in the State of Maryland or in the county where the work is performed. All work done under Sections 804, 805, 806, 807, 810 (except loop wire), 811, 814, 816, 817, and 820 shall be performed by a journeyman electrician. Obtain and pay for all permits, licenses, and inspection fees.

820.03.02 Testing. Supply all personnel and equipment required to perform the following tests. Furnish four certified copies of the complete test reports to the Engineer.

At least 30 days prior to the commencement of each test, submit the types, styles, or catalog numbers of all required testing equipment. Include a written certification stating when the testing equipment was last calibrated by an Administration approved testing agency. The calibration date shall be within 180 days of the date when the tests are to be performed. Perform all tests in the presence of the Engineer.

Immediately repair or replace any defects found in the completed installation.

- (a) **Ground Resistance Testing.** Use a megger ground tester, using the null balance fall of potential method. Corrected readings greater than 25 ohms will not be accepted.
- (b) **Circuit Testing.** Determine the insulation resistance on all cables of every circuit except those installed in lighting structures. Cable insulation resistance shall be at least 10 megohms at 500 volts D.C., except loop detector wire and loop detector lead in shall be at least 100 megohms at 500 volts D.C.

Demonstrate to the Engineer that all conductors are continuous, free from short circuits and unspecified grounds, and that all circuits are properly connected.

- (c) **Performance Testing.** Conduct a performance test using the design power source. Operate the electrical system, including automatic control equipment, for 30 consecutive days. If any component fails, replace it immediately and continue the test. Record each fault, the method and date of correction of each, and the beginning and end of the 30-day test period. If more than 5 percent of any component fails during the test, replace the component and restart the 30-day test cycle for the entire system.
- (d) **Illumination Testing.** Conduct an illumination test, conforming to procedures approved by the Administration, to determine the illumination characteristics of the roadway lighting installation.

820.03.03 Traffic Signal Testing. Conduct testing without causing a hazard to the traveling public.

Maintain all new materials until satisfactorily tested and their operation is accepted by the Engineer.

Signal heads and signs that are in place, but not in use, shall be entirely covered with opaque burlap.

After completion, testing, and acceptance, place new traffic signals on flashing operation for a 72 hour period prior to placing the signals on full color operation. Existing full color and flashing signals shall not flash, but shall be kept in operation until the new signal is completed, satisfactorily tested, and approved.

Remove STOP signs at new full color signals at the end of the 72 hour flashing period. Provide a log of the date and time of removal to the Engineer.

Upon acceptance and placement of the new traffic control device into operation, remove unnecessary signal heads, signs, spans, and mast arms.

New traffic signals, exclusive of signal system interconnect installation, may be placed into operation when testing is completed and upon acceptance by the Engineer. Upon completion of the signal system interconnect installation, the signal system interconnect shall also be satisfactorily tested and approved by the Engineer.

820.04 MEASUREMENT AND PAYMENT. General electrical work and testing and the as-built drawings will not be measured but the cost will be incidental to the other pertinent items specified in the Contract Documents.

SECTION 821 — BREAKAWAY BASE SUPPORT SYSTEMS

821.01 DESCRIPTION. Furnish and install breakaway base support systems or install Administration furnished breakaway base support systems if applicable.

821.02 MATERIALS. Breakaway base support systems shall conform to the breakaway requirements specified in AASHTO Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Breakaway Base Support Systems

QPL

821.03 CONSTRUCTION. Install breakaway base support systems for signals, lighting, and signing, including post hinge assembly units for sign structures, as specified in the Contract Documents and in conformance with the manufacturer's recommendations. Grade the

ground adjacent to the breakaway base as specified in the Contract Documents.

821.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, backfill, grading, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Breakaway Base Support Systems will be measured and paid for at the Contract unit price per each for breakaway support systems furnished and installed as specified in the Contract Documents.

Pick up, delivery and installation of Administration supplied breakaway base support systems will be measured and paid for at the Contract unit price per each for the pertinent Install Breakaway Base item.

SECTION 822 — REMOVE AND RELOCATE EXISTING SIGNS AND SIGN STRUCTURES

822.01 DESCRIPTION. Remove and relocate existing signs and sign structures.

822.02 MATERIALS. Not applicable.

822.03 CONSTRUCTION. Make all existing cable safe in accordance with the appropriate electrical codes.

822.03.01 Removing Existing Signs. Existing signs may be relocated during construction. Remove existing and relocated signs when the new signing system is complete. All new signs in a particular sequence giving similar directions shall be installed before existing signs are removed.

After removing the sign structure, remove the remaining concrete foundations as specified in 207.03.01. Holes left after sign removal shall be backfilled, compacted, and restored to conditions similar to the surrounding area.

822.03.02 Relocating Existing Signs. Relocate existing signs as specified in the Contract Documents and as part of the new signing system. For removal and backfill of remaining concrete foundations, refer to 822.03.01.

822.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for removing and relocating existing signs and sign structures, removing existing concrete foundations, backfilling and

compacting existing holes left after foundation removal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

822.04.01 Remove Existing Ground Mounted Signs and Supports will be measured and paid for at the Contract unit price per square foot area of the sign. Removal of sign supports and concrete foundations will not be measured but the cost will be incidental to the Contract unit price for removing the signs.

822.04.02 Remove Signs from Existing Overhead Structure will be measured and paid for at the Contract unit price per square foot area of the sign. Removal of sign supports, sign luminaire supports, luminaires, conduit, and cable will not be measured but the cost will be incidental to the Contract unit price for removing the signs.

822.04.03 Relocate Existing Ground Mounted Signs will be measured and paid for at the Contract unit price per square foot area of the sign. Removal and disposal, or removal and relocation of the sign support will not be measured but the cost will be incidental to the Contract unit price for relocating the signs.

822.04.04 Relocate Signs from Existing Overhead Structure will be measured and paid for at the Contract unit price per square foot area of the sign. Removal and relocation of sign supports, luminaires, and luminaire supports will not be measured but the cost will be incidental to the Contract unit price for relocating the signs.

822.04.05 Remove Existing Cantilever or Overhead Sign Structure and Signs and Supports will be measured and paid for at the Contract unit price per each structure. Disconnecting the electrical service and removal of concrete foundations will not be measured but the cost will be incidental to the Contract unit price for removing the structure.

822.04.06 If required for new sign supports; concrete for sign foundations, galvanized steel beam sign posts, wood sign supports, and breakaway base support systems for steel beams will be paid for as specified in the applicable portions of Sections 801, 802, 812 and 821 respectively.

SECTION 823 — REMOVE AND RELOCATE OR REMOVE AND DISPOSE OF ROADWAY LIGHTING STRUCTURES

823.01 DESCRIPTION. Remove and relocate or remove and dispose of roadway lighting structures.

823.02 MATERIALS.

Hardware	909.10
Conduit	921.07

823.03 CONSTRUCTION. Remove concrete foundations and place backfill as specified in 822.03.01. Lighting structures removed and not reused shall become the property of the Contractor. Remove and store lighting structures scheduled to be reused on the same project in accordance with GP-6.02.

Make all existing cable safe in conformance with the appropriate electrical codes.

823.04 MEASUREMENT AND PAYMENT. Remove and Dispose of Roadway Lighting will be measured and paid for at the Contract unit price per each. The payment will be full compensation for the removal and disposal of the lighting structure, removal of existing concrete foundation, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Remove and Relocate Roadway Lighting Structure will be measured and paid for at the Contract unit price per each. The payment will be full compensation for the removal, storage, reinstallation, connection to existing lighting circuits, removal of existing concrete foundations, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 824 — MODIFY EXISTING SIGN MESSAGES

824.01 DESCRIPTION. Remove existing and add new sign copy, shields, and arrows for existing signs, or overlay existing sign messages.

824.02 MATERIALS.

Reflective and Nonreflective Sheeting and Copy	950.03
Sign Materials	950.08

824.03 CONSTRUCTION.

824.03.01 Modifying Signs with Demountable Copy. Remove existing copy or shields carefully. Prior to installing the new material, clean the sign background material thoroughly using mild detergent and water.

When specified, cover existing demountable copy with sheet aluminum at least 0.040 in. thick. The overlay shall have the same background and copy as the sign.

824.03.02 Modifying Signs with Direct Applied Copy. When specified, cover existing copy with sheet aluminum at least 0.040 in. thick. The overlay shall have the same background and copy as the sign.

Direct applied overlays may be used for minor modifications to sign messages in conformance with the manufacturer's recommendations.

824.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

824.04.01 Modify Message on Existing Ground Mounted or Overhead Signs will be measured and paid for at the Contract unit price per each removed or each installed character for the type of sign installation specified. Characters include shields, arrows, and sign copy.

824.04.02 Overlay Existing Ground Mounted or Overhead Signs will be measured and paid for at the Contract unit price per square foot, removed or installed for the type of sign specified.

SECTION 825 — CUTTING AND CAPPING MAST ARMS AND POLES

825.01 DESCRIPTION. Cut, clean, galvanize, and cap mast arms, mast arm poles, pedestal poles, and strain poles.

825.02 MATERIALS.

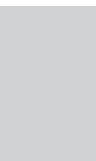
Cold Galvanizing Compound

A 780

825.03 CONSTRUCTION. Galvanized parts that have been cut or chipped to bare metal shall be repaired per A 780.

Saw cut the pole or mast arm to the required length. Clean the area inside and outside with a wire brush. Spray cold galvanizing compound on the affected area. Place an end cap of matching size.

825.04 MEASUREMENT AND PAYMENT. Cutting and Capping of Mast Arms and Poles will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.



CATEGORY 900 MATERIALS

900.01 GENERAL. Sample, test, and inspect all materials included in this Category as specified in the most recently published cited standards. The specification limits for each material are established and deviations from these limits are prohibited except when, in the judgment of the Engineer, the deviation will not be detrimental to the work. In these cases, refer to the appropriate specification governing price adjustments for nonconformance.

Within 30 days after receipt of notification of award of the Contract, submit in writing, to the Office of Materials Technology (OMT), the proposed sources of all materials to be incorporated into the project. Update and submit all nursery stock sources to OMT 45 days prior to the planting season in which the planting is to begin. Do not introduce material into the work until sources are approved. The Administration reserves the right to completely or partially test any material for Specification compliance.

Sample according to the Administration's Sample Testing and Frequency Guide unless otherwise directed. All source approvals are made subject to continuing production of materials conforming to these Specifications. Material sources may be rejected where it is evident that the material tends to be of marginal quality when compared to the Specification limits in any of its specified properties.

900.02 TECHNICIAN QUALIFICATION REQUIREMENTS. Technicians performing Quality Assurance/Quality Control sampling and testing shall be qualified through the certification program provided by the Administration. Private laboratories performing testing shall be in the AASHTO Accreditation Program or approved by the Administration.

Technicians include those who work for inspection agencies, Contractors, consultants, producers, private laboratories, and State and local government employees.

SECTION 901 — AGGREGATES

901.01 This Section includes the material details, quality requirements, and test methods applicable to aggregates. Grading requirements are outlined in Tables 901 A and 901 C; physical properties in 901 B and 901 D. Force drying may be used in the preparation of samples for grading tests conducted in the field.

TABLE

AGGREGATE GRADING REQUIREMENTS

MATERIAL		SIEVE SIZE					
		2-1/2"	2"	1-1/2"	1"	3/4"	1/2"
CRUSHER RUN AGGREGATE CR -6 (f)(g)		—	100	90–100	—	60–90	—
BANK RUN GRAVEL — SUBBASE		100	—	—	90–100	—	60–100
GRADED AGGREGATE — BASE DESIGN RANGE (a)		—	100	95–100	—	70–92	—
TOLERANCE (b)		—	-2	±5	—	±8	—
BANK RUN GRAVEL — BASE		100	—	—	85–100	—	60–100
COARSE AGGREGATE - PORTLAND CEMENT CONCRETE	57 and UNDERDRAIN (h)	—	—	100	95–100	—	25–60
	67	—	—	—	100	90–100	—
	7	—	—	—	—	100	90–100
FINE AGGREGATE — PORTLAND CEMENT CONCRETE, UNDERDRAIN, and PNEUMATIC MORTAR (d)		—	—	—	—	—	—
COARSE AGGREGATE — LIGHTWEIGHT PORTLAND CEMENT CONCRETE		—	—	—	100	90–100	—
FINE AGGREGATE — LIGHTWEIGHT PORTLAND CEMENT CONCRETE (d)		—	—	—	—	—	—
FINE AGGREGATE/SAND MORTAR and EPOXIES (d)		—	—	—	—	—	—
MINERAL FILLER		—	—	—	—	—	—
CRUSHED GLASS (e)		—	—	—	—	100	—

(a) To establish target values for design.

(b) Production tolerance.

(c) ±2 for field grading (omitting T 11).

(d) Fine aggregate includes natural or manufactured sand.

(e) Crushed glass shall not contain more than one percent contaminants by weight.

(f) Not to be used in the structural part of any Administration project.

(g) Recycled asphalt pavement may be used as a component not to exceed 15 percent and is not subject to aggregate physical property requirements in TABLE 901 B.

(h) When this material is used for drainage applications, recycled concrete is prohibited.

901 A

TEST METHOD T 27

SIEVE SIZE									
3/8"	No. 4	No. 8	No. 10	No. 16	No. 30	No. 40	No. 50	No. 100	No. 200
—	30-60	—	—	—	—	—	—	—	0-15
—	—	—	35-90	—	—	20-55	—	—	5-25
50-70	35-55	—	—	—	12-25	—	—	—	0-8
±8	±8	—	—	—	±5	—	—	—	±3(c)
—	—	—	35-75	—	—	20-50	—	—	3-20
—	0-10	0-5	—	—	—	—	—	—	—
20-55	0-10	0-5	—	—	—	—	—	—	—
40-70	0-15	0-5	—	—	—	—	—	—	—
100	95-100	—	—	45-85	—	—	5-30	0-10	—
10-50	0-15	—	—	—	—	—	—	—	—
100	85-100	—	—	40-80	—	—	10-35	5-25	—
—	100	95-100	—	—	—	—	—	0-25	0-10
—	—	—	—	—	100	—	95-100	—	70-100
—	0-55	—	—	45-85	—	—	—	0-10	—

- (a) To establish target values for design.
- (b) Production tolerance.
- (c) ±2 for field grading. (omitting T 11)
- (d) Fine aggregate includes natural or manufactured sand.
- (e) Crushed glass shall not contain more than one percent contaminants by weight.
- (f) Not to be used in the structural part of any Administration product.
- (g) Recycled asphalt pavement may be used as a component not to exceed 15 percent and is not subject to aggregate physical property requirements in TABLE 901 B
- (h) When this material is used for drainage applications, recycled concrete is prohibited.

TABLE

AGGREGATE PHYSICAL

MATERIAL TYPE I	TEST METHOD				
	S P E C I F I C A T I O N	T 90	T 104	T 112	T 113
		PI	SODIUM SULFATE SOUNDNESS	CLAY LUMPS and FRIABLE PARTICLES	CHERT; LESS THAN 2.40 Sp Gr
	max	% max	% max	% max	
CRUSHER RUN AGGREGATE CR-6	D 2940 (h)	6	12	—	—
BANK RUN GRAVEL — SUBBASE	D 2940	9	12	—	—
GRADED AGGREGATE — BASE	D 2940	6	12	—	—
BANK RUN GRAVEL — BASE	D 2940	9	12	—	—
COARSE AGGREGATE — PCC (b)	M 80 CLASS A	—	12	2.0	3.0
FINE AGGREGATE — PCC (b)(d)	M 6 CLASS B	—	10	3.0	—
COARSE AGGREGATE — LIGHTWEIGHT PCC	M 195	—	—	2.0	—
FINE AGGREGATE — LIGHTWEIGHT PCC (f)	M 195	—	—	2.0	—
FINE AGGREGATE/SAND MORTAR and EPOXIES	M 45	—	10	1.0	—
MINERAL FILLER (g)	M 17	NP	—	—	—
CRUSHED GLASS	M 80	—	12	—	—

- (a) Dimensional ratio of calipers shall be 5:1.
- (b) Test coarse and fine aggregate for PCC for alkali silica reactivity (ASR) per MSMT 212.
- (c) 1.5 if material passing No. 200 sieve is dust of fracture, free of clay or shale.
- (d) In areas exposed to traffic, manufactured sand shall have a minimum ultimate polish value of 8, based on the parent rock.
- (e) 5.0 for concrete not subject to surface abrasion.
- (f) Fine aggregate meeting M 6 may be used if the lightweight concrete does not exceed the maximum unit weight specified in the Contract Documents.
- (g) Fly ash shall not exceed 12 percent loss on ignition.
- (h) Other approved inert materials of similar characteristics may be used provided they meet these provisions. When crushed reclaimed concrete is used, the soundness loss by five cycles of the magnesium sulfate test shall not exceed 18 percent when tested as specified in T 104.

901 B

PROPERTY REQUIREMENTS

TEST METHOD					
T 112 and T 113	T 11	T 113	D 4791 (a)	T 96	T 21
SUM OF CLAY LUMPS, FRIABLE PARTICLES and CHERT	MATERIAL FINER THAN No. 200 SIEVE	COAL and LIGNITE	FLAT and ELONGATED	LOS ANGELES ABRASION	ORGANIC IMPURITIES
% max	% max	% max	% max	% max	max
—	—	—	15	50	—
—	—	—	—	50	—
—	—	—	15	50	—
—	—	—	—	50	—
3.0	1.0(c)	0.5	12	50	—
—	4.0(e)	1.0	—	—	3.0
—	—	—	12	—	—
—	—	—	—	—	3.0
—	—	0.5	—	—	3.0
—	—	—	—	—	—
—	—	—	—	45	—

TABLE
ASPHALT

AGGREGATE GRADING REQUIREMENTS, % PASSING

MATERIAL		SIEVE SIZE		
		19.0 mm	12.5 mm	9.5 mm
HOT MIX ASPHALT SUPERPAVE - 4.75mm		—	—	100
GAP GRADED HOT MIX ASPHALT - 9.5mm		100	100	75–90
GAP GRADED HOT MIX ASPHALT -12.5mm		100	90–99	70–85
GAP GRADED HOT MIX ASPHALT -19.0mm		100	82–88	60 max
MATERIAL		SIEVE SIZE		
		3/4in.	1/2in.	3/8in.
SLURRY SEAL (SS) AND LATEX MODIFIED SLURRY SEAL (LMSS)	MIX II	—	—	100
	MIX III	—	—	100
CHIP SEAL SURFACE TREATMENT	7	100	90–100	40–70
	8	—	100	85–100

Note: HMA Superpave 4.75 mm shall be designed with ESAL ranges of 0.3 to less than 3.0 million.

901 C

MIXES

FOR MIX DESIGN, TEST METHOD T 27

SIEVE SIZE						
4.75 mm	2.36 mm	1.18 mm	600 μm	300 μm	150 μm	75 μm
80-100	36-76	—	—	—	—	2-12
30-50	20-30	—	—	—	—	8-13
28-40	18-30	—	—	—	—	8-11
22-30	14-20	—	—	—	—	9-11
SIEVE SIZE						
No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
90-100	65-90	45-70	30-50	18-30	10-21	5-15
70-95	45-70	28-50	19-34	12-25	7-18	5-15
0-15	0-5	—	—	—	—	—
10-30	0-10	0-5	—	—	—	—

TABLE

AGGREGATE PHYSICAL PROPERTY

MATERIAL	TEST METHOD				
	S P E C I F I C A T I O N	T 90	T 104	T 112	T 113
		PI	SODIUM SULFATE SOUNDNESS	CLAY LUMPS and FRIABLE PARTICLES	CHERT LESS THAN 2.40 Sp Gr
	max	% max	% max	% max	
HOT MIX ASPHALT SUPERPAVE— 4.75mm	M323	NP	12	2.0	3.0
HOT MIX ASPHALT SUPERPAVE— 9.5, 12.5, and 19.0mm HIGH ESAL	M323	NP	12	2.0	3.0
HOT MIX ASPHALT SUPERPAVE— 9.5, 12.5, and 19.0mm LOW ESAL	M323	NP	12	2.0	3.0
HOT MIX ASPHALT SUPERPAVE—9.5, 12.5, and 19.0mm 8PV	M323	NP	12	2.0	3.0
HOT MIX ASPHALT SUPERPAVE— 25.0 and 37.5mm	M323	NP	12	2.0	3.0
GAP GRADED HOT MIX ASPHALT SUPERPAVE— 9.5, 12.5, and 19.0mm	M323	NP	12	2.0	3.0
SLURRY SEAL (SS) and LATEX MODIFIED SLURRY SEAL (LMSS)	—	NP	12	—	—
CHIP SEAL SURFACE TREATMENT	M 80, CLASS A	—	—	2.0	3.0
CRUSHED GLASS	M 80	—	12	—	—

- (a) Dimensional ratio of calipers shall be 5:1.
- (b) Polish Value (PV) shall be 5.5 when any aggregate being blended has a PV less than 5.0. PV shall be 5.0 when the aggregate from each source has a PV 5.0 or greater. Aggregate from no more than two sources may be blended. Determine proportions of blended aggregate under MSMT 416. Not applicable for Gap Graded surface mixes or any other surface mix requiring high polish aggregate.
- (c) PV and British Pendulum Number (BPN) determined on parent rock. When recycled asphalt pavement (RAP) is used the PV shall be 4.
- (d) 1.0 for samples taken at the point of production. Samples taken at any point after shipment shall not have more than 1.5 percent finer than No. 200 sieve.
- (e) PV shall be 9 when any aggregate being blended has a PV less than 8. PV shall be 8 when the aggregates from each source has a PV of 8 or greater. When carbonate rock is used, it shall have a minimum of 25 percent insoluble residue retained on the No. 200 sieve.
- (f) No blending allowed.
- (g) Dimensional ratio of calipers shall be 3:1/5:1.
- (h) The test for flat and elongated particles (max/min) shall be conducted on the blend.
- (i) Test conducted on particles retained on the No. 4 sieve.

901 D

REQUIREMENTS FOR ASPHALT MIXES

TEST METHOD						
T 112 and T 113	T 11	T 113	D 4791 (a)	T 96	MSMT 411	T 279
SUM OF CLAY LUMPS, FRIABLE PARTICLES and CHERT	MATERIAL FINER THAN No. 200 SIEVE	COAL and LIGNITE	FLAT and ELONGATED (h)	LOS ANGELES ABRASION (LA)	PV (e)	BPN (c)
% max	% max	% max	% max	% max	min	min
3.0	—	0.5	10	45	5 (b)	—
3.0	—	0.5	10	45	5 (b)	—
3.0	—	0.5	10	45	5 (b)	—
3.0	—	0.5	10	45	8 (e)	—
3.0	—	0.5	10	45	—	—
3.0	—	0.5	20/5 (g)(i)	30	8 (e)	—
—	—	—	—	—	4 (f)	16
3.0	1.0 (d)	0.5	—	45	—	—
—	—	—	—	45	—	—

901.01.01 Steel Slag. Steel slag may be used for chip seal surface treatment, but not for any other aggregate.

901.02 STONE FOR RIPRAP, CHANNELS, DITCHES, SLOPES, AND GABIONS. Use field or quarry stone of approved quality. Stone may be certified from a source previously approved. Ensure that maximum dimension does not exceed four times the minimum dimension.

901.02.01 Stone for Riprap. Ensure that stone for riprap is uniformly graded from the smallest to the largest pieces as specified in the Contract Documents. The stone will be accepted upon visual inspection at the point of usage, as follows:

CLASS OF RIPRAP	SIZE	PERCENT OF TOTAL by weight
0	Heavier than 33 lb	0
	Heavier than 10 lb	50
	Less than 1 lb	10 max
I	Heavier than 150 lb	0
	Heavier than 40 lb	50
	Less than 2 lb	10 max
II	Heavier than 700 lb	0
	Heavier than 200 lb	50
	Less than 20 lb	10 max
III	Heavier than 2000 lb	0
	Heavier than 600 lb	50
	Less than 40 lb	10 max

Note: Optimum gradation is 50 percent of the stone being above and 50 percent below the midsize. Reasonable visual tolerances will apply.

901.03 STONE FOR CHANNELS AND DITCHES. Meet the size requirements of Class I Riprap and the following:

QUALITY REQUIREMENTS	
TEST AND METHOD	SPECIFICATION LIMITS
Apparent Specific Gravity T 85, min	2.50
Absorption T 85, % max	3.0
Sodium Sulphate Soundness - 5 cycles, 2-1/2 to 1-1/2 in. Aggregate T 104, % loss max	20

901.04 STONE FOR SLOPES. M 43, size number 1 omitting T 11. The stone shall also meet the quality requirements specified in 901.03.

901.05 STONE FOR GABIONS. Meet the quality requirements specified in 901.03 and the following except that the loss by sodium sulfate shall be greater than 12 percent:

DEPTH OF BASKET in.	SIZE OF INDIVIDUAL PIECES *
6	3 – 6
9	4 – 7
12	4 – 7
18	4 – 7
36	4 – 12

*Size of pieces are determined visually.

SECTION 902 — PORTLAND CEMENT CONCRETE AND RELATED PRODUCTS

902.01 MATERIAL STORAGE. Store material as specified or as directed.

902.02 CERTIFICATION OF PORTLAND CEMENT AND BLENDED HYDRAULIC CEMENT. The manufacturer shall furnish certification as specified in TC-1.03. The certification shall also include:

- (a) The mill shall report its quality control procedures, and submit a new report whenever there is a procedural change.
- (b) The mill’s control laboratory shall be inspected by the Cement and Concrete Reference Laboratory of the National Institute of Standards and Technology on their regularly scheduled visits. The Engineer shall be provided with copies of the reports of these inspections along with an account of the action taken to correct cited deficiencies.
- (c) Records of data accumulated by the quality control procedures shall be produced upon request.
- (d) A certified document shall accompany each shipment stating that the contents conform to all applicable requirements. Additionally, the document shall show the producer’s name, mill location, carrier number, date loaded, weight contained in carrier, silo number, consignee, destination, Contract number, and type of cement. The signature and title of the signer shall be shown on the document.

- (e) The mill shall, upon request, supply certified chemical and physical test values that can be associated with any sample representing cement drawn from a particular silo on a given date.
- (f) Acceptance of cement by certification will be terminated if test results differ from mill results by more than the precision limits given in the test method. The acceptance procedure will then revert to storage testing and approval prior to shipment.

902.03 PORTLAND CEMENT. M 85, with the fineness and the time of setting determined using T 131 and T 153, respectively.

902.04 BLENDED HYDRAULIC CEMENT. M 240, Type I (PM) or a Type IP containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition is 3.0 percent. Do not use ground iron blast furnace slag for blending. The requirement for a manufacturer's written statement of the chemical composition is waived.

902.05 MASONRY CEMENT. C 91, except the water retention and staining tests are waived.

902.06 CONCRETE ADMIXTURES. Do not use Concrete admixtures that contribute more than 200 ppm of chlorides based on the cement content when tested per MSMT 610. Use only prequalified admixtures.

Do not use pozzolan and Type I (PM) or Type IP cement in the same mix. Since the strength gains are delayed with these materials, a longer period of time may be required for curing and form removal.

902.06.01 Air Entraining Admixtures. M 154.

902.06.02 Chemical Admixtures. M 194, Type A, D, or nonchloride C.

902.06.03 High Range Water Reducing Admixtures. M 194, except that it shall be a liquid, the water content shall be a maximum of 85 percent of that of the control, and the durability factor shall be at least 90. Use Type F for early strength, which shall produce a 12-hour compressive strength of at least 180 percent of the control. Use Type G when early strength is not specified. The manufacturer shall furnish certification as specified in TC-1.03. The certification shall include curves indicating the fluid ounces of admixture per 100 lb of cement as related to water reduction and strength gain for 12 hours when used with a minimum cement factor of 700 lb.

902.06.04 Pozzolans. The use of pozzolans may be requested to control alkali silica reactivity or for other reasons. When a pozzolan is used, determine the minimum cement factor and water/cement ratio on the basis of the combined weight of cement and pozzolan. See Table 902 B for percentage of fly ash, ground iron blast furnace slag, and microsilica.

- (a) **Fly Ash.** M 295, pozzolan Class C or F, except that the maximum permissible moisture content is 1.0 percent, and when used in concrete Mix Nos. 3 and 6 the maximum loss on ignition is 3.0 percent.
- (b) **Ground Iron Blast Furnace Slag.** M 302, Grade 100 or 120.
- (c) **Microsilica.** C 1240, except that the oversize requirement is waived.

902.06.05 Ground Iron Blast Furnace Slag. M 302, Grade 100 or 120. A request may be submitted to substitute a maximum of 50 percent of the weight of cement with ground iron blast furnace slag. When ground iron blast furnace slag is used, determine the minimum cement factor and water/cement ratio on the basis of the combined weight of the cement and ground iron blast furnace slag.

902.06.06 Synthetic Fibers. C 1116, Type III. When specified, fibers shall be 1/2 to 1-1/2 in. long. The manufacturer shall furnish certification as specified in TC-1.03. Use the fiber manufacturer's recommendations for the quantity of fibers used and their point of introduction into the mix.

902.07 PORTLAND CEMENT CONCRETE CURING MATERIALS. Use burlap cloth, sheet materials, liquid membrane forming compounds, or cotton mats.

902.07.01 Burlap. M 182, Class 1, 2, or 3.

902.07.02 Sheet Materials. M 171 with the following exceptions:

- (a) **White Opaque Burlap Polyethylene Sheeting.** Tensile strength and elongation requirements are waived. Use sheeting having a finished product weight of not less than 10 oz/yd².
- (b) **White Opaque Polyethylene Backed Nonwoven Fabric.** 902.07.02(a) with the thickness requirement waived. Use material having a finished product weight of at least 5 oz/yd².
- (c) **White Opaque Polyethylene Film.** Tensile strength and elongation requirements are waived.

902.07.03 Liquid Membrane. M 148. Field control testing of the white pigmented curing compounds shall be on the basis of weight per gallon. The samples shall not deviate more than ± 0.3 lb/gal from the original source sample.

902.07.04 Cotton Mats. Cotton mats consist of a filling material of cotton bats or bats covered with unsized cloth and tufted or stitched to maintain the shape and stability of the unit when handling, and under job conditions.

Use coverings consisting of cotton cloth, burlap, or jute having the following properties:

- (a) Cotton cloth covering shall weigh at least 6.0 oz/yd^2 and have an average of at least 32 threads/in. of warp and at least 28 threads/in. of filling. Use raw cotton, cotton comber waste, cotton card strip waste, or combinations thereof as the raw material used in the manufacture of the cotton cloth.
- (b) Burlap or jute covering for cotton mats shall weigh at least 6.4 oz/yd^2 and have at least 8 threads/in. of warp and at least 8 threads/in. of filling. Use the grade known commercially as "firsts" and they shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability.

Use a cotton bat, or bats made of raw cotton, cotton waste, cotton linters, or combinations thereof as the filling material for the mats. Mats shall weigh at least 12 oz/yd^2 .

902.08 FORM RELEASE COMPOUNDS. Use form release compounds that effectively prevent the bond of the concrete to the forms. Form release compounds shall not cause discoloration of the concrete or adversely affect the quality or rate of hardening at the interface of the forms.

The flash point of the form release compound shall be at least 100 F when tested per T 73.

902.09 PARAFFIN WAX. Use clear paraffin wax for use as a bond breaker for concrete. The flash point shall be at least 380 F when tested under D 92.

902.10 PORTLAND CEMENT CONCRETE. Section 915 and as specified herein.

902.10.01 Proportioning. Prior to the start of construction, submit to the OMT the source and proportions of materials to be used for each concrete mix. The mixture shall meet 902.10.03.

The concrete, with the exception of water and chemical admixtures, shall be proportioned by weight. Water and chemical admixtures may be proportioned by volume or weight. The mix shall be uniform and workable.

902.10.02 Materials.

Coarse Aggregate	901.01
Fine Aggregate	901.01
Cement	902.03 and 902.04
Concrete Admixtures	902.06
Water	921.01

902.10.03 Portland Cement Concrete Mixtures.

The concrete mixes shall meet the following:

TABLE

PORTLAND CEMENT				
MIX NO.	28 DAY SPECIFIED COMPRESSIVE STRENGTH	STANDARD DEVIATION	CRITICAL VALUE	MIN CEMENT FACTOR
	psi	psi	psi	lb/yd ³
1	2500	375	2430	455
2	3000	450	3010	530
3	3500	525	3600	580
4	3500	525	3600	615
5	3500	525	3600	580
6	4500	675	4770	615
7	4200	630	4420	580
8	4000	600	4180	750

Note 1: When concrete is exposed to water exceeding 15 000 ppm sodium chloride content, Type II cement shall be used. In lieu of a Type II cement, a Type I cement may be used in combined form with an amount of up to 50 percent replacement with ground iron blast furnace slag, or an amount of up to 25 percent replacement with Class F fly ash. Submit the proposed mix proportions and satisfactory test results per C 1012 showing a sulfate resistance expansion not exceeding 0.10 percent at 180 days.

Note 2: The temperature of Mix No. 6 when used for other than superstructure work as defined in TC-1.03 shall be 70 ± 20 F.

Note 3: Type A or D admixture shall be added to bridge, box culvert, and retaining wall concrete.

Note 4: Nonchloride Type C admixtures may be used when approved.

Note 5: Other Slump Requirements:

- (a) When a high range water reducing admixture Type F or Type G is specified, the slump shall be 4 to 8 in.
- (b) When synthetic fibers are specified, the slump shall be 5 in. maximum.
- (c) When concrete is to be placed by the slip form method, the slump shall be 2-1/2 in. maximum.

902 A

CONCRETE MIXTURES				
COARSE AGGREGATE SIZE	MAX WATER/CEMENT RATIO	SLUMP RANGE	TOTAL AIR CONTENT	CONCRETE TEMPERATURE
M 43	by wt	in.	%	F
57, 67	0.55	2 – 5	5 – 8	70 ± 20
57, 67	0.50	2 – 5	5 – 8	70 ± 20
57, 67	0.50	2 – 5	5 – 8	70 ± 20
57, 67	0.55	4 – 8	N/A	70 ± 20
7	0.50	2 – 5	5 – 8	70 ± 20
57, 67	0.45	2 – 5	5 – 8	65 ± 15
57	0.50	1-1/2 – 3	5 – 8	70 ± 20
7	0.42	2 – 5	5 – 8	65 ± 15

Coarse and fine aggregate having an expansion up to 0.10 percent when tested for alkali silica reactivity (ASR) per MSMT 212 may be used without restriction. Aggregates having an expansion greater than 0.10 but less than 0.35 percent are considered reactive and may only be used when one of the options in table 902B are employed. Those having an expansion of 0.35 percent and greater are prohibited.

TABLE 902 B

OPTION	ALKALI CONTENT OF CEMENT % max	REPLACE CEMENT WITH		SPECIFICATION
		MATERIAL	% BY WEIGHT	
1	1.50	Class F Fly Ash	15 – 25	M 295
2	1.50	Ground Iron Blast Furnace Slag	25 – 50	M 302 Grade 100 or 120
3	1.50	Microsilica	5 – 7	C 1240
4	—	Blended Cement (a)	100	M 240
5	0.60 (b)	Low Alkali Cement	100	M 85

(a) Pozzolan content of 15 to 25 percent by weight of cement.

(b) For mixes (Mix 6 Modified, 12 Hour Patch Mix) used for portland cement concrete pavement repairs; the maximum allowable percentage of alkalis in portland cement is 0.70.

When reactive aggregate is used, designate which option will be used to control the formation of the ASR gel. If an option other than option 5 in Table 902 B is chosen, conduct tests per MSMT 212 using the reactive aggregate and the proposed cementitious material. The expansion test results shall not be greater than 0.10 percent. When more than one reactive aggregate is used in a concrete mix, each shall be tested individually and the maximum amount of pozzolan required to reduce the expansion of all the aggregates to 0.10 percent or less shall be used. Submit the aggregate source, test results, and the percent and type of replacement cement. The Engineer may withhold source approval pending verification testing.

902.10.04 Trial Batch. A trial batch shall be prepared to certify that each mix meets 902.10.05 and .06. Approval will be given when the test results meet the minimum required average strength.

Make arrangements with OMT at least two weeks in advance, to have an authorized representative present during the batching and testing. Each trial batch shall consist of at least 3 yd³ of concrete. Supply all materials, equipment, and labor required to produce the trial batches and conduct the required tests at no additional cost to the Administration.

OMT may waive the requirement for a trial batch when past performance records show that the required average strength requirement has been met.

902.10.05 Design Required Average Strength. The required average strength (f_{cr}) will be the larger of:

$$f_{cr} = f_c' + (1.34 \times S)$$

or

$$f_{cr} = f_c' + (2.33 \times S) - 500$$

where:

- f_c' = the 28 day specified compressive strength.
- S = the standard deviation as specified in 902.10.06.

A test is defined as the average strength of two companion cylinders.

902.10.06 Standard Deviation.

- (a) When past performance records are available, a standard deviation will be established from documented performance records of the producer consisting of a minimum of 15 consecutive 28 day compressive strength tests obtained within the last 12 months.

The standard deviation will be established as the product of the calculated standard deviation and multiplier.

NUMBER OF TESTS	MULTIPLIER FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

NOTE: Interpolate for intermediate number of tests.

- (b) When past performance records are not available, the required average strength shall meet the following:

SPECIFIED COMPRESSIVE STRENGTH f_c', psi	REQUIRED AVERAGE COMPRESSIVE STRENGTH f_{cr}', psi
Less than 3000	$f_c' + 750$
3000 – 4000	$f_c' + 1000$
4001– 5000	$f_c' + 1200$
over 5000	$f_c' + 1400$

902.10.07 Standard of Control. The average of all sets of three consecutive strength tests shall equal or exceed the critical value as specified in 902.10.03, which is computed using the following formula:

$$\text{Critical Value} = f_c' + (1.14 \times S) - 500$$

Failure to conform to this criteria will be cause for immediate investigation and remedial action up to and including suspension of production. Use a design standard deviation equal to 15 percent of the specified strength for calculation until at least 15 test results are obtained.

Compute the actual average strength and standard deviation upon the availability of 28 day strength data comprising of at least 15 tests. Should this determination indicate an excessive margin of safety, the concrete mix may be modified to produce lower average strength as approved. If these calculations indicate a coefficient of variation greater than 15, the quality of the concrete and testing will be evaluated.

902.10.08 Testing. Sample per T 141. Test as follows:

TEST	METHOD	MINIMUM TEST FREQUENCY	RESPONSIBILITY
Temperature (e)	T 309	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Slump (a)(e)	T 119	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Air Content (a)(e)	T 152 T 196	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Compression (b)(c)(d)	T 23	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Compression (b)(c)(d) Mix No. 7 Only	T 23	3 per Day	Project Engineer

- (a) A second test will be made when the first slump or air content test fails. Acceptance or rejection will be based on the results of the second test.
- (b) Compressive strength tests are defined as the average of two companion cylinders.
- (c) The Contractor shall be responsible for the making of all early break cylinders and furnishing the molds, stripping, curing/delivery of all cylinders, including 28 day cylinders, to the testing laboratory.
- (d) The Project Engineer shall be responsible for making, numbering, and signing the 28 day cylinders.
- (e) When constructing plain and reinforced concrete pavements, the testing frequency for slump, air content, and temperature shall be 1 per 100 yd³ or fraction thereof.

902.10.09 Acceptance. Concrete will be acceptable if both of the following requirements are met:

- (a) The average of all sets of three consecutive strength tests equal or exceed the specified design strength.
- (b) No individual strength test (average of two companion cylinders) falls below the specified design strength by more than 500 psi.

902.10.10 Price Adjustment. A price adjustment will be based on the Contract unit price per cubic yard of concrete. If the unit is a lump sum item, the price per cubic yard for the concrete will be determined by dividing the cubic yards into the Contract lump sum price.

- (a) **Test Results More Than 500 psi Below Specified Design Strength.** Failing strength tests will be considered individually with a price adjustment being applied on the percentage basis as shown below.

(Price per yd³) × (quantity of yd³ represented by the failing concrete strength) × (percent of failure).

Example:

$$\$400.00 \text{ per yd}^3 \times 50 \text{ yd}^3 \times [1 - (3600/4500 \text{ psi})] = \$4,000.00$$

No payment will be allowed when the test results fall below 50 percent of the specified design strength for structural concrete or 40 percent for incidental concrete.

The Engineer will determine when the strength of the concrete represented by the failing tests is sufficient to remain in place or whether it shall be removed and replaced with Specification concrete.

- (b) Test Results 500 psi or Less Below Specified Design Strength.** Strength failures 500 psi or less than the specified design strength will be averaged with the next two consecutive tests. If those two tests include a failure greater than 500 psi, those tests will be evaluated as in 902.10.10(a) and replaced with the next consecutive test. If the resulting average falls below the specified design strength, a price adjustment will be applied as specified in the table below. Any failure will only be included in one grouping.

STRENGTH BELOW SPECIFIED (avg of 3 tests) DESIGN LEVEL, psi	ADJUSTMENT FACTOR
MIX NO. 1 THRU MIX NO. 7	
1 – 100	0.005
101 – 200	0.01
201 – 300	0.02
301 – 400	0.04
401 – 500	0.08

Adjustment price equals (price per yd³) × (quantity of yd³ represented by the failing cylinders) × (the adjustment factor).

Example:

$$\$400.00 \text{ per yd}^3 \times 50 \text{ yd}^3 \times 0.01 = \$200.00$$

902.10.11. Lightweight Concrete Mix 10. Use two companion cylinders as control testing for Compression Test and Density of Cured Concrete for each 100 yd³, or fraction thereof, according to M 195 and C 567, respectively.

Lightweight concrete shall have compressive strength of at least 4500 psi. It shall be composed of Type I portland cement, an approved air entraining admixture, Type A or D chemical admixture, water, lightweight coarse aggregate, and fine aggregates. Proportion the mix as specified in 211.2 of the ACI's Recommended Practices for Selection Proportions for Structural Lightweight Concrete. Fly ash or ground iron blast furnace slag may be substituted for portland cement per 902.06.

Provide concrete meeting the following requirements:

PROPERTY	LIMIT	REMARKS
Cement Content	700 lb/yd ³ , max	—
Average Density of Cured Concrete	118 lb/ft ³ , max	—
Air Entrainment (Entrapped Plus Entrained)	6 - 9%	Volumetric Method T 196
Slump		T 119
When coarse aggregate absorption >10 %	3 in., max	—
When coarse aggregate absorption ≤10 %	2 - 5 in.	—
Water		
Added to mix using saturated aggregates	0.45, max	Water/cement ratio
Net (including absorbed water)	0.75, max	Water/cement ratio

902.11 MORTAR FOR GROUT. Mortar used for grouting anchor bolts, pipe, handrail posts, and miscellaneous items shall be composed in accordance with one of the following:

- (a) One part portland cement or blended hydraulic cement and one part mortar sand by dry loose volume.
- (b) Prepared bag mixes consisting of portland cement or blended hydraulic cement and mortar sand. The prepared mixes shall produce a mortar meeting the strength requirements specified.
- (c) Use nonshrink grout when specified. The grout shall have a minimum compressive strength of 5000 psi in seven days when tested per T 106, except that the cube molds shall remain intact with a top firmly attached throughout the curing period. The nonshrink grout shall have a minimum expansion of 0.0 percent after seven days when tested per T 160.
- (d) Epoxy grout shall consist of sand and epoxy mixed by volume per the manufacturer's recommendations. The grout shall be capable of developing a minimum compressive strength of 6500 psi in 72 hours when tested per MSMT 501. Sand for epoxy grout shall be as specified in 901.01.

- (e) An epoxy or polyester anchoring system may be used when approved in accordance with the manufacturer's recommendations. Strength values shall be as specified.

902.12 LINSEED OIL. A 50-50 mixture (by volume) of boiled linseed oil meeting Federal Specification TT-L-190 and kerosene per D 3699.

902.13 LATEX MODIFIED CONCRETE (LMC). Portland cement concrete containing prequalified Laboratory approved styrene butadiene latex emulsion.

Latex emulsion shall have a minimum of 90 percent of the nonvolatiles as styrene butadiene polymers. The latex emulsion shall conform to Table 902.13 A. The material shall be stored in suitable containers and be protected from freezing and exposure to temperatures in excess of 85 F.

LMC shall be proportioned using volumetric mixing and designed as follows:

LATEX MODIFIED CONCRETE	
MATERIAL	SPECIFICATION LIMITS
Portland Cement, CWT/yd ³ , min	6.6
Latex Emulsion/Cement Ratio	0.31 – 0.34
Water/Cement Ratio, max	0.22
Entrained Air, %	6.0 ± 3
Slump, in.	5 ± 1

The physical properties of LMC shall conform to Table 902.13 B. Furnish the necessary 3 x 6 in. molds per M 205 to be used for the fabrication of compressive strength cylinders.

Control and Acceptance Sampling.

- (a) Submit a sample of at least 2 qt of the styrene butadiene latex emulsion to OMT for each lot of material used in a day's production.
- (b) A batch for LMC is defined as the capacity of the equipment being used on the project. Slump and air samples shall be taken and tested before the placement of a batch is permitted. The slump shall be measured four to five minutes after discharge from the mixer. The test material shall be deposited off the deck and not be

disturbed during this waiting period. One additional sample for slump and air shall be taken randomly during the placement of each batch. For seven day compressive strength, two tests each per batch are required. A test is defined as consisting of two companion cylinders. The samples for these tests will be taken at random while the placement is in progress.

TABLE 902.13 A

REQUIREMENTS FOR CHEMICAL PROPERTIES OF LATEX EMULSION MATERIALS				
PROPERTY	SPECIFICATIONS		QUALITY ASSURANCE TESTS	
	LIMITS	TOLERANCE	PREQUALIFICATION TESTS	CONTROL and ACCEPTANCE
Color	White	—	X	X
pH	9.0 – 11.0	—	X	X
Weight, lb/gal	8.40 – 8.47	—	X	X
Solids Content, %	46 – 53	—	X	X
*Butadiene Content, % of polymer	30 – 40	—	—	—
Viscosity @ 10 rpm-cps	Match Original	± 20	X	X
*Surface Tension, dynes/cm max	50	—	—	—
*Mean Particle Size, polymer – Å	1400 – 2500	—	—	—
Coagulum, % max	0.10	—	X	X
*Freeze-Thaw Stability, coagulum, % max	0.10	—	X	X
Infrared Spectra of Latex Film	Match Original	—	X	X
Infrared of Alcohol, Soluble Portion of Latex	Match Original	—	X	X
Shelf Life, min	1 yr	—	X	—

Note 1: Quality assurance tests shall be conducted per MSMT 612 except those denoted by an * shall be conducted per FHWA RD – 78-35.

Note 2: The original or prequalification sample shall be accompanied by the producer’s certification on all of the tests and properties noted above and as specified in TC-1.03. The certification shall contain actual test values of the product and the infrared spectrograph.

Note 3: A separate certification is required for each lot of material. The certification shall note the date of manufacture, lot size, and whether or not the material is identical to the formulation of the original sample.

TABLE 902.13 B

LATEX MODIFIED CONCRETE PHYSICAL PROPERTIES			
TEST PROPERTY	TEST VALUES	QUALITY ASSURANCE TESTS	
		PREQUALIFIED TESTS	CONTROL and ACCEPTANCE
7 Day Compressive Strength, psi min	3000	X	X
28 Day Compressive Strength, psi min	3500	X	—
42 Day Compressive Strength, psi min	3500	X	—
7 Day Flexural Strength, psi min	550	X	—
28 Day Flexural Strength, psi min	650	X	—
42 Day Shear Bond Strength, psi min	2000	X	—
Durability Factor, 300 cycles, % min	85	X	—
Chloride Permeability, ppm max	510	X	—
Scaling Resistance, 50 cycles, max	3	X	—

Note 1: Quality assurance tests shall be conducted per MSMT 721.

Note 2: Seven Day Compressive Strength Test will be used for Control and Acceptance of the material. The minimum specified design strength is 3000 psi at seven days. The mix design approval and acceptance will be based on a coefficient of variation of 10 percent with a probability of 1 in 10 tests falling below the specified strength. Only test values 80% or greater than the specified strength will be accepted.

902.14 RAPID HARDENING CEMENTITIOUS MATERIALS FOR CONCRETE PAVEMENT REPAIRS. Materials shall be a dry, packaged cementitious mortar having less than 5 percent by weight of aggregate retained on the 3/8 in. sieve and meet the following requirements:

Classification.

- Class I — For use at ambient temperatures below 50 F.
- Class II — For use at ambient temperatures of 50 to 90 F.
- Class III — For use at ambient temperatures above 90 F.

Chemical Requirements. C 928, except the material shall not contain organic compounds such as epoxy resins or polyesters as the principal binder.

Physical Requirements. Meet the following when tested per MSMT 725:

COMPRESSIVE STRENGTH, psi min				
CLASSIFICATION	< 2 hr	2-6 hr	6 hr	28 days
Type I — Slow	—	—	2000	4500
Type II — Rapid	—	2000	—	4500
Type III — Very Rapid	2500	—	—	4500

TEST RESULTS	
TEST PROPERTY	LIMITS
Bond Strength, 7 days, psi min	2000
Length Change, increase after 28 days in water, based on length at 3 hr, % max	+ 0.15
Length Change, decrease after 28 days, % max	- 0.15
Freeze Thaw, loss after 25 cycles in 10% CaCl ₂ solution, % max	8
Initial Setting Time, minutes min	10

Marking. All packages delivered to the project shall be marked with the following information:

- (a) Date material was packaged.
- (b) Approximate setting time.
- (c) Recommended dosage of water or liquid component.
- (d) Mixing instructions.

- (e) Class or temperature range.

Certification. The manufacturer shall furnish certification as specified in TC-1.03 showing the actual test results for each class and type of material submitted to the Laboratory.

SECTION 903 — MASONRY PRODUCTS

903.01 SEWER BRICK. M 91, Grade SM, with a standard size of 2-1/4 x 3-3/4 x 8 in.

903.02 MANHOLE BRICK. M 91, Grade MS.

903.03 BUILDING BRICK. M 114, Grade SW.

903.04 HOLLOW CONCRETE MASONRY BLOCK. C 90, Grade N, Type I, normal weight.

903.05 SOLID CONCRETE MASONRY BLOCK. C 139.

903.06 MORTAR FOR MASONRY. Composed in accordance with one of the following:

- (a) One part portland or blended cement and three parts mortar sand by dry loose volume and hydrated lime not to exceed 20 percent of the cement by weight.
- (b) One part masonry cement and three parts mortar sand by dry loose volume.
- (c) Prepared bag mixes consisting of masonry cement and mortar sand. The prepared mixes shall produce a minimum compressive strength of 500 psi in seven days when tested using the applicable procedures specified in C 91.

Materials for mortar shall meet the following:

Mortar Sand	901.01
Portland Cement	902.03
Blended Cement	902.04
Masonry Cement	902.05
Water	921.01
Lime	921.03

SECTION 904 — PERFORMANCE GRADED ASPHALT BINDERS AND HOT MIX ASPHALT

904.01 CERTIFICATION. The manufacturer and hauler shall furnish certifications as specified in TC-1.03 and the following:

The manufacturer shall certify:

- (a) Date and time of loading.
- (b) Tank or blending system.
- (c) Identification of hauling unit.
- (d) Binder grade, temperature, and quantity of materials.
- (e) Complete certified analysis.
- (f) Lot number, if applicable.
- (g) Mixing and compaction temperatures.

The hauler shall certify:

- (a) Identification of hauling unit.
- (b) Binder grade and source of last delivery.
- (c) The date of the last delivery using this hauling tank and volume of material remaining in the tank at the time of current loading.

904.02 PERFORMANCE GRADED ASPHALT BINDERS. Performance graded asphalt binders for mixes containing all virgin materials, recycled asphalt pavement materials, or roofing shingles from manufacturing waste shall meet M 320, Table 1, for the specified performance grade. The asphalt binder recovered from the final plant mixed material will be considered Rolling Thin Film Oven (RTFO) material and shall meet M 320, Table 1 for the specified performance grade.

The performance graded binder shall be preapproved by the Administration. Submit a certificate of analysis showing conformance with the Performance Graded Binder Specification M 320 and the critical cracking temperature in conformance with PP 42, Standard Practice for

Determination of Low-Temperature Performance Grade (PG) of Asphalt Binder, for the binders specified in the Contract Documents.

The PG binder for HMA mixes shall be achieved by the use of Neat Asphalt with elastomer polymer modifications when needed.

904.03 EMULSIFIED ASPHALTS. M 140 or M 208 with the following exceptions:

- (a) Cement mixing tests are waived.
- (b) Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F.
- (c) Maximum of 3.0 percent by volume of oil distillate.
- (d) The sieve test requirement for field samples shall be a maximum of 0.4 percent.

904.04 HOT MIX ASPHALT (HMA). Mixes shall be produced in a plant as specified in Section 915.

904.04.01 Aggregates. Section 901 and M 323 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles using D 4791. When recycled asphalt pavement is used in an HMA mix as defined in MSMT 412, it shall be considered an aggregate source.

904.04.02 Mix Design. Develop Superpave mix designs in conformance with R 35 except that “Table 1, Superpave Gyrotory Compaction” shall be replaced with the following table:

DESIGN LEVEL	20-Year Design Traffic, ESALs	Ndesign
1	<300,000	50
2	300,00 to <3,000,000	65
3	3,000,000 to <10,000,000	80
4	10,000,000 to <30,000,000	80
5	≥30,000,000	100

HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, M 323, and be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

Crushed, recycled asphalt pavement (RAP) material and maximum of 5 percent roofing shingles from manufacturing waste may be used in the mix design. Allowable percentage and suitability for use shall be determined in conformance with MSMT 412 and M 323. When using less than 20 percent RAP, binder grade adjustments are not required.

Surface mixes using 20 percent or more Rap and base mixes using more than 25 percent RAP shall be tested and evaluated in accordance with TP 62: Determining Dynamic Modulus of Hot-Mix Asphalt Concrete Mixtures, to determine plant mixing capabilities. A demonstration strip or mix verification may be required before placement.

The use of RAP, not to exceed 10 percent, may be considered for applications where higher polish value aggregates are required and in mixes requiring elastomer type polymer binder. Approval for use will be on an individual project basis by OMT. Placement areas within the project limits shall be designated by OMT. These applications shall require isolated RAP stockpiles from an identified single source. Submit documentation of RAP stockpile management, quality, and traceability for approval prior to use.

Do not use crushed glass in surface mixes. Do not use roofing shingles in gap-graded mixes or mixes requiring elastomer type polymer binder.

904.04.03 Mix Design Approval. At least 30 days prior to paving operations, submit data from the laboratory study to the engineer for tentative approval. Submit mix designs in an approved format. Include the following:

- (a) Mix designation.
- (b) Source, percentage, and grade of performance graded asphalt binder.
- (c) Source, gradation, and proportion of each component aggregate.
- (d) Target aggregate gradation.
- (e) Plant where the HMA mix will be produced.
- (f) Plant target mixing temperature based on viscosity of 0.22 Pa·s.
- (g) Ratio of dust to binder material on effective asphalt.

- (h) Maximum specific gravity at the target binder content.
- (i) Mix design grading plotted on 0.45 power gradation chart.
- (j) Tensile strength ratio and worksheets.
- (k) The bulk specific gravity at N_{design} gyrations.
- (l) The air void content (percent V_a) at N_{design} gyrations.
- (m) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at N_{design} gyrations (T 312).
- (n) All consensus and source properties.
 - (1) Coarse aggregate angularity.
 - (2) Flat and elongated.
 - (3) Sand equivalent.
 - (4) Uncompacted void content of fine aggregate.
 - (5) Bulk and apparent specific gravity of coarse and fine aggregate.
 - (6) Absorption of coarse and fine aggregate.

With each mix design submitted to OMT for approval, include a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed mix design to be unsatisfactory, OMT may require that a more suitable design be submitted.

When a change to the source of aggregate used in the mix is proposed, submit a revised mix design with the information required above and in 904.04.02. If a change in the Performance Grade binder source becomes necessary, conduct a stripping test in conformance with MSMT 410, prior to approval. The Administration may require an antistripping additive test in conformance with D 4867 before giving the final approval.

Field Verification of Mix Design. After receiving tentative approval for the mix design from the Asphalt Technology Chief Representative, conduct a field verification of the mix at the beginning of production in each plant. Field verification shall be performed by the certified personnel as specified in 504.03. Prepare the verification samples per R 35. Notify the Engineer at least two working days in advance of the scheduled verification.

Verification Evaluation.

- (a) Initial verification shall consist of four samples tested for the parameters listed in MSMT 735, Table 2. These samples shall be randomly drawn from the first day's production. If the first day of production is less than 2000 tons, the verification testing may be spread over the number of days needed to accumulate 2000 tons. A verification sample and test is required on any day that exceeds 200 tons of production. Complete the verification testing no later than on the day when production has reached the 2000 tons. Evaluate the verification tests results as specified in MSMT 735.
- (b) If the mix produced by the plant conforms to the parameters listed in MSMT 735, Table 2 with a Percent within Specification Limit (PWSL) of at least 85, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in ESAL loads, verification may be limited to volumetric analysis at the Engineer's discretion.
- (c) If the mix produced by the plant does not conform to the parameters listed in MSMT 735, Table 2 with a PWSL of at least 85, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between the approved Mix Design and Adjusted Mix Design are as follows:

TEST PROPERTY	PERMISSIBLE ADJUSTMENT % (*)
Larger than 1/2 in. (12.5 mm) sieve	± 5
1/2 in. (12.5 mm) thru No. 4 (4.75 mm) sieves	± 4
No. 8 (2.36 mm) thru No. 100 (1.50 μm) sieves	± 3
No. 200 (75 μm) sieve	± 1.0
Binder Content	± 0.20

*The permissible adjustment for all mixes shall be within control points.

When an adjustment is made to the mix design, perform a second verification to ensure that the modified mix conforms to all design requirements. Meet the time and tonnage limitations as specified in (a). If the adjusted mix meets the PWSL, production may proceed. If the mix does not meet these requirements, suspend production for the mix and submit a new mix design for approval. Design the new mix as specified in MSMT 412 or R 35.

- (d) If subsequent designs submitted due to nonconformance do not meet (b) during the initial verification, suspend production for the mix until corrective action is taken as approved by the Engineer.

Thin Lifts. When specified lift thickness does not meet 3-times nominal maximum aggregate size for fine graded mix designs or 4-times nominal maximum aggregate size for coarse graded mix designs, the lift thickness shall be designated as a thin lift. Fine graded and coarse graded mix designs shall be determined in accordance with M 323, Table 4, Gradation Classification, and the table below.

Thin Lift Mix Design Identification Table

Mix Designation	Gradation Classification Control Sieve Mix Design Target (%Passing)	
	Fine Graded	Coarse Graded
4.75mm	A thin lift is a specified pavement thickness < 1 inch.	A thin lift is a specified pavement thickness < 1 inch.
9.5mm	When the 2.36mm (#8) is > or = 47%, a thin lift is a specified pavement thickness < 1 1/8 inches	When the 2.36mm (#8) is < 47%, a thin lift is a specified pavement thickness < 1 1/2 inches
12.5mm	When the 2.36mm (#8) is > or = 39%, a thin lift is a specified pavement thickness < 1 1/2 inches	When the 2.36mm (#8) is < 39%, a thin lift is a specified pavement thickness < 2 inches
19.0mm	When the 4.75mm (#4) is > or = 47%, a thin lift is a specified pavement thickness < 2 1/4 inches	When the 4.75mm (#4) is < 47%, a thin lift is a specified pavement thickness < 3 inches
25.0mm	When the 4.75mm (#4) is > or = 40%, a thin lift is a specified pavement thickness < 3 inches	When the 4.75mm (#4) is < 40%, a thin lift is a specified pavement thickness < 4 inches
37.5mm	When the 9.50mm (3/8) is > or = 47%, a thin lift is a specified pavement thickness < 4 1/2 inches	When the 9.50mm (3/8) is < 47%, a thin lift is a specified pavement thickness < 6 inches

904.04.04 Antistripping Additives. HMA shall have a Tensile Strength Ratio (TSR) of at least 0.85 when tested in conformance with D 4867. The freeze-thaw conditioning cycle is required. HMA mixes not meeting the minimum TSR requirement shall include an antistripping additive.

When an antistripping additive is needed, the exact quantity shall be determined by the producer in conformance with D 4867 based on a minimum TSR of 0.85.

When a heat stable antistripping additive is used, the dosage rate shall be at least 0.20 percent of the total weight of asphalt. The additive shall be introduced at the plant by line blending, metering, or otherwise measuring to ensure accurate proportioning and thorough mixing.

When hydrated lime is used, it shall be added in slurry form at the rate of 1.0 to 1.5 percent by weight of total aggregate. The hydrated lime shall conform to C 1097. Lime slurry shall be sprayed uniformly on the damp, cold aggregate on the feed belt prior to entry into the HMA plant dryer.

Plant control and acceptance of the mix shall be based on MSMT 410 with respect to its stripping potential.

904.04.05 Plant Control. The following tolerances shall apply:

TABLE 904 A – MIX TOLERANCES

PHYSICAL PROPERTY	TOLERANCE: PLANT SITE OR HAULING UNIT SAMPLES (b)	TOLERANCE: PROJECT SITE BEHIND THE PAVER SAMPLES(b)
Passing No. 4 (4.75 mm) sieve and larger, %	± 7	± 7
Passing No. 8 (2.36 mm) thru No. 100 (150 µm) sieve, %	± 4	± 5
Passing No. 200 (75 µm) sieve, %	± 2	± 2
Asphalt content, %	± 0.4	± 0.5
Ratio of dust to binder material	0.6 to 1.6 (a)	0.6 to 1.6 (a)
Mix temperature leaving plant versus mix design temperature, F	± 25	NA
Deviation of maximum specific gravity per lot versus design maximum specific gravity	± 0.030	± 0.040
Voids, total mix, (VTM), %	4.0 ± 1.2	4.0 ± 1.2
Voids, total mix, 4.75 mm mix (VTM), %	3 ± 2	3 ± 2
Voids in mineral aggregate, (VMA), %	± 1.2 from design target	± 1.2 from design target
Voids filled asphalt (VFA), %	Within spec	Within spec
Bulk specific gravity, G_{mb} , %	± 0.022	± 0.022
G_{mb} at N_{max} , %	+ 0.5	+ 0.5

(a) Not applicable to 4.75 mm.

(b) For mixes other than Gap Graded HMA.

PWSL computations shall be performed for maximum specific gravity, voids in the total mix, voids in the mineral aggregate, and voids filled with asphalt. This computation shall be performed as specified in 504.04.02 using the moving average of the last three consecutive test values for each parameter. If the PWSL for the three test values falls below 85, corrective action shall be taken to bring the PWSL to at least

85. If the PWSL drops below 68, production shall be suspended until corrective action is taken as approved by the Engineer.

904.05 GAP GRADED STONE MATRIX ASPHALT (GGSMA).

904.05.01 Aggregates. Refer to 904.04.01.

904.05.02 Mix Design. Refer to 904.04.02 and the following table:

MIX TOLERANCES

PHYSICAL PROPERTIES	MIX DESIGN
VCA* Mix, %	Less than VCA _{drc}
VMA, %	18.0 min.
VTM, %	3.5
N _{design} Gyration	100
AC% by volume	6.5 min.
Draindown, % max	0.3
Stabilizer, by weight of total mix, %	0.2 – 0.4

*VCA – voids in coarse aggregate.

MIX SHIPMENT AND PLACEMENT TOLERANCES FOR GGSMA

PHYSICAL PROPERTY	TOLERANCE: PLANT SITE OR HAULING UNIT SAMPLES	TOLERANCE: PROJECT SITE BEHIND THE PAVER SAMPLES
Passing No. 3/8 (9.50 mm) sieve and larger, %	± 5	± 5
Passing No.4 (4.75 mm) sieve, %	± 4	±5
Passing No.8 (2.36 mm) sieve, %	± 4	±5
Passing No.16 (1.18 mm) sieve, %	± 4	± 5
Passing No.30 (0.60 mm) sieve, %	± 3	± 4
Passing No.50 (0.30 mm) sieve, %	± 3	± 4
Passing No.100 (0.15 mm) sieve, %	± 3	± 4
Passing No. 200 (75 μm) sieve, %	± 2	± 2
Asphalt content, %	± 0.4	± 0.5
Ratio of dust to binder material	NA	NA
Mix temperature leaving plant versus mix design temperature, F	± 25	NA
Deviation of maximum specific gravity per lot versus design maximum specific gravity	±0.030	±0.040
Voids, total mix, (VTM), %	3.5 ± 1.2	3.5 ± 1.2
Voids in coarse aggregate (VCA)	Less than VCA _{drc}	Less than VCA _{drc}
Voids in mineral aggregate, (VMA), %	17.0 min	17.0 min
Voids filled asphalt (VFA), %	NA	NA
Stabilizer, by weight of total mix, %	±0.1	NA

PWSL computations shall be performed for maximum specific gravity, voids in the total mix, and voids in the mineral aggregate. This computation shall be performed as specified in 504.04.02 using the moving average of the last three consecutive test values for each parameter. If the PWSL for the three test values fall below 85, corrective action shall be taken to bring the PWSL to at least 85. If the PWSL drops below 68, production shall be suspended until corrective action is taken as approved by the Engineer.

904.05.03 Mix Design Approval. Refer to 904.04.03.

904.05.04 Stabilizer. GGSMA shall incorporate a stabilizer selected from a source currently approved by the Administration.

904.05.05 Stabilizer Supply System. A separate system for feeding shall be used to proportion the required amount into the mixture so that uniform distribution is obtained.

When a batch plant is used, the stabilizer shall be added to the aggregate in the weigh hopper and both dry and wet mixing times shall be increased. The stabilizer shall be uniformly distributed prior to the addition of asphalt cement into the mixture. The plant shall be interlocked so that asphalt can not be added until the stabilizer has been introduced into the mix.

When a drum plant is used, the stabilizer shall be added to the mixture in a manner that prevents the stabilizer from becoming entangled in the exhaust system.

The stabilizer supply system shall include low level and no-flow indicators, and a printout of the status of feed rate in lb/minute and have a 60 second plant shut down function for no-flow occurrences.

The stabilizer supply line shall include a section of transparent pipe for observing consistency of flow or feed.

All stabilizer addition systems shall be as approved by the Engineer.

904.05.06 Antistripping Additives. Refer to 904.04.04.

SECTION 905 — PIPE

905.01 CERTIFICATION. The manufacture shall furnish certification for all pipe as specified in TC-1.03.

MATERIAL	SPECIFICATION	REMARKS
Nonreinforced Concrete Pipe	M 86, Class 3	—
Reinforced Concrete Pipe	M 170, Class 4 and 5	Load bearing option
Concrete End Sections	M 170	Class 3 pipe reinforcement required
Corrugated Polyethylene Pipe	M 294	—
Corrugated Polyethylene Drainage Pipe	M 252	Perforated underdrain and underdrain outlet pipe.
Polyvinyl Chloride (PVC) Profile Wall Pipe	M 304	—
Polyvinyl Chloride (PVC) Pipe	M 278	Underdrain outlet pipe
	M 278 (a)	Perforated underdrain
Reinforced Concrete Arch Culvert	M 206	—
Reinforced Concrete Elliptical Pipe	M 207	Load bearing option Class HE-IV
Preformed Rubber Joint for Circular Pipe	M 198, Type A	—
Corrugated Steel Pipe, Pipe Arches and Underdrain	M 36 (b), (c)	End finish shall be annular corrugations
Corrugated Aluminum Alloy Pipe	M 196 (b)	End finish shall be annular corrugations
Structural Plate for Pipe, Pipe Arches and Arches	M 167	—
Copper Pipe	Fed Spec WW – T-799, Type K	—
Polyethylene (PE) Precoated Corrugated Steel Pipe	M 245 and M 246	Minimum thickness 10 mil on each of the surfaces.
Concrete Drain Tile	M 178	—
Non-Asbestos Fiber-Cement Storm Drain Pipe	C 1450	—
Reinforced Concrete Low-Head Pressure Pipe	C 361	—

- (a) Perforations shall conform to the requirements of F 758.
- (b) Bands with dimples are prohibited.
- (c) All Corrugated Steel Pipe shall be aluminum-coated Type 2 conforming to M 274 unless otherwise specified.

905.02 CERTIFIED REINFORCED CONCRETE PIPE PLANTS. Reinforced concrete pipe conforming to the Specifications will be accepted on the manufacturer's certification based on the requirements outlined below. This includes the sampling, testing, documentation, and certification of the product by the manufacturer in combination with an Administration monitoring program.

Initial Inspection. Any plant initially setting up and starting production will be subjected to a comprehensive inspection to determine whether plant equipment and personnel conform to all applicable Specifications and that suitable testing facilities will be available. The Administration will accept certification by a professional engineer registered in the State of Maryland that the plant facilities conform to all applicable Specifications; however, final acceptance will be determined by the Administration.

905.02.01 Responsibilities of the Concrete Pipe Producer. Perform quality control operations at the plant to ensure that the material conforms to specifications. The quality control process will be subject to unannounced periodic verification by representatives of the Engineer. The plant's quality control personnel shall fully participate in the verification.

Submit a quality control plan for approval prior to the start of production. In addition, submit a quality control plan annually for review and approval. Submit any change in personnel, production, testing facility, and policy as a supplement to the plan. The plan shall include the following:

- (a) The manner in which the materials will be handled.
- (b) The following quality control procedures:
 - (1) The names, qualifications, and responsibilities of the quality control personnel and the designation of a quality control manager.
 - (2) Sampling and testing methods and frequencies.
 - (3) Method used for inspecting reinforcement cages prior to and during production.
 - (4) Method of curing.

- (5) Method of maintaining accurate quality control records.
- (6) Samples of forms approved by the Administration.
- (7) Patching procedure.
- (8) Method of preparation of units for shipping.
- (9) Method of identification of each unit as tested and approved.

A pipe lot is defined as a maximum 14 day production run of concrete pipe, all being of like size, material, strength designation, and manufacturing process. The 14 days need not be consecutive, as long as they occur within a one month period and the process is not altered in any way between production days. The lot size may include up to 1000 pieces for 12 to 36 in. pipe or 500 pieces for 42 in. and larger pipe.

A three-edge bearing test to produce a 0.01 in. crack is required for each lot in conformance with M 170, section 5.1.1.

Perform at least one three-edge bearing test per year to ultimate load on each size and class of pipe manufactured and shipped to Administration projects to verify that the applicable specified ultimate load can be achieved.

Perform at least one absorption test per year on each size and class of pipe manufactured and shipped to Administration projects.

Ensure that the ultimate load test and absorption test is completed on the first lot of the year of that size and class pipe shipped to Administration projects.

905.02.02 Test Facilities. The producer's facilities, equipment, and quality control personnel shall be capable of conducting the tests specified in T 280 and shall be as approved.

The quality control personnel shall be identified by a number used for testing and stamping pipe for shipping.

The producer shall maintain yearly calibration certificates on all equipment used for testing.

The producer may elect to use the services of an independent commercial testing laboratory that is acceptable to the Engineer in lieu of conducting their own tests.

905.02.03 Shipment. Pipe may be shipped to the Administration's projects when the required testing for all pipe in the lot has been completed with acceptable results and all of the pipe to be shipped is at least the age of the test specimens at testing.

Prior to shipping, mark the following information on the inside of each pipe.

- (a) Plant name.
- (b) Plant location.
- (c) Size of pipe.
- (d) Class of pipe.
- (e) Date of manufacture.
- (f) Quality control stamp.
- (g) Quality control personnel number.

905.02.04 Certification. A manufacturer's certification shall accompany each shipment of pipe. A copy of the certification shall be delivered to the Engineer, the Administration's laboratory, and the Contractor for each shipment. One copy shall remain at the plant. The certification shall include the following;

- (a) The plant name, address, and location.
- (b) Size and class of the pipe.
- (c) Date of manufacture and shipment.
- (d) Number of pieces.
- (e) Administration Contract number.
- (f) Statement of Specification compliance.

- (g) Signature and number of the quality control personnel that inspected the shipment.

905.02.05 Records. All testing and inspection documents shall be maintained at the production plant for at least three years from the manufactured date and shall be made available to the Administration upon request.

The producer shall collect and maintain conformance certificates and mill test reports for aggregates, cement, fly ash, joint material, reinforcing steel, and other materials intended for use in products used on Administration projects.

905.02.06 Quality Control Forms. The producer shall maintain an Administration approved quality control form for all pipe produced for use on Administration projects. Each form, for each lot shall contain the following:

PIPE DIMENSIONS	REINFORCEMENT	TESTS	GENERAL INFORMATION
Diameter Length Wall Thickness Joint Style	Size Spacing Area-Spec and Test Results Adequacy and Quality of Welds and Splices	Absorption Spec and Test Results Once per year Visual Inspection	Plant Name Technician Signature Lot Identification Production Dates Pipe Class Units Per Lot Material Sources Cement Fine Aggregate Coarse Aggregate Reinforcement
THREE EDGE BEARING			
0.01 in. Crack Strength Spec and Test Results	Ultimate Strength Spec and Test Results Once per year		

905.02.07 Responsibilities of the Administration. Verification of certification will be performed at the discretion of the Administration a minimum of once per year.

The Administration reserves the right to discontinue acceptance of reinforced concrete pipe if the verification process indicates that materials, test procedures, or finished pipe do not conform to the Contract Documents and Quality Control Program.

905.03 CERTIFIED CORRUGATED POLYETHYLENE PIPE PLANTS. Polyethylene pipe conforming to the Specifications will be accepted on the manufacturer's certification based on the requirements outlined below. This includes the sampling, testing documentation, and certification of the product by the manufacturer in combination with an Administration Monitoring Program.

905.03.01 Responsibilities of the Corrugated Polyethylene Pipe Producer. Submit a quality control plan for approval. The plan shall be site specific and include the following:

- (a) A detail of how the producer proposes to control the equipment, materials, and production methods to ensure that products produced are in conformance with the Specifications.
- (b) A list of the personnel responsible for production and quality control at the site, including information on how to contact each person.
- (c) Identification of the physical location of the plant.
- (d) The method of identification of each lot of material during manufacture, testing, storage, and shipment.
- (e) The method of sampling and testing of raw materials and of the finished product, including lot sizes, type of material tests performed, and a description of equipment modifications or equipment developed in-house to perform the tests.
- (f) A plan for dealing with quality control sample failures, which shall include how the producer plans to initiate an immediate investigation and what corrective action will be implemented to remedy the cause of the problem.
- (g) A statement as to what determines lot size (i.e. a single days production, 15 000 linear feet, etc.) A lot is defined as a

production run of pipe, all being of like size, material, and manufacturing process.

905.03.02 Test Facilities. The Certification Program requires all tests to be conducted at laboratories that are accredited by AASHTO or approved by the Administration. Each source may establish and maintain its own laboratory for the performance of quality control testing or may request to utilize an approved independent laboratory. The producer shall make a written request and have written approval from the Administration prior to having material tested off site. The equipment required for all approved laboratories shall be sufficient to perform the required test procedures as required by the applicable specification and standards.

905.03.03 Certification. A manufacturer's certification shall accompany each shipment of pipe. A copy of the certification shall be delivered to the Engineer and the Contractor for each shipment. One copy shall remain at the plant. The certification shall include the following:

- (a) Plant name, address, and location.
- (b) Lot or production identification.
- (c) Date of manufacture and shipment.
- (d) Number of units of each size pipe or total linear feet of each size pipe.
- (e) Administration Contract number.
- (f) Statement of Specification compliance.
- (g) Signature of the quality control manager, or authorized representative (name shall be designated in the Quality Control Plan).

905.03.04 Records. All testing and inspection documents shall be maintained at the manufacturing facility for at least three years from the manufactured date, and shall be made available to the Administration upon request.

905.03.05 Quality Control Forms. The manufacturer shall maintain an Administration approved quality control form for all pipe produced for Administration projects. Include the following:

GENERAL INFORMATION	TESTS
Plant Identification QC Technician's Signature Lot Identification Production Dates Tubing/Pipe Dimension Perforation Dimensions Workmanship Identification Markings	Pipe Stiffness Pipe Flattening Elongation* Environmental Stress Cracking Brittleness Low Temperature Flexibility*

*Type C or CP only.

905.03.06 Responsibilities of the Administration. The Administration will randomly conduct at least one plant inspection per year with the cooperation and assistance of the producer to ensure conformance with specifications and quality control requirements. Visual inspection will be made by the Engineer when pipe is received on the project. The Administration will verify the manufacturer's certification test results by sampling in conformance with the Administration's Frequency Guide.

SECTION 906 — GABIONS

906.01 WIRE FOR GABIONS. All wire including tie and connecting wire shall have a tensile strength of at least 60 000 psi when tested per A 370. All wire sizes and mesh spacing shall be as recommended by the manufacturer.

Stainless steel interlocking fasteners meeting A 313 may be substituted for wire ties. When subjected to directional tension along its axis, the fastener shall remain in a closed and locked condition for a minimum force of 900 lb.

906.01.01 Galvanized Coating for Gabions. Galvanized coating for fabric, ties, and connecting wire shall not be at least 0.8 oz/ft² when tested per A 90.

906.01.02 Polyvinyl Chloride (PVC) Coating for Gabions. PVC coating for fabric, ties, and connecting wires shall exhibit no weight loss when tested per MSMT 508. Color shall meet Federal Standard 595, gray color No. 26440 or green color No. 24533, and match throughout the project.

SECTION 907 — PILES AND PILING

907.01 TIMBER PILING. M 168.

907.01.01 Resin and Fiberglass Caps for Timber Pile Heads. Meet the following:

PROPERTY	SPECIFICATION LIMITS	TEST METHOD
MOISTURE INSENSITIVE RESIN		
Tensile Strength, psi, min	5000	D 638
Tensile Elongation, % min	0.05	D 638
Compressive Strength, psi min	9000	C 109
Abrasive Resistance, *l/mil min	60	D 968
WOVEN GLASS CLOTH		
Weight, oz/yd ² min	9	—
Type	Volan A	—

*liters (l) of fine aggregate per mil thickness of resin

907.02 STEEL PIPE PILES. A 252, Grade 2.

907.03 STEEL BEARING PILES. A 36, including all splice material.

907.04 STEEL SHEET PILES. A 328. Sheet pile accessories A 36. High strength bolts 909.07.

907.05 WELDING MATERIALS. AASHTO/AWS D1.5.

SECTION 908 — REINFORCEMENT STEEL

908.00 CERTIFICATION. The steel manufacturer shall furnish certification for each heat of steel as specified in TC-1.03.

908.01 DEFORMED REINFORCEMENT. Unless otherwise specified, reinforcement bars and reinforcement bars used as anchoring devices shall be Grade 60 deformed bars per A 615 or A 706. Deformed bars shall be epoxy coated when specified. Epoxy powder shall be as specified in 917.02.

908.02 PLAIN REINFORCEMENT. Unless otherwise specified, dowel bars and dowel bars used as ties in portland cement concrete pavement expansion and contraction joints shall be plain round steel bars meeting A 615, Grade 60 or A 36. Bars shall be epoxy coated. Epoxy powder shall be as specified in 917.02. All dowel bars used for traverse joints shall have a maximum pullout strength per M 254.

908.03 STAINLESS STEEL BARS. Stainless steel bars may be used in lieu of epoxy coated plain bars. Stainless steel shall meet A 276, Type SM-29. Deformed stainless steel bars shall meet A 615 for cross sectional area and deformations.

908.04 SLEEVES FOR DOWEL BARS IN PAVEMENT EXPANSION JOINTS. Sleeves for dowel bars shall be of sheet metal capable of sliding over $2 \pm 1/4$ in. of the dowel and have a closed end with a stop to hold the end of the sleeve at a minimum distance of 1 in. from the end of the dowel bar.

908.05 WELDED STEEL WIRE FABRIC. M 55. Fabric used in pavement construction shall be furnished in flat sheets.

908.06 WELDED DEFORMED STEEL WIRE FABRIC. M 221. **908.07 FABRICATED STEEL BAR MATS.** Steel shall meet A 184.

908.07 WIRE FABRIC FOR PNEUMATICALLY APPLIED MORTAR AND CONCRETE ENCASEMENT. Fabric shall meet A 185 and be galvanized as specified in 906.01.01. Fabricate from size W1.4 wire on 3 in. centers in each direction or from W0.9 wire on 2 in. centers in each direction.

908.08 COLD DRAWN STEEL WIRE. Concrete reinforcement shall meet M 32.

908.09 TIE DEVICES FOR CONCRETE PAVEMENT. Tie device sizes shall be as specified and produce a frictional force of at least 160 lb/ft per foot of spacing when tested per MSMT 512.

908.10 STEEL STRAND. M 203, Grade 270, Low Relaxation Strand.

SECTION 909 — METALS

909.00 CERTIFICATION. The metal producer shall furnish certification as specified in TC-1.03. The certification shall include actual mill test results. The chemical and physical properties of the finished metal products shall also be furnished by the processing manufacturer.

909.01 STRUCTURAL STEEL. Structural steel shall meet the requirements specified. All primary load carrying members shall meet the supplementary toughness requirements of M 270, Zone 2.

Primary load carrying members are as follows or as designated in the Contract Documents: Finger joint steel from which saw tooth configurations have been cut, all stringers, cover plates, bearing stiffeners, splice plates, pins and pin links for straight rolled steel beam bridges; all flanges, webs, bearing stiffeners, splice plates, pins and pin links for straight steel girder bridges. Additionally, on curved rolled steel beam and steel girder bridges; all diaphragms, cross frames, lateral bracing, including connection plates to main stringers.

909.02 STEEL FOR MISCELLANEOUS USE. A 36 or A 709, Grade 36. Steel for bearings on structures shall conform to A 709, Grade 50.

909.03 WELDING MATERIALS. AASHTO/AWS D1.5.

909.04 GRAY IRON CASTINGS. A 48, Class 30B.

909.05 STEEL STUD SHEAR DEVELOPERS.
AASHTO/AWS D1.5.

909.06 BOLTS, NUTS, AND WASHERS FOR GENERAL USE. A 307, galvanized per A 153. Anchor bolts shall be galvanized and meet A 709, Grade 36.

909.07 HIGH STRENGTH BOLTS, NUTS, AND WASHERS.
A 325.

909.08 ANCHOR BOLTS FOR TRAFFIC SIGNALS, HIGHWAY LIGHTING, AND SIGNS. F 1554, Grade 55 S1. Anchor bolts shall be galvanized for the full length of the threads and 3 in. below the threads per A 153. Nuts shall be hex nuts meeting A 194, Grade 2H or A 563, Gr DH. Flat washers shall be heavy washers per F 436. All hardware shall be galvanized per A 153.

909.09 CAST WASHERS. Cast washers, ogee washers, and special cast washers per A 47. Cast washers shall be hot dip galvanized. The coating shall meet the thickness, adherence, and quality requirements of A 153.

909.10 HARDWARE. Spikes, wood screws, staples, brads, lag screws, carriage bolts, and other parts under the general heading of HARDWARE shall be composed of carbon steel and meet Federal Specification FF-N-105.

909.11 STEEL FORMS. Steel bridge deck forms and deck form supports that remain in place shall be fabricated from steel per A 653, Designation SS, Grades 33 through 80, Coating Designation G 165. The minimum thickness of uncoated steel shall be 0.0359 in.

SECTION 910 — BEARINGS

910.00 CERTIFICATION. The bearing producer shall furnish certification as specified in TC-1.03. The certification shall include actual mill test results. The chemical and physical properties of the finished bearings shall also be furnished by the processing manufacturer.

910.01 BRONZE OR COPPER ALLOY BEARING AND EXPANSION PLATES. Either of cast bronze or rolled copper alloy.

910.01.01 Cast Bronze. B 22, Alloy No. 91100 or No. 91300.

Self-lubricating bronze bearing plates shall be an article of standard production by an approved manufacturer of such equipment. They shall be provided with trepanned recesses (not grooves) that shall be filled with a lubricating compound consisting of graphite and metallic substances with a lubricating binder capable of withstanding the atmospheric elements. The lubrication compound shall be compressed into the recesses by pressure to form dense, nonplastic lubricating inserts. The lubricating area shall comprise at least 25 percent of the total area. The static coefficient of friction shall not exceed 0.10.

The certification shall be as specified above and shall include the actual test results showing that bearing plates of the same design as those supplied meet the static coefficient of friction requirements.

Test specimens shall be at least 4 in. long by 4 in. wide. The static coefficient of friction shall be determined by testing a specimen plate subjected to a vertical pressure of 1000 psi and 1000 cycles consisting of 1/2 in. horizontal strokes at a speed not to exceed 9 cycles per minute. Conduct testing at an ambient temperature of 77 ± 9 F. The static coefficient of friction on the specimen bearing plate shall be calculated by dividing the total applied vertical load on the plate into the total horizontal load required to start motion between the bearing plate and its mating surface while subject to the vertical load. Upon completion of the test, the bronze plate shall show no signs of galling.

910.01.02 Rolled Copper. Per PB 100, Alloy No. 51000.

910.02 STRUCTURAL BEARING PADS. The manufacturer shall furnish certification as specified in TC-1.03.

910.02.01 Elastomeric Pads. Elastomeric bearing pads shall meet the material requirements described in the AASHTO Standard Specifications for Highway Bridges. The elastomeric bearing shall be 60 durometer hardness, Shore Type A. Accompanying the certificate for elastomeric bearing pads shall be two standard ASTM tensile slabs molded from the same compound batch as the furnished elastomeric bearings.

The static load deflection of any layer of elastomeric bearing pads shall not exceed 7 percent at 800 psi average unit pressure when tested under laboratory conditions.

The design load for the elastomeric bearing pads will be as specified. The manufacturer shall proof load each steel reinforced bearing design with a compressive load of 1.5 times the maximum design load and specify that the material conforms to the material certification.

When test specimens are cut from an actual bearing pad, a reduction of 10 percent in the minimum requirements for original tensile strength and ultimate elongation will be required.

910.02.02 Self-Lubricating Bearing Assembly. A fabric reinforced elastomeric pad, Tetrafluoroethylene (TFE) bonded to the pad, and a stainless steel sheet. All elements shall meet AASHTO Standard Specifications for Highway Bridges as modified herein.

Fabric reinforced elastomeric pad shall be Type A, durometer hardness of 70 to 90. Stainless steel sheet shall be Type 304, minimum thickness of 16 gauge. The surface of the stainless steel sheet in contact with TFE shall have a 2B finish and be welded to the sole plate using an approved welding procedure.

910.02.03 Preformed Fabric Pads for General Application. Multiple layers of 8 oz cotton duck impregnated and bound with high quality natural rubber or of equally suitable materials, approved by the Engineer and compressed into resilient pads of uniform thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of at least 10 000 psi without detrimental reduction in thickness or extrusion.

SECTION 911 — JOINTS

911.01 JOINT SEALER AND CRACK FILLER. D 3405 as modified by MSMT 404. The manufacturer shall furnish certification as specified in TC-1.03. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If a range of temperatures is recommended, the midpoint will be used as the pour point.

911.01.01 Silicone Joint Sealer and Crack Filler. Low modulus, one component compounds. If a primer is required, it shall be as recommended by the sealant manufacturer and be placed on the joint faces following the insertion of the backup material.

Silicone material, when tested at 73 ± 3 F and 45 to 55 relative humidity, shall meet the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Shore A Hardness, at 7 days	D 2240	10-25
Tensile Strength at 150 % Elongation, psi max	D 412 Die C	45
Elongation, % min	D 412 Die C	700
Adhesion in Peel, lb/in. min	Fed Spec TT-S-00230	20
Flow, 0.01 in. max	T 187	0.3
Tack-Free Time, minutes	D 2377	20-75

Each container of silicone sealer and crack filler shall have a shelf life of at least six months. Material more than six months old shall be retested.

911.02 PREFORMED JOINT FILLERS. M 153. Bituminous fiber type shall meet M 213, with the bitumen content determined per T 164. The weathering test is not required for either type of material.

911.03 PREFORMED JOINT INSERTS. M 220.

911.04 PREFORMED POLYCHLOROPRENE ELASTOMERIC COMPRESSION JOINT SEALS. The manufacturer shall furnish certification as specified in TC-1.03.

911.04.01 Roadway Seals for Concrete Pavement. M 220.

911.04.02 Bridge Seals. M 297. The minimum depth of all seals measured at the contact surface shall be at least 90 percent of the minimum uncompressed width of the seal.

911.04.03 Lubricant Adhesive. The lubricant adhesive shall be compatible with the preformed joint seals and concrete. The Engineer will determine if consistency is suitable at the time of installation.

The manufacturer shall furnish certification as specified in TC-1.03 showing that lubricant adhesive meets the following:

TEST and METHOD	SPECIFICATION LIMITS
Viscosity, D 1084, Method B, CP min	25 000
Film Strength, D 412, psi min	2000
Elongation, D 412, % min	250

Each container shall be plainly marked with the manufacturer's name or trademark, lot number, and date of manufacture. Do not use lubricant adhesive after nine months from the date of manufacture.

911.05 NEOPRENE STRIP SEALS. The manufacturer shall furnish certification as specified in TC-1.03 showing that the neoprene strip seals meet the following:

PHYSICAL PROPERTIES FOR PREFORMED ELASTOMERIC STRIP SEALS		
PROPERTY	REQUIREMENT	TEST METHOD
Tensile Strength, psi min	2000	D 412
Elongation at Break, %, min	250	D 412
Hardness, Type A Durometer, points	60 ± 5	D 2240 (modified)(a)(c)
Oven Aging, 70 hr at 212 F Tensile Strength, % loss, max Elongation, % loss, max Hardness, Type A Durometer, points change	20 20 0 to + 10	D 573 D 2240 (modified)(a)(c)
Oil Swell, ASTM oil 3 70 hr at 212 F weight change, % max	45	D 471
Ozone Resistance 20% strain, 300 pphm in air, 70 hr at 104 F	No Cracks	D 1149 (modified)(b)
Low Temperature Stiffening 7 days at 14 F Hardness, Type A Durometer, points change	0 to + 15	D 2240 D 2240 (modified) (a)(c)
Compression Set, 70 hr at 212 F, % max	40	D 395 Method (modified) (b)(a)

- (a) The term “modified” in the table relates to the specimen preparation. The use of the strip seal as the specimen source requires that more applications than specified in either of the modified test procedures be used. The specimen modification shall be agreed upon by the purchaser and producer or supplier prior to testing.
- (b) Test per procedure A of D 518. Ozone concentration is expressed in pphm.
- (c) The hardness test shall be performed with the durometer in a durometer stand as recommended in D 2240.

911.05.01 Special Molded Intersection Pieces. Where joint elements intersect, a special strip seal element manufactured by molding in one piece from neoprene material similar to that specified above shall be 10 in. from point of intersection to nearest end along center line of joint in any direction. Ends shall be plane and square to facilitate bonding to adjacent extruded areas, and corners of sharp angles shall be rounded sufficiently to relieve damaging stress concentrations. Angles to which moldings are fabricated shall be within 5 degrees of the actual angle as specified in the Contract Documents to avoid excessive deformation when installed in steel joint components.

Lubricant adhesive for use in installing and bonding neoprene seal elements to steel joint components shall be one part moisture curing polyurethane and hydrocarbon solvent mixture having the following physical properties:

TEST and METHOD	SPECIFICATION LIMITS
Average Weight, lb/gal	8 ± 0.8
Solids Content, % min	65
Adhesives shall remain liquid from, F	5 to 120
Film Strength, D 412, psi min	2000
Elongation, D 412, % min	250

Steel extrusions and neoprene seals shall be matching components by the same manufacturer. The steel extrusions shall have a thickness of at least 3/8 in. All steel portions of the joint assembly shall be painted with an inorganic zinc rich primer meeting 912.03 and applied as specified in Section 435.

911.06 SEALER FOR LOOP DETECTOR. Type A two part epoxy or Type B, one part polyurethane. The manufacturer shall furnish certification as specified in TC-1.03. Do not mix aggregate with the sealer material. Apply the sealer in accordance with the manufacturer's recommendations.

911.06.01 Tests. Meet to the following:

TYPE A – TWO PART EPOXY	
TEST and METHOD	SPECIFICATION LIMITS
Viscosity, cone and plate Viscometer@ 25 C, cps max	12 000
Pot life @ 25 C, minutes min	10
Cure time @ 25 C, no tackiness, hr max	1
Hardness, Type A durometer, D 2240	50 – 60
Tensile elongation, D 638, % min	100
Water absorption, D 570, %/24 hr max	0.5
Oil absorption, D 471, % max	0.02
Volume resistivity @ 25 C, D 257, ohm-cm min	2.4×10^{10}
TYPE B - ONE PART POLYURETHANE	
TEST and METHOD	SPECIFICATION LIMITS
Viscosity, Brookfield RVF #6 spindle @ 20 rpm 25 C, cps max	30 000
Cure time @ 25 C, no tackiness, hr max	24
Hardness, Rex Type A	50 – 60
Tensile strength, D 412, psi min	500
Tensile elongation, D 412, % min	300
ARC resistance, D 495, sec min	70
Dielectric constant, D 150, min	6 @ 50 hz 4.25 @ 500 kHz
Nonvolatile content, %	85

911.07 ROOFING PAPER. Roofing paper used in expansion joints shall be composed of roofing felt saturated and coated on both sides with an asphaltic material. It shall weigh at least 39.8 lb/100 ft² and not crack when bent 90 degrees over a 1/2 in. radius at room temperature.

911.08 WATER STOPS. Rubber or polyvinyl chloride (PVC).

Shall be of the shape and dimensions specified. The cross section shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the water stop is uniform.

Shall meet the following:

TEST and METHOD	SPECIFICATION LIMITS
Tensile Strength, D 412, psi min	2000
Elongation @ Break, D 412, % min	300
Hardness, Rubber, Type A durometer, D 2240	55 ± 5
Hardness, PVC, Type A durometer, D 2240	75 ± 5

Furnish a test sample for each lot or shipment of water stop. The manufacturer shall furnish certification as specified in TC-1.03.

911.09 ASPHALT SEALER FOR CONCRETE PIPE. A mixture of asphalt, mineral filler, and petroleum solvents, and having adhesive and cohesive properties. Each container shall be clearly marked with a lot number, manufacturer, and location of manufacturer.

The supplier shall furnish a certified copy of the test results showing that the sealer meets the following:

TEST and METHOD	SPECIFICATION LIMITS
Residues by evaporation, nonvolatile matter, D 2939, % min	70
Inorganic filler on ignition, ash content, D 2939, %	15 – 45

911.10 CLOSED CELL NEOPRENE SPONGE ELASTOMER. D 1056, Type S. Skin coating is optional. The material shall meet the following:

TEST and METHOD	SPECIFICATION LIMITS
Compression Deflection, D 1056	Pressure necessary for 25 % deflection, 5 – 10 psi, one layer 1/2 in. thick pad @ 70 ± 5 F
Accelerated Aging Test	Change in compression deflection after aging 7 days @ 158 F, 20 % max
Permanent Set,* D 1056	50 % deflection @ 158 F for 22 hr, 40 % max residual permanent set after 10 days recovery, 10 % max
Water Absorption by weight	2 in. immersion of 1.129 in. diameter sample for 24 hr @ room temperature, 10 % max
Water Resistance, D 1171	Quality retention, 6 weeks exposure, 100 %

*Method to calculate permanent set:

$$\text{Permanent set} = \frac{(t_0 - t_1) \times 100}{t_0}$$

where:

t_0 = original thickness of sample, and

t_1 = thickness of specimen 30 minutes after removal of clamps or after 10 days recovery.

911.11 DRAINAGE TROUGHS.

911.11.01 Neoprene Drainage Troughs. M 220, and the following:

NEOPRENE DRAINAGE TROUGHS		
PHYSICAL PROPERTY	METHOD	LIMITS
Thickness, in. min	—	1/4
Tensile Strength, psi min	D 412	2000
Elongation at Break, % min	D 412	250
Hardness, Type A Durometer	D 2240 (modified)	60 ± 5
Compression Set, 22 hr @ 212 F, % max	D 395	35
Oven Aging, 70 hr @ 212 F		
Tensile Strength, % loss max	D 573	20
Elongation, % loss max		20
Hardness, Type A Durometer (points change)		0 to + 10

911.11.02 OPTIONAL PREFORMED FABRIC DRAINAGE TROUGHS. A sheet composed of multiple plies of 15 ± 5 oz/yd² polyester fabric laminated with butadiene acrylonitrile, vulcanized to form an integral laminate. Physical properties of the laminate shall meet the following:

ALTERNATE PREFORMED FABRIC DRAINAGE TROUGHS		
PHYSICAL PROPERTY	METHOD	LIMITS
No. of Plies	—	3
Laminate Weight, lb/ft ² min	—	0.85
Thickness, in. min	—	5/32
Breaking Strength, lb/in. min	D 378	1200
Elongation at Break, % max	D 378	30
Elongation at 1/10 Breaking Strength, % max	D 378	3

911.12 SHIMS FOR NOISE BARRIER INSTALLATION. Either neoprene or composite elastomer with a durometer of 60 ± 5 (Shore A) value.

SECTION 912 — COATING SYSTEMS FOR STRUCTURAL STEEL

912.01 GENERAL. The Office of Materials Technology (OMT) will maintain a list of Approved Paint Manufacturers. Only manufacturers on this list will be acceptable. Unless otherwise specified, paint shall be tested in accordance with Federal Test Method Standard 141. Only one formulation per color will be permitted per project. Tests shall be performed at 75 F and 50 percent relative humidity unless otherwise specified. All paint shall be satisfactory for brushing, rolling, or spraying. All paints within a system shall be from the same manufacturer and shall be tinted at the point of manufacture to differentiate between coats, existing coats, and bare metal. Paint shall be shipped in the original containers and all containers shall bear the identification of the paint, consisting of the manufacturer's name, the name or title of material, volume of contents, manufacturer's paint identification number, the date of manufacture, color name and number, handling instructions, precautions, and the batch number.

912.01.01 Approved Paint Manufacturers. Admission onto the list of Approved Paint Manufacturers will be based upon the acceptance of the manufacturer's submitted Quality Control Plan.

912.01.02 Quality Control Plan. The Quality Control Plan shall define the manufacturer's process to ensure the quality of the products during and upon completion of the manufacturing process. As a minimum, the Quality Control Plan shall list the following information:

- (a) Name of quality control tests and test procedures used.
- (b) Detailed description of the test procedures if not a standard test.
- (c) Frequency of quality control tests.
- (d) Maintenance of quality control records and length of time that they will be maintained.

912.01.03 Acceptance. The paint manufacturer shall furnish certified test results for each lot and color of paint as specified in TC-1.03. Certified test results for each lot shall list the actual test results for the specified properties. The certification shall be approved by OMT prior to shipment, and a copy shall accompany each shipment.

912.01.04 Original Infrared Spectrogram. The manufacturer shall submit an original analysis of vehicle solids by infrared spectroscopy performed as specified in D 2621 as follows:

- (a) For zinc primer coatings, infrared spectrum (2.5 to 15 μm) of each vehicle component.
- (b) For two component coatings, infrared spectrum (2.5 to 15 μm) of each single component and each mixed component, when applicable, in appropriate mixing ratios.

912.01.05 Certification Verification Tolerances. The manufacturer's facilities will be visited at random intervals, and samples will be taken. A comparison will be made between the manufacturer's certified test results and the Administration's tests results on the same batch. The tolerances between these results shall meet the following:

TEST	TOLERANCE	TEST METHOD
Total Solids by mass, %	± 2	D 2369
Pigment Content by mass, %	± 2	D 2698 or D 4451
Vehicle Solids by mass, %	± 2	D 2369
Viscosity, KU	± 10	D 562
Unit Weight, lb/gal	± 0.5	D 1475

*Volatile Organic Compound (VOC) maximum limits shall meet the current regulations governing the point of application.

912.02 PRIMER COATS AND SEALERS.

912.02.01 Inorganic Zinc Rich. M 300, Type I or IA. Zinc dust shall meet D 520, Type II.

912.02.02 Aluminum Epoxy Mastic. Aluminum epoxy mastic primer shall have one component that is the condensation product of the reaction of epichlorohydrin with bisphenol A. Drying times shall be 8 hours maximum to touch, 24 hours minimum to 30 days maximum for recoat, and 48 hours maximum for hard. Minimum pot life shall be three hours. Solids by weight shall be 90 percent minimum and 80 to 90 percent by volume. Viscosity shall be 95 to 140 KU and flexibility shall pass a 180 degree bend around a 3/4 in. mandrel when tested per D 522. The material shall resist sagging when tested per D 4400 with no sagging at the manufacturer's recommended wet film thickness. The material shall weigh 13.0 ± 0.5 lb/gal.

912.02.03 Organic Zinc Rich. SSPC-Paint 20, Type II.

912.02.04 Zinc Rich Moisture Cured Urethane. One-component having a minimum zinc pigment content in the dry film of 80 percent. Minimum solids shall be of 80 percent by weight and 62 percent by volume. The viscosity shall be 95 to 105 KU, and shall be capable of being applied at 50 percent greater film build than required without runs or sags per D 4400. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table except that the maximum loss for Abrasion Resistance shall be 82.0 mg, and Salt Spray after 1000 hours shall be 1/32 in. maximum.

912.02.05 Micaceous Iron Oxide and Aluminum Filled Moisture Cured Urethane. A minimum solids of 75 percent by weight and 60 percent by volume.

The viscosity shall be 95 to 100 KU. The coating shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.02.06 Penetrating Sealer. A viscosity of 75 to 101 KU and be able to penetrate and seal existing coatings and substrate. It shall be suitable for application over marginally prepared steel and most generic types of aged coatings. The sealer shall conform to one of the following:

- (a) Epoxy penetrating sealer shall be cross-linked amido-amine epoxy primer/sealer having two components mixed in accordance with the manufacturer's recommendations. It shall be a minimum 95 percent solids by weight.
- (b) Moisture cured urethane micaceous iron oxide filled penetrating primer/sealer shall be one component having a minimum 75 percent solids by weight. It shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.03 INTERMEDIATE COATS.

912.03.01 Acrylic. A single component 100 percent acrylic and have minimum solids of 48 percent by weight and 36 percent by volume. Maximum dry time to touch and recoat shall be 2 and 8 hours, respectively.

912.03.02 Epoxy Polyamide. Epoxy polyamide intermediate coat shall have one component that is the condensation product of the reaction of epichlorohydrin with bisphenol A. The epoxy polyamide shall have a 3.0 minimum fineness of grind (Hegman Units), and minimum solids of 75 percent by weight and 62 percent by volume. Maximum dry time to touch and recoat shall be 6 and 15 hours, respectively.

912.03.03 Micaceous Iron Oxide Moisture Cured Urethane. Micaceous Iron Oxide Moisture Cured Urethane shall be one-component having minimum solids of 80 percent by weight and 60 percent by volume. The viscosity shall be 90 to 100 KU. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall meet the Moisture Cured Urethanes Additional Performance Criteria Table. The micaceous iron oxide content shall be at least 3.0 lb/gal.

912.04 FINISH COATS. The color number will be specified in the Contract Documents and shall conform to Federal Standard 595. All finish coats shall resist sagging when tested per D 4400 with no sagging at the manufacturer's recommended wet film thickness.

912.04.01 Acrylic. Refer to 912.03.01.

912.04.02 Aliphatic Urethane. Finish coat shall have minimum solids of 70 percent by weight and 47 percent by volume. Drying time to touch and hard shall be the minimum recommended by the paint manufacturer.

912.04.03 Moisture Cured Aliphatic Urethane. Finish coat shall be one-component having a maximum free monomer content of 0.7 percent. Minimum solids shall be 75 percent by weight and 60 percent by volume, and the viscosity shall be 70 to 80 KU. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.05 PAINT SYSTEMS. As specified in the Paint Systems Table.

PAINT SYSTEMS TABLE

PAINT	COAT	SECTION	DRY FILM THICKNESS, mils, min - max	USAGE
SYSTEM A				
Inorganic Zinc	I	912.02.01	3.0 - 5.0	Shop Primer
Acrylic	II	912.03.01	2.0 - 4.0	First Field Coat
Acrylic	III	912.04.01	2.0 - 4.0	Finish Coat
SYSTEM B				
Inorganic Zinc	I	912.02.01	3.0 - 5.0	Shop Primer
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	First Field Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat
SYSTEM C				
Organic Zinc	I	912.02.03	3.0 - 5.0	Primer/First Cover-All Coat
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	Second Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat
SYSTEM D				
Organic Zinc	I	912.02.03	3.0 - 5.0	Primer/First Cover-All Coat
Acrylic	II	912.03.01	2.0 - 4.0	Second Cover-All Coat
Acrylic	III	912.04.01	2.0 - 4.0	Finish Coat
SYSTEM E				
Aluminum Epoxy Mastic	I	912.02.02	5.0 - 8.0	Primer/First Cover-All Coat
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	Second Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat
SYSTEM F				
Micaceous Iron Oxide, Aluminum Filled Moisture Cured Urethane	I	912.02.05	2.0 - 3.0	Primer/First Cover-All Coat

PAINT	COAT	SECTION	DRY FILM THICKNESS, mils, min - max	USAGE
Micaceous Iron Oxide Moisture Cured Urethane	II	912.03.03	3.0 - 5.0	Second Cover-All Coat
Moisture Cured Aliphatic Urethane	III	912.04.03	1.5 - 2.0	Finish Coat
SYSTEM G				
Zinc Rich Moisture Cured Urethane	I	912.02.04	2.0 - 3.0	Primer/First Cover-All Coat
Micaceous Iron Oxide Moisture Cured Urethane	II	912.03.03	3.0 - 5.0	Second Cover-All Coat
Moisture Cured Aliphatic Urethane	III	912.04.03	1.5 - 2.0	Finish Coat
SYSTEM H				
Penetrating Sealer	I	912.02.06	1.0 - 2.0	Sealer
Aluminum Filled Epoxy Mastic	II	912.02.02	3.0 - 5.0	Spot Coat
Aliphatic Urethane	III	912.04.02	3.0 - 5.0	Finish Coat

**MOISTURE CURED URETHANES
ADDITIONAL PERFORMANCE CRITERIA TABLE**

TEST PROPERTY	TEST METHOD	TEST CRITERIA	COAT I and II	ENTIRE SYSTEM
Cyclic Salt Fog/UV Exposure of Painted Metal	D 5894	Final Ratings: Rusting: 6 min Blistering: 10 min Rust Creep: 6 max Cracking: Degree and Type Flaking: Degree and Type	1000 hr	3000 hr
Salt Spray	B 117	1/32 in Scribe, 1/16 in. max undercut	1000 hr	3000 hr
Abrasion Resistance	D 4060	Taber Abraser, CS-17 Wheel, 1000 g load, 1000 cycles, max loss	100 mg	56 mg
Adhesion	D 3359	Cross-Cut Tape Test	No peeling or removal	No peeling or removal
Flexibility	D 522	Conical Mandrel Bend Test, min elongation	10 %	40 %
Pencil Hardness	D 3363	min	F	F
Accelerated Weathering	G 53	QUV using UV - B Lamp, time after no more than 10 % loss of gloss	—	400 hr
Impact Resistance	D 2794	min	—	40 in.·lb
Chemical Resistance, Solutions	Fed. Spec. T-C-550 4.4.6	5 % Sodium Hydroxide 5 % Hydrochloric Acid 5 % Sulfuric Acid 5 % Acetic Acid	—	Unaffected - Slight discoloration permitted
Reversed Impact	D 2794	Rapid Deformation	—	No cracking or delamination

SECTION 913 — WATERPROOFING

913.00 CERTIFICATION. The producer shall furnish certification as specified in TC-1.03.

913.01 ASPHALTIC MATERIALS FOR DAMPPROOFING AND WATERPROOFING.

913.01.01 Hot Applied Asphalt. D 449.

913.01.02 Cold Applied Asphalt. Meet the following when tested per MSMT 423, Procedure A. The material shall not contain isocyanide or any derivative of cyanide.

TEST and METHOD		SPECIFICATION LIMITS		
		GRADE I	GRADE II	GRADE III
R and B Softening Point T 53		104 – 143 F	145 – 170 F	172 – 200 F
Penetration, 0.10 mm, T 49	32 F, 200 g, 60 sec	10 min	5 min	5 min
	77 F, 100 g, 5 sec	30 – 100	25 – 50	20 – 40
	115 F, 50 g, 5 sec	100 min	130 max	100 max
Permeability, g/cm ³ , max, MSMT 423		0.09	0.09	0.09
Flow test, mm, max, MSMT 423		CC	20	15
Flexibility, 60 F, MSMT 423		No peeling or loss of adhesion		
Imperviousness Test, MSMT 423		No pitting or discoloration		
Sag test, MSMT 423		No movement		

Grade I— Suitable for below ground and horizontal applications.

Grade II—Suitable for below ground and above ground where surface temperatures do not exceed 120 F.

Grade III—Suitable for below ground and above ground where surface temperatures exceed 120 F.

913.01.03 Cold Applied Asphalt Emulsion. D 1227, Type II, using D 2939, modified by MSMT 423, Procedure B.

913.02 PRIMER FOR USE WITH ASPHALT FOR DAMPPROOFING AND WATERPROOFING. D 41.

913.03 FABRIC SATURATED WITH ASPHALT FOR USE IN WATERPROOFING. D 173.

913.04 DAMPPROOFING AND WATERPROOFING MEMBRANE.

The adhesive side of the membrane shall be protected with a special release paper that can be easily removed for installation. The membrane shall meet the following requirements:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Grab Tensile Strength, lb/in. @ 12 in./minute rate of loading, min	D 5034	70
Pliability, 180° bend, 1 in. mandrel @ 20 F	D 146	unaffected
Resistance to Puncture, lb min	E 154 (square mounting frame method)	40
Permeance, perm (kg/Pa · s · m ²), max	E 96, Method B	0.1
Weight, oz/yd ² min	D 3776	40
Primer	—	as specified by the manufacturer

Roll and sheet waterproofing membrane may be accepted on certification. The manufacturer shall furnish certification as specified in TC-1.03 with actual test results showing that the material meets these Specifications.

913.05 SHEET METAL FOR FLASHING. Shall be of the material and gauge specified.

913.05.01 Copper. B 152 for weight per square foot and gauge.

913.05.02 Galvanized Sheets. A 653, Coating Designation G 90.

SECTION 914 — CHAIN LINK FENCE

914.00 CERTIFICATION. The manufacturer shall furnish certification as specified in TC-1.03. A sample of the fence fabric shall be submitted with the fabric certification.

914.01 CHAIN LINK FENCING FABRIC. Fabric shall be 2 in. mesh woven from coated No. 6 gauge wire for 6 ft and 8 ft fence and No. 9 gauge wire for 5 ft fence unless otherwise specified. The ends shall have a knuckled selvage at the bottom and a barbed selvage at the top. The fabric shall conform to M 181. Type I fabric shall meet Class D coating. Vinyl coated steel shall meet F 668, Class 2B thermally fused. Vinyl color shall be warm gray or black as specified.

914.01.01 Fence Fabric for Super Silt Fence. Galvanized fabric for super silt fence shall meet 914.01, except that it shall be woven from No. 9 gauge wire having a Class C coating. The fabric shall be 42 in. high.

914.02 TIE WIRES, LINE POST CLIPS, TENSION WIRES, AND TENSION WIRE CLIPS. M 181. The galvanized coating shall have a minimum weight of 1.2 oz/ft². When used with aluminum coated steel fabric; these items shall be coated with aluminum at a minimum weight of 0.40 oz/ft². The tension wire used with polyvinyl chloride (PVC) coated steel fabric shall have the same coating thickness and color requirements as the fence fabric.

914.03 POSTS, BRACES, FITTINGS, AND HARDWARE. M 181. When specified to be PVC coated, these items shall be thermally fused and bonded. The PVC thickness shall be 10 to 15 mil except that bolts, nuts, and washers shall be metallic coated steel.

When opting to use round posts, the posts shall meet industry standards for Class 1 or 2.

914.04 GATES. The fabric used for gates shall be identical to the fencing fabric. The gate frame and other hardware shall meet 914.02 and 914.03. When the gate frame is PVC coated, movable fittings shall be field coated with a PVC coating specifically prepared for this purpose.

914.05 BARBED WIRE. A 121. The barbed wire shall be 12-1/2 gauge with four point round barbs at 5 in. spacing and Class 3 coating.

SECTION 915 — PRODUCTION PLANTS

915.01 GENERAL. These specifications are applicable to all batching and proportioning plants.

915.01.01 Approval. The plant from which the Contractor proposes to obtain material shall be approved by the Office of Materials Technology (OMT) before starting deliveries.

915.01.02 Lead Time. Notify OMT at least two working days prior to the start of operations. OMT shall be kept informed of plant operational procedures and be notified when a change is planned. Inspectors shall have safe access to all areas of the plant for the performance of their duties. All equipment, tools, machinery, and parts of the plant shall be maintained in a satisfactory working condition at all times.

915.01.03 Storage. The storage and handling of aggregates in stockpiles and bins shall be done in a manner that will prevent segregation, intermingling, and contamination by foreign material or equipment. Bins discharging to feeder systems shall be equipped with accessible calibrated devices to vary the quantity of material being fed.

915.01.04 Measuring Devices. Measuring devices shall meet the current edition of the National Institute of Standards and Technology Handbook 44, except as modified by Table 915. The producer shall provide all personnel and equipment for calibrating measuring devices.

Before the plant starts any proportioning operation, and at least once each year thereafter, all measuring devices, meters, dispensers, test weights, and other measuring devices shall be inspected, tested, and certified to be in proper operating condition by an approved testing agency. During the period of operation, all measuring devices, meters, dispensers, and other measuring devices shall be tested monthly and certified for accuracy and operating condition by the producer or an approved testing agency. Any weighing device by which materials are sold by weight as a basis of payment shall be tested monthly and certified by an approved testing agency. The Engineer shall be notified at least two working days in advance of monthly scale inspections. The certifications shall state capacities, minimum graduations, loads applied, degree of accuracy, and magnitude.

Balance and zero conditions of scales shall be checked daily, and at any other time requested by OMT. The Engineer may, at any time, direct that any measuring device be tested by the producer or an outside agency if there is any doubt about the accuracy of the measuring device. Certificates of inspection shall be posted in a prominent place in the plant, and a copy shall be promptly submitted to the Engineer.

Production plant tolerances shall meet the following table:

TABLE 915

MATERIAL	*MAINTENANCE TOLERANCE	UNIT OF MEASURE
Aggregate	0.2%	Weight
Portland Cement or Blended Hydraulic Cement of Ground Iron Blast Furnace Slag or Fly Ash	0.2%	Weight
Asphalt	0.2%	Weight or Volume
Water	1.5%	Weight or Volume
Additives	0.5%	Weight or Volume

* Maintenance tolerance shall be the specified percent of the total capacity of the scale or the smallest scale graduation, whichever is greater.

If during the monthly check, the measuring devices are found to deviate from the allowable tolerance, they will be suspended from use until recalibrated to the Specification requirements. A price adjustment will apply to materials sold and accepted by weight that are supplied during the measuring device malfunction period when the malfunction resulted in an overpayment. The measuring device malfunction period is defined as the elapsed time between the two successive monthly checks.

915.01.05 Sampling Equipment. The producer shall provide all personnel and equipment for obtaining samples from the last practical point prior to combination with other ingredients or introduction into the mixer. Sampling of liquid binder from HMA plants shall be from a tap located at the last practical, safe point, between the binder control unit and the plant (M 156 and D 140). Sampling shall meet Tables 1 and 2 of the MSMT Manual. The sampling equipment shall have a minimum capacity of 30 lb and be positioned in a manner that will provide an accurate representation of the material being furnished. When the size of the sample is too large to be transported, approved sample splitting devices shall be available at the point of sampling that will split the sample to no more than twice the proper testing size.

915.01.06 Quality Control Laboratory. At proportioning or batching plants the producer shall provide an on-site Administration approved laboratory suitable for conducting the various tests required. An off site laboratory requires approval of the Engineer. Continued approval of the laboratory and the testing personnel will be subject to periodic inspection

by the Administration. Any deficiencies shall be corrected to the satisfaction of the Engineer or the approval will be withdrawn.

915.02 HOT MIX ASPHALT (HMA) PLANTS. Meet M 156, and equipped with Automatic Batching and Recording of Batching, except as modified in 915.01 and the following:

- (a) **Dryer.** The fuel used for drying aggregates shall be compatible with the plant manufacturer's recommendations.
- (b) **Hot Aggregate Bins.** New plants shall meet M 156.
- (c) **Mixer Unit for Batch Method.** Minimum dry and wet mixing times shall be 5 seconds and 15 seconds, respectively.
- (d) Truck scale weighing shall meet the National Institute for Standards and Technology (NIST), except as follows:
 - (1) A plant summary shall be kept by the producer showing the Contract number, truck identification (ID) number, ID of the type of mix being produced, the number of truck loads, and the total tons of mix.
 - (2) The producer shall supply a delivery ticket with the ID number, Contract number, ID of the type of mix, date, truck ID number, time loaded, gross and tare weights, and net weight of the mix for each load. When requested by the Engineer, the temperature of the mix shall be shown on the delivery ticket.
- (e) **Automatic Weighing and Printout.** The producer shall use an approved plant automatic weighing and printing system. A printed delivery ticket for each load shall be provided with the cumulative total weighed into the truck, Contract number, time loaded, I.D. of the type of mix, and net weight of mix. When requested by the Engineer, the temperature of the mix shall be shown on the delivery ticket. The temperature may be handwritten.
- (f) **Hauling Units.** Transport the mixture to the work site in units previously cleaned of all foreign material, and with the contents of each load completely covered with suitable material of sufficient size to protect it from the weather. Each unit shall have convenient access from ground level to insert thermometers to determine mix temperature.

Treat the inside surface of all hauling units with an approved release agent that will not contaminate or alter the characteristics

of the mixture. Petroleum derivatives are prohibited. Approval will be based on results from tests performed per MSMT 414.

- (g) Drum mixer plants shall be calibrated per MSMT 453 and approved. A monitoring station for the purpose of controlling the entire operation shall be provided. If any part of this control system fails, an alternative control system approved by the Engineer may be used for a maximum of two working days.

The producer shall determine the moisture content of all aggregates per MSMT 251.

915.02.01 Certified Hot Mix Asphalt (HMA) Plant. The producer is responsible for quality control of plant operations to ensure that the material meets Specifications. The quality control process will be subject to unannounced periodic inspection by representatives of the Engineer when Administration projects are in progress. The plant's certified technician shall fully participate in the inspections.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specifications. The Administration will accept certification by a professional engineer registered in the State of Maryland that the plant facilities meet all applicable Specifications; however, final acceptance will be determined by the Administration.

Responsibilities of the HMA Producer.

- (a) **Notification.** Notify the Engineer one working day prior to producing materials for Administration projects. Report total tons shipped to Administration projects one business day of completed daily shipments.
- (b) **Quality Control.** The minimum sampling and testing frequencies and criteria necessary for quality control of the HMA is the responsibility of the producer. Develop and use a quality control plan acceptable to the Engineer that addresses all elements necessary for quality control in the plant.

Conduct the minimum sampling and testing as specified in MSMT 735, Table 2. Additional sampling and testing shall be performed when directed. The Engineer shall be offered the opportunity to witness all sampling and testing.

- (c) **Reports.** The test results shall be furnished to the Engineer on documents approved by the Administration.

Responsibilities of the Administration.**(a) Split Samples to Evaluate the Effectiveness of the Plant Quality Control Operation.**

A minimum of once during five days of plant shipments that require behind the paver Quality Assurance (QA) mixture box samples, a required QA sample shall be properly split and used to evaluate the effectiveness of the plant Quality Control (QC) operation. The plant QC operation shall test and submit results to the Administration in accordance with MSMT 735, Table 2, within 48 hours after receiving and properly splitting the sample.

(1) Effective Plant Quality Control Operation. When QC and QA split sample results compare within AASHTO Acceptable Range of Two Test Results, Multi-Laboratory Precision parameters for binder content and percent passing the #4, #8, and #200 gradation sieves, the QC operation will be evaluated as effective.

(2) Ineffective Plant Quality Control Operation. When QC and QA split sample results do not compare within AASHTO Acceptable Range of Two Test Results, Multi-Laboratory Precision parameters for all the indicated tests, the QC operation will be evaluated as ineffective. Three consecutive ineffective evaluations will be cause to discontinue shipments to Administration projects. An investigation will be conducted to determine the cause of the differences. After a cause is determined and three consecutive split samples are within the precision parameters, the QC operation will be re-evaluated as effective and shipments may resume. If the plant QC operation disagrees with the Administration's decision, the dispute may be resolved as specified in (e) below.

(b) Recertification of HMA Plant. Documentation of corrective action shall be submitted to the Engineer by a professional engineer registered in the State of Maryland. When this documentation is approved, a comprehensive inspection will be conducted to recertify the HMA plant.

(c) Independent Assurance Audits (IAA). The Administration will evaluate the proficiency and equipment of QC/QA Technicians through audits performed on a random basis as outlined in the Quality Assurance Manual. The technician being audited shall cooperate with the IAA Technician in the evaluation of their proficiency and equipment.

- (d) **Technician Certification.** Per MSMT 731 and the Mid-Atlantic Region Technician Certification Program (MARTCP).
- (e) **Dispute Resolution System.** This is a general procedure to resolve conflicts resulting from discrepancies between test results from the Engineer and producer, and nontest related disputes of sufficient magnitude to impact payment.

When a dispute arises, the producer or Engineer will file a written complaint to the Chief Engineer describing the nature of the dispute along with the pertinent information. The Chief Engineer will appoint a panel of three members to resolve the conflict. The panel will include a member selected by the asphalt industry. The panel will make recommendations to the Chief Engineer. The Chief Engineer will decide the disposition of the dispute based on the panel's recommendations.

A written report from the panel describing all subsequent actions and final disposition of the dispute shall be included in the project records.

If subsequent disputes arise on the same issue, the written report will be included as a resource during the resolution process.

915.03 PORTLAND CEMENT CONCRETE PLANTS. M 157, except as modified herein, including the applicable requirements of 915.01.

915.03.01 Storage of Aggregate. Coarse and fine aggregate for use in portland cement concrete shall be maintained at a uniform moisture content in excess of its saturated surface dry condition. Water added for this purpose shall meet 921.01.

915.03.02 Temperature of Water and Cement. The plant shall be equipped with approved methods of heating and cooling the mix. The temperature of the plastic concrete shall meet 902.10.03. The temperature of the cementitious materials and the mixing water at the time they are used in the mix shall not exceed 170 F.

915.03.03 Load Tickets. An Administration approved computer generated batch ticket indicating the pertinent information per M 157 shall be provided in duplicate for each load. The ticket shall indicate maximum allowable water, and maximum water allowed for jobsite slump adjustment. Distribution shall be made as specified in 915.03.05 (c)(2). The producer's copy shall be readily available for inspection upon request by the Engineer. A completed Administration

Form 116 shall be issued for each load in the event a computer generated batch ticket cannot be provided.

915.03.04 Mixers and Agitators. The requirements for mixers and agitators and for mixing and delivery of ready mixed concrete shall conform to M 157 with the following exceptions:

- (a) During transit, operate drums at agitating speed only. Mixing during transit is prohibited.
 - (1) At least 85 percent of design water requirement shall be added at the plant through the certified plant water meter.
 - (2) Water for slump adjustment may be added at the plant through the Administration approved truck water system under the supervision of the certified concrete technician, provided the maximum specified water/cement ratio is not exceeded.
 - (3) A maximum of 3 gal of water per cubic yard of concrete may be added at the job site provided the maximum specified water/cement ratio is not exceeded.
 - (4) Adding water after partial discharge of the load is prohibited.
- (b) Loading of mixers or agitators that contain wash water in the drum is prohibited.
- (c) When the concrete is specified or permitted to be made by volumetric batching and continuous mixing, the batching and mixing unit shall meet C 685. Calibration shall meet MSMT 558.

Where no mixer performance tests are made for stationary mixers, the minimum mixing time is 75 seconds.

915.03.05 Certified Concrete Plant. The producer shall be responsible for quality control of plant operations to ensure that the material meets Specification requirements. The quality control process will be subject to unannounced periodic inspection by OMT. Full participation in the inspection by the plant's certified technician will be required.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specification requirements. The Administration will accept certification, by a professional engineer registered in the State of Maryland, that the plant facilities meet all applicable Specification requirements. However, final acceptance will be determined by the Administration.

Responsibilities of the Concrete Producer.

- (a) **Notification.** Notify OMT one working day prior to producing materials for Administration projects.
- (b) **Quality Control.** Have the certified concrete plant technician present while concrete is being batched and delivered to the project. This technician shall supervise concrete production.
- (1) Develop and use an acceptable Quality Control Plan that addresses all elements necessary for quality control in the plants.
 - (2) Control tests shall be performed by the certified concrete plant technician. This technician shall perform moisture tests, adjust proportions of aggregate for free moisture, complete and sign batch or approved delivery tickets, and ensure quality control of the batching operations.
 - (3) Technician certification will be awarded upon satisfactory completion of examinations administered by the Administration per MSMT 560.
 - (4) Supply all necessary test equipment.
 - (5) Sample frequency shall meet the MSMT Frequency Guide, Table 1.
- (c) **Reports.** The following reports shall be processed by the producer:
- (1) Administration Form 113, daily, stating that the material was sampled and tested in accordance with the Administration's sampling and testing guidelines and complies with the applicable Specifications. Make a distribution to the producer's file and Administration's Laboratory.
 - (2) Administration Form 116, for each load. Make a distribution to the project file and producer's file.
 - (3) Administration Forms for all concrete materials sampled at the plant per MSMT Frequency Guide, Table 1.
 - (4) Test Worksheet, daily, for all tests performed at the plant.

Responsibilities of the Administration.**(a) Comprehensive Inspection.****(b) Acceptance Inspection and Testing.**

(1) If deficiencies are found during an Administration inspection, the producer will be notified immediately to correct the deficiencies to the satisfaction of the Engineer. Production will be suspended for critical deficiencies.

(2) If consecutive inspections reveal identical deficiencies, or if additional deficiencies are found, the producer will be notified that a reinspection will be held in two production days. All deficiencies shall be corrected by the reinspection date.

(3) If reinspection fails, the OMT will assign an Inspector to monitor plant operations for a maximum of five Administration production days. If at the end of this period the quality control process is not satisfactory, plant approval will be rescinded and the plant shall be recertified before Administration production will be continued.

(4) Recertification of Concrete Plant. Documentation of corrective action shall be submitted to the OMT by a professional engineer registered in the State of Maryland. When this documentation is approved by the Engineer, a comprehensive inspection will be conducted to recertify the concrete plant.

(c) Independent Assurance Audits (IAA). The Administration will evaluate the proficiency and equipment of QC/QA Technicians through audits performed on a random basis as outlined in the Quality Assurance Manual. The Technician being audited shall cooperate with the IAA Technician in the evaluation of their proficiency and equipment.

(d) Technician Certification per MSMT 560.

915.03.06 Moisture Probes. Moisture probe readings may be used in place of actual daily moisture testing of fine aggregate. When used, moisture probes shall be calibrated and maintained per the manufacturer's recommendations. Actual moisture tests for the fine aggregate shall be performed weekly and as directed. When the actual tests of the fine aggregate indicate a difference of greater than 0.5 percent free moisture than that of the moisture probe readings, a second actual test shall be performed immediately. When the second test indicates a moisture

difference of greater than 0.5 percent, then the moisture probe shall be recalibrated per the manufacturer's recommendations and verified. Records of all calibrations and weekly tests shall be maintained and made available to the Engineer.

915.04 BASE COURSE PLANTS.

915.04.01 Nonstabilized. Base course plants producing graded aggregate base material without a stabilizing agent shall meet 915.01, 915.04.03, and the following:

- (a) The material is produced in a processing plant using an approved aggregate source.
- (b) The Quality Control Plan shall be submitted to and approved by the OMT prior to production.
- (c) The production shall meet the gradation requirements of the approved job mix formula.
- (d) The required moisture content shall be maintained prior to shipment.
- (e) Stockpiles shall be maintained to prevent segregation.
- (f) Frozen aggregates shall not be used.
- (g) Mixed material shall be handled and transported in a manner that will minimize segregation and the loss of moisture. All loads shall be covered in accordance with State laws unless hauling is off road and approved by the Engineer.

915.04.02 Stabilized. Stabilized base course plants shall meet 915.01, 915.04.03, and the following:

- (a) Mechanical mixers shall be used, as approved. All plants shall be equipped with automatic cutoff devices interlocked so the plant will stop operating if delivery of any component of the mix fails.
- (b) The amount of stabilization shall be determined per MSMT 254.
- (c) The charge in a batch mixer or rate of feed to a continuous mixer shall not exceed that which will permit complete mixing of all materials.
- (d) Mixed materials shall be handled and transported in a manner that will minimize segregation and loss of moisture or volatiles. All

loads shall be covered in accordance with State laws unless hauling is off road and approved by the Engineer.

- (e) When cement is used as a stabilizing agent, the amount of water added at the plant shall be controlled to obtain a uniform mixture that meets the required density.
- (f) When emulsified asphalt is used as a stabilizing agent, all aggregate shall contain moisture in excess of the saturated surface dry condition at time of mixing.

915.04.03 Certification of Base Course Plants. The quality control and condition of all materials used in base courses, as well as all necessary adjustments required in using the materials, is the responsibility of the base course producer. The quality assurance process will be subject to unannounced periodic inspection by representatives of the OMT when Administration projects are in progress. The plant's certified technician shall participate in the inspection.

Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specification requirements. After the initial inspection the plant shall meet 915.01.04. The Administration will accept certification by a professional engineer registered in the State of Maryland that the plant facilities meet all applicable Specification requirements. However, final acceptance will be determined by the Administration.

Responsibilities of the Base Course Producer.

- (a) **Notification.** Notify the OMT one working day prior to producing materials for Administration projects.
- (b) **Quality Control.** The producer is responsible for quality control of plant operations to ensure that the material meets Specification requirements. All producers supplying base courses shall have a certified base course plant technician present while base course material is being plant mixed and delivered to the project. This technician shall supervise base course production.
 - (1) Control tests shall be performed by a certified base course plant technician. This technician shall obtain samples and test per MSMT Frequency Guide, Table 1 and 2.
 - (2) Technician certification will be awarded upon satisfactory completion of an examination given by the Administration in per MSMT 562. The certification shall be as follows:

Applications for certification shall be obtained from OMT a minimum of 30 days prior to producing material for the Administration.

OMT will contact the producer and schedule an examination based on AASHTO and MSMT procedures and knowledge of the Administration's base course plant reports and documentation.

Upon satisfactory completion of the examination, a certificate will be issued.

- (3) Supply all necessary test equipment and provide on-site facilities suitable for conducting the required tests. Off-site test facilities require approval of OMT.
- (c) **Reports.** The following reports shall be processed by the producer:
- (1) Administration Form MD SHA Form 43, daily, stating that the material was sampled and tested using the Administration's sampling and testing guidelines and meets the applicable Specifications. Distribution to the Administration's Laboratory and producer's file.
 - (2) Administration Form MD SHA Form 88, for all additives introduced at the plant, frequency in accordance with Table 2. Make a distribution to the producer's file and Administration's Laboratory.
 - (3) Daily Plant Certification Form showing that a technician was on duty at the plant. Make a distribution to project file and producer's file.
 - (4) Test Worksheet, daily, for all tests performed at the plant.
 - (5) Base course plant checklist daily. Make a distribution to producer's file.

Responsibilities of the Administration.

(a) Comprehensive Inspection.

(b) Acceptance Inspection and Testing.

- (1) If deficiencies are found, as defined in the base course plant checklist during an acceptance inspection, the producer will be

notified immediately and operations will be suspended if corrections are not made to the satisfaction of the Engineer.

- (2) If on consecutive inspections identical deficiencies are found, the producer will be notified that a reinspection will be held in two Administration production days. All deficiencies shall be corrected by the reinspection date. OMT will determine whether plant certification will be revoked.
- (c) **Independent Assurance Audits (IAA).** The Administration will evaluate the proficiency and equipment of QC/QA Technicians through audits performed on a random basis as outlined in the Quality Assurance Manual. The technician being audited shall cooperate with the IAA Technician in the evaluation of their proficiency and equipment.
- (d) **Recertification of Aggregate Base Course Plant.** Documentation of corrective action shall be submitted by a professional engineer registered in the State of Maryland. When this documentation is approved, a comprehensive inspection will be conducted to recertify the base course plant.
- (e) **Technician Certification.** Per MSMT 562.

915.05 CERTIFIED PRECAST CONCRETE PLANTS. All plants producing precast concrete items shall be certified by the National Precast Concrete Association. The producer is responsible for quality control plant operations to ensure that the material meets Specifications. The quality control process will be subject to unannounced periodic inspection by representatives of the Concrete Technology Division. The plant's certified technician shall fully participate in the inspections.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether plant equipment and personnel meet all applicable Specifications and that suitable testing facilities will be available. The Administration will accept certification by a professional engineer registered in the State of Maryland that the plant facilities meet all applicable Specifications; however, final acceptance will be determined by the Administration.

915.05.01 Responsibilities of the Precast Concrete Producer.

- (a) **Notification.** Notify the Engineer at least two working days prior to producing materials for Administration projects.
- (b) **Quality Control Procedures.** Quality control procedures shall include the following:

- (1) Sampling and testing per Tables 1, 2, and 3 of the MSMT Sample Frequency Guide.
 - (2) The method of inspecting reinforcement steel placement and forms prior to pouring concrete.
 - (3) The method of curing the concrete.
 - (4) The method of maintaining accurate quality control records.
 - (5) Samples of documents approved by the Engineer.
 - (6) Patching procedures.
 - (7) Methods of preparing the concrete units for shipment.
 - (8) A method of identifying each piece as tested and approved by quality control.
- (c) **Quality Control Plan.** Submit a Quality Control Plan prior to the start of production. The plan shall indicate the following:
- (1) All precast concrete products shall meet the Standards or approved working drawings. All materials shall be from an Administration approved source and meet all applicable Specifications.
 - (2) The plan shall indicate how the producer intends to handle all of its materials. Certification of materials shall be as specified in the MSMT Sample Frequency Guide.
 - (3) The names, qualifications, and responsibilities of a Quality Control Manager and a Quality Control Technician.
- (d) **Quality Control Technician.** The Quality Control Technician may be approved if certified from at least one of the following:
- (1) The Precast/Prestressed Concrete Institute Plant Certification Program, PCI Technician Level I, minimum.
 - (2) American Concrete Institute, ACI Field Technician Level I.
- (e) **Test Equipment and Facilities.** Supply all necessary test equipment and provide Administration approved facilities suitable for conducting the various tests required. Off site test facilities shall be approved by the Engineer.

915.05.02 Responsibilities of the Administration.**(a) Comprehensive Inspection.****(b) Verification Testing.**

- (1) Verification of certification will be performed a minimum of once per year at the discretion of the Administration.
- (2) The Administration reserves the right to discontinue acceptance of precast units if its verification indicates that materials or test procedures do not meet the Contract Documents.

SECTION 916 — SOIL AND SOIL-AGGREGATE BORROW

916.01 BORROW EXCAVATION. A soil or soil aggregate mixture meeting the following:

Maximum dry density and optimum moisture content of the material per T 180, Method C unless the material has more than 35 percent retained on the No. 4 sieve, in which case Method D shall be used. Material with a maximum dry density of less than 100 lb/ft³ is unsatisfactory and shall not be used in embankments unless otherwise specified in the Contract Documents. Potentially expansive materials, such as steel slag, are prohibited.

Recycled portland cement concrete or recycled HMA pavement may be used as common, select, and modified borrow with the written approval of the Engineer. Recycled portland cement concrete, recycled HMA pavement, and processed contaminated soil are prohibited for use within 1 ft of the surface in any area to be vegetated. All recycled or rehandled materials shall meet Section TC-6.10.

916.01.01 Select Borrow. A-2, A-3, or A-2-4 material as specified in the Contract Documents. The maximum dry density shall not be less than 105 lb/ft³.

916.01.02 Capping Borrow. Meet the select borrow requirements except when A-3 material has less than 10 percent retained on the No. 10 sieve, at least 15 percent shall pass the No. 200 sieve. Determine sieve analysis using T 88.

916.01.03 Modified Borrow. A minimum of 50 percent retained on the No. 4 sieve, a maximum liquid limit of 30 using T 89, and a maximum plasticity index of 9 using T 90. The maximum dry density shall not be less than 125 lb/ft³. A-5 material, as defined in the Contract Documents is prohibited.

916.01.04 Common Borrow. A maximum dry density of not less than 100 lb/ft³.

SECTION 917 — MISCELLANEOUS PROTECTIVE COATINGS

917.01 EPOXY PROTECTIVE COATINGS FOR CONCRETE. The protective coatings shall be two component epoxy systems for use in conjunction with concrete. One component shall be a clear or pigmented condensation product of the reaction of epichlorohydrin with bisphenol A, the resin of which shall be composed of 100 percent reactive constituents. The other component shall be a clear polyamide hardener.

The producer shall submit a sample of each component for laboratory analysis. The sample shall be coded as the original sample. The original and all subsequent samples shall meet the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Pot Life, hr min	Fed. Spec TT-C-535	8
Color	Fed. Std. 595	Gray No. 26440
Dry Film Thickness 1st coat, mil min 2nd coat, mil min	D 1005	2 3
Sagging	D 4400	Shall pass test for Recommended Film Thickness
Flexibility	Federal Spec TT-P-115	Shall not crack, check or delaminate
Infrared Spectrogram	Equipment Manufacturer's Procedure	Each component shall match original sample
Tensile Strength, psi min	MSMT 609	400

917.02 FUSION BONDED EPOXY POWDER COATINGS FOR STEEL. M 284. A one-coat, heat curable, thermosetting powdered coating that is electrostatically applied on metal surfaces as specified in the Contract Documents. For reinforcement steel, the color shall be bright, in order to contrast with the normal color of reinforcement and rust (e.g. orange, red, green, yellow etc. and not brown or any color in the rust family). If reinforcement steel is coated before fabrication, all hairline cracks and minor damage on fabrication bends shall be patched, even if there is no bond loss. The epoxy coating material shall be selected from the pre-qualified materials list maintained by the Office of Materials Technology.

917.02.01 Touch Up System. Material used for the touch up system shall be a two part epoxy system designated and color matched for patching the epoxy coating used.

Patching material shall be available through the manufacturer of the epoxy powder. The patching material shall be fully cured one hour after application at 35 F ambient.

917.02.02 Certification. The manufacturer shall furnish certification as specified in TC-1.03.

917.03 FUSION BONDED POLYESTER POWDER.

917.03.01 Materials. The polyester powder shall be a super durable TGIC (Triglycidyl Isocyanurate) polyester meeting 917.03.05. The polyester powder shall be selected from the prequalified materials list maintained by the Office of Materials Technology.

Material used for the touch up system shall be a two component aliphatic polyurethane meeting 912.04.02, and color matched for patching the polyester coating used. The coating thickness of the touch up material shall be the same as the thickness of the polyester and can be applied in multiple coats.

917.03.02 Cleaning and Coating. Cleaning and coating shall be performed in an environmentally controlled plant that is fully enclosed and approved by the Administration.

All items to be coated shall be free of any oil or grease, and shall be abrasive blasted to Near White per SSPC SP-10. Cleaned surfaces shall be protected from high humidity, rainfall and surface moisture, and shall not be allowed to flash rust. The blast profile shall be 2 to 3 mils as determined per D 4417, Method C.

The thickness of the cured coating shall be 7 ± 2 mils when measured per D 1186.

The cured coating shall have a pencil hardness of 2H when tested per D 3363.

The color of the coating shall match the Federal Standard 595 color number specified in the Contract Documents.

Using a 67-1/2 volt wet sponge detector, the polyester coating shall be checked for holidays, pinholes, and discontinuities. There shall be no more than one deficiency per 5 ft².

917.03.03 Acceptance. The acceptance of a polyester powder will be based on the quality control test results required on the manufacturer's certification. The coating applicator is responsible for reviewing certifications to ensure meeting 917.03.04. The coating applicator shall maintain a file of all reviewed certifications.

917.03.04 Certification. The polyester powder manufacturer shall furnish production batch certification as specified in TC-1.03 showing that the material meets the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Infrared Spectrogram	D 2621	Match prequalification sample
Taber Abrasion Resistance, mg loss, max	D 4060	100
Specific Gravity	D 5965 (Method A)	Prequalification sample \pm 0.02
Color	E 1331 or E 1338	Match Fed. Std. 595 color no. specified in Contract Documents

917.03.05 Polyester Prequalification Requirements. The following physical tests will only be required to prequalify the polyester, and will not be required for certification:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Abrasion Resistance	Taber Abraser CS-10, 1000 gm load, 1000 cycles, D 1044	100 mg max weight loss
Adhesion	D 3359, Method A (Bonderite 1000 panel)	Rating 5A
Gloss	D 525, 60° initial	30 - 45 per Fed. Std 595
Hardness	D 3363	Min 2H - No gouge
Impact	D 2794	Pass 80 in.·lb
Salt Spray Resistance	B 117, D 1654 1000 hr (Bonderite 1000 panel)	Table 2, Rating 7
Thickness	G 12	7 ± 2 mils
Color	E 1331 or E 1338	As specified in the Contract Documents from Fed. Std. 595 Color No. 20040
Infrared Spectrogram	Equipment manufacture's procedures	Manufacturer's IR
Weather Resistance	D 4587, test condition D Test shall be conducted with a UVA lamp (340 nm peak) for 1000 hr	50 % min gloss retention
Specific Gravity	D 5965	Manufacturer's result

917.04 DUPLEX ZINC-POLYESTER POWDER COATING SYSTEM.

917.04.01 Materials.

Organic Zinc Rich Paint	912.02.03
Fusion Bonded Polyester Coating and Touch Up System	917.03
Hot Dip Galvanized Zinc	A 123 and A 153

This duplex system consists of a cathodic zinc layer applied by either the hot dip galvanizing process, or the application of an organic zinc rich paint and a barrier layer of polyester powder coating.

Prior to application of a duplex system, the applicator shall have demonstrated the ability to properly apply and cure the materials of the system.

Material used for the touch up system shall be a two component aliphatic polyurethane meeting 912.04.02, and color matched for patching the polyester coating used. The coating thickness of the touch up material shall be the same as the thickness of the polyester and can be applied in multiple coats.

917.04.02 Cleaning and Coating. Cleaning and coating shall be performed in an environmentally controlled plant that is fully enclosed and approved by the Administration.

(a) Zinc Coating.

- (1) Hot Dip Galvanized Method.** When a polyester powder is to be applied over hot dip galvanizing, the galvanized surface shall be prepared by solvent cleaning per SSPC SP-1, followed by brush off blast cleaning using grit per SSPC SP-7. The blast profile shall be 2 to 3 mils as determined per D 4417, Method C. When the blast cleaning exposes bare steel, the bare steel shall be spot primed with an organic zinc rich coating. The polyester powder shall be applied within 24 hours of surface preparation. The cured polyester powder shall meet the requirements of (b).
- (2) Organic Zinc Rich Paint Method.** When a polyester powder is to be applied over an organic zinc rich paint, they shall be applied in a continuous operation. The surface shall be prepared by solvent cleaning per SSPC SP-1, followed by abrasive blast cleaning using grit to a condition per SSPC SP-10, Near White. The blast profile shall be 2 to 3 mils as determined per D 4417, Method C. The organic zinc rich paint shall be fully cured prior to application of the polyester powder. The thickness of the organic zinc rich paint shall be 3 to 5 mils as determined per D 1186.

- (b) Polyester Coating.** The thickness of the polyester coating shall be 5 to 9 mils for methods (a) (1) and (2) when measured per D 1186. The cured coating shall have a pencil hardness of 2H when tested per D 3363.

Material used for the touch up system shall be a two component aliphatic polyurethane meeting 912.04.02, and color matched for patching the polyester coating used. The coating thickness of the touch up material shall be the same as the thickness of the polyester and can be applied in multiple coats.

The color of the coating shall match the Federal Standard 595, color number as specified.

Using a 67-1/2 volt wet sponge detector, the polyester coating shall be checked for holidays, pinholes, and discontinuities. There shall be no more than one deficiency per 5 ft².

917.04.03 Acceptance. Organic zinc rich paint 912.01.03. Polyester powder 917.03.03. Hot dip galvanized zinc shall be based on inspections per A 123, A 153, and the Contract Documents.

917.04.04 Certification. Polyester powder 917.03.04. Organic zinc rich paint 912.02.03.

917.05 PAINT SYSTEM FOR NEW GALVANIZED STRUCTURES.

917.05.01 Materials. All paint within the paint system shall be from the same manufacturer. The manufacturer shall be on the list of Approved Paint Manufacturers maintained by the Office of Materials Technology. The paint shall meet the following:

Primer Coat	912.03.02, 2 to 5 mils
Finish Coat	912.04.02, 2 to 4 mils
Color	Federal Standard 595
Brown	Color No. 20040
Black	Color No. 27038
Green	Color No. 24108

917.05.02 Cleaning and Coating. Shall be performed in an environmentally controlled plant that is fully enclosed and approved by the Administration.

917.05.03 Surface Preparation. New galvanized steel shall not have been water or chromate quenched. The surface shall be solvent cleaned per SSPC SP-1 using a nonresidue solvent and a lint free cloth. The surface shall then be brush off blasted per SSPC SP-7 using grit. Damaged areas shall be repaired per A 780. If repair is made using an organic zinc rich primer, the primer shall meet 912.02.03.

917.05.04 Paint Application. If application of primer does not immediately follow the brush off blasting, each item shall be stored in an environment free of moisture and dust. The primer shall be applied per the manufacturer's recommendations within 12 hours of brush off blasting.

After the primer has properly cured, the finish coat shall be applied per the manufacturers' recommendation.

917.05.05 Acceptance. The finished painted surface shall be holiday free when tested with a low voltage holiday detector (minimum 30 volts), using tap water. If holidays are detected, the coatings may be repaired with additional coatings per A 780 or they may have the paint stripped and recoated at no additional cost.

SECTION 918 — TRAFFIC BARRIERS

918.00 CERTIFICATION. The manufacturer shall furnish certification as specified in TC-1.03.

918.01 TRAFFIC BARRIER W BEAM. M 180, Type II or IV for rail elements and end treatments. In lieu of galvanizing, rail elements may be coated with a minimum of 5 mil dry film thickness of inorganic zinc rich primer meeting 912.02.01. The primer shall be applied as specified in Section 435 after the rail elements are fabricated.

918.02 TRAFFIC BARRIER POSTS. M 183 for steel and M 111 for galvanized coating. In lieu of galvanizing, posts may be coated with a minimum of 5 mil dry film thickness of inorganic zinc rich primer meeting 912.02.01. The primer shall be applied as specified by the manufacturer after the posts are fabricated.

918.03 HARDWARE FOR TRAFFIC BARRIERS. M 183 for quality of steel and M 232 for galvanized coating.

918.04 TIMBER RAIL AND POSTS. M 168.

918.05 WIRE ROPE. Federal Specification RR-W-410, Type I, General Purpose, Class 2, 6 by 19, improved plow steel, fiber core. The individual wire strands shall have a zinc coating of 0.8 oz/ft² when tested per T 65.

SECTION 919 — RESERVED

SECTION 920 — LANDSCAPING MATERIALS

920.01 SOILS. Topsoil, Subsoil, and Bioretention Soil Mix shall conform to requirements of this section. Soils shall be sampled, tested and approved per specifications of MSMT 356 by the Soils and Aggregates Technology Division of the Office of Materials Technology, or by other approved tests or laboratories. Soils shall be amended as specified by the Nutrient Management Plan (NMP).

920.01.01 Salvaged Topsoil. The surface material classified as topsoil that is removed from the project and stored for reuse. Salvaged topsoil shall conform to the following:

COMPOSITION - SALVAGED TOPSOIL					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Prohibited Weeds	—	Free of seed or viable parts of shattercane, Johnsongrass, Canada thistle, bull thistle, plumeless thistle, musk thistle, and common reed when inspected before transportation.			
Debris	—	1.0 % or less by weight of cement, concrete, asphalt, crushed gravel or construction debris when inspected.			
Grading Analysis	T 87	Sieve Size		Passing by Weight Minimum %	
		2 in.		100	
		No. 4		90	
		No. 10		80	
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	20	75
		Silt	0.050 – 0.002	10	60
		Clay	less than 0.002	5	30
Soil pH	D 4972	pH of 4.8 to 7.4. Apply limestone to soil with pH 4.8 to 6.1 per NMP. Apply sulfur or iron sulfate to soil with pH 7.1 to 7.4 per NMP.			
Organic Matter	T 194	1.0 to 8.0 % OM by weight. Apply compost to soil with 1.0 to 1.7% OM per NMP to achieve at least 2.0% OM.			
Nutrient Content	Mehlich-3	Administration will assess. Apply fertilizer per NMP for nitrogen requirement and optimum fertility index values (FIV) for phosphorus and potassium.			
Soluble Salts	EC1:2 (V:V)	800 ppm (1.25 mmhos/cm) or less. Apply gypsum to soil with 500 to 800 ppm (0.78 to 1.25 mhos/cm) per NMP.			
Harmful Materials	—	Shall not contain substances in concentrations that are harmful to human health, water quality, or plant growth. Industrial waste such as ash, slag, raw sludge, dredge spoil, or similar materials shall not be soil components.			

920.01.02 Furnished Topsoil. A natural, friable, surface soil that is uniform in color and texture, and not derived from the project.

Furnished topsoil shall conform to the following.

(a) Composition.

COMPOSITION - FURNISHED TOPSOIL		
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT
Prohibited Weeds	—	Free of seed and viable parts of species in 920.01.01, and viable parts of Bermudagrass, quackgrass, and yellow nutsedge.
Debris	—	920.01.01
Grading Analysis	T 87	920.01.01
Textural Analysis	T 88	920.01.01
Soil pH	D 4972	pH of 5.2 to 7.4. Apply limestone to soil with pH 5.2 to 6.1 per NMP. Apply sulfur or iron sulfate to soil with pH 7.1 to 7.4 per NMP.
Organic Matter	T 194	920.01.01
Nutrient Content	Mehlich-3	920.01.01
Soluble Salts	EC1:2 (V:V)	500 ppm (1.25 mmhos/cm) or less.
Harmful Materials	—	920.01.01

(b) Storage. Soil shall be a homogenous mixture stored at a specific, identifiable site in a stockpile constructed as specified in 308.03.28 and 701.03.02(c).

(c) Approval. Ensure that Form 27B has been completed and that a source of supply letter for the soil has been submitted and approved. Tests shall be completed and approval granted before soil is delivered.

(d) Certification and Delivery. Certification shall be submitted that the soil is delivered from an approved stockpile. Certification shall accompany the first load of soil delivered each day.

920.01.03 Salvaged Subsoil. The subsurface material classified as subsoil that is removed from the project and stored for reuse. Salvaged subsoil shall conform to the following:

COMPOSITION - SALVAGED SUBSOIL					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Prohibited Weeds	—	920.01.01			
Debris	—	5.0 % or less by weight of cement, concrete, asphalt, crushed gravel or construction debris when inspected.			
Grading Analysis	T 87	Sieve Size		Passing by Weight Minimum %	
		2 in.		100	
		No. 4		85	
		No. 10		60	
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	20	85
		Silt	0.050 – 0.002	10	60
		Clay	less than 0.002	5	40
Soil pH	D 4972	pH of 4.5 to 7.4.			
Organic Matter	T 194	0.1 to 5.0 % by weight.			
Soluble Salts	EC1:2 (V:V)	1000 ppm (1.56 mmhos/cm) or less.			
Harmful Materials	—	920.01.01			

920.01.04 Furnished Subsoil. A natural subsurface soil that is uniform in texture and not derived from the project. Furnished subsoil shall conform to the following:

- (a) Composition.

COMPOSITION - FURNISHED SUBSOIL		
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT
Prohibited Weeds	—	920.01.01
Debris	—	920.01.03
Grading Analysis	T 87	920.01.03
Textural Analysis	T 88	920.01.03
Soil pH	D 4972	920.01.03
Organic Matter	T 194	920.01.03
Soluble Salts	EC1:2 (V:V)	700 ppm (1.09 mmhos/cm) or less
Harmful Materials	—	920.01.01

(b) Storage. 920.01.02(b).

(c) Approval. 920.01.02(c).

(d) Certification and Delivery. 920.01.02(d).

920.01.05 Bioretention Soil Mix (BSM). A homogeneous mixture composed by loose volume of 5 parts Coarse Sand, 3 parts Base Soil, and 2 parts Fine Bark. BSM shall conform to the following:

(a) Components. Components of BSM shall be sampled, tested and approved before mixing as follows:

(1) Coarse Sand. MSMT 356. Coarse Sand shall be washed silica sand or crushed glass that conforms to ASTM Fine Aggregate C-33. Coarse Sand shall include less than 1% by weight of clay or silt size particles, and less than 5% by weight of any combination of diabase, greystone, calcareous or dolomitic sand.

(2) Base Soil. Base Soil shall be tested and certified by the producer to conform to the following requirements:

COMPOSITION - BASE SOIL					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Prohibited Weeds	—	Free of seed and viable plant parts of species in 920.06.02(a)(b)(c) when inspected.			
Debris	—	No observable content of cement, concrete, asphalt, crushed gravel or construction debris when inspected.			
Grading Analysis	T 87	Sieve Size		Passing by Weight Minimum %	
		2 in.		100	
		No. 4		90	
		No. 10		80	
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	50	85
		Silt	0.050 – 0.002	5	45
		Clay	less than 0.002	5	10
Soil pH	D 4972	pH of 5.7 to 6.9.			
Organic Matter	T 194	1.0 to 10.0 % by weight.			
Soluble Salts	EC1:2 (V:V)	500 ppm (1.25 mmhos/cm) or less.			
Harmful Materials	—	920.01.01(a)			

- (3) Fine Bark.** Fine Bark shall be the bark of hardwood trees that is milled and screened to a uniform particle size of 2 in. or less. Fine Bark shall be composted and aged for 6 months or longer, and be free from sawdust and foreign materials.

A 1 to 2 lb sample of Fine Bark shall be submitted to the Landscape Operations Division for examination.

(b) Composition. BSM shall be sampled and tested according to the requirements of MSMT 356 and conform to the following:

COMPOSITION- BIORETENTION SOIL MIX (BSM)						
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT				
Weeds	—	Free of seed and viable plant parts of species in 920.06.02(a)(b)(c) when inspected.				
Debris	—	920.01.05(a)(2)				
Textural Analysis	T 88	Particle		% Passing by Weight		
		Size	mm	Minimum	Maximum	
		Sand	2.0 – 0.050	55	85	
		Silt	0.050 – 0.002	–	20	
		Clay	less than 0.002	1	8	
Soil pH	D 4972	pH of 5.7 to 7.1.				
Organic Matter	T 194	Minimum 1.5 % by weight.				
Nutrient Analysis and Soluble Salts	Mehlich-3	Concentration				
		Element	Minimum		Maximum	
			ppm	FIV	ppm	FIV
		Calcium (Ca)	32	25	no limit	no limit
		Magnesium (Mg)	15	25	no limit	no limit
		Phosphorus (P)	18	25	92	100
	Potassium (K)	22	25	no limit	no limit	
	Sulfur (SO ₄)	25	n/a	no limit	no limit	
	EC1:2 (V:V)	Soluble Salts	40	n/a	500	n/a
Harmful Materials	—	920.01.01(a).				

(c) Amendment or Failure. BSM that does not conform to composition requirements for pH or nutrient analysis shall be amended as specified by the NMP. BSM that exceeds maximum phosphorus concentration or fails other composition requirements will not be accepted, and shall not be delivered or used as BSM.

(d) Storage. 920.01.02(b). BSM shall be stored in a stockpile that is protected from weather under tarp or shed. BSM stored for 6 months or longer shall be resampled, retested, and reapproved before use.

(e) Approval. 920.01.02(c).

(f) Certification and Delivery. 920.01.02(d).

920.02 SOIL AMENDMENTS.

920.02.01 Limestone. Limestone shall be an approved agricultural product manufactured and labeled for increasing soil pH. Limestone shall contain at least 85 percent calcium and magnesium carbonates. Dolomitic limestone shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates.

Limestone shall be supplied as a fine powder, or as pellets produced from fine powder, that conforms to the following:

LIMESTONE GRADING ANALYSIS	
SIEVE Size Number	PASSING BY WEIGHT Minimum %
10	100
20	98
100	50

920.02.02 Sulfur. Sulfur shall be an approved agricultural product manufactured and labeled for reducing soil pH. Sulfur labeled as a fertilizer may also be used to supply sulfur as a plant nutrient. Sulfur shall be supplied as a fine powder or pelletized powder with a minimum purity of 90 percent elemental sulfur.

920.02.03 Iron Sulfate. Iron sulfate shall be an approved agricultural product manufactured and labeled for reducing soil pH. Iron sulfate labeled as a fertilizer may also be used to supply sulfur or iron as a plant nutrient. Iron sulfate shall be supplied as a fine powder or pelletized powder with a minimum purity of 15 percent water soluble iron derived from ferrous sulfate.

920.02.04 Gypsum. Gypsum shall be an approved agricultural product manufactured and labeled as an aid for improving soil structure and removing soil soluble salts, or as a fertilizer to supply calcium and sulfate. Gypsum shall be supplied as a fine powder or pelletized powder with a minimum purity of 68 percent calcium sulfate dihydrate.

920.02.05 Compost.

- (a) **Compost Types.** Compost shall be either Type A (biosolids) or Type B (source-separated), and will be subject to approval by the Landscape Operations Division as follows:

- (1) **Biosolids Compost (Type A).** Type A Compost shall be approved for distribution by the Maryland Department of the Environment (MDE).
- (2) **Source-Separated Compost (Type B).** Type B Compost shall be produced by a compost operator certified by the Maryland Department of Agriculture (MDA).

Type B Compost shall be tree leaf compost or non-tree leaf compost. Type B Compost produced from lawn clippings shall be tested for contaminants in conformance with Maryland law and regulations.

- (b) **Stability.** Compost shall be biologically mature and no longer able to reheat to thermophilic temperatures.
- (c) **pH.** Compost shall have a pH of 6.0 to 7.5 except when specified in Sections 710 and 711 where it shall have a pH of 6.0 to 7.0.
- (d) **Soluble Salts.** Type A Compost shall have a soluble salt concentration less than 10.0 mmhos/cm, and Type B Compost shall have soluble salts concentration less than 5.0 mmhos/cm.
- (e) **Moisture.** Compost shall have a moisture content of 30 to 55 percent.
- (f) **Particle Size and Grading.** Compost shall be screened so that it has a uniform particle size of 0.5 in. or less, with grading analysis as follows.

COMPOST GRADING ANALYSIS	
SIEVE SIZE mm	PASSING BY VOLUME Maximum %
4.75	90
0.425	25
0.75	2.2

920.02.06 Peat Moss. A milled sphagnum peat moss with negligible woody substances.

920.02.07 Aged Pine Bark Fines. Derived from the bark of pine trees that have been composted and milled to a fineness approved for use by the Landscape Operations Division.

920.02.08 Water Absorbent Gel. A cross linked polyacrylamide agricultural product used to maintain moisture around bare root plants and as a soil conditioner. Formulas used shall conform to the manufacturer's recommendations.

920.03 FERTILIZERS.

920.03.01 Composition. Fertilizers shall be commercial grade labeled for use as agricultural fertilizer, and shall conform to Federal and Maryland State regulations and the Standards of the Association of Official Analytical Chemists. All analyses are subject to approval by the Landscape Operations Division prior to application.

Standard and Special Fertilizers shall be the following:

(a) **Standard Fertilizer.** Standard fertilizers shall be produced of ingredients, analysis, and composition as follows:

(1) **Ingredients.** One or more of the following:

FERTILIZER INGREDIENTS	
ammonium nitrate	polymer coated urea
ammonium sulfate	potassium chloride
biosolids	potassium sulfate (SOP)
diammonium phosphate (DAP)	sulfur coated urea
isobutylidene diurea	triple super phosphate
methylene urea	urea
monoammonium phosphate (MAP)	ureaform (UF)

(2) **Analysis and Composition.** Standard fertilizers shall contain nitrogen (N), phosphorus (P), potassium (K), and sulfate (SO₄) derived from ingredients above.

STANDARD FERTILIZER ANALYSIS and COMPOSITION		
FERTILIZER	USE	SECTION
0-0-50 SOP ^a	Supply P and SO ₄	705, 706, 707, 708, others
5-20-20 ^b	Refertilization	705
11-52-0 MAP ^a	Supply N and P	706, 707, others
15-30-15 ^b	Temporary seeding	704
20-16-12 (83% UF with MAP and SOP) ^c	Turfgrass establishment and other seeding	705, 706, 707, 708, 709
38-0-0 UF ^a	Slow-release N	705, 706, 707, 708, others

^a Purity shall be at least 98% UF, MAP, or SOP as indicated.

^b Shall be a mixture of any ingredients listed in 920.03.01(a)(1) with no more than 2% by weight of any combination of other materials.

^c Shall be a mixture of UF, MAP, and SOP with no more than 2% by weight of any combination of other materials.

(b) Special Fertilizers. Special fertilizers shall be of ingredients, analysis, and composition as follows:

(1) Ingredients. Special fertilizers shall provide label analysis guaranteeing nitrogen, phosphorus, and potassium from ingredients in (a) and also include plant micronutrients, coatings, or materials to augment their performance.

(2) Analysis and Composition. As follows:

SPECIAL FERTILIZER ANALYSIS and COMPOSITION		
FERTILIZER*	USE	SECTION
14-14-14 Polymer-coated with minor nutrients	Plant installation.	710, 711
20-10-5 21 to 23 grams per tablet. 13% water insoluble and 7% water soluble N, with minor nutrients	Tree, shrub, vine installation.	710
20-20-20 Water soluble powder with minor nutrients	Fertilizer solution application after plant installation.	710, 711, others

* Shall be a mixture of any ingredients listed in 920.03.01(a)(1) and (b)(1) with no more than 5% by weight of any combination of other materials.

920.04 MULCHES. Materials used as mulch shall have a uniform texture and be free from foreign materials or concentrations of metals, chemicals, or other substances that are harmful to human health, water quality, or plant growth.

920.04.01 Straw Mulch. Shall consist of thoroughly threshed stems and leaves of barley, oats, rye, and wheat.

Straw mulch shall be in an air-dry condition suitable for application with a mulch blower or other equipment.

Straw mulch shall be visually inspected to ensure it is free of objectionable quantities of mold, foreign substances, and weed seeds.

920.04.02 Wood Cellulose Fiber Mulch. A uniformly processed wood product that is able to form a homogenous slurry with seed, fertilizer, and other materials under agitation with water.

The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye to provide easy visual inspection for uniformity of application.

The manufacturer shall furnish certification as specified in TC-1.03 of the Technical Association of Pulp and Paper Industry (TAPPI) in conformance with the following:

WOOD CELLULOSE FIBER	
TEST PROPERTY	TEST VALUE
Particle Length	Approx. 0.5 in.
Particle Thickness	Approx. 0.063 in.
Net Dry Weight Content	Minimum as stated on bag
pH, TAPPI Standard T 509,	4.0 – 8.5
Ash Content, TAPPI Standard T 413	7.0% maximum
Water Holding Capacity	90% minimum

The material shall be delivered in packages of uniform weight, which shall not exceed 75 lb net weight and shall bear the name of the manufacturer, the net weight, and a supplemental statement of the net weight content.

920.04.03 Shredded Hardwood Bark (SHB) Mulch. Shall consist of natural bark derived from hardwood trees that has been milled and screened to a maximum 4 in. particle size.

SHB mulch shall contain negligible quantities of sawdust or other non-bark woody materials.

920.04.04 Composted Wood Chip (CWC) Mulch. Shall consist of natural wood mechanically reduced to a maximum size of 2 x 2 x 0.5 in. by a chipping machine before being composted.

Grading analysis of CWC mulch shall be as follows:

COMPOSTED WOOD CHIP MULCH	
SIEVE SIZE in.	PASSING BY VOLUME Maximum %
2	100
1	30
0.5	10

920.05 SOIL STABILIZATION MATTING.

920.05.01 Soil Stabilization Matting (SSM). SSM products shall be selected from the Office of Materials Technology's, Qualified Products List for Soil Stabilization Matting Manufacturers.

SSM shall consist of machine-produced matting of uniform thickness, weave, or distribution of fibers supplied in rolls at least 40 in. wide. SSM shall be smolder resistant.

The chemical components shall be nonleaching, nontoxic to vegetation and germinating seed, and noninjurious to the skin.

SSM shall conform to the following:

SOIL STABILIZATION MATTING				
TEST PROPERTY and METHOD	TYPE A	TYPE B	TYPE C	TYPE D
Functional Longevity	Degradable; 24 months	Non-degradable; Permanent	Non-degradable; Permanent	Degradable; 48 months
Matting Fiber	Excelsior	Non-woven; synthetic, UV-stabilized	Synthetic lattice; easily soil infilled and compacted.	Woven coir
Netting on Top and Bottom	Degradable, synthetic	Non-degradable synthetic; UV-stabilized	—	—
Netting Opening	No more than 2.0 x 1.0 in.	No more than 0.75 x 0.75 in.	—	—
Stitching, Thread, and Spacing	Degradable, no more than 4.0 in. apart	Non-degradable, UV-stabilized, synthetic, no more than 4.0 in. apart	—	—
Thickness D 6525	At least 0.25 in.	At least 0.30 in.	At least 0.50 in.	At least 0.30 in.
Weight D 6475, D 6655	At least 9.6 oz per yd ²	At least 10.0 oz per yd ²	At least 7.0 oz per yd ²	At least 19.0 oz per yd ²
Tensile Strength (MD) D 6818	At least 6.25 lb per in.	At least 12.5 lb per in.	At least 14.6 lb per in.	—
Tensile Strength (TD) D 6818	At least 4.7 lb per in.	At least 12.5 lb per in.	At least 14.6 lb per in.	—
Tensile Strength > 500 hr. exp. D 4355	—	At least 80% of original	At least 80% of original	—
Light Penetration D 6567	At least 15 %	At least 15%	—	—
Porosity or Open Area	—	—	At least 80%	At least 35%
Soil Loss Ratio at 2 in. per hr. for 30 min. D 6459	At least 5.0 to 1	At least 5.0 to 1	—	—
Shear for 0.5 in. soil loss D 6460	At least 1.75 lb per ft ²	At least 2.5 lb per ft ²	—	—

920.05.02 Fasteners for Soil Stabilization Matting and Turfgrass Sod. Fasteners marked 'X' shall used as specified in Section 709.03.05 and conform to the following:

(a) Wood Peg.

WOOD PEG. Wood, biodegradable, Untreated; single leg is driven into the soil so that wider top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in. long, 3/8 in. thick; top 1 in. wide, tapered to base.	X	X		

(b) T-Head Pin.

T-HEAD PIN. Molded plastic; biodegradable. Single leg with barbs is driven into the soil so that molded T-Head top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in. long, 3/8 in. thick; head 1 in. wide.	X	X		

(c) Circle-Top Pin.

CIRCLE-TOP PIN. Steel wire; single leg is driven into the soil so that coil or loop top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
11 gauge; leg 6 in long.	X	X		
11 gauge; leg 8 in. long.	X	X		

(d) Round-Head Pin.

ROUND-HEAD PIN. Molded plastic; biodegradable. Single leg with barbs is driven into the soil so that molded disk top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in long; head 1 in. dia.	X	X		
Approx. 8 in long; head 1 in. dia.	X	X		

(e) U-Shape Staple.

U-SHAPE STAPLE. Steel wire; two main legs are driven into the soil so that top of staple is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
11 gauge bent into U shape; legs 6 in. long; top 1 to 1-1/2 in. wide.	X	X		
8 gauge bent into U shape; legs 8 in. long; top 1 to 1-1/2 in. wide.	X	X	X	X
8 gauge bent into U shape.; legs 12 in. long; top 1 to 1-1/2 in. wide			X	X

(f) Fabric Pin.

FABRIC PIN. Steel nail; single leg is driven into the soil so that steel washer top is flush with SSM.	Turfgrass Sod	Soil Stabilization Matting		
		TYPE A	Type B	Type C and D
11 gauge approx. 12 in. long.			X	X
3/16 in. approx 18 in. long.			X	X

920.06 SEED AND TURFGRASS SOD STANDARDS.

920.06.01 Names and Naming. The authority for common and scientific names shall be the USDA NRCS, The Plants Database website at <http://plants.usda.gov>. Cultivar names shall be those of the registered cultivar.

Plant and seed identification, tags, and labels shall correspond to the common name and scientific name of the species in The Plants Database. Any conflict in names or naming shall be resolved by the Engineer in consultation with the Landscape Operations Division.

920.06.02 Prohibited Weeds.**(a) Weeds Prohibited in Turfgrass Sod and SHA Seed Mixtures.**

Turfgrass Sod, SHA Turfgrass Seed Mix, SHA Temporary Seed Mix, and Additive Seed shall be free from seed or viable parts of the following species:

WEEDS PROHIBITED IN TURFGRASS SOD AND SHA SEED MIXTURES	
COMMON NAME	SCIENTIFIC NAME
annual bluegrass	<i>Poa annua</i> L.
balloonvine	<i>Cardiospermum halicacabum</i> L.
Bermudagrass	<i>Cynodon dactylon</i> (L.) Pers.
Canada Thistle	<i>Cirsium arvense</i> (L.) Scop.
Carolina horsenettle	<i>Solanum carolinense</i> L.
common corncockle	<i>Agrostemma githago</i> L.
common reed = phragmites	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.
crested anoda = spurred anoda	<i>Anoda cristata</i> (L.) Schldtl.
dodder	<i>Cuscuta spp.</i> L.
field bindweed	<i>Convolvulus arvensis</i> L.
Japanese bristlegrass = giant foxtail	<i>Setaria faberi</i> Herrm.
Java-bean = sicklepod	<i>Senna obtusifolia</i> (L.) Irwin and Barneby
Johnsongrass	<i>Sorghum halepense</i> (L.) Pers. and hybrids
meadow garlic = wild onion	<i>Allium canadense</i> L.
plumeless thistle	<i>Carduus</i> L.
quackgrass	<i>Elytrigia repens</i> (L.) Gould
Rough cocklebur	<i>Xanthium strumarium</i> L.
serrated tussock	<i>Nassella trichotoma</i> (Nees) Hack.
wild garlic	<i>Allium vineale</i> L.
yellow nutsedge	<i>Cyperus esculentus</i> L.

- (b) Weeds Prohibited in Meadow and Wildflower Seed.** Meadow and Wildflower Seed shall be free of species listed in (a) and the following species:

WEEDS PROHIBITED IN MEADOW and WILDFLOWER SEED	
COMMON NAME	SCIENTIFIC NAME
asiatic tearthumb = mile-a-minute	<i>Polygonum perfoliatum L.</i>
burdock and related species	<i>Arctium L.</i>
canarygrass and related species	<i>Phalaris L.</i>
common wormwood = mugwort	<i>Artemisia vulgaris L. var. vulgaris</i>
dogbane and related species	<i>Apocynum L.</i>
eastern poison ivy	<i>Toxicodendron radicans (L.) Kuntze</i>
fig buttercup = lesser celandine	<i>Ranunculus ficaria L. var. bulbifera Marsden-Jones</i>
garlic mustard	<i>Alliaria petiolata (M. Bieb.) Cavara and Grande</i>
Giant hogweed	<i>Heracleum mantegazzianum Sommier and Levier</i>
Japanese honeysuckle, Tatarian honeysuckle and related species	<i>Lonicera L.</i>
Japanese Knotweed	<i>Polygonum cuspidatum Siebold and Zucc.</i>
lesser knapweed = spotted knapweed	<i>Centaurea nigra L.</i>
multiflora rose	<i>Rosa multiflora Thunb.</i>
Nepalese browntop = Japanese stiltgrass	<i>Microstegium vimineum (Trin.) A. Camus</i>
purple loosestrife and related species	<i>Lythrum L.</i>
poison hemlock	<i>Conium maculatum L.</i>
silvergrass and related species	<i>Miscanthus Andersson</i>
thistle and related species	<i>Cirsium Mill., Onopordum L.</i>

- (c) Weeds Prohibited in Shrub Seed.** Shrub Seed shall be free of species listed in (a) and (b) and the following species:

WEEDS PROHIBITED IN SHRUB SEED	
COMMON NAME	SCIENTIFIC NAME
common buckthorn	<i>Rhamnus cathartica L.</i>
burningbush	<i>Euonymus alatus (Thunb.) Siebold</i>
Japanese barberry	<i>Berberis thunbergii DC.</i>
oriental bittersweet	<i>Celastrus orbiculatus Thunb.</i>
privet, etc.	<i>Ligustrum L.</i>
oleaster; Russian olive, autumn olive, related species	<i>Elaeagnus L.</i>
tree of heaven	<i>Ailanthus altissima (Mill.) Swingle</i>

920.06.03 Turfgrass Sod. Turfgrass Sod shall be Maryland Certified Sod and comply with the Maryland Turfgrass Law and Regulations of the State of Maryland.

- (a) Each load of turfgrass sod shall bear a Maryland State Certified Label and be in good health at the time of delivery.
- (b) Turfgrass sod shall be field grown in the State of Maryland and be sufficiently knitted when harvested to resist breakage under normal handling.
- (c) Prior to harvest, Tall Fescue sod shall be mowed to a height of 2.0 to 3.5 in. Bermudagrass sod shall be mowed from 0.75 to 1.0 in. height.
- (d) Turfgrass sod shall be machine cut in strips at least 14 in. wide.
- (e) Turfgrass sod shall be uniform thickness of 0.75 to 1.25 in., excluding top growth, with thatch thickness less than 3/8 in.

920.06.04 Approved Cultivars. Refer to ‘Specifications for Seed and Seed Mixes’, a list of cultivars of species approved for use in seed mixes and specifications maintained by the Landscape Operations Division. Only cultivars included on that list may be used. When no cultivar is specified, any common type cultivar of the species may be provided.

920.06.05 Seed Testing and Sampling. Seed shall comply with the Maryland Seed Law and Regulations of the State of Maryland. Seed suppliers shall assume charges for seed inspections and testing.

- (a) **SHA Mixtures and Additive Seed.** SHA Turfgrass Seed Mix, SHA Special Purpose Seed Mix, SHA Temporary Seed Mix, and certified cultivars of Additive Seed shall be sampled and tested by an inspector of the Maryland Department of Agriculture, Turf and Seed Section (MDA) for percent purity, percent germination, percent weed seed, noxious weed content, and conform to MDA Standards for Maryland Certified Seed. SHA Seed Mixtures shall carry MDA Certified Seed tags that show the purity, germination, weed seed, and noxious weed seed content.
- (b) **Unmixed Seed.** Seed supplied for use as Meadow Seed or Shrub Seed shall be supplied in containers of a single species, unmixed. Each species shall be tested for purity, germination, and weed seed; and carry tags provided by the grower or distributor that

indicate the test results. When the quantity of seed delivered to a project of a meadow species exceeds 0.10 lb., or the quantity of seed of a shrub species exceeds 0.50 lb., the seed shall be tested for noxious weed seed content by MDA. A sample that conforms to the minimum weight requirement of MDA for a seed sample of meadow or shrub species shall be submitted for testing at least 21 days before the scheduled seeding date. The seed will be returned after evaluation. Tested seed shall be accompanied by MDA documentation to indicate the seed conforms to requirements when it is mixed or seeded.

920.06.06 Standards for Seed Species. Seed supplied in lots of individual species or used to produce mixes shall conform to the requirements of this section for minimum percent germination, minimum purity, and maximum percent of weed seed.

Meadow or shrub seed that does not conform to these standards may be used after review and approval by the Engineer in consultation with the Landscape Operations Division. The seed will be subject to use at increased seeding rates or measures to compensate for reduced substandard seed purity, weed content, or germination.

- (a) **SHA Turfgrass Seed Mix and SHA Special Purpose Seed Mix.** Species included in SHA Turfgrass Seed Mix and SHA Special Purpose Seed Mix shall be MDA Certified Seed of approved cultivars and conform to the following requirements for minimum percent purity, maximum percent weed seed, and minimum percent germination:

TURFGRASS SEED SPECIES			
COMMON NAME, and SCIENTIFIC NAME	PURITY Min %	WEED Max %	GERM Min %
Chewings fescue <i>Festuca rubra</i> L. ssp. <i>fallax</i> (Thuill.) Nyman	98	0.5	85
red fescue <i>Festuca rubra</i> L. ssp. <i>rubra</i>	98	0.5	85
hard fescue <i>Festuca brevipila</i> Tracey	98	0.5	85
Kentucky bluegrass <i>Poa pratensis</i> L. ssp. <i>pratensis</i>	95	0.4	80
perennial ryegrass <i>Lolium perenne</i> L. ssp. <i>perenne</i>	98	0.5	85
sheep fescue <i>Festuca ovina</i> L.	98	0.5	85
tall fescue <i>Schedonorus phoenix</i> (Scop.) Holub = <i>Festuca elatior</i> L.	98	0.5	85

- (b) **Temporary and Grass Additive Seed.** Species included in SHA Temporary Seed Mix, or used as Additive Seed with SHA Turfgrass Seed Mix or SHA Special Purpose Seed Mix shall conform to the following requirements for minimum percent purity, maximum percent weed seed, and minimum percent germination:

TEMPORARY and GRASS ADDITIVE SEED SPECIES			
COMMON NAME, and SCIENTIFIC NAME	PURITY Min %	WEED Max %	GERM Min %
cereal rye <i>Secale cereale</i> L.	98	0.1	85
common barley, winter type <i>Hordeum vulgare</i> L.	98	0.3	85
common oat, winter type <i>Avena sativa</i> L.	98	0.5	85
common wheat, winter type <i>Triticum aestivum</i> L.	98	0.1	85
Italian ryegrass = annual ryegrass <i>Lolium perenne</i> L. ssp. <i>multiflorum</i> (Lam.) Husnot	95	0.3	85
foxtail bristlegass = foxtail millet <i>Setaria italica</i> (L.) P. Beauv.	99	0.1	80
Lehmann lovegrass <i>Eragrostis lehmanniana</i> Nees	98	0.5	80
weeping lovegrass <i>Eragrostis curvula</i> (Schrad.) Nees	98	0.5	80

- (c) **Legume Additive Seed.** Species used as Additive Seed with SHA Turfgrass Seed Mix or SHA Special Purpose Seed Mix shall be MDA Certified Seed when cultivars are specified and conform to the following requirements for minimum percent purity, maximum percent weed seed, minimum percent germination, and maximum percent hard seed.

LEGUME ADDITIVE SEED SPECIES				
COMMON NAME, SCIENTIFIC NAME, and CULTIVARS	PURITY Min	WEED Max %	GERM Min %	HARD Max %
birdsfoot trefoil <i>Lotus corniculatus</i> L. var. <i>corniculatus</i>	98	0.5	85	20
crownvetch <i>Securigera varia</i> (L.) Lassen	98	0.5	80	30
sericea lespedeza <i>Lepedeza cuneata</i> (Dum. Cours.) G. Don cv. Interstate or Interstate 76	98	0.5	85	20

Note: Minimum percent germination includes all seed identified as hard seed.

- (d) **Meadow Forb Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:
- (1) **Purity.** Weed and/or other crop seed content shall be 2.5 percent or less by weight. Seed that does not conform to this specification may be used after approval by the Engineer in consultation with the Landscape Operations Division at increased seeding rates, or with measures to compensate for increased weed or crop seed content.
 - (2) **Origin.** Seed shall either be collected from native sources in USDA Hardiness Zone 5b, 6a, 6b and 7a in the States of Maryland, Pennsylvania, New York, New Jersey, Delaware, Virginia, West Virginia, or North Carolina, or shall be grown and produced from seed certified to have been collected from sites in the USDA Hardiness Zones of those States. Seed that does not conform to origin requirements may be used after review and approval by the Engineer in consultation with the Landscape Operations Division.

(3) **Species.** Seed shall conform to the following species, subspecies and varieties:

MEADOW FORB SEED SPECIES	
COMMON NAME	SCIENTIFIC NAME
Allegheny monkeyflower = square stem monkeyflower	<i>Mimulus ringens</i> L. var. <i>ringens</i>
bearded beggarticks = showy tickseed	<i>Bidens aristosa</i> (Michx.) Britton
blackeyed Susan	<i>Rudbeckia hirta</i> L. var. <i>hirta</i> <i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw.
browneyed Susan	<i>Rudbeckia triloba</i> L. var. <i>triloba</i> <i>Rudbeckia triloba</i> L. var. <i>pinnatifida</i> Torr. and A. Gray
common boneset	<i>Eupatorium perfoliatum</i> L. var. <i>perfoliatum</i>
common evening primrose	<i>Oenothera biennis</i> L.
crimson-eyed rose mallow	<i>Hibiscus moscheutos</i> L.
eastern purple coneflower	<i>Echinacea purpurea</i> (L.) Moench
flat-top goldenrod = grass-leaved goldenrod	<i>Euthamia graminifolia</i> (L.) Nutt. <i>Euthamia graminifolia</i> (L.) Nutt. var. <i>graminifolia</i> <i>Euthamia graminifolia</i> (L.) Nutt. var. <i>hirtipes</i> (Fernald) C.E.S. Taylor and R.J. Taylor
gray goldenrod	<i>Solidago nemoralis</i> Aiton var. <i>nemoralis</i>
lanceleaf tickseed = lanceleaf coreopsis	<i>Coreopsis lanceolata</i> L.
Maryland senna	<i>Senna marilandica</i> (L.) Link
Maximilian sunflower	<i>Helianthus maximiliani</i> Schrad.
New England aster	<i>Symphotrichum novae-angliae</i> (L.) G.L. Nesom
New York aster	<i>Symphotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>elodes</i> (Torr. and A. Gray) G.L. Nesom <i>Symphotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>novi-belgii</i> <i>Symphotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>villicaule</i> (A. Gray) J. Labrecque and L. Brouillet
New York ironweed	<i>Vernonia noveboracensis</i> (L.) Michx.
partridge pea	<i>Chamaecrista fasciculata</i> (Michx.) Greene <i>Chamaecrista fasciculata</i> (Michx.) Greene var. <i>fasciculata</i> <i>Chamaecrista fasciculata</i> (Michx.) Greene var. <i>macrosperma</i> (Fernald) C.F. Reed
king of the meadow = tall meadow rue	<i>Thalictrum pubescens</i> Pursh
seedbox	<i>Ludwigia alternifolia</i> L.
smooth blue aster	<i>Symphotrichum laeve</i> (L.) A. Löve and D. Löve var. <i>laeve</i> <i>Symphotrichum laeve</i> (L.) A. Löve and D. Löve var. <i>concinnum</i> (Willd.) G.L. Nesom
smooth oxeye = ox-eye sunflower	<i>Heliopsis helianthoides</i> (L.) Sweet var. <i>helianthoides</i> <i>Heliopsis helianthoides</i> (L.) Sweet var. <i>scabra</i> (Dunal) Fernald
spotted trumpetweed = spotted joe pye weed	<i>Eupatoriadelphus maculatus</i> (L.) King and H. Rob. var. <i>maculatus</i>

stiff goldenrod	<i>Oligoneuron rigidum</i> (L.) Small var. <i>rigidum</i>
sundial lupine = wild blue lupine	<i>Lupinus perennis</i> L. ssp. <i>perennis</i> <i>Lupinus perennis</i> L. ssp. <i>perennis</i> var. <i>perennis</i> <i>Lupinus perennis</i> L. ssp. <i>perennis</i> var. <i>occidentalis</i> S. Watson
swamp milkweed	<i>Asclepias incarnata</i> L. <i>Asclepias incarnata</i> L. ssp. <i>incarnata</i> <i>Asclepias incarnata</i> L. ssp. <i>pulchra</i> (Ehrh. ex Willd.) Woodson
swamp sunflower = narrow-leaved sunflower	<i>Helianthus angustifolius</i> L.
swamp verbena = blue vervain	<i>Verbena hastata</i> L. var. <i>hastata</i>
talus slope penstemon = tall white beardtongue	<i>Penstemon digitalis</i> Nutt. ex Sims
trumpetweed = joe pye weed	<i>Eupatoriadelphus fistulosus</i> (Barratt) King and H. Rob.
wild bergamot	<i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> <i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> var. <i>mollis</i> (L.) Benth. <i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> var. <i>rubra</i> A. Gray <i>Monarda fistulosa</i> L. ssp. <i>brevis</i> (Fosberg and Artz) Scora, ined.

(e) **Meadow Grass, Sedge, and Rush Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

(1) **Purity.** Refer to 920.06.06(d)(1). Grasses with awns shall be debarbed or deawned.

(2) **Origin.** Refer to 920.06.06(d)(2). Cultivars may be produced in any state east of the Mississippi River.

- (3) **Species.** Seed shall conform to the following species, subspecies, varieties, and cultivars:

MEADOW GRASS, SEDGE and RUSH SEED SPECIES	
COMMON NAME and CULTIVARS	SCIENTIFIC NAME
big bluestem cv. Niagara	<i>Andropogon gerardii</i> Vitman
longhair sedge = bristly sedge	<i>Carex comosa</i> Boott
broomsedge bluestem = broomsedge	<i>Andropogon virginicus</i> L. <i>Andropogon virginicus</i> L. var. <i>virginicus</i> <i>Andropogon virginicus</i> L. var. <i>decipiens</i> C.S. Campbell
deertongue cv. 'Tioga'	<i>Dichanthelium clandestinum</i> (L.) Gould
fox sedge	<i>Carex vulpinoidea</i> Michx. var. <i>vulpinoidea</i>
gamagrass cv. 'Meadowcrest', 'Pete'	<i>Tripsacum dactyloides</i> (L.) L.
Indiangrass cv. 'Rumsey'	<i>Sorghastrum nutans</i> (L.) Nash
little bluestem cv. 'Aldous'	<i>Schizachyrium scoparium</i> (Michx.) Nash var. <i>scoparium</i> <i>Schizachyrium scoparium</i> (Michx.) Nash var. <i>divergens</i> (Hack.) Gould
shallow sedge = lurid sedge	<i>Carex lurida</i> Wahlenb.
rattlesnake mannagrass	<i>Glyceria canadensis</i> (Michx.) Trin.
common rush = soft rush = lamp rush	<i>Juncus effusus</i> L. var. <i>conglomeratus</i> (L.) Engelm. <i>Juncus effusus</i> L. var. <i>decipiens</i> Buchenau <i>Juncus effusus</i> L. var. <i>pylaei</i> (Laharpe) Fernald and Wiegand <i>Juncus effusus</i> L. var. <i>solutus</i> Fernald and Wiegand
switchgrass cv. 'Blackwell', 'Shelter'	<i>Panicum virgatum</i> L. var. <i>virgatum</i> <i>Panicum virgatum</i> L. var. <i>spissum</i> Linder
woolgrass	<i>Scirpus cyperinus</i> (L.) Kunth

- (f) **Wildflower Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

- (1) **Purity.** Species shall be 98 percent purity or greater, with 75 percent germination or greater, and with weed and/or other crop seed content of 2.5 percent or less by weight. Seed that does not conform to purity requirements may be used after approval by the Engineer in consultation with the Landscape Operation Division at increased seeding rates, or with measures to compensate for increased weed or crop seed content.

(2) **Origin.** Any State of the United States.

(3) **Species.** Seed shall conform to the following species, subspecies, varieties, and cultivars:

WILDFLOWER SEED SPECIES	
COMMON NAME and CULTIVARS	SCIENTIFIC NAME
firewheel = annual gaillardia	<i>Gaillardia pulchella</i> Foug. <i>Gaillardia pulchella</i> Foug. var. <i>pulchella</i>
blackeyed Susan	<i>Rudbeckia hirta</i> L. var. <i>hirta</i> <i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw.
calendula	<i>Calendula officinalis</i> L.
lemon beebalm	<i>Monarda citriodora</i> Cerv. ex Lag.
garden cosmos = pink cosmos cv. 'Sensation'	<i>Cosmos bipinnatus</i> Cav.
doubtful knight's-spur = rocket larkspur	<i>Consolida ajacis</i> (L.) Schur
Siberian wallflower	<i>Erysimum</i> × <i>marshallii</i> (Henfr.) Bois
Moroccan toadflax = Spurred Snapdragon	<i>Linaria maroccana</i> Hook. f.
common sunflower cv. 'Autumn Beauty'	<i>Helianthus annuus</i> L.
garden cornflower = bachelors button	<i>Centaurea cyanus</i> L.
sulphur cosmos = yellow cosmos cv. 'Bright Lights'	<i>Cosmos sulphureus</i> Cav.

(g) **Shrub Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

(1) **Purity.** Weed and/or other crop seed content shall be 0.5 percent or less by weight. Minimum purity and minimum germination shall conform to the requirements of (3), below.

(2) **Origin.** Refer to 920.06.06(d)(2).

(3) **Species.** Seed shall conform to the following species, subspecies, and varieties:

SHRUB SEED SPECIES		
SPECIES Including Subspecies and Variety	PURITY Min %	GERM Min %
American black elderberry <i>Sambucus nigra</i> L. ssp. <i>canadensis</i> (L.) R. Bolli	98	60
American cranberrybush <i>Viburnum opulus</i> L. var. <i>americanum</i> Aiton	99	70
black chokeberry <i>Photinia melanocarpa</i> (Michx.) K.R. Robertson and Phipps	99	70
bristly locust <i>Robinia hispida</i> L. var. <i>fertilis</i> (Ashe) R.T. Clausen <i>Robinia hispida</i> L. var. <i>hispida</i>	99	90
chokecherry <i>Prunus virginiana</i> L. var. <i>virginiana</i>	99	70
common buttonbush <i>Cephalanthus occidentalis</i>	98	60
common ninebark <i>Physocarpus opulifolius</i> (L.) Maxim., orth. cons.	99	75
common winterberry <i>Ilex verticillata</i> (L.) A. Gray	99	60
desert false indigo <i>Amorpha fruticosa</i> L.	98	70
fragrant sumac <i>Rhus aromatica</i> var. <i>aromatica</i>	99	85
gray dogwood <i>Cornus racemosa</i> Lam.	99	70
inkberry <i>Ilex glabra</i> (L.) A. Gray	98	60
mapleleaf viburnum <i>Viburnum acerifolium</i> L.	99	70
nannyberry <i>Viburnum lentago</i> L.	99	75
red chokeberry <i>Photinia pyrifolia</i> (Lam.) K.R. Robertson and Phipps	85	60
red elderberry <i>Sambucus racemosa</i> L. var. <i>racemosa</i>	95	70
redosier dogwood <i>Cornus sericea</i> L. ssp. <i>sericea</i>	99	70
silky dogwood <i>Cornus amomum</i> Mill.	98	70
smooth sumac <i>Rhus glabra</i> L.	99	80
southern arrowwood <i>Viburnum dentatum</i> L. var. <i>dentatum</i> <i>Viburnum dentatum</i> L. var. <i>venosum</i> (Britton) Gleason <i>Viburnum recognitum</i> Fernald	99	70
spicebush <i>Lindera benzoin</i> (L.) Blume var. <i>benzoin</i>	95	60
staghorn sumac <i>Rhus typhina</i> L.	99	85
steepleshbush <i>Spiraea tomentosa</i> L.	85	70
swamp rose <i>Rosa palustris</i> Marsh.	99	65
witch hazel <i>Hamamelis virginiana</i> L.	99	70

920.06.07 Seed Mixes. Refer to 920.06.01 thru .06 and the document ‘Specifications for Seed and Seed Mixes’ maintained by the Landscape Operations Division, which includes lists of approved cultivars.

(a) SHA Turfgrass Seed Mix.

SHA TURFGRASS SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
90	tall fescue	<i>Schedonorus phoenix</i> (Scop.) Holub
5	Kentucky bluegrass	<i>Poa pratensis</i> L. ssp. <i>pratensis</i>
5	perennial ryegrass	<i>Lolium perenne</i> L. ssp. <i>perenne</i>

(b) SHA Special Purpose Seed Mix.

SHA SPECIAL PURPOSE SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
75	hard fescue	<i>Festuca brevipila</i> Tracey
20	Chewings fescue	<i>Festuca rubra</i> L. ssp. <i>fallax</i> (Thuill.) Nyman
5	Kentucky bluegrass	<i>Poa pratensis</i> L. ssp. <i>pratensis</i>

(c) SHA Temporary Seed Mix.

SHA TEMPORARY SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
95	common wheat, winter type	<i>Triticum aestivum</i> L.
	common barley, winter type	<i>Hordeum vulgare</i> L.
	common oat, winter type	<i>Avena sativa</i> L.
	cereal rye, winter type	<i>Secale cereale</i> L.
5	foxtail bristlegrass = foxtail millet	<i>Setaria italica</i> (L.) P. Beauv.

920.07 PLANT MATERIALS.

920.07.01 Certificate and Licenses. Sellers, distributors, installers or producers of nursery stock shall possess the Plant Dealer License, Plant Broker License, or Nursery Inspection Certificate of the Maryland Department of Agriculture, or substitute a similar certificate or licenses from another State where they do business.

920.07.02 Plant Material Inspection. Plant material will be inspected for conformance with 920.07.03 thru .05, and tagged with Administration Plant Material Inspection Seals (Seals) as follows:

- (a) **Inspection.** The Plant Material Inspection will be conducted in Maryland at the nursery where the plant material is grown, or at the brokerage where the plant material is sold.

When plant material is produced by a nursery outside Maryland, the Inspection will be conducted at the Contractor's holding area, or at the project site before planting, unless otherwise specified in the Contract Documents.

The Contractor shall ensure that the plant material is present for inspection on the scheduled date, and that it meets the requirements of 920.07. The condition and identity of plant material will be subject to re-inspection for the duration of the Contract.

- (b) **Scheduling.** The Inspection will be scheduled by the Engineer in consultation with the Landscape Operations Division. At least 14 days notice to schedule an Inspection within Maryland, and at least 45 days notice to schedule an Inspection outside Maryland.
- (c) **Seals.** The Administration will determine which plants, if any, will be tagged with Seals.

When Seals are placed upon representative plants within a block of plant material, the plant material delivered for installation shall be similar in size, shape and character to the plant material that received Seals.

Plant material that is delivered with broken or missing Seals, or that is not similar to the plant material within the block that was tagged with Seals will be rejected.

- (d) **Rejected Plants.** Plant materials which do not meet these requirements will be rejected. Plant material rejected at the nursery or holding area shall not be delivered to the project; if delivered, it shall immediately be removed.

Plants shall not be installed until the Plant Material Inspection has been completed and satisfactory identification has been provided.

920.07.03 Plant Material Standards. Plant material shall be grown, identified, graded, and delivered in good condition as specified in this section.

- (a) **Hardiness Zones of Origin.** Plant material shall be nursery grown within plant hardiness zones 5, 6, or 7 according to the ‘USDA Plant Hardiness Zone Map’ unless otherwise specified. Plant material shall be dug and transported in conformance ANSI Z60.1. Bare root deciduous plants shall be delivered in a dormant condition. Roots shall be adequately protected and kept moist.
- (b) **Names and Identification.** Refer to 920.06.01. Plant material shall be clearly and correctly identified by the grower or distributor. Plant materials that are misidentified, or not satisfactorily tagged or labeled, or do not conform to the accepted characteristics of the species or cultivar, will be rejected.
- (c) **ANSI Standards.** Plant material shall conform to ‘American Standard for Nursery Stock (ANSI Z60.1) of the American Nursery and Landscape Association. Plant grades shall be those established in ANSI Z60.1, and shall include plants from that size up to but not including the next larger grade size. When specimen plants are specified by the Contract documents, the specimen requirement shall also be met. Plant material which does not meet the standards of this section shall be rejected.
- (d) **Health and Sanitation.** Plant material shall be in good health and be declared and certified free from disease and insects as required by law for transportation, and shall be free from pest-related stress and pest damage.

Plants shall be healthy, free from physical defects and stresses, and have well-developed branches and a vigorous root system. Plants that exhibit wilt, shriveling, insufficient root mass, broken or loose root balls, or inadequate protection will be rejected.

Container grown plants shall be well rooted, vigorous and established in the size pot specified, shall have well balanced tops for their pot size, and shall not be root bound.

Plants grown in fields or containers which include Ailanthus, Canada thistle, Johnsongrass, or yellow nutsedge will be rejected.

- (e) **Shade and Flowering Trees.** Shade and flowering trees shall be symmetrically balanced. Major branch unions shall not have ‘V’ shaped crotches, bark inclusion or unions derived from water sprouts (epicormic growth) capable of causing structural weakness.

Trees shall be free of unhealed branch removal wounds greater than 1 in. diameter, or wounds or scars caused by staking, wire or ties, or any other defect which could cause structural failure or disfigurement.

Shade trees and central leader flowering trees shall have a single main trunk. Trunk height to the lowest branch shall conform to the following:

HEIGHT TO LOWEST BRANCH	
CALIPER in.	HEIGHT ft
1-1/2 and 1-3/4	4
2 to 2-1/2	5
3	6

- (f) **Unacceptable Plants.** Plant material that becomes unacceptable after installation shall be rejected as specified in 710.03.18.

920.07.04 American Holly (*Ilex opaca* Aiton). Each lot of plants shall include 90 percent female plants and 10 percent male plants of cultivars selected from the following:

AMERICAN HOLLY CULTIVARS		
FEMALE		MALE
Angelica	Miss Helen	David
Arlene Leach	Old Heavy Berry	Jersey Knight
B and O	Patterson	Leather Leaf
Dan Fenton	Satyr Hill	Nelson West
Jersey Princess	Wyetta	North Wind

920.07.05 Plant Storage and Handling. Adequate facilities shall be provided for plant storage. Plants shall be handled with care to avoid damage.

- (a) **Bulbs.** Bulbs shall be stored under appropriate climate control.

- (b) **Annual Plants.** Annual plants shall be kept moist.
- (c) **Bare Root Plants.** Bare root plants shall be kept moist and heeled into moist soil or other suitable material until installed. During transport, the roots shall be covered with canvas, burlap or straw.
- (d) **Balled and Burlapped and Container Grown Plants.** Balled and burlapped plants and container grown plants shall be kept moist and installed within seven days of delivery, or the root balls or containers shall be covered with mulch or straw until removed for installation.

920.08 MARKING AND STAKING MATERIALS.

920.08.01 Outline Stakes. Outline stakes shall be full cut 1.75 x 1.75 in. sound hardwood, 48 in. long, as approved.

920.08.02 Stakes. Stakes for supporting trees shall be rough sawn, straight grain hardwood reasonably free from bark, knot holes, excessive warping, or other imperfections. Stakes shall be full cut 2.0 x 2.0 in. thickness.

920.08.03 Wire. Wire shall be No. 12 and 14 gauge new annealed galvanized wire.

920.08.04 Wire Rope. Wire rope shall be 0.25 in. zinc coated steel wire seven strand as commonly used for guying large trees.

920.08.05 Cable Clamps. Cable clamps shall be zinc galvanized steel.

920.08.06 Hose. Hose shall be 5/8 in. inside diameter corded synthetic rubber hose.

920.08.07 Turnbuckles. Turnbuckles shall be zinc galvanized with 4.5 in. openings and 5/16 in. threaded ends with screw eyes.

920.08.08 Anchors. Tree anchors shall be earth anchors of a type commonly used for anchoring large trees.

920.09 WATER, PESTICIDES, AND ADJUVANTS.

920.09.01 Water. Water used for the installation and establishment of vegetation shall not contain concentrations of substances that are harmful to plant growth.

Water derived from public and municipal water systems in Maryland shall be acceptable for irrigation, fertilization, or mixing with pesticides. Water derived from wells or other sources may be used when it has soluble salts concentration less than 500 ppm, sodium less than 50 percent of total salts, and pH between 5.0 to 7.8.

920.09.02 Seed Carrier. Seed carrier shall be one or more inert, horticultural-grade materials used to improve seed mixing and distribution through a spreader or drill. Seed carriers shall be free flowing, easily mixable with seed, and nontoxic to seed, plants, humans, and wildlife. Seed carrier shall include one or more of the following:

- (a) **Calcined Clay.** Calcined clay shall be a furnace-baked clay product.
- (b) **Cocoa Shell.** Cocoa shell shall be processed cocoa seeds.
- (c) **Oyster Shell.** Oyster shell shall be crushed shells of oyster or other mollusk.
- (d) **Vermiculite.** Vermiculite shall be heat-expanded mineral mica.
- (e) **Perlite.** Perlite shall be heat-expanded mineral perlite.

920.09.03 Pesticides. Pesticides shall be EPA-approved and registered for use in Maryland to control plants, fungi, insects or other pests. Pesticides shall be approved for use, and acceptable application rates established by the Landscape Operations Division as follows:

- (a) **Herbicide.** Herbicide shall control or prevent regrowth of plants or vegetation.
- (b) **Insecticide.** Insecticide shall control or protect against insect or other arthropod pests.
- (c) **Fungicide.** Fungicide shall control or protect against fungal or bacterial pests.
- (d) **Other Pesticides.** Other pesticides shall control or protect against other pests.

920.09.04 Marking Dye. Marking dyes shall be used to color spray solutions, be nonphytotoxic, oil or water soluble, and compatible with the

pesticide products they are applied with. Marking dye products and application rates shall be approved by the Landscape Operations Division.

920.09.05 Spray Adjuvant and Wetting Agent. Spray adjuvant and wetting agents shall be mixable with water and compatible with the pesticides or other products they are applied with.

920.09.06 Antidesiccant. Antidesiccant and antitranspirant products shall be materials that provide a film over plant surfaces to limit water loss. These products and application rates shall be approved by the Landscape Operations Division.

SECTION 921 — MISCELLANEOUS

921.01 WATER FOR CONCRETE MIXES. Water shall be clear and meet the pH requirements of T 26, Method B. If questionable quality is suspected, the water shall meet the limits of the comparison tests with distilled water per T 26. Determine the chloride concentration of water used in mixing and curing of portland cement concrete per D 512. Chloride content shall not exceed the following limits:

Bridge Superstructure and Prestressed Concrete	500 ppm
Latex Modified Concrete	50 ppm
Other Concrete and Water Used in Curing	1000 ppm

921.02 MOISTURE AND DUST CONTROL AGENTS.

921.02.01 Calcium Chloride. M 144, Type S, Grade I, Class A for Solid calcium chloride. Calcium chloride in solution shall contain a minimum of 30 percent salts. The solution shall be made using potable water in a quantity designated by the Engineer. When analyzed per MSMT 601, the residue shall meet M 144.

921.02.02 Magnesium Chloride. Flakes shall meet the following:

TEST PROPERTY	SPECIFICATION LIMITS
Magnesium Chloride MgCl ₂ , %	46.0 – 47.0
Calcium Chloride CaCl ₂ , %	2.0 – 3.0
Potassium Chloride KCl, %	0.5 – 1.0
Sodium Chloride NaCl, %	0.5 – 1.0
Sulfates, % max	0.05

When used as a solution, shall contain 30 to 32 percent solids.

921.03 LIME.

921.03.01 Hydrated lime shall meet the chemical requirements of C 206, Type N when used in finishing; or C 207, Type N when used for masonry.

921.03.02 Hydrated lime for soil stabilization shall have a minimum combined calcium oxide and magnesium oxide content of 65 percent when tested per C 25 and meet the following gradation:

SIEVE SIZE	PERCENT RETAINED max
3/8 in.	0
No. 30	3
No. 200	25

921.03.03 Quicklime shall have a combined calcium oxide and magnesium oxide content of 75 percent minimum and a gradation of 100 percent passing the 3/8 in. sieve when tested per C 25.

921.04 EPOXY ADHESIVES. Epoxy resin bonding material shall consist of a thermosetting epoxy resin and a hardener. The individual components of mixed epoxy shall not settle or skin and contain no volatile solvents, lumps, or foreign materials. The epoxy shall meet C 881. Unless otherwise specified, epoxy adhesive used for bearing and expansion pads shall be nonsagging.

The manufacturer shall furnish certification as specified in TC-1.03. The certification or data sheet shall show actual test results for each required property of the type, grade, and class of epoxy submitted, and shall accompany each sample.

The manufacturer shall supply actual bond test results for each batch submitted for use.

921.05 STRUCTURAL TIMBER AND LUMBER. M 168. The manufacturer shall furnish certification as specified in TC-1.03.

921.06 TIMBER PRESERVATIVES. M 133 for Preservatives and pressure treatment.

921.07 CONDUITS.

921.07.01 Metallic Conduit.

MATERIAL	SPECIFICATION
Electrical Metallic Tubing	UL 797
Intermediate Metal Conduit	UL 1242
Rigid Metal Conduit	UL 6
Rigid Steel Conduit, Zinc Coated	ANSI C80.1
Metallic Outlet Boxes	UL 514A
Fittings for Conduit and Outlet Boxes	UL 514B

921.07.02 Nonmetallic Conduit. The manufacturer shall furnish certification as specified in TC-1.03. Each length shall be stamped or embossed with the grade or type and applicable UL or NEMA designation.

MATERIAL	SPECIFICATION
Schedule 40 and 80 Rigid Polyvinyl Chloride (PVC) Conduit	UL 651
Electrical Plastic Tubing (EPT) and Electrical Plastic Conduit (EPC-40 and EPC-80)	NEMA TC 2
Nonmetallic Outlet Boxes, Flush Device Boxes and Covers	UL 514C
Electrical Nonmetallic Conduit (ENC)	NEMA TC 13
PVC Fittings for use with Rigid PVC Conduit and Tubing	NEMA TC 3
Flexible PVC Coated Conduit	UL 360
Liquid Tight Flexible Nonmetallic Conduit for Detector Sleeves	UL 1660

921.07.03 PVC Coated Metallic Conduit. NEMA RN 1. PVC externally coated, galvanized, rigid steel conduit and electrical metallic tubing.

921.08 STRAW BALES. When used for erosion and sediment control straw bales shall meet the Contract Documents and be approximately 14 x 18 x 36 in.

921.09 GEOTEXTILES.

921.09.01 Geotextile Requirements. All geotextiles shall be listed in the National Transportation Product Evaluation Program (NTPEP) for geotextiles. The geotextile shall be manufactured from fibers consisting of long chain synthetic polymers, composed of a minimum 95 percent by weight of polyolefins or polyesters. The fibers shall be formed into a stable network so that the filaments or yarns retain their dimensional stability relative to each other, including selvages. The geotextile shall meet the following:

MARYLAND APPLICATION CLASS		TYPE OF GEOTEXTILE	GRAB STRENGTH lb D 4632	PUNCTURE STRENGTH lb D 6241	PERMITTIVITY sec ⁻¹ D 4491	APPARENT OPENING SIZE, max mm D 4751	TRAPEZOID TEAR STRENGTH lb D 4533
SD	TYPE I	NONWOVEN	160	56	0.50	0.43	55
		WOVEN, MONOFILAMENT	250	90	0.50	0.43	90
	TYPE II	NONWOVEN	160	56	0.20	0.25	55
		WOVEN, MONOFILAMENT	250	90	0.20	0.25	90
PE	TYPE I	NONWOVEN	200	80	0.70	0.43	80
		WOVEN, MONOFILAMENT	250	90	0.70	0.43	90
	TYPE II	NONWOVEN	200	80	0.20	0.25	80
		WOVEN, MONOFILAMENT	250	90	0.20	0.25	90
	TYPE III	NONWOVEN	200	80	0.10	0.22	80
		WOVEN, MONOFILAMENT	250	90	0.10	0.22	90
SE	NONWOVEN	200	80	0.20	0.30	80	
	WOVEN	250	90	0.20	0.30	90	
ST	WOVEN	300*	110	0.05	0.15**	110	
F	WOVEN	100	—	0.05	0.60	—	
E	NONWOVEN	90	30	0.50	0.30	30	

Note 1: All property values are based on minimum average roll values in the weakest principle direction, except for apparent opening size.

Note 2: The ultraviolet stability shall be 50 percent after 500 hours of exposure for all classes, except Class F, which shall be 70 percent (D 4355).

* Minimum 15 percent elongation.

** This is a MINIMUM apparent opening size, not a maximum.

Only those geotextiles that have been tested by NTPEP will be considered candidates for use. In addition, the geotextiles shall meet the Contract Documents and the Geotextile Acceptance and Quality Assurance Procedure, MSMT 732.

Geotextiles used for reinforcement applications shall have a separate approval process.

921.09.02 Seam and Overlap. D 4884. When geotextiles are joined by sewing, the geotextile seam shall meet the following:

- (a) Seams shall be either “J” or “Butterfly” type and shall utilize a lock stitch.
- (b) Seams shall meet the tensile strength requirements for the geotextile when tested across the seam.
- (c) The durability of the thread for seaming shall be at least equal to the geotextile itself.

921.09.03 Securing Pins or Staples. Shall be a minimum 10 in. length and be designed to securely hold the geosynthetic in place during construction.

921.10 POLYETHYLENE (PE) MANHOLES. D 1248, Type III, Class C, Category 3, Grade P34. Working drawings shall be submitted to the Engineer prior to fabrication.

Compressive strength shall be determined per D 2412, modified pipe stiffness test. Pipe stiffness shall be a minimum of 12 psi at 5 percent deflection, including joints. Axial compressive strength shall be a minimum of 10 000 lb at less than 3 percent deflection.

PE manholes for storm drains shall be manufactured with an invert bowl that will not interrupt flow. Manholes for sanitary sewers shall have a factory molded invert for channeled flow.

The manufacturer shall furnish certification as specified in TC-1.03. The certification shall accompany each shipment of PE manholes and show actual test results, the quantity of manhole sections, and date of manufacture. Manholes shall be marked with the manufacturer’s name and trademark.

921.11 PREFORMED FIBERGLASS. Meet the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Density, g/cm, min	D 792	1.25
Absorption, % max	D 570	1.0
Tensile Strength, average of five specimens each direction*, psi min	D 638	10 000
Thickness (unless otherwise specified), in.	—	3/16
Thickness Tolerance, in.	—	+1/16, -0
Color No.	Fed. Std. 595	26622

* Longitudinal and transverse directions.

SECTION 922 — PREFABRICATED EDGE DRAINS

922.01 CERTIFICATION. The manufacturer shall furnish certification as specified in TC-1.03.

922.02 PREFABRICATED EDGE DRAINS. Shall be flexible, rectangular conduit consisting of supporting drainage core encased in a geotextile.

Drainage Core. Material shall be manufactured from polymers having a high resistance to deterioration by pavement deicing salts, petroleum based materials, and naturally occurring soil chemicals. The core shall have sufficient flexibility to withstand bending and handling without damage or significant weakening.

The core geotextile contact point spacing for post and cusped sheet type cores shall not exceed 1.125 in. Elongated pipe core sections shall have a 7.5 in./ft minimum open area to allow lateral flow into the core. Cores with support on only one side shall have a minimum of 5 percent of the area of that support side in unobstructed flow. Drainage core shall meet the following requirements:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Thickness, in. min	—	0.75
Compressive Strength, psi, @ 20% maximum deformation, min	(a)	40
In-plane Flow Rate, gal/min/ft of width, min	D 4716 (b)	15

(a) D 5034 for crushed sheet and post type cores.

D 2412 for elongated pipe type cores.

(b) 10 psi load after 100 hr at a hydraulic gradient of 0.1.

Geotextile Wrap. 921.09, Class SD, Type II.

The fabric shall be bonded to contact points of supporting core for post and cusped sheet type cores to ensure that the geotextile does not sag into the core flow area. The geotextile shall be tightly stretched over the core for elongated pipe type cores.

922.03 FITTINGS. Fittings for the pavement edge drain systems, including, but not limited to end seals, splices, outlets, and shunts shall meet the manufacturer's recommendations and be of sufficient strength to withstand construction handling and permanent loading. All fittings shall be as approved.

922.04 OUTLET PIPE. Pipe for outlets shall be 6 in. minimum diameter and meet Section 905.

SECTION 923 — SLURRY SEAL

923.01 AGGREGATES. Aggregates shall be crushed stone, compatible with the emulsion, and shall meet Section 901.

923.02 MINERAL FILLER. Section 901.

923.03 EMULSIFIED ASPHALT. M 208, Grade CSS-1h, except that the cement mixing test is waived.

Emulsified asphalt shall not separate before placement of SS or LMSS.

923.04 LATEX MODIFIED EMULSION. The latex modifier and other emulsifiers shall be milled into the asphalt cement. The emulsified asphalt shall be modified by the addition of 3.0 ± 0.4 percent latex solids

by weight of the asphalt. The latex modifier shall be an unvulcanized styrene butadiene rubber (SBR) or 100 percent natural latex in liquid form. The manufacturer shall furnish certification as specified in TC-1.03 showing actual test results meeting these Specifications.

923.05 MIX DESIGN APPROVAL. Mix design data shall be submitted to the Engineer for approval at least three weeks in advance of the paving operation. The mix design shall list the ingredients and their proportions as well as the gradation of the proposed aggregate.

The SBR latex modifier shall meet the following:

TEST PROPERTY	SPECIFICATION LIMITS
Styrene butadiene Ratio	24:76 ± 1.5
Solids Content, % min	60
pH, max	6.2
Weight Per Gallon, Wet Basis @ 25 C, lb min Dry Basis @ 25 C, lb min	7.9 4.5

Latex modified emulsion CSS-1h shall meet M 208 modified as follows:

The 100 percent natural latex shall be a high ammonia natural latex meeting D 1076, Type I.

The mix design report shall show test results meeting the following:

TEST PROPERTY	SPECIFICATION LIMITS
MSMT 403, Mixing Test, minutes min	2
MSMT 403, Setting Time, minutes max	30
MSMT 403, Water Resistance	Slight Discoloration
MSMT 403, Wet Track Abrasion, g/ft ² max	75
International Slurry Seal Association (ISSA) TB 139, Set Time Test, 30 minutes, kg/cm min	12

The percent of residual asphalt, based on the dry aggregate weight, shall be between 8.0 and 12.5 for Type II Mix and 7.0, and 11.0 for Type III Mix, each having a control tolerance of ± 1.0 percent.

The Contractor shall submit sufficient material for testing the mix design whenever corroborating information is required by the Engineer.

RESIDUE REQUIREMENTS	
TEST PROPERTY	SPECIFICATION LIMITS
Penetration @ 25 C, min	30
Ductility @ 25 C, min @ 4 C, min	150 100
R and B Softening Point, F, min	140
Cement Mixing Test	Waived

The latex modified emulsion, after standing undisturbed for 24 hours, shall be a uniform color throughout.

923.06 MIX DESIGN. The stability shall be a minimum of 1800 lb and the flow shall be 0.06 to 0.16 in. when tested per T 245, Modified (modification permits air drying of the mixture at 70 to 75 F for a minimum of 24 hours, followed by placement in a 140 F oven and drying to a constant weight prior to reheating and placing in molds).

SECTION 924 — RESERVED

SECTION 925 — DETECTABLE WARNING SURFACES

925.01 GENERAL. The detectable warning surface shall conform to the most recent accessibility guidelines of the Americans with Disabilities Act (ADA). The Office of Materials Technology will maintain a list of pre-qualified products, from which a surface shall be selected. Prior to inclusion on the list of products, the manufacturer's shall submit test results, to the Office of Materials Technology, showing conformance to the table of physical properties as specified in 925.06. In addition, the manufacturer's shall submit complete conforming physical property test results in six month intervals, beyond the date of the original prequalification testing. Materials shall meet certification requirements prior to use on a project. Submit the proposed source of supply, and specific product, to the Engineer, for approval.

925.02 COMPOSITION. The surface shall be either flexible or rigid. The Office of Materials Technology shall be notified of any changes to the composition of a prequalified detectable warning product. In this case, the manufacturer shall re-submit complete test results showing conformance to the table of physical properties as specified in 925.06.

925.03 SIZE. The detectable warning surface shall be 24 in. wide in the direction of pedestrian travel, and extend the full width of the curb ramp, landing, or blended transition.

925.04 CONFIGURATION AND DIMENSIONS. The surface shall consist of a system of truncated domes, aligned in conformance with, and meeting the dimensional requirements of the most recent ADA accessibility guidelines. Each dome shall have a base diameter of 0.9 in. to 1.4 in. a top diameter of 50 to 65 percent of the base diameter, minimum, to 65 percent of the base diameter, and a height of 0.2 in. Arrange the truncated domes in a square grid with center-to-center spacing of 1.66 in. to 2.35 in.

925.05 COLOR. Detectable warning product shall contrast with adjoining surfaces in conformance with current ADA requirements. The color shall be homogenous throughout the surface.

925.06 PHYSICAL PROPERTIES. The detectable warning surface shall meet the following requirements:

PROPERTY	TEST METHOD	SPECIFICATION LIMIT
Slip Resistance Coefficient	C 1028 (dry method)	.80 minimum
Abrasive Wear, index	C 501	150 minimum
Fade (UV) Resistance/Color Retention	G 151/ G 154 (Cycle1)	No fading or change in color after 3000 hours*
Chemical Stain Resistance	D 1308**	No discoloration or staining
Freeze/Thaw Resistance	C 1026	No disintegration
Adhesion/Bond Strength	C 482	No adhesion failure
Contrast	Contrast percentage formula*** using E 1349 to determine cap Y brightness/light reflectance values (LRV)	Current ADA requirement****

*Chromaticity coordinates (CIE system) checked per E 1349, before and after test.

**Immersion Test for acid solution, soap solution, and detergent solution reagents. Spot Test, Open for salts, lubricating oils and greases. Tests shall be conducted at 77 F for durations of 16 hrs.

***Contrast % = $[(B_1 - B_2)/B_1] \times 100$,

where B_1 = (LRV) of the lighter area, and B_2 = (LRV) of the darker area.

****For the purpose of determining whether a material meets acceptable contrast criteria, inserting cap Y brightness of detectable warning surface, and assume a value of 15 for the cap Y brightness of cured concrete, to determine percentage difference. When a detectable warning surface is to be installed on any material other than cured concrete, additional testing will be required to ensure the contrast requirements are met.

925.07 CERTIFICATION. The manufacturer shall furnish certification stating that the detectable warning surface meets all Maryland State Highway Administration specification requirements, and that the surface meets the most recent ADA accessibility guidelines.

With the exception of test results, the certification shall be as specified in TC-1.03.

SECTION 926 THRU 949 — RESERVED

SECTION 950 — TRAFFIC MATERIALS

950.01 PRECAST CONCRETE TRAFFIC BARRIER. As specified in the Contract Documents. Welded wire fabric as specified in 908.05.

950.02 RESERVED.

950.03 REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES. Unless otherwise specified in the Contract Documents, retroreflective sheeting for signs shall meet 950.03.02, .03, or .04. When yellow type III, IV, VI, VII, or IX, is specified in the Contract Documents, fluorescent yellow shall be used. Retroreflective sheeting for channelizing devices shall meet 950.03.02, .03, .04, .05 or .07.

Sign sheeting shall be selected from the QPL. All Retroreflective Sheeting shall meet D 4956.

Sign legend and background sheeting shall be from the same sheeting manufacturer.

950.03.01 Type III Retroreflective Sheeting. D 4956, Type III and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE III SHEETING							
Minimum Coefficient of Retroreflection (R_A) $\text{cd}/(\text{lx} \cdot \text{m}^2)$							
Observation Angle°	Entrance Angle	White	Yellow	Red	Blue	Green	Brown
0.2	+40	100	60	18	7	15	3
0.5	+40	60	45	10	7	10	2.5

950.03.02 Type IV Retroreflective Sheeting. D 4956, Type IV and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE IV SHEETING Minimum Coefficient of Retroreflection (R_A) $cd/(lx \cdot m^2)$ E-810 (Average of 0 and 90 degrees Orientation)							
Observation Angle°	Entrance Angle°	White	Yellow	Red	Green	Blue	Orange
.2	+40	120	80	16	12	9	29
0.5	+40	55	40	10	8	4	14
1.0	+40	9	8	1	0.8	0.5	1

950.03.03 Type IX Retroreflective Sheeting. D 4956 Type IX, and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE IX SHEETING Minimum Coefficient of Retroreflection (R_A) $cd/(lx \cdot m^2)$ Per ASTM E-810 (Average of 0 and 90 degrees Orientation)								
Observation Angle°	Entrance Angle°	White	Yellow	Fluor. Yellow	Fluor. Yellow Green	Red	Green	Blue
0.2	+40	90	70	55	75	26	9.8	4.5
0.5	+40	35	27	15	23	10	3.5	1.5
10.	+40	10	8.8	6	8	3	1.6	0.8

950.03.04 Temporary Traffic Signs (TTS).

- (a) All rigid temporary traffic signs shall be fluorescent orange and meet D 4956, Type VII or Super High Efficiency, Full Cube Retroreflective Sheeting.
- (b) All temporary flexible rollup signs shall be fluorescent orange and meet D 4956, Type VI.

950.03.05 Black Sheeting. Shall be nonreflective.

950.03.06 Drums for Maintenance of Traffic. D 4956 Type VII.

950.04 OVERHEAD SIGN STRUCTURES. Structural steel shall meet A 709, Grade 36. Steel tubes or pipes A 595, Grade A or API 5-LX52. Design and minimum thickness of material shall meet AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. All steel shall be galvanized per A 123. Hardware shall be galvanized per A 153.

950.05 BACKFILL MATERIAL FOR TRENCHES FOR BURIED CABLE. The lower 1 ft depth of trench shall be fine aggregate meeting Section 901. Material above the 1 ft depth shall be select material as specified in Section 916.

950.06 ELECTRICAL CABLE AND WIRE. A standard commercial product manufactured not more than one year prior to the date of the Contract. All cable and wire shall be made of copper.

950.06.01 Direct Burial Cable. A single conductor stranded, with an unshielded, chemically crosslinked thermosetting polyethylene insulation rated for 600 volts. The cable shall be suitable for direct earth burial or installation in ducts or conduit and shall meet UL Type USE, XHHW or THW and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Sizes shall be as specified.

950.06.02 Building Cable and Wire. 600 V, plastic insulated, nylon jacketed and shall meet UL Type THWN/THHN and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Sizes shall be as specified.

950.06.03 Cable Duct. Shall consist of cables preinstalled in either a polyvinyl chloride (PVC) or polyethylene (PE) plastic duct meeting NEMA TC 7 and the NEC. PVC shall meet D 3485. PE duct shall be manufactured from black, virgin, high density PE resin meeting D 1248, Type III, Grade P34, Class C, Category 5. Minimum inside diameter of duct shall be 1-1/2 in. Cable shall be rated for 600 volts.

950.06.04 Ground Wire and Rods. Ground wire shall be bare medium drawn copper. Ground wire shall be of the size (solid or stranded) configuration shown in the Contract Documents. Ground rods shall be 0.75 in. diameter, a minimum of 10 ft in length, with a steel core and copper jacket.

950.06.05 Traffic Signal Cable. Per IMSA Specification 19-1, Conductors shall be stranded No. 14 AWG.

950.06.06 Loop Detector Lead-In Cable. Per IMSA Specification 50-2. Shall be two conductor, No. 14 AWG, PE jacketed.

950.06.07 Loop Detector Wire. Single conductor, 600 V, No. 14 AWG, 19 strand wire in a flexible PE tubing.

950.06.08 Voice Grade Communication Cable. Self-supporting cable shall be solid No. 19 AWG and meet IMSA specification 40-4. Underground cable shall meet IMSA specification 60-2.

950.06.09 Electric Service Wire. Electric service wire for traffic signals, intersection control beacons, hazard identification beacons, and luminaires mounted on traffic signal structures shall have three individual wires. Each wire shall be seven stranded. Electric service wire color identification by spray paint, tape, heat shrink tubing, or any other after manufacturing method is prohibited.

950.07 LIGHTING STRUCTURES. Per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, based on 90 mph wind loads, luminaire weight of 70 lb and luminaire projected area of 3 ft².

Ground mounted lighting structures consist of a one piece, round tapered shaft, a cast steel anchor base for steel structures and a cast aluminum base for aluminum structures, bracket arms, complete with all necessary accessories including anchor bolts, pole top, shims, grounding lug, and handhole.

Steel shafts shall meet A 595, Grade A. After forming and welding, the shaft shall have a smooth finish with only one longitudinal weld and no transverse welds. Steel bracket arms and mounting brackets shall meet A 53, Schedule 40. Structures shall be either mechanically or hot-dipped galvanized. The coating shall meet the thickness, adherence, and quality requirements of A 123.

Aluminum shafts and bracket arms shall be spun from one piece of extruded tubing meeting B 241, 6000 T6 series alloy. The shaft and bracket shall be cold worked to form the required taper.

Each lighting structure shall be provided with a permanent 2 x 4 in. tag fabricated from clear anodized 1/16 in. thick aluminum. The edge shall be smooth with rounded corners and the tag shall fit the lighting structure shaft. Tags shall be secured to shafts by means of four 1/8 in. diameter 18-8 stainless steel round head drive screws or self-tapping screws. The identifying letters or numerals as specified.

950.08 SIGNS. The manufacturer or supplier shall furnish certification as specified.

950.08.01 Sheet Aluminum Sign Panels. B 209, with an anodized mill finish. Alloys shall be either 6061 T6 or 5052-H38.

950.08.02 Extruded Aluminum Sign Panels and Edge Strip. B 221, alloy 6063 T6.

950.08.03 Hardware. Shall be clear anodized, meeting of the following: B 209, alloy 2024 T4; or B 211, alloy 2024 T4, 6262 T9, 6061 T6, 7075 T6 or 2017 T4.

950.09 STEEL SPAN WIRE. A 475, Class C. 1/4 or 3/8 in. diameter and seven wire strand.

950.10 CONDUIT. As specified in Section 805 and 921.07.

950.11 ELECTRICAL CONDUIT DETECTOR TAPE. Consists of one layer of aluminum foil laminated between two layers of inert plastic film. The foil shall be 3 in. wide with a tensile strength of 60 lb. The plastic film shall have a minimum thickness of 4.5 mil.

950.12 LUMINAIRES AND LAMPS. A complete lighting device consisting of a housing, support clamp, reflector, refractor or flat lens, socket, lamp, integral ballast, terminal block, associated hardware, and necessary wiring. All parts of the luminaire shall incorporate the latest ratings and design improvements. Luminaires shall incorporate individual twist lock photoelectric cells when specified. Exposed hardware shall be stainless steel.

950.12.01 Luminaire Construction.

- (a) Bracket arm mounted luminaire housing shall be cast aluminum with natural finish. The housing shall contain and support the reflector, refractor or flat lens, socket, ballast, terminal block, and support clamp. Provisions shall be made for leveling and adjusting the luminaire to the specified transverse and longitudinal position to the roadway.

The refractor or flat lens retaining ring shall be securely latched with an operable hinge made from noncorrodible material.

The reflector shall be of specular polished alzak aluminum or equivalent aluminum reflective surface and be held firmly in the housing but easily removed without the use of special tools.

Silicone rubber, ethylene propylene terpolymer, dacron felt gaskets, or other gasketing materials as approved by the Engineer, shall seal the optical assembly at the socket entry and between the refractor and reflector to make a dust tight optical system. The reflector shall be clean and free from scratches.

Glass for the refractor or flat lens shall be heat resistant, borosilicate glass and shall be free of imperfections. The optical system of the luminaire shall clearly indicate the street side and curb side.

The socket shall be a mogul screw shell with large center contact spring providing a firm contact with the lamp base and have lamp grips to prevent the lamp from loosening. The shell shall be of the skeleton type or shrouded in porcelain. The contacts shall be identifiable. Socket extension adapters will be permitted for special applications when directed. Luminaires providing various ANSI/IES type of distribution by socket adjustment shall also include a means of identification to associate each lamp position with each distribution type. The socket adjustment shall provide positive positioning by means of index holes, lugs, or notches. Slots with infinite settings are prohibited.

The ballast shall be a high power factor, auto regulator type, capable of operating from a multiple circuit and shall operate a high intensity discharge lamp of the type, wattage, and voltage specified. Multitap ballasts shall be provided where supply voltage is 277 volts or less. The ballast shall start the lamp at temperatures as low as -20 F, and shall deliver rated lamp current at circuit voltage variation of plus or minus 10 percent. The primary power factor shall not be less than 90 percent with normal secondary load. The ballast assembly shall be provided with plug in connectors and installed on a hinged door to permit ready interchange of ballast.

Provide glare shields on luminaires where specified or as directed. The glare shield shall cut off the upward component of light but shall not reduce the total output of the luminaire more than 3 percent.

(b) Bridge underpass luminaires shall be a complete lighting device, consisting of a cast aluminum housing, a door with cast aluminum frame, and thermal shock resistant glass refractor attached to the frame with a stainless steel latch, hinges and retaining chain, a specular polished alzak aluminum reflector, a shrouded adjustable porcelain socket, and an integral ballast as

specified above. The refractor and reflector shall direct all useful light well below all normal driver viewing angles to ensure that glare will be at a minimum.

- (c) Sign lighting luminaires shall be of the type specified in the Contract Documents. The refractor shall be permanently sealed to the door assembly with silicone adhesive around its perimeter. The reflector shall be a single piece dieform of sheet aluminum alloy 3002 or as approved, processed to Alcoa Class SI alzak finish. A heavy duty mogul lampholder shall be securely mounted to the reflector with a galvanized steel bracket. The refractor/door assembly shall be nonpermanently sealed to the luminaire housing and reflector assembly with a single piece neoprene gasket to effectively seal the luminaire and locked in place by stainless steel spring-loaded latches. The refractor/door assembly shall open and be held captive by double pivot internally mounted stainless steel hinges, and shall be removable.

Weepholes shall be provided in the bottom of the housing in the lowest area of the luminaire as normally mounted.

The sign lighting luminaire shall be designed to properly illuminate the sign with the lamp source type and size as specified in the Contract Documents. The Contractor shall submit for the approval, working drawings showing locations and aiming angles of luminaires with relation to each of the signs of the various sizes.

950.12.02 Lamps shall be provided for luminaires of the type and wattage specified. Lamps shall be first line, high quality and be as approved. Lamp wattage, horizontal or vertical initial lumens, rated lamp life, and percent of initial lamp lumens at end of rated lamp life shall be as specified or as follows:

TYPE	WATTS	INITIAL LUMENS	RATED LIFE (10 hr/start)	PERCENT INITIAL LUMENS
Deluxe Mercury	175	8 600	24 000	74
Deluxe Mercury	250	12 100	24 000	74
Deluxe Mercury	400	22 500	24 000	60
H.P. Sodium	100	9 500	20 000	74
H.P. Sodium	150	16 000	24 000	74
H.P. Sodium	200	22 000	24 000	72
H.P. Sodium	250	30 000	24 000	73
H.P. Sodium	310	37 000	24 000	72
H.P. Sodium	400	50 000	24 000	73
Metal Halide	250	20 000	10 000	80
Metal Halide	400	40 000	15 000	80

950.13 CONTROL AND DISTRIBUTION EQUIPMENT.

950.13.01 Circuit Breakers. Molded case type having a minimum rating of 10 000 amp interrupting capacity (AIC) and be quick make, quick break, thermal magnetic, trip indicating, and have common trip on all multiple breakers with internal tie mechanism. They shall have the current and voltage ratings and number of poles as specified in the Contract Documents, and be treated to resist fungus and be ambiently compensated for the enclosure and proximity to adjacent breakers. All circuit breakers shall be the bolt in type.

950.13.02 Photoelectric Controls. Solid state, cadmium sulfide type with hermetically sealed silicone rectifier rated 120 V, 60 cycle AC and 1000 watts maximum load. Built in surge protection shall be provided, and a fail safe operating feature shall be included so that the lighting circuits will remain energized in the event the photo control components become inoperative. Nominal operating levels of this control shall turn on at a minimum vertical illumination value of 3 ft-c and turn off at a maximum vertical illumination value of 6 ft-c. These limitations shall be set by the manufacturer, and tolerances of plus or minus 20 percent for the specified value will be acceptable.

Photoelectric controls for luminaires and lighting controls shall be twist lock type. A suitable mounting bracket with locking type receptacle and all other necessary mounting hardware shall be furnished.

950.13.03 Contactors and Relays. Contactors of the current ratings and number of poles specified. They shall be fully rated for all classes of load to 600 V and shall have an interrupting rating of 600 percent of rated current. A HAND-OFF-AUTOMATIC selector switch shall be provided in the photoelectric cell circuit. Relays shall be the type, size, and contact ratings as specified.

950.13.04 Panel Boards. Federal Specification W-P-115 and shall be suitable for operation on the voltage and type service specified. They shall be UL listed and labeled. Panel boards shall be equipped with the number and size circuit breakers specified. Circuit breakers in panel boards shall meet Federal Specification W-C-375 and shall be bolted to copper busses. Buss ratings shall be as specified.

950.13.05 Lightning Arresters. Shall be secondary type, having the specified number of poles and 0 to 650 V RMS. Arresters shall be provided with suitable mounting brackets and all other necessary mounting hardware.

950.13.06 Control Power Transformers. Control power transformers shall be the dry type, two windings, of the size and voltage ratings specified.

950.13.07 Enclosures. Shall meet the NEMA type specified and be dead front type weatherproof metal enclosed self-supporting structures, as specified. Free standing enclosures shall be fabricated from sheet aluminum and be as specified herein. Panel and control equipment cabinets shall be the manufacturer's standard enclosure for the type and application specified. They shall have door clamps, solid neoprene gaskets, welded seams, stainless steel external hardware, and continuous hinges with stainless steel pins. Enclosures shall have two weep holes in the bottom and shall be equipped for padlocking.

950.13.08 Pad Mounted Enclosures. For ventilation, all cabinets shall be provided with louvered vents in the front door with a removable air filter.

- (a) Louvers shall meet the NEMA Rod Entry Test for 3R rated ventilated enclosure.
- (b) Filters for all cabinets shall be 16 in. long, 12 in. wide and 1 in. thick. The filter shall cover the vents and be held firmly in place with top and bottom brackets and a spring loaded upper clamp.
- (c) Exhaust air shall be vented out of the cabinet between the top of

the cabinet and the main access door. The exhaust area shall be screened with a material having a maximum hole diameter of 1/8 in.

950.13.09 Thermostats and Fans. A thermostatically controlled cooling fan shall be provided for all cabinets. The fan and thermostat shall be rated for 125 percent of capacity and shall be mounted at the top of the cabinet.

- (a) Thermostats shall be the inline type, single pole, 120 V, 10 amps with a minimum range of 40 to 80 F.
- (b) The fan shall have a minimum rated capacity of 100 CFM air flow and a minimum rated design life of 100 000 hours.
- (c) The thermostat shall be manually adjustable, within a 10 degree range, from 70 to 160 F.

950.13.10 Disconnect Switches and Utility Connections. NEMA standard KS 1-1990. Disconnect switch enclosure shall be Type 4 stainless steel, with external operating handle, enclosure cover interlock, and external switch mechanism handle with provisions for securing in both the **ON** and **OFF** positions by padlock. The switch mechanism shall be of heavy duty design with quick make, quick break type operations, and visible blades.

The disconnect switch shall be fusible with integral fuse puller. Single phase disconnect switches shall have 2 poles with a solid neutral and shall be rated at 240 V. Three phase disconnect switches shall have 3 poles with a solid neutral and shall be rated at 600 V. The design of the neutral bar may be factory or field installable.

Disconnect switch fuseholders for traffic signals, intersection control beacons, and intersection lighting operating at 120 V shall be single phase 60 amps (fused 35 amps).

Disconnect switch fuseholders for hazard identification beacons and luminaires mounted on traffic signal structures operating at 120 V shall be rated single phase 30 amps (fused 20 amps).

Disconnect switches for lighting control cabinets shall have the same number of poles and amperage rating specified in the electrical service equipment item.

Disconnect switches for electrical service distribution cabinets shall be 200 amp, 2 pole, and single phase.

950.14 ELECTRICAL CABLE AND WIRE CONNECTORS.

950.14.01 Cable Connectors and Connector Kits. For use in lighting structures, hand holes, junction or pull boxes, and for terminating underground cables in lighting structures shall be rated for a minimum of 600 V service. Cable connectors shall be compression type, applied by means of a compression tool. Connectors shall be fabricated from high strength copper alloy. Plated connectors fabricated from metals other than copper are prohibited. Bolted type connectors shall be utilized for splicing bare ground conductors.

950.14.02 Connector Kit Components. Each cable connector kit shall be furnished with all component parts described under the various listed types. Each kit shall contain sufficient silicone compound to lubricate metal parts and the housing for each assembly along with complete installation instructions.

- (a) All housings shall be made of water resistant synthetic rubber suitable for burial in the ground or exposure to sunlight. Each housing shall form a watertight seal around the cable at the point of disconnection and between the insert body and enveloping Y housing.
- (b) All copper pins, sockets, and fuse contacts shall have a minimum conductivity of 90 percent. The crimpable portion shall be fully annealed while the rest of the device is maintained in its original state.
- (c) Plastic sleeves shall be rigid, molded insulating plastic material of sufficient outside diameter to form a watertight fit with its related housing. Wall thickness shall be 0.10 in. maximum, and sleeve lengths of 4 and 7 in. shall be available.
- (d) All fuses shall be rated 600V, 100 000 amps AIC.

950.14.03 Connector Types. Each cable connector kit furnished shall be one of the following types:

- (a) Type I - Unfused, quick disconnect inline connector kit containing:
 - (1) A copper pin crimpable to a conductor.
 - (2) A receptacle having a centrally located, recessed locking socket constructed so that it is filled and retained by its housing and a disposable assembly pin.
 - (3) A plug housing for retention of the copper pin.

- (4) A receptacle housing with disposable protective sleeve.
- (b) Type II - Fused, quick disconnect inline connector kit containing:
- (1) A pair of spring loaded copper fuse contacts suitable for gripping the specified cartridge fuse. One contact shall be crimpable on a conductor and after insertion into its proper position within the load side plug housing, be capable of being securely retained therein. The other contact shall be preassembled for retention within the line side of the connector body.
 - (2) A load side housing permanently marked "Load Side".
 - (3) A disposable assembly pin.
 - (4) A fuse of the specified amp rating.
- (c) Type III - Fused, quick disconnect Y connector kit containing:
- (1) A pair of spring loaded copper fuse contacts suitable for gripping the specified cartridge fuse. One contact shall be crimpable on a conductor and after insertion into its proper position within the load side plug housing, be capable of being securely retained therein. The other contact shall be preassembled for retention within a Y insert body.
 - (2) A line side Y housing with two water seal cable ports.
 - (3) Two terminal lugs, each having a mounting hole.
 - (4) A bolt and a self-locking nut.
 - (5) A Y insert body with preassembled line side fuse contact and a ring tongue terminal.
 - (6) A load side plug housing permanently marked "Load Side".
 - (7) A disposable assembly pin.
 - (8) A fuse of specified amp rating.
- (d) Type IV - Unfused, quick disconnect Y connector kit containing:
- (1) A copper pin crimpable to a conductor and suitable for retention in the load side receptacle housing.

- (2) A Y insert body with preassembled load side copper socket and ring tongue terminal.
- (3) A line side Y housing with two water seal cable ports.
- (4) Two terminal lugs, each having a mounting hole.
- (5) A bolt and self-locking nut.
- (6) A load side receptacle housing.

950.15 TRAFFIC SIGNAL HEADS. Pedestrian signal indications and vehicular signal heads shall meet the Institute of Transportation Engineers (ITE) Specifications.

- (a) All materials shall be clean, smooth, and free from flaws, cracks, blowholes, and other imperfections.
- (b) Signal heads shall be furnished with the section assembled together including all hardware as specified in the Contract Documents.
- (c) All metallic signal head hardware shall be stainless steel material.
- (d) Vehicular, optically-programmed and pedestrian signal heads shall be capable of mating to the same type of the signal heads from either the top or bottom of each housing.
- (e) All hardware furnished shall be installed on the corresponding fitting and threaded component.

Mounting hardware shall meet the following:

ITEM	DESCRIPTION	A	B	C	D
1	Aluminum Alloy - Casting	A 319	A 380	A 713	6063 T6
2	Yield Strength, ksi	18	23	25	25
3	Tensile Strength, ksi	27	47	35	30
4	Brinell Hardness	70	80	75	73
5	Elongation (% in 2 in.)	1.5	4	3	12
6	Stainless Steel	A 316	-	-	-
7	Galvanized Steel	A 157	A 153	G 60	-
8	Steel-Flat Sheet	16 gauge	-	-	-
9	Coating	*	Anodized Finish	-	-

*Using Federal Standards 595, the signal head housing shall be yellow meeting Color Chip No. 13538. The signal head door and visor shall be optical flat (dull) black, Color No. 37038. Aluminum signal heads shall be painted using fusion bonded polyester coating method.

Hardware.

Hub plate shall meet A, 1 thru 5 and 9B.

- (a) Span wire hanger clamp shall meet C, 1 thru 5.
- (b) Balance adjuster shall meet 6A, 7A, and 7B.
- (c) 2-way lower arm shall meet 7C and 8A.
- (d) 2-way tri-stud arm shall meet A, 1 thru 5.
- (e) Span wire entrance fitting shall meet C, 1 thru 5.
- (f) Mast arm mount signal bracket (1-way, 2-way, and 5-section) shall meet 1A and 1D.
- (g) Side pole upper and lower arm assembly shall meet 1B thru 5B or 1D thru 5D.

Vehicular Signal Heads and Pedestrian Signal Indications Housings and Doors.

- (a) Aluminum signal head housings and doors shall be die-cast aluminum as specified in the ITE Vehicle Traffic Control Signal Head Specification.
- (b) Dual hinge-latch mechanisms shall be mounted on the signal head housing and not the signal head door.

Captive door latch mechanisms (one for 8 in. and two for 12 in. vehicular signal heads, and one for 9 in. and two for 12 in. pedestrian signal indications) shall secure the door to the housing by use of stainless steel eyebolts and wing nut assemblies.

- (c) All openings to the housing interior shall be provided with a gasket meeting the physical properties listing in UL 508 and that forms a weather tight seal.

Visors.

- (a) Visors shall be as specified in the ITE Vehicle Traffic Control Signal Head Specification and shall be tunnel type. Visors shall be 10 in. deep for 12 in. vehicular signal heads, 8 in. deep for 8 in. vehicular signal heads, 9 in. deep for 12 in. pedestrian signal indications, and 9.5 in. deep for optically programmed signal heads.
- (b) Visors shall be secured to the signal head door by a minimum of four screws mounted perpendicular to the face of the signal head door.
- (c) Visors for aluminum vehicular signal and pedestrian signal sections shall be made from aluminum alloy sheet. Visors for polycarbonate signal sections shall be either formed from sheet plastic or assembled from one or more injection, rotational, or blow-molded polycarbonate sections.

Optical System. Vehicular and pedestrian traffic control signal indications shall meet the following.

- (a) **Signal Head Lamps.** Approved by the Office of Traffic and Safety.
- (b) **Reflector.** Shall be made of aluminum.

Reflector support assembly shall be die cast aluminum, separate from the reflector and fully encompass the periphery of the reflector.

Reflector support assembly shall be spring hinged to allow access to the rear of the signal head main body without the use of tools.

- (c) **Lens.** Shall be standard (ball) red, yellow, or green, or specified arrow red, yellow, or green traffic signal lens.

The lens shall be glass.

Directional arrow lenses shall have the same brilliance, regardless which direction they are positioned in the signal face.

The lens shall fit into a one-piece slotted neoprene lens gasket designed to provide a weather resistant fit to the housing door. Lenses shall be secured by a flat clip/screw design fastened from the inside of the signal head door perpendicular to the face of the door. The flat clip/screw design shall not pass through the lens itself.

All pedestrian signal heads shall provide the messages of “walk” and “don’t walk” in the international walking person and the raised hand symbols.

Optical System for Optically Programmed Signal Heads.

- (a) The indication from the lens shall meet the requirements of ITE transmittance and chromaticity standards.
- (b) Optically programmed signal heads shall have an optical system containing a color filter, lamp fixture, lamp collar, optical limiter/diffuser, and objective lens.
- (c) Lamp fixtures shall be comprised of a separately accessible housing and integral lamp support, indexed ceramic socket, and self-aligning and quick release lamp retainer. Electrical connection between case and lamp housing shall be accomplished with an interlock assembly that disconnects the lamp holder when opened.
- (d) The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 900 to 1200 ft distance and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be composed of heat-resistant glass.
- (e) Optically programmed signal heads shall utilize incandescent PAR type lamps. The lamp shall be coupled to the diffusing element.

The diffusing element may be discrete or integral with the convex surface of the optical limiter.

- (f) The objective lens shall be a high resolution annular incremental lens hermetically sealed within a flat laminate of weather resistant acrylic or as approved by Office of Traffic and Safety. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about its axis without displacing the primary image.

Electrical.

- (a) The entire signal head assembly shall be either listed or labeled by a Maryland State Fire Marshall or a recognized electrical inspection agency.
- (b) Wiring connections at the lamp socket shall lock and not be of the male/female demountable type.
- (c) A unitized bail wire with integral spring shall secure the socket to the rear of the reflector. The lamp socket shall have a serrated base to permit locking.
- (d) Each single section and the middle section of three section signal heads shall have a minimum of a six section, twelve position terminal block capable of accepting three number 14 AWG spade terminal ends. The top section of two section pedestrian signal indications shall be furnished with a minimum of five section, ten position terminal blocks capable of accepting three number 14 AWG spade terminal ends.
- (e) Optically programmed signal heads shall not contain a resistance device for use as an intensity controller with integral means for regulating its intensity between limits as a function of individual background illumination.