§602

Section 600
INCIDENTAL CONSTRUCTION

SECTION 601 (VACANT)

SECTION 602 - REHABILITATION OF CULVERT AND STORM DRAIN PIPE

602-1 DESCRIPTION. Rehabilitate culvert and storm drain pipe in accordance with these specifications, the contract documents, and as directed by the Engineer.

602-2 MATERIAL REQUIREMENTS.

602-2.01 General. Materials requirements are specified in the following subsections:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement Concrete</td>
<td>501</td>
<td>Tunnel Liner Plate (relining)</td>
<td>707-05</td>
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<tr>
<td>Shotcrete</td>
<td>583</td>
<td>Steel</td>
<td></td>
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<tr>
<td>Concrete Repair Material</td>
<td>701-04</td>
<td>Aluminum</td>
<td>707-13</td>
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<tr>
<td>Vertical Overhead Patching Material</td>
<td>701-08</td>
<td>Corrugated Aluminum Pipe</td>
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<tr>
<td>Grout Sand</td>
<td>703-04</td>
<td>Corrugated Aluminum Structural</td>
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<tr>
<td>Polyester Formed In Place Pipe Liner</td>
<td>706-06</td>
<td>Plate for Pipe and Pipe Arches</td>
<td>707-14</td>
</tr>
<tr>
<td>PVC Pipe (relining)</td>
<td>706-10</td>
<td>Anchor Bolts for Corrugated Culverts</td>
<td>707-20</td>
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<tr>
<td>(Profile Wall)</td>
<td></td>
<td>Zinc Chromate Primer</td>
<td>708-04</td>
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<tr>
<td>(Corrugated)</td>
<td></td>
<td>Membrane Curing Compound</td>
<td>711-05</td>
</tr>
<tr>
<td>High Density Polyethylene Pipe (relining)</td>
<td>706-11</td>
<td>Coal Tar Epoxy Paint</td>
<td>SSPC-16</td>
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<td>(Profile Wall)</td>
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<td>(Smooth Wall)</td>
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<td>Corrugated Steel Pipe (Concrete Lined)</td>
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<tr>
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<tr>
<td>(Polymer Coated)</td>
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Materials referencing SSPC will be accepted on the basis of Manufacturer’s certification.

602-2.02 Fill Material for Annular Space. Design the fill material for the annular space between the existing and new liner pipe in accordance with the pipe Manufacturer’s recommendations. Calculate the required fill material based on the existing culvert/storm drain internal diameter (minus deformations) and the external diameter of liner pipe.

602-3 CONSTRUCTION DETAILS. Provide the Engineer with written details of how the work is to be progressed a minimum of 10 days prior to starting. Include pipe manufacturer’s instructions, dewatering, assembly drawings, necessary insertion and bracing methods, and proposed shotcreting, concrete, and void filling methods.

602-3.01 Existing Pipe Preparation. Dewater, clean and inspect the existing pipe. Determine the location of and remove obstructions that may prevent proper installation of the paving or the relining material. Locate holes and perforations and hammer sound the interior walls of the existing pipe to identify all voids around the pipe’s periphery. For small inaccessible pipes, generally less than 1200 mm in diameter, sounding is not required; use a closed circuit television and camera to provide a visual inspection. Fill all voids within 300 mm of the existing pipe’s circumference. Provide strutting and bracing as required to insure stability of the pipe. For small inaccessible pipes, less than 1200 mm in diameter, preliminary filling of voids in the existing pipe’s periphery is not required.
§602-3.02 Handling & Installing Relining Materials

**A. General.** Install each run of pipe with the same material for the entire run unless otherwise identified in the contract documents or approved by the Engineer. Do not allow water to flow along the invert during concrete or fill material placement.

**B. Paving Inverts with Concrete.** Apply §603-3.07 Concrete Paving for Corrugated Structural Plate Pipe.

**C. Lining with Shotcrete.** Apply the requirements of Section 583, Shotcrete with the exception of the following:

- The application is not limited to repair of concrete surfaces. Corrugated metal pipe is another material that can be shotcreted.
- Apply 50 mm minimum over the crests of the corrugations.

**D. Lining with Polyester Formed-in-Place Pipe Liner.** Provide the Engineer with written design details and calculations for determining the thickness of the cured-in-place-pipe (CIPP), the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube.

Use a liner with the following criteria:

- One or more layers of flexible needled felt or an equivalent material as approved by the Materials Bureau.
- Be flexible enough to fit irregular pipe sections and be able to negotiate pipe bends.
- Use a plastic coated outside layer that is compatible with the resin system.
- Must use either a styrene based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible to the inversion system being used.
- Vacuum impregnate the tube with the resin and use a volume of resin that fills all voids in the tube material at nominal thickness and diameter. Adjust the volume by adding a minimum of 5% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

1. **Installation.** A cured-in-place-pipe (CIPP) may be installed by either a hydrostatic head or air pressure inversion system. Maintain the pressure between the minimum and maximum during the inversion process and a continuous record of the pressure during the cure period. If the pressure deviates such that it is outside the range of the minimum and maximum pressure, remove the installed tube from the conduit.

   a. **Hydrostatic Head.** Insert the tube into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, turn the tube inside out and attach it to the standpipe thereby creating a leakproof seal. Apply a hydrostatic head to fully extend the liner to the next designated manhole or termination point. Insert the tube into the vertical standpipe. Do not over-stress the felt fiber during the inversion process. Alternative methods using a hydrostatic head will be subject to approval of the Engineer.

   b. **Air Pressure.** Connect the tube to the upper end of the guide chute to create a leak proof seal with the impermeable plastic membrane side out. Turn the tube inside out as it enters the guide chute. Adjust the inversion air pressure to cause the impregnated resin tube to invert from point to point and to hold the tube tight against the pipe wall to produce dimples at the side connections.

2. **Curing.** Cure the liner with heated water circulated throughout the section so as to uniformly raise the temperature above that required to cure the resin. Monitor the temperature of the incoming and outgoing water supply from the heat source to the circulating equipment. Initial cure occurs during temperature heat-up and is considered complete when the remote temperature sensor indicates the temperature has reached the Manufacturer’s recommendation for the initial
resin cure. After reaching the initial cure temperature, raise and hold the temperature to the post-cure temperature as recommended by the Manufacturer.

Cool the liner to a temperature of 38°C before relieving the static head in the inversion standpipe. Cool-down may be accomplished by adding cool water to the inversion standpipe to replace warm water being drained from a small hole made in the downstream end. Alternative methods of curing will be subject to approval of the Engineer.

3. Workmanship. The finished pipe liner should be continuous over the entire length of an inversion run and be free of dry spots, lifts and delaminations. If any dry spots, lifts and delaminations exist, remove the liner in those areas. Mark a line 1 m from both ends of the distressed area, cut the distressed area out, and replace it to the satisfaction of the Engineer. If the Cured-In Place-Pipe (CIPP) does not fit against its termination point, seal the space between the pipe and liner with a resin mixture compatible with the CIPP.

4. Storm Drain Lateral Connections. Reconnect the existing storm drain lateral connections after the liner has cured in place. Use robotic cutting devices to reestablish tie-ins in non-man entry pipes.

E. Lining with a new Liner Pipe. Liner pipe sections may be pushed or pulled into place. Prior to relining, install skids or place a concrete or grout bed in the invert. Finish the bed to the specified line and grade depicted in the contract plans, and taper the edges to allow the annular fill material to flow freely in the space between the liner pipe and the bed. If installing skids, use 2 m lengths staggered to allow the annular fill material to flow beneath and around the liner pipe. Secure the skids to the invert of the existing pipe such that the bottom of the liner pipe does not drag along the invert during relining, or the skids may be welded or banded to the liner pipe’s exterior in a manner approved by the Engineer. Before relining, pull or push a single piece of liner through the pipe to verify liner clearance.

Follow the Manufacturer's instructions for handling and assembling the pipe, except as modified in the Contract Documents or as directed by the Engineer. Brace the liner against the existing pipe such that it maintains line and grade during filling of the annular space. Place the bracing so as to allow unimpeded flow of fill material into the entire annular space. Secure the liner before filling the annular space.

When required, reconnect existing storm drain lateral connections by utilizing an open cut excavation, internal connection or remote installation using robotics. Prior to filling the annular space connect and seal all laterals between the new liner pipe and the existing lateral.

Fill the entire annular space. Provide a minimum annular space of 25 mm for fill material between the new and existing pipes, and details on how to hold the liner pipe to line and grade until the fill material has set.

If the actual fill material used is less than the anticipated (calculated) fill or an inspection of the relined culvert indicates that there are voids in the annular space, the Contractor must provide the EIC with a plan to correct voids found. Depending on the location and size of the voids, additional grouting may be required in these areas. This may be accomplished by re-grouting in those areas within the culvert. The voids must be filled to the satisfaction of the Engineer at no additional cost to the state.

1. Lining with Polyethylene Pipe. Prior to relining, install skids or place a concrete or grout bed as per §602-3.02 E. Lining with a new Liner Pipe.

Reline with Smooth Wall Polyethylene Pipe or Profile Wall Polyethylene Pipe. Insert one end of the liner into the existing pipe leaving approximately 1.5 m outside. Place the opposing end of the second section against the exposed end of the first section. Assure that the two sections are in alignment and have the same slope.

Install a gasket on the male end of the liner pipe. Pull the couplings together until the female and male ends are locked together. Install joined liners into the culvert and repeat until completely lined.
§602

Install all pipe, fittings, adapters and appurtenances according to the Manufacturer’s recommendations. Limit joint separations to less than 12 mm between adjoining sections. Field cuts will be permitted only at the terminal ends. No pipe length less than 1 m will be allowed.

Perform all butt fusion, welding and extrusion welding of HDPE pipe in accordance with the Manufacturer’s recommendation. Have a Manufacturer’s representative present during any fusion or welding operations.

2. Lining with Corrugated Metal Pipe. Use Corrugated Aluminum Pipe, Aluminum-Coated (Type 2) Corrugated Steel Pipe, Concrete Lined Corrugated Steel Pipe, or Polymer Coated Corrugated Steel Pipe. Apply zinc-chromate primer, or an equivalent as approved by the Materials Bureau, to all aluminum surfaces that will come in contact with concrete or grout.

Prior to relining, install skids or place a grout bed as per §602-3.02 E. Lining with a new Liner Pipe.

Insert and brace the liner pipe to the specified line and grade, and align adjacent pipe sections such that port holes, if used, are placed as detailed in the contract plans (Alignment bolts are not adequate bracing by themselves). Sever all alignment bolts not fully turned out and grind them flush to the new pipe interior. If port holes are used, provide fittings and plugs compatible with the delivery equipment. Insert the plugs into the fittings as the operation is completed. Limit joint separations to 12 mm between adjoining sections. To insure that fill material remains in the annular space, place internal expanding joint bands with annular corrugations and foam gaskets at each joint. Before filling the annular space brace, strut the bands. Remove the bracing and struts upon completion of this work.

3. Lining with Polyvinyl Chloride Pipe. Prior to relining, install skids or place a concrete or grout bed as per §602-3.02 E. Lining with a new Liner Pipe.

Reline with a Profile Wall PVC Pipe or Corrugated Wall PVC Pipe with integral bell and spigot joints.

Place a nose cone over the leading pipe spigot to protect the edge as it is pulled or pushed through the culvert. Use a pushing or pulling ring/plate to install the liner. Monitor the jacking and pushing loads in accordance with the Manufacturer’s specifications and guidelines.

4. Lining with Corrugated Aluminum Structural Plate Pipe. Prior to relining, install skids or place a concrete or grout bed as per §602-3.02 E. Lining with a new Liner Pipe. Apply zinc-chromate primer, or an equivalent as approved by the Materials Bureau, to the entire exterior surface of the pipe.

Submit fabrication details, including assembly drawings, pipe insertion methods, and bracing details, to the Engineer.

Align adjacent pipe sections such that port holes, if used, are placed as detailed in the contract plans. If port holes are used, provide port hole fittings and plugs compatible with the delivery equipment. Insert the plugs into the fittings as the grouting operation is completed. Alignment bolts are not adequate bracing by themselves. Sever all alignment bolts not fully turned out and grind them flush to the new pipe interior. Do not impede the flow of fill material into the annular space with bracing material.

5. Lining with Steel or Aluminum Tunnel Liner Plate. Install two flange liner plates. Use a lap type longitudinal seam. Fabricate the lap to allow a continuous cross section of the plates through the seam. Use an offset depth equal to the metal thickness for the full width of plate, including flanges. Drilling, punching or drifting to correct defects in manufacturing will not be permitted. Plates with improperly punched holes will be rejected.

Use 5 bolts per 450 mm width of plate in each lapped longitudinal joint and stagger the bolts in the ridges and valleys. Follow the Manufacturer’s recommendation for circumferential and longitudinal bolt spacings.

602-3.03 Damaged Pipe and Repair. Repair any damage to the existing pipe caused by the relining operation consistent with Section 603 Culverts and Storm Drains.
602-4 METHOD OF MEASUREMENT

602-4.01 Relining with new pipe. This work will be measured as the number of meters along the bottom centerline, measured to the nearest meter.

602-4.02 Paving inverts. This work will be measured as the number of square meters, determined by the paved width measured along the pipes circumference and the length along the centerline of the pipe measured to the nearest square meter.

602-4.03 Shotcreting. This work will be measured as the number of square meters, determined by the shotcreted width measured along the pipes circumference and the length along the centerline of the pipe measured to the nearest square meter.

602-5 BASIS OF PAYMENT. Include the cost of furnishing all labor, materials, and equipment necessary to complete the work in the unit price bid. Include the cost of all fill material needed to fill the annular space between the existing pipe and the liner pipe, and the removal of any obstructions, intrusions or damaged pipe prior to relining. The quantity of fill material required to fill voids beyond 300 mm outside of the existing pipe’s circumference will be paid under a separate item.

For Paving Inverts and Shotcreting, include the cost of furnishing all labor, materials and equipment necessary to complete the work for the unit price bid and include all necessary preparations to the existing pipe.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>602.2001</td>
<td>Paving Inverts with Portland Cement Concrete</td>
<td>Square Meter</td>
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<tr>
<td>602.2101</td>
<td>Lining Culvert with Shotcrete</td>
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<td>Lining with Polymer Coated CSP 12ga, (75x25) or (125x25)</td>
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Refer to Contract Proposal for full Item Number and full description.

SECTION 603 - CULVERTS AND STORM DRAINS

603-1 DESCRIPTION. Construct culverts and storm drains in accordance with these specifications, the contract plans, and the appropriate standard sheets.
603-2 MATERIALS

603-2.01 General. Materials requirements are specified in the following subsections:

- Geotextile
- Portland Cement Concrete
- Portland Cement
- Masonry Cement
- Concrete Repair Material
- Mortar Sand
- Non-Reinforced Concrete Pipe
- Reinforced Concrete Pipe
- Reinforced Concrete Elliptical Pipe
- Reinforced Concrete End Sections
- Smooth Interior Corrugated
- Polyethylene Pipe
- Corrugated Steel Pipe (Non-Pressure)
- Corrugated Structural Steel Plate for Pipe, Pipe-Arches and Underpasses
- Galvanized Steel End Sections
- Aluminum End Sections
- Corrugated Aluminum Pipe
- Corrugated Aluminum Structural
- Plate for Pipe and Pipe-Arches
- Anchor Bolts for Corrugated Culverts
- Zinc Chromate Primer
- Wire Fabric for Concrete
- Plastic Coated Fiber Blankets
- Membrane Curing Compound
- Water

603-3 CONSTRUCTION DETAILS

603-3.01 Excavation. Apply the requirements specified in Section 206, Trench, Culvert and Structure Excavation, except as modified by the Contract Documents or as directed by the Engineer.

603-3.02 Laying Pipe

A. General. Lay all pipe in close conformity to line and grade having a full, firm and even bearing at each joint and along the entire length of pipe. Lay all pipe beginning at the downstream end and progress upstream. Use the same material in each run of pipe unless otherwise directed by the Engineer.

B. Handling and Assembly of Pipe. Follow the Manufacturer’s instructions or approved Materials Details except as modified on the Contract Plans or as directed by the Engineer.

C. Bell and Spigot Type Pipe. Lay all pipe with the bells upstream. Where the spigot end of an existing pipe does not fit the bell end of a new pipe, construct a concrete collar as shown on the Standard Sheets. Fill the bottom half of the space on the inside of the pipe between the existing spigot and the new bell with an approved concrete repair material (§701-04). Alternate designs may be submitted to the Director, Materials Bureau, for approval.

Where the spigot end fits into the bell end and the clearance is so great as to render the elastomeric gasket or preformed sealer ineffective, join the pipe by caulking a gasket of jute or oakum into the joint space and then fill with mortar of equal parts of Portland Cement and Mortar Sand or a preformed or poured caulking compound of a type approved by the Engineer.

D. Round Corrugated Metal Pipe and Pipe-Arches. Place steel or aluminum pipe with longitudinal seams located at the sides. Place circumferential seams with laps in the downstream direction so flow of water is directed over instead of under each succeeding downstream section.

E. Corrugated Structural Plate Pipe and Pipe-Arches. Assemble the plates for corrugated steel or aluminum structural plate pipe and pipe-arches to form the circular pipe or pipe-arch cross section as defined by the pipe manufacturer.

For metal pipe arches, install the bolts nearest the visible edge of the lapped joint in the valley at the top of the corner plate of the corrugations. Cover the joint with the top of the corner plate on the outside of the structure with a geotextile conforming to Geotextile Underdrain from the Department's
Materials Bureau Approved List. Extend the covering a minimum of 300 mm beyond each side of the joint for its entire length. A minimum of 300 mm is required for any longitudinal lap.

**F. Polyethylene Pipe.** Handle, store and assemble all pipe in accordance with the Approved Materials Details except as modified in the Contract Documents or by the Engineer. Joint misalignment resulting in offsets greater than 6 mm or joint separations greater than 13 mm between adjoining sections of pipe will not be allowed. Field cuts are permitted only at the terminal ends and with a minimum pipe length of one (1) meter.

**G. Corrugated Metal End Sections.** Assemble all pipe end sections in accordance with the Contract Documents or as approved by the Engineer.

**H. Thickness Measuring Equipment.** Prior to laying any pipe, provide the Engineer with equipment to measure gauge and steel coating thickness. Gauge shall be measured with a micrometer caliper. Measure steel coating thickness with a Type II Fixed Probe Magnetic Gauge meeting the requirements of Steel Structures Painting Council Specification SSPC-PA2. When the Engineer verifies the required gauge and coating thickness the pipe may be laid. Micrometer calipers and Type II probes shall remain the property of the Contractor.

**603-3.03 Bedding and Backfilling Pipe.** Apply the standards of 203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits, and Direct Burial Cables and the appropriate NYSDOT Standard Sheets. Select Granular Fill used to backfill around aluminum or aluminum coated pipes will be free of portland cement unless the pipe sections are thoroughly coated with Zinc Chromate Primer, §708-04 or an equivalent alternative as approved by the Materials Bureau. 100% of the Select Granular Fill used around Type IR and IIR corrugated aluminum pipe must pass a 50 mm sieve.

**603-3.04 Damaged Pipe and Repair**

**A. General.** Repair, realign or replace pipe that is damaged or disturbed through any cause occurring prior to acceptance of the contract. Pipe which is defective, and determined by the Engineer as unrepairable, will be unacceptable for installation and shall be replaced as directed by the Engineer at no cost to the State.

**B. Concrete Pipe.** Repair concrete pipe in accordance with the requirements set forth in §706-02 Reinforced Concrete Pipe. The repairs will be acceptable if they are sound, properly finished and cured, as determined by the Engineer, and the repaired pipe conforms to the requirements of the Contract Documents.

**C. Damaged Bituminous Coating and Paving.** Damage to bituminous coating shall be repaired with asphalt repair material. The repair material shall appear on the Department's Approved List. Damage to bituminous paving shall be repaired by an application of the original hot material for areas 0.2 m² or less in each pipe section. Damage to bituminous paving in areas greater than 0.2 m² in a pipe section will cause for rejection of that section.

**D. Polyethylene Pipe.** Polyethylene pipe with damaged ends may be incorporated into the work at terminal locations provided the damaged portion is totally removed by the field cut. Repair or replacement of pipe that is disturbed, damaged or misaligned must provide the same product as a new pipe installation, as determined by the Engineer. After backfilling operations are complete, inspect the pipe for deflection. No more than 5% deflection of the internal diameter will be allowed. If this is exceeded, the pipe will be rejected and removed at the Contractor's expense.

**603-3.05 Field Strutting of Corrugated and Structural Plate Pipe.** Field strutting of corrugated metal pipe and structural plate pipe may be done at the Contractor's option and expense to provide added protection from construction equipment and other loads during installation, backfilling and filling above the pipe. The method and scheduling of installation and removal of strutting, must be approved by the
Engineer. Field strutting shall constitute installation of structurally sound timber sills, compression caps and struts.

603-3.06 Joints

A. Corrugated Metal Pipe. Use corrugated band field connections for corrugated metal pipe and pipe arch connections. Lap the band on equal portions of each culvert section to be connected. All connections shall be an approved type, fabricated and installed so that a secure and firm pipe connection may be readily made in the field. Thoroughly coat all aluminum or aluminum coated field connections in contact with concrete with Zinc Chromate Primer §708-04 or an equivalent alternative as approved by the Materials Bureau and permit to dry prior to concrete placement.

B. Structural Plate Pipe. Assemble plates for structural plate pipe and pipe arches with joints staggered such that not more than three (3) plates come together at any one point. Tighten all nuts for field or shop assembled plates to at least 200 but not more than 400 N\cdot m of torque, before filling and backfilling are commenced. Supply the Engineer-in-Charge with an approved torque wrench.

C. Concrete Pipe. For round concrete pipe, use flexible water-tight elastomeric gaskets. For elliptical pipe and cattle pass use concrete pipe joint sealing compound meeting the requirements of §705-16. Install all sealants at the time the pipe is being laid to line and grade.

To detect leakage in the finished installation, internal pressure tests will be required in concrete pipe only when specified in the Contract Documents. If a leakage test is required, use an exfiltration test between consecutive manholes. Perform the test by filling the pipe with water to a height 600 mm above the top of the pipe at the upstream manhole and allowing the pipe to remain saturated for a period of 72 hours prior to checking for leakage. No more than 23 L/m of pipe diameter per meter of pipe length in a 24 hour period will be allowed.

Where a culvert or a storm drain system is open at either one or both ends, with or without end sections, use a minimum of 2300 mm. Round pipe less than 600 mm in diameter, elliptical pipe, and larger diameter round pipe beginning with 1675 mm diameter where the weight of the pipe section requires a shorter length shall have a minimum length of 1800 mm.

Shorter sections will be permitted where they are required to obtain an exact length of culvert. Use of shorter sections requires approval by the Engineer. For closed storm drain systems, drains having structures such as drop inlets on each end, the length of sections is unspecified.

Connect the first three full sections at the open end(s) of a culvert or storm drain system together to restrain movement of the sections. A full section is defined as a section with a minimum laying length of 2300 or 1800 mm as defined in the preceding paragraph. An end section is considered as the first section. If a short section is used at the end or within the first three full sections of a culvert, connect it together with the first three full sections.

Use a device at the springline on each side of the pipe to restrain the sections from movement. Use a device at least 3600 mm in length when using 2300 mm minimum length pipe sections and at least 3000 mm in length when used with 1800 mm minimum length sections. Securely anchor the devices to the pipe, with minimum slack in the device and the joints. Locate anchoring points a minimum of 450 mm from the end of the pipe sections and the flared end sections. Anchor each end of the device with a 25 mm diameter bolt with a nut and washer, or its equivalent, through the section wall. Apply ANSI B 18.2.1, ANSI B 18.2.2 and ANSI B 27.2, Grade A or B respectively for all nuts, bolts, and washers. For all round pipe 1300 mm in diameter and smaller, and/or equivalent diameter elliptical pipe use a steel strap for the restraining device conforming to ASTM A36 with a minimum width of 57 mm, 6 mm minimum thickness with 30 mm maximum diameter holes centered 38 mm from each end. For pipe larger than 1300 mm in diameter and for cattle pass, the requirements for the restraining devices will be shown on the contract plans. Apply the requirements of §719-01, Galvanized Coatings and Repair Methods: Type I for straps and Type II for nuts, bolts, and washers for the steel strap and anchoring hardware.

Alternative designs of the restraining device and anchoring hardware will be considered for approval by the Director of the Materials Bureau if they provide equivalent restraining properties and durability.
Restraining devices may be placed on either the inside or outside of the pipe. If placed on the inside, the device shall not protrude from the wall to the degree where flow would be obstructed. Only cold bending of the restraining device is allowed. Holes in the pipe and end sections required for the anchor bolts may be drilled in the field.

**D. Ductile Iron Pipes.** Form joints by caulking a gasket of jute or oakum into the hubs and then filling with mortar consisting of equal parts of Portland Cement Type I or Type II, Mortar Sand, or at the Contractor's option, a preformed or poured caulking compound of a type approved by the Engineer. For sanitary sewer systems, apply the joint requirements of ASTM C425.

**E. Polyethylene Pipe Connections.** Manufactured ends shall be used for joint assemblies; no field cuts are permitted unless approved by the Engineer. No separations greater than 13 mm are permitted between adjoining sections of pipe. Use only appropriate fittings for lateral connections supplied by the pipe manufacturer and shown on the standard sheet titled, “Drainage Structure Details” except that the pipe shall protrude 50 mm into the basin to provide a 45° battered grout seal. Apply the battered grout seal to both the interior and exterior faces of the basin.

**F. Dissimilar Metal Pipe Connections.** Use a sleeve gasket when joining corrugated pipe or end sections to pipes or end sections fabricated of dissimilar metals between the pipe(s) and the coupling band. Keep the ends apart, to prevent electrical contact between the dissimilar metals. Apply the requirements of AASHTO M36 for all gaskets.

**G. Breaking into Existing Drainage Structures.** When breaking into existing drainage structures to make a pipe connection remove only the minimum amount of material from the wall of the structure. After inserting the pipe, fill the cavity between the pipe exterior and the wall of the drainage structure with mortar made from mortar sand, masonry cement, and water mixed three parts sand to one part cement. Large spaces may be chinked with brick, block, or approved stones.

**H. Tolerance.** A 13 mm difference in diameter is allowed when joining round pipes or the spans or rises of pipe-arcs. A 38 mm difference is allowed in the perimeters. These tolerances may be attained by proper production control or by match-marking pipe ends.

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**603-3.07 Concrete Paving for Corrugated Structural Plate Pipe.** Place reinforced Portland Cement Concrete over the inverts of corrugated structural plate pipe where specified and indicated on the Contract Documents, so as to form a smooth interior. Do not place pavement until the embankment has been completed over the pipe and settlement has been completed to the satisfaction of the Engineer.

Place the steel fabric reinforcement on the crests of corrugations and securely fasten to the pipe or pipe-arch by welding or by other methods acceptable to the Engineer. Place the reinforcement to provide a 100 millimeter minimum clearance from the edges of concrete and lap 150 mm minimum. Unless otherwise shown on the plans, the steel fabric reinforcement shall consist of No. 6 gauge wire at 150 mm centers transversely and longitudinally.

Finish the pavement to a smooth surface acceptable to the Engineer. Within 18 hours after completion of finishing, protect the surface by either an approved curing cover or an approved membrane curing compound applied at a minimum rate of 0.27 L/m². However, any concrete in the invert that would be exposed to sunlight must be cured immediately after the finishing operations have been completed and the surface water has evaporated.

Cure the concrete for a minimum period of 48 hours before water is permitted to flow on the invert. If the atmospheric temperature is below 7°C, the requirements of 555-3.08C, Provisions for Concreting in Cold Weather, shall apply.
§603

603-3.08 Relaying Pipe. Carefully remove, clean, preserve, haul and relay pipe as directed by the Engineer or as called for in the Contract Documents. The relaid pipe shall be true to line and grade, and have a full, firm, even bearing and be comparable to newly laid pipe. Construct joints of relayed pipe as specified in §603-3.06. When existing pipe is damaged during removal or relaying, rendering it unfunctional, replace it with new pipe at no additional cost to the State. Existing pipe which is determined by the Engineer to be unfit for relaying may be destroyed before removal.

Apply the requirements of §603-3.03 for backfill and placement.

603-3.09 Anchor Bolts. Unless instructed otherwise, use anchor bolts, as specified in §707-20 to anchor the ends of corrugated metal pipes, and sectional plate arches to either reinforced or plain concrete headwalls.

603-4 METHOD OF MEASUREMENT

603-4.01 Pipe. The Engineer will measure the pipe, in meters along the bottom centerline, furnished and incorporated into the work in accordance with the Contract Documents.

603-4.02 End Sections. The Engineer will count the number of units of each size or diameter furnished and incorporated into the work in accordance with the Contract Documents.

603-4.03 Relaying Pipe. The Engineer will measure the existing pipe relayed and any new pipe laid and furnished to replace existing pipe, in meters along the bottom centerline, incorporated into the work in accordance with the Contract Documents.

603-4.04 Concrete Collars. The Engineer will count the number of concrete collars furnished and incorporated into the work in accordance with the Contract Documents.

603-5 BASIS OF PAYMENT

603-5.01 General. The accepted quantities of all pipe construction and reconstruction will be paid for at the contract price bid which will include the cost of furnishing all labor, materials and equipment necessary to complete the work including those joints made with oakum, portland cement and mortar or poured caulking compounds.

For concrete end sections include the cost of the restraining devices and their installation. If no end sections are specified and restraining devices are required, include the cost of the restraining devices in the unit price bid for the pipe. Include the cost of bituminous coating or concrete paving including steel wire fabric reinforcement, when specified in the unit price bid for the respective pipe items. Include the cost of breaking into existing drainage structures to connect new pipe in the unit bid price for the respective pipe items. Include the cost of anchor bolts, when required, in the unit bid price for pipe items.

Progress payment may be made to the extent of 80% of the price bid for pipe items requiring concrete invert paving when the installation is substantially completed and backfilled to a minimum of 600 mm over the top of the pipe plus whatever additional cover is necessary to protect the installation from construction traffic. The remaining 20% will be paid upon completion of the invert paving.

Excavation, granular fill and backfill will be paid for separately under their appropriate items in Sections 203 and 206, as applicable except include the additional costs necessary for the special gradation for Backfill Material for Corrugated Aluminum Pipe-Type IR and the additional cost necessary to assure the backfill material be free of portland cement in the unit bid price for these pipes.

Include the cost of adding water for compaction in the price bid, unless items for furnishing water equipment and applying water are included in the proposal.

Payment for the geotextile material and its installation is included under the structural pipe arch item.

603-5.02 End Sections. Include the cost of all labor, materials and equipment necessary to complete the work as specified in the contract documents. The cost of the restraining devices and their installation, required for concrete pipe, shall be included in the unit price bid for the end sections.
### §603-5.03 Concrete Collars.

Include the cost of all labor, materials (including concrete repair material) and equipment necessary to complete the work as specified in the contract documents.

**Payment will be made under:**

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<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<td>Corrugated Steel Pipe- Type IIR</td>
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§603

603.60xx Reinforced Concrete Pipe Class III
603.61xx Reinforced Concrete Pipe Class IV
603.62xx Reinforced Concrete Pipe Class V
603.66xx Reinforced Concrete Horizontal Elliptical Pipe Class HE II
603.67xx Reinforced Concrete Horizontal Elliptical Pipe, Class HE III
603.69xx Reinforced Concrete Vertical Elliptical Pipe, Class VE IV
603.70xx Reinforced Concrete Vertical Elliptical Pipe, Class VE V
603.71xx Reinforced Concrete Vertical Elliptical Pipe, Class VE VI
603.72xx Reinforced Concrete Cattle Pass
603.73xx Reinforced Concrete Pipe End Sections
603.74xx Reinforced Concrete Pipe Class II
603.80xxxx Corrugated Steel Pipe-Polymer Coated (68x13)
603.81xxxx Corrugated Steel Pipe-Polymer Coated Paved Invert (68x13)
603.82xxxx Corrugated Steel Pipe-Arch Polymer Coated (68x13)
603.83xxxx Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (68x13)
603.84xxxx Corrugated Steel Pipe-Polymer Coated (75x25) or (125x25)
603.85xxxx Corrugated Steel Pipe-Polymer Coated Paved Invert (75x25) or (125x25)
603.86xxxx Corrugated Steel Pipe-Arch Polymer Coated (75x25) or (125x25)
603.87xxxx Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (75x25) or (125x25)
603.88xxxx Corrugated Steel Pipe-Aluminum Coated (Type II) (68x13)
603.89xxxx Corrugated Steel Pipe-Arch Aluminum Coated (Type II) (68x13)
603.90xxxx Corrugated Steel Pipe-Aluminum Coated (Type II) (75x25) or (125x25)
603.91xxxx Corrugated Steel Pipe-Arch Aluminum Coated (Type II) (75x25) or (125x25)
603.92xxxx Corrugated Steel Pipe-Aluminum Coated (Type 2) Type IR
603.93xxxx Corrugated Steel Pipe-Arch Aluminum Coated (Type 2) Type IIR
603.95xx Ductile Iron Pipe
603.96xxxx Smooth Lined Corrugated Aluminum Pipe (68 x 13)
603.97xxxx Smooth Lined Corrugated Aluminum Pipe (75 x 25)
603.98xx Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe
603.99 Relaying Pipe

Refer to Standard Contract Pay Item Catalog for full Item Number and full Description. Numbers in parentheses (without denotation) are spacing and depth of corrugations in millimeters.

SECTION 604 - DRAINAGE STRUCTURES

604-1 DESCRIPTION

604-1.01 General. This work shall consist of the construction or alteration of drainage structures, manholes, leaching basins and transverse drainage interceptors in accordance with these specifications, the contract plans and the standard sheets.

604-1.02 Adjustment Rings and Frames for Drainage Structures and Manholes. The Contractor shall furnish and install prefabricated adjustment rings and frames for drainage structures and manholes. The extensions shall elevate and support drainage structure grates or manhole covers without the necessity of removing the original drainage structure frame or manhole casting, when the roadway is resurfaced.
604-2 MATERIALS

604-2.01 Drainage Structures and Manholes. Materials used for the construction of drainage structures and manholes shall be as indicated on the plans, and/or Standard Sheets, and shall conform to the requirements of the following:

- Cast-in-Place Concrete - Class A 501
- Frames and Grates 655
- Concrete Repair Material 701-04
- Concrete Grouting Material 701-05
- Precast Concrete Driveway and Sidewalk Pavers 704-13
- Premolded Resilient Joint Filler 705-07
- Masonry Mortar 705-21
- Reinforced Concrete Pipe 706-02
- Precast Concrete Drainage Units 706-04
- Bar Reinforcement, Grade 420 709-01
- Wire Fabric for Concrete Reinforcement 709-02
- Cold Drawn Wire for Concrete Reinforcement 709-09
- Steps for Manholes 725-02

604-2.02 Transverse Drainage Interceptors. Materials used for the construction of transverse drainage interceptors shall meet the requirements of §604-2.01, except that bar reinforcement shall meet the requirements of §709-04, Epoxy Coated Bar Reinforcement, Grade 420.

Transverse drainage interceptors, if precast, shall meet the requirements of §706-04, Precast Concrete Drainage Units.

Dowels shall be fabricated from epoxy coated bar reinforcement conforming to §709-04.

604-2.03 Leaching Basins. Materials used for the construction of leaching basins shall conform to the requirements of §604-2.01 and shall be as indicated on the plans. Concrete for precast units shall conform to the requirements of §706-04, Precast Concrete Drainage Units.

604-2.04 Adjustment Rings and Frames for Drainage Structures and Manholes. Materials for prefabricated adjustment rings and frames for drainage structures and manholes shall conform to the following:

- Prefabricated Adjustment Rings & Frames for Drainage Units & Manholes 715-13

604-2.05 Altering Drainage Structures, Leaching Basins and Manholes. Materials for the repair and alteration of existing structures shall meet the requirements of §604-2.01 and shall be as indicated on the contract plans. Structures originally constructed with concrete block, common brick or concrete brick shall be altered with Precast Concrete Driveway and Sidewalk Pavers, §704-13, unless indicated otherwise on the contract plans.

604-3 CONSTRUCTION DETAILS

604-3.01 Excavation. Excavation shall be in conformance with the Construction Details of §206-3 Trench, Culvert and Structure Excavation.

604-3.02 Concrete Drainage Structures and Manholes. Concrete drainage structures and manholes shall be constructed in accordance with the requirements of these specifications, the Standard Sheets and plans. The Contractor shall have the option of erecting either cast-in-place or precast drainage structures unless specified otherwise. Cast-in-place drainage structures shall be constructed of Class A concrete and to the requirements of Section 555 Structural Concrete.

The Contractor shall have the option of constructing either a rectangular or circular drainage structure when such option is specified and allowed in the contract documents. When the circular structure is
selected, it shall conform to the requirements of §706-04 and will require submission of complete working drawings to the Engineer for review and approval.

Contractor proposed changes to drainage structures shown on the Standard Sheets or on the plans, other than minor changes approved by the Engineer, shall require submission of complete working drawings to the Engineer for review and approval.

Unless prohibited in the contract documents, the Contractor shall have the option of reducing the size of the drainage structure riser above the uppermost pipe entry in accordance with the requirements of the Standard Sheets. Flat slab reducer designs proposed by the Contractor shall be subject to the review and approval of the Engineer and shall be accompanied by the following:

1. Working drawings prepared by a Professional Engineer licensed to practice in New York State.
2. The design calculations used in the preparation of the working drawings.

Acceptance of flat slab tops or platforms for flat slab reducer designs will be on the Basis of Proof-of-Design Test or on the Basis of Rational Design as required by ASTM C478.

**604-3.03 Masonry Construction.** Masonry construction, when indicated on the plans or standard sheets, shall consist of concrete pavers laid in full mortar beds. All joints shall be full mortar joints not greater than 12 mm wide. When specified, the outside of the masonry construction shall be plastered with 12 mm thick mortar coat.

**604-3.04 Leaching Basins.** Leaching basins shall be constructed in accordance with these specifications and the contract plans.

**604-3.05 Pipe Entries.** All pipe(s) built into the wall(s) of a drainage structure shall be flush with the inside face of the drainage structure wall and shall project outside a sufficient distance to allow connection with the adjoining section. The wall knockouts and sealing the space around the pipe shall be in accordance with the Standard Sheets. The bell of concrete pipe shall be cut off at every pipe entry where the bell enters the drainage structure.

**604-3.06 Steps.** Drainage structures steps may be cast or bolted in place during construction, mortared with a concrete grouting material after the structure is completed or attached by friction locking into preformed or drilled holes. The steps shall clear all pipes. Steps in risers and conical top sections shall be aligned to form a continuous ladder with rungs equally spaced vertically in the completed structure at a maximum distance of 400 mm. Steps shall be embedded into the walls of the riser or conical section a minimum of 75 mm. The rung shall project a minimum clear distance of 100 mm from the walls of the riser or conical sections measured from the point of embedment.

**604-3.07 Frames and Grates.** Frames and grates shall be as specified in the contract documents. Frames located in the top slab or top of the uppermost riser shall be secured and held in place by a minimum of 4 stirrups or studs per frame, welded to the frame near the corners. Parallel bar frames shall contain shear stud anchors, for the purpose of transferring loads, as required and detailed on the standard sheet for parallel bar grates and frames. Shear stud anchors, when required, shall replace the frame securing stirrups or studs.

**604-3.08 Altering Drainage Structures, Leaching Basins and Manholes.** Reconstruction and adjustment of existing drainage structures shall be as detailed and specified on the contract plans. Construction with cast-in-place concrete shall conform to the requirements of Section 555, Structural Concrete.

Frames, grates and covers to be reused shall be removed, cleaned and reset at the required elevations. New frames, grates and manhole covers shall be installed when specified. Upon completion, each structure shall be cleaned of any accumulation of silt, debris or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

**604-3.09 Adjustment Rings and Frames for Drainage Structures and Manholes.** Prior to the placement of the surface course and after the placement of the binder course, when required, the
Contractor shall install adjustment rings and frames for manholes and drainage units. The adjustment ring or frame shall be placed so the manhole cover or drainage unit grate will not protrude above the finished surface of the pavement.

To assure a firm and secure fit with the adjustment ring or frame, the seat of the existing manhole casting or drainage unit frame shall be free of all foreign material at the time of installation. The entire assembly shall be set on the seat of the existing manhole casting or drainage unit frame and the locking devices shall be tightened evenly. The manhole cover or drainage unit grate shall then be set upon the seat of the adjustment ring or frame.

The Contractor shall be responsible for insuring that the adjustment rings and frames are compatible with the existing manhole castings and covers or drainage frames and grates.

All rings or frames shall be protected from displacement caused by traffic maintained on the roadway or equipment used in the paving operation.

The Contractor shall have the option of removing and resetting the existing manhole casting or drainage unit frames to the required grade where shown on the plans or approved by the Engineer.

604-3.10 Transverse Drainage Interceptors. This work shall consist of the construction of reinforced concrete transverse drainage interceptors with frames and grates, and dowels as shown on the plans or Standard Sheets. Unless specifically designated on the plans and/or in the proposal, the Contractor shall have the option of constructing cast-in-place or precast transverse drainage interceptors.

A. Cast-in-Place. Cast-in-place transverse drainage interceptors shall conform to the requirements of Section 555 Structural Concrete. The cast-in-place interceptors shall be constructed so that they have construction joints at a maximum spacing of 7.3 m, unless the Engineer gives written directions otherwise or a longer length is specified on the plans.

B. Precast Interceptors. Precast interceptors shall be laid in reasonably close conformity to line and grade and shall have a full, firm and even bearing at each joint and along their entire length.

They shall be handled and assembled in accordance with the manufacturer's instructions, except as modified on the plans or by the Engineer's written directions. Six (6) millimeter thick Premoulded Resilient Joint Filler shall be placed in the joint between the units, and the lifting hole and dowels shall be grouted with material conforming to §701-04 or §701-05.

Underdrain and Underdrain Filter shall be installed when shown on the plans or directed by the Engineer.

The underdrain pipe shall be installed in accordance with §605-3.01, and the underdrain filter shall be placed in accordance with §605-3.02 except when the details of either or both are modified on the plans or by the Engineer's written order.

604-3.11 Backfill. No structure shall be backfilled until all the mortar has completely set. The requirements of §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cable, shall apply.

604-4 METHOD OF MEASUREMENT

604-4.01 Drainage Structures, Leaching Basins and Manholes. Drainage structures, leaching basins and manholes will be measured for payment by the number of linear meters of height measured to the nearest tenth of a meter from the bottom of the base to the top of the masonry, including the top slab.

604-4.02 Transverse Drainage Interceptors

A. Cast-In-Place. Cast-in-place transverse drainage interceptors will be measured by the actual length of interceptor placed.

B. Precast. Precast transverse drainage interceptors will be measured by multiplying the number of whole units by the nominal length of each unit and adding thereto the length of any fractional units incorporated in the work. The nominal length of the units shall be indicated on the Standard Sheet.
604-03 Altering Drainage Structures, Leaching Basins and Manholes. Altering drainage structures, leaching basins and manholes will be measured by the number of structures altered.

604-04 Adjustment Rings and Frames for Drainage Structures and Manholes. This work will be measured by the number of prefabricated adjustment rings or frames furnished and installed.

604-5 BASIS OF PAYMENT

604-01 Drainage Structures, Leaching Basins and Manholes. The unit price bid per linear meter shall include the cost of all labor, equipment and materials, including bar reinforcement and welded wire fabric, necessary to complete the work, except the following:

A. Excavation. Excavation will be paid for under Trench and Culvert Excavation.

B. Backfill. Backfill of drainage structures and leaching basins will be paid for under the item(s) shown in the contract documents.

C. Frames, Covers and Grates. Frames, covers and grates will be paid for under the appropriate payment items for Frames and Grates in Section 655.

604-02 Contractor Options. When the specifications allow the Contractor to substitute a precast circular drainage unit in lieu of a rectangular drainage unit or the Contractor constructs a flat slab reducer design under the provisions of §604-3.02, the following basis of payment provisions will apply.

1. §604-01 will apply.
2. Payment for excavation and backfill will be for those quantities determined for the original structure.
3. No adjustments will be made to the unit price bid for the original structure.

604-03 Altering Drainage Structures, Leaching Basins and Manholes. The unit price bid for each shall include the cost of all materials, labor and equipment necessary to satisfactorily complete the work including all necessary cleaning, excavation, backfill, and replacement of any pavement, shoulder and sidewalk courses, subcourses, curbs, drives, lawns and any other surface. Frames, covers or grates to be reused that are broken by the Contractor’s operations shall be replaced at the Contractor’s expense. New frames, covers and grates will be paid for under the appropriate payment items for Frames and Grates in Section 655.

604-04 Adjustment Rings and Frames for Drainage Structures and Manholes. The unit price bid for each adjustment ring or frame shall include the cost of all material, labor and equipment necessary to satisfactorily install the adjustment rings and frames. If the Contractor elects to reset the existing casting or frames, the costs of the work involved in the removal and replacement of existing disturbed pavement shall be included in the price bid for the adjustment rings and frames.

604-05 Transverse Drainage Interceptors. The price per linear meter bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except the excavation will be paid for under Trench and Culvert Excavation, and the Underdrain and Underdrain Filter will be paid for under their respective items.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</thead>
<tbody>
<tr>
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<td>604.06</td>
<td>Transverse Drainage Interceptors</td>
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<td>XX = Region (01 through 11)</td>
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<tr>
<td></td>
<td>YY = Serialized 01 to 99 *</td>
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<td>604.10</td>
<td>Prefabricated Adjustment Rings for Manholes</td>
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<tr>
<td>604.11</td>
<td>Prefabricated Adjustment Frames for Drainage Structures</td>
<td>Each</td>
</tr>
</tbody>
</table>
§604

604.30XXYY  Rectangular Drainage Structure
    XX = Structure Type **
    YY = Frame No. **

604.31XXYY  Rectangular Drainage Structure with Round Option
    XX = Structure Type **
    YY = Frame No. **

604.32XXYY  Rectangular Drainage Structure with Concrete Cap
    XX = Structure Type **
    YY = Frame No. **

604.40XX M  Round Precast Manhole
    XX = Type **

604.50XXYY  Special Drainage Structure
    XX = Region (01 through 11)
    YY = Serialized 01 to 99 *

* Serialized number identified structure detailed on the plans.
** Structure type and frame number are as defined on the Drainage Structure Details Standard Sheets and the Grate and Frame Standard Sheets.

SECTION 605 - UNDERDRAINS

605-1 DESCRIPTION. The work shall consist of constructing underdrain installations in accordance with these specifications and in conformity with the lines, grades, and cross-sections shown on the plans or established by the Engineer.

605-2 MATERIALS

605-2.01 Underdrain Pipe. Underdrain pipe shall meet the requirements specified in the following subsections of Section 700-Materials Details for the type of pipe specified in the contract documents:

- Corrugated Steel Pipe - Type III 707-02
- Porous Concrete Pipe Underdrain 706-05
- Extra Strength Porous Concrete Pipe Underdrain 706-05
- Perforated Corrugated Polyethylene Underdrain Tubing 706-13
- Corrugated Aluminum Pipe - Type III 707-13
- Perforated Polyvinyl Chloride Underdrain Pipe 706-18

Optional underdrain pipe shall meet the requirements of any of the above listed subsections of Section 700-Materials Details at the Contractors option except that porous concrete and vitrified clay pipe shall not be permitted in an edge of pavement underdrain installation. Aluminum and steel shall be 16 gage.

605-2.02 Granular Filter Materials. Underdrain Filter Material shall consist of crushed stone, sand, gravel or screened gravel. Material tests and quality control methods pertaining to the item requirements and work of this Section will be performed in conformance with the procedures contained in the appropriate Departmental publication in effect on the date of advertisement of the project. These publications are available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau.

The procedure for acceptance or rejection of these materials shall be as described in the appropriate Soil Control Procedure (SCP) manual.

Underdrain Filter Type I and Type II shall be stockpiled.

A. Underdrain Filter Type I

1. Soundness:
   The soundness of material meeting the requirements of §703-02, Coarse Aggregates or §703-10, Lightweight Aggregates, is acceptable for Underdrain Filter Type I. When the Contractor elects to use material from sources not approved under §703-02 or §703-10, the soundness of the
material shall be tested and shall have a loss not exceeding 20 percent by weight after four (4) cycles of the Magnesium Sulphate Soundness Test.

2. Gradation:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0 mm</td>
<td>100</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>30 - 100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>0 - 30</td>
</tr>
<tr>
<td>2.0 mm</td>
<td>0 - 10</td>
</tr>
<tr>
<td>850 µm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

B. Underdrain Filter Type II

1. Soundness:
   The soundness of material meeting the requirements of §703-02, Coarse Aggregates or §703-10, Lightweight Aggregates, is acceptable for Underdrain Filter Type II. When The Contractor elects to use material from sources not approved under §703-02 or §703-10, the soundness of the material shall be tested and shall have a loss not exceeding 20 percent by weight after four (4) cycles of the Magnesium Sulphate Soundness Test.

2. Gradation:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 mm</td>
<td>100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>20 - 100</td>
</tr>
<tr>
<td>2.0 mm</td>
<td>0 - 15</td>
</tr>
<tr>
<td>850 µm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

C. Underdrain Filter Type III. Material for Underdrain Filter Type III shall meet the gradation and quality requirements of §703-07 Concrete Sand.

605-3 CONSTRUCTION DETAILS

605-3.01 Underdrain Pipe. The construction details of Section 603 shall apply. The type of filter material to be used at any location will be as shown on the plans unless otherwise directed by the Engineer. A carefully levelled and compacted bed of this material shall be prepared just prior to the placement of the underdrain pipe. The upgrade end of corrugated polyethylene underdrain pipe shall be closed with a solid plastic cap; the upgrade end of all other types of underdrain pipe shall be closed with a suitable plug. Unless otherwise shown on the plans or specified by the Engineer, the underdrain pipe shall be placed with the perforations down. In the event that the semi-circular option of the Steel Pipe underdrain is utilized, the pipe shall be placed such that the flat surface is on the top.

A. Perforated Corrugated Polyethylene Underdrain Tubing and Perforated Polyvinyl Chloride Underdrain Pipe. When these underdrains are daylighted through the side slope they shall be protected from sunlight by using a minimum one meter long section of corrugated steel or aluminum pipe at the outlet. The metal pipe, shielding the underdrain, shall extend a minimum of 150 mm into the ground and overlap the underdrain by a like distance for 100 mm and 150 mm underdrains. For underdrains from 200 mm through 300 mm the shielding pipe shall extend at least 300 mm into the ground and overlap the underdrain by a like distance. In no case shall the outlet end of the underdrain be exposed or extend beyond the end of the metal pipe shielding it. The metal pipe for shielding the underdrain shall be of such internal diameter to easily slip over the underdrain. To prevent intrusion of the filter material into the joint between the metal and underdrains, one of the
following methods shall be used: A reducer fitting placed over the joint, roofing felt wrapped around the joint, or another method approved by the Engineer.

Perforated corrugated polyethylene underdrain tubing and perforated polyvinyl chloride underdrain pipe will melt and burn when exposed to flame. Flame damage or damage by deterioration, crushing or stretching will be cause for rejection.

**B. Optional Underdrain Pipe.** The Contractor shall not intermix types of underdrain in the same run of pipe.

**605-3.02 Underdrain Filter.** After the pipe installation has been inspected and approved, Underdrain Filter shall be loosely placed around and over the pipe to such a depth that, after compaction, Underdrain Filter will extend to a level 150 mm above the underdrain pipe or to the next course, whichever is less. Subsequent lifts of Underdrain Filter shall be no more than 150 mm thick prior to compaction and shall be compacted by two passes of an approved vibrating pad or drum type compactor. The remainder of the installation shall be in accordance with the applicable standard sheet or as indicated on the plans.

For corrugated polyethylene underdrain tubing the filter material shall be placed around and over the tubing to such a depth that, after compaction, the underdrain filter material shall extend to a level 300 mm or to the next course whichever is less above the tubing. At this stage the surface of the filter material shall be compacted by three passes of a vibrating pad or drum type compactor. The remainder of the backfill shall be placed in maximum 600 mm loose lift thicknesses and compacted by three passes of a vibrating pad or drum type compactor after the placement of each lift.

In the event that a pipe is not included in this installation, the filter shall be placed in horizontal layers not exceeding 150 mm in thickness prior to compacting. Each lift shall be compacted by two passes of an approved vibrating pad or drum type compactor.

No compaction control tests will be required.

**605-3.03 Underdrain Filter at Structures.** Underdrain Filter, Type I material, shall be placed adjacent to structures as specified on the contract plans. The lift thickness for the loose Type I material shall not exceed 150 mm and shall precede the placement of each lift of the adjacent backfill material. A physical barrier may be used to facilitate placement of the Underdrain Filter and adjacent backfill. This barrier shall not be left in place and shall be removed prior to compaction of the material. Each lift of filter material and backfill material located within a minimum distance of one meter from the backwall plus the footing heel projection shall be compacted simultaneously. Compactive effort for this material shall be provided by two passes of a vibratory compactor approved by the Engineer. Placement and compaction operations shall be conducted in a manner so as to insure that the top surface of each lift of Type I filter material shall not be contaminated by the adjacent backfill materials. No compaction control tests will be required for the Type I filter material.

**605-4 METHOD OF MEASUREMENT**

**605-4.01 Underdrain Pipe.** The quantity of underdrain pipe to be paid for will be the number of linear meters of pipe incorporated in the completed work in accordance with the plans and specifications and as directed by the Engineer.

**605-4.02 Underdrain Filter.** The quantity of underdrain filter material to be paid for under this item will be the number of cubic meters of material computed between the payment lines as shown on the plans, or where changes have been ordered, as established by the Engineer. A deduction shall be made for pipes (based on nominal diameters) and other payment items, when the combined cross-sectional area exceeds 0.1 m$^2$, unless otherwise shown on the plans. No deduction will be made for the cross-sectional area of an existing facility.

If the excavation for the underdrain extends outside these payment lines, it shall be backfilled with Underdrain Filter material meeting the requirements of this specification, furnished and installed at the Contractor's expense.

**605-4.03 Underdrain Filter at Structures.** The quantity of Underdrain Filter Type I material shall be computed for payment as the number of cubic meters within the payment lines shown on the contract.
§605

plans or as modified by the Engineer. No deduction will be made for the volume occupied by the underdrain pipe.

605-5 BASIS OF PAYMENT

605-5.01 Underdrain Pipe. The unit price bid per linear meter for this work shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Excavation, granular fill and backfill will be paid for separately under their appropriate items in Sections 203 and 206, as applicable.

605-5.02 Underdrain Filter. The unit price bid per cubic meter shall include the cost of furnishing all labor materials and equipment necessary to complete the work. No direct payment will be made for any losses of material which may result from compaction, foundation settlement, erosion, or any other causes; the cost of such losses shall be included in the price bid for this item. Any contaminated underdrain filter material shall be replaced by the Contractor as directed by the Engineer at no cost to the State.

Excavation, granular fill and backfill will be paid for separately under their appropriate items in Sections 203 and 206, as applicable.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>605.04xx</td>
<td>Porous Concrete Pipe Underdrain</td>
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</tr>
<tr>
<td>605.05xx</td>
<td>Extra Strength Porous Concrete Pipe Underdrain</td>
<td>Meter</td>
</tr>
<tr>
<td>605.07xx</td>
<td>Corrugated Steel Pipe - Type III</td>
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<td>605.08xx</td>
<td>Corrugated Aluminum Pipe - Type III</td>
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<td>Underdrain Filter, Type I</td>
<td>Cubic Meter</td>
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<td>605.15xx</td>
<td>Perforated Corrugated Polyethylene Underdrain Tubing</td>
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<td>605.16xx</td>
<td>Perforated Polyvinyl Chloride Underdrain Pipe</td>
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<tr>
<td>605.17xx</td>
<td>Optional Underdrain Pipe</td>
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</table>

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

SECTION 606 - GUIDE RAILING

606-1 DESCRIPTION. This work shall consist of the construction, reconstruction, removal, disposal, storage, and resetting of highway barrier systems and component parts in accordance with the specifications, standard sheets, manufacturer’s drawings, manufacturer’s directions and contract documents to the lines and grades shown on the plans or established by the Engineer.

The types of barrier systems are designated as follows:

Cable Guide Railing
Corrugated Beam Guide Railing and Median Barrier
Heavy Post Blocked-Out Corrugated Beam Guide Railing and Median Barrier
Box Beam Guide Railing and Median Barrier
Concrete Barrier
Pier Protection

606-1.01 I-Beam Posts for Existing Highway Barrier. Under this work the Contractor shall furnish and install I-beam posts and necessary hardware for existing highway barriers in accordance with the plans, specifications, and as directed by the Engineer.

606-1.02 Guide Railing with Extra Long Posts. Under this work the Contractor shall furnish and install guide railing of the type specified with extra long (2135 mm) posts in accordance with the contract documents, and as directed by the Engineer.
606-1.03 Retensioning Existing Cable Guide Railing. Under this work the Contractor shall retension existing guide rail cables in accordance with the plans, specifications and as directed by the Engineer.

606-2 MATERIALS. Materials shall meet the requirements specified in the following subsections of Section 700--Materials and ASTM Specifications:

Concrete Grouting Material 701-05
Precast Concrete Median Barrier 704-05
Premoulded Resilient Joint Filler 705-07
Joint Filler ASTM D 1056 Grade 2B1 or 2B2
Wire Fabric For Concrete Reinforcement 709-02
Epoxy Coated Bar Reinforcement, Grade 420 709-04
Wood and Timber Posts and Timber Blockouts 710-13
Galvanized Steel Barrier Posts 710-14
Corrugated Beam Guide Railing and Median Barrier 710-20
Box Beam Guide Railing and Median Barrier 710-21
Cable Guide Railing 710-22
Box Beam End Assembly Type III and Box Beam Median Barrier End Assembly, Type C 710-24
Guide Rail and Median Barrier Systems (Rustic) 710-25
Galvanized Coatings And Repair Methods 719-01
Epoxy Polysulfide Grout 721-03
Anchor Bolts 723-60
Reflective Sheeting 730-05 (Materials Designation 730-05.02)
Paint for Galvanized Surfaces 708-06
Rolled Steel Channels for Continuity Connections ASTM A36
Steel Plates for Continuity Connections ASTM A36

606-2.01 Steel Hardware. Steel posts, plates, channels, stiffeners, block-outs, angles, brackets, slipbases and other miscellaneous steel hardware not referenced to or specified by §710-14, §710-20, §710-21, §710-22, §710-24 or other sections of this specification shall be fabricated as shown in the contract plans and documents from steel meeting the requirements of ASTM A36 unless specified otherwise. All components shall be galvanized in accordance with §719-01, Type I or II. Components shall be fabricated prior to galvanizing. Similar hardware associated with Rustic barrier systems shall meet the requirements of §710-25.

606-2.02 Anchor Bolts and Studs. Anchor bolts and studs embedded or grouted in concrete for securing post and railing base plates shall meet the requirements of §723-60. Nuts and washers shall meet the requirements of ASTM A325M.

Anchor studs, bolts or rods embedded in concrete anchorage units for terminating guide rail and median barrier systems shall have minimum yield and tensile strength meeting the requirements of ASTM F568 Class 4.6.

Anchor studs, bolts, rods, nuts and washers shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type II unless indicated otherwise on the plans or standard sheets.

Grout for anchor studs and bolts shall conform to the requirements of §721-03 or §701-05.

606-2.03 Fasteners. Bolts, nuts and washers shall conform to the following unless specified otherwise on the plans, standard sheets, manufacturer’s drawings’, or in the contract documents.

Bolts ASTM F568 Class 4.6
Nuts ASTM A563M Grade A or Better
Washers ASTM F436M
Bolts, nuts and washers shall be galvanized in accordance with the provisions of §719-01 Galvanized Coatings and Repair Methods, Type II. Fasteners associated with Rustic barrier shall meet the requirements of §710-25 Guide Rail And Median Barrier Systems (Rustic).

**606-2.04 I-Beam Posts for Existing Highway Barrier.** I-beam posts for existing highway barrier shall conform to the requirements of §710-14 Galvanized Steel Barrier Posts or §710-25 Guide Rail And Median Barrier Systems (Rustic) as specified or required in the contract documents. Posts shall conform to the details shown on the plans or the latest edition of the standard sheet for the guide railing or median barrier affected. Hardware (nuts, bolts, “J” bolts, offset beams or block-outs, back up plates, washers, and shelf angles) necessary shall conform to the requirements of the current specifications and standard sheets for the highway barrier affected.

**606-2.05 Extra Long Guide Rail Posts.** Extra long Guide Rail Posts shall conform to the requirements of §710-14 Galvanized Steel Barrier Posts or §710-25 Guide Rail And Median Barrier Systems (Rustic) as specified or required in the contract documents. The posts shall conform to the details for extra long posts shown on the standard sheets or plans.

**606-2.06 Concrete for End Assembly Anchors And Post Embedments.** Cast-in-place concrete shall meet the requirements of Class A Concrete in Section 501 Portland Cement Concrete-General. The Contractor may submit, for approval by the Director of the Materials Bureau, a mix at least equivalent to the specified Class A Concrete, with a minimum cement content of 340 kg/m³.

Precast concrete anchorage units, when selected as an alternate to cast-in-place units by the Contractor, shall meet the requirements of Section 704-03 Precast Concrete-General.

**606-2.07 Concrete Barrier**

- **A. Precast Concrete Barrier.** The requirements of §704-05 shall apply
- **B. Cast-in-Place Concrete Barrier.** Concrete shall meet the requirements specified for Class A Concrete in §501, Portland Cement Concrete--General. Reinforcement shall meet the material requirements §606-2 and be of the type and sizes as indicated on the standard sheets and plans.
- **C. Machine Formed Concrete Barrier.** The concrete shall meet the requirements specified for Class I Concrete in §501, Portland Cement Concrete--General. Reinforcement shall meet the material requirements of §606-2 and shall be of the type and sizes as indicated on the standard sheets and plans.

**606-2.08 Resetting Guide Railing, Median Barrier, Anchorage Unit Assemblies and End Assemblies.** The materials comprising the existing system shall be used if they conform to the materials requirements specified for new guide rail systems and are found to be in satisfactory condition as determined by the Engineer. The Contractor shall supply all new hardware (splice tongues, plates, nuts, bolts, washer, etc.) Replacement materials shall meet the material requirements specified for new guide rail systems. Galvanizing of railing and posts may be repaired in accordance with §719-01, Galvanized Coatings and Repair Methods.

**606-2.09 Heavy Post Blocked-Out Corrugated Beam Guide Railing and Median Barrier.** The material requirements for §710-20 Corrugated Beam Guide Railing and Median Barrier shall apply except that posts, timber, plastic or synthetic block-outs, soil plates, expansion anchors, hardware and fasteners shall be as detailed on the standard sheets for Heavy Post Blocked-Out Corrugated Beam Guide Railing and Median Barrier. The Wood and Timber Posts and Timber Block-Outs shall conform to §710-13. The Plastic and Synthetic Block-Outs for Heavy Post Guiderail Systems shall conform to §710-26.

**606-2.10 Corrugated Beam Guide Rail Transition To Bridge Rail, Concrete Barrier and Concrete Parapets.** Corrugated beam rail sections shall conform to the requirements of §710-20. All remaining material shall conform to the requirements of §710-23 except that:
A. Posts for rustic barrier shall conform to the requirements of §710-25.
B. Block-outs and stiffening channels shall conform to ASTM A36.
C. All components shall be galvanized in accordance with §719-01 *Galvanized Coating and Repair Methods*, Type I or Type II. If required by the plans, the components shall be painted to match the existing railing. Painting shall be done in accordance with Section 657 except that:

1. Painting with rollers will not be permitted.
2. Spray painting will be allowed only if the components are painted at a location away from the work site, acceptable to the Engineer.

D. Shop drawings will not be required. Approval of the system will be made by the Engineer.

606-2.11 Rustic Barriers. Materials for rustic box beam and corrugated beam guide rail and median barrier systems respectively shall meet the requirements of §710-25. When rustic posts are specified for cable barriers the posts shall meet the requirements for posts of §710-25.

606-2.12 Pier Protection. Half section concrete barrier units shall be precast and conform to the requirements of §704-05 Precast Concrete Median Barrier. The box beam guide rail shall conform to the requirements of §710-21 Box Beam Guide Railing and Median Barrier.

606-2.13 Object Marker. All object markers required at vehicle openings or driveways shall be fabricated from the following materials conforming to Section 700 Materials:

- Aluminum Sign Panels 730-01
- Reflective sheeting, Materials Designation 730-05.02 or Materials Designation 730-05.03 730-05
- Acrylic Plastic Reflex Reflectors 730-10

The posts for mounting object markers shall be galvanized steel U section posts weighing 1.6 kg/m.

606-2.14 Transitions Constructed of, or with, Concrete. Concrete transition between concrete barriers of different shapes and the concrete elements of transitions between metal barriers and concrete barriers shall conform to §606-2.07 Concrete Barrier, A. Precast Concrete Barrier or, with the permission of the Engineer, B. Cast-in-Place Concrete Barrier.

606-3 CONSTRUCTION DETAILS

606-3.01 General. All barrier systems and transitions described by these specifications shall be subject to the following requirements.

A. Inspection of Rail Elements. Immediately prior to erection, the rail elements shall be inspected for damage. Bends or kinks in the railing, not specifically required by the contract documents, shall constitute sufficient cause for rejection. Straightening of such bends or kinks will not be allowed.

Erection of all guide rail, median barrier, transitions and connections shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

B. Field Galvanizing For Repair. Field galvanizing repair shall be allowed only when the total damaged area on each piece or component is less than 2 percent of the coated surface, or 10 000 mm², whichever is less. Any single piece or component with total damaged area greater than the amount specified above shall be rejected and replaced by the Contractor. Field galvanizing repair shall be done in accordance with the requirements of the Repair section of §719-01 Galvanized Coating And Repair Methods.
C. Field Welding. Field welding shall not be permitted unless noted in the contract documents. When specified, welding shall comply with the requirements of the SCM.

D. Erection. Posts, railing, barrier systems, rail transitions, end assemblies, anchorage units, and pier protection shall be erected in the position and manner indicated on the standard sheets, manufacturer’s drawings, manufacturer’s directions and contract plans and in a manner approved by the Engineer. Rail mounting height shall be within ± 6 mm of that indicated on the standard sheets and plans.

Prior to installing guide rail, median barrier, transitions, or end terminals, the Contractor shall determine the locations of all structures, including underground structures, that may be affected by the installation. If the determinations disclose that there are conflicts between the proposed installation of guide rail, median barrier, transition, or end terminal and other structures, including underground structures, the Contractor shall discuss with and recommend to the Engineer alternative locations or types of guide rail, median barrier, transition, or end terminal, subject to the approval of the Engineer, that will not be in conflict with the structure, including underground structure.

Posts and foundation tube(s) shall be driven unless otherwise specified by the Engineer. The driving shall be accomplished with approved equipment and methods that will leave the posts and foundation tube(s) in their final position, free of any distortion, burring or other damage. When posts and foundation tube(s) are driven through asphalt concrete or a bituminous treated material, the Contractor shall take care to prevent damage to the paved or treated areas. Large holes and voids caused by driving the posts and foundation tube(s) shall be filled and compacted with a bituminous treated material or asphalt concrete similar to that damaged. The small area adjacent to the post and foundation tube(s) disturbed during installation or where gaps exist at the post and foundation tube(s) after pavement repairs shall be sealed with a bituminous material approved by the Engineer.

As an alternate to driving posts and foundation tube(s) on unpaved medians and where site conditions are such that driving is not possible, the Contractor shall carefully excavate for all post and foundation tube(s) holes. Post and foundation tube(s) holes and post and foundation tube(s) foundation structures shall be backfilled and backfilled material compacted in accordance with §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables.

On structures and paved medians, base plates for posts shall be anchored as shown on the plans and as specified by the Engineer. Where drilling and grouting is required, the Contractor shall take care to prevent damage to the concrete, asphalt or other paved surfaces. The proposed construction method and equipment for drilling and grouting of holes shall be submitted to the Engineer for approval before drilling and grouting operations begin. Anchoring devices shall be grouted with §701-05, Concrete Grouting Material or §721-03 Epoxy Polysulfide Grout.

The work of installing the guide railing system when it abuts stabilized shoulder courses shall be coordinated and progressed to provide the least disturbance between the two phases of the work.

All posts shall be aligned to a tolerance of 6 mm for plumb and grade line.

Curved box beam and corrugated beam guide railing and median barrier rail elements shall require shop curving in accordance with Table 606-1.

<table>
<thead>
<tr>
<th>TABLE 606-1 SHOP CURVED GUIDE RAILING AND MEDIAN BARRIER</th>
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<tr>
<td><strong>Barrier Type</strong></td>
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<tr>
<td>Box Beam Guide Railing</td>
</tr>
<tr>
<td>Box Beam Median Barrier</td>
</tr>
<tr>
<td>Corrugated Beam Guide Railing</td>
</tr>
<tr>
<td>Corrugated Beam Median Barrier</td>
</tr>
</tbody>
</table>

When shop curving is required, the rail element shall be shop-worked to the radius that the barrier will be installed on.

E. Concrete Anchorage Units. Concrete anchors shall be constructed as detailed on the standard sheets. Excavation shall meet the requirements of §206-3 of the Standard Specifications. The bottom of the anchor shall have a full and even bearing on the surface under it. After the concrete anchor is in place, the excavation shall be backfilled in accordance with §203-3.15 of the Standard Specifications.
F. **End Terminals and Assemblies.** The following shall apply to end terminals or assemblies to be installed under this section.

1. **Drawings.** For end terminals and end assemblies not shown on standard sheets or detailed in the plans, the Contractor shall submit two copies of the manufacturer’s drawings, modified as necessary to reflect site conditions, to the Engineer for approval prior to ordering any materials required under this section. Drawings of parts not detailed on the plans, but which are necessary to develop the full performance of the end assemblies or terminals shall also be provided. The Contractor shall commence work of installation of end assemblies or terminals only after approval of the above mentioned drawings and authorization from the Engineer to do so.

2. **Manuals.** In addition to the drawings mentioned above, the Contractor shall deliver to the Engineer two (2) copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type end terminal or assembly being installed but not shown on the standard sheet.

3. **Coordination with Other Work.** The work of furnishing and installing all types of end assemblies shall be coordinated with the removal of existing impact attenuators or end assemblies, the installation of guide railing or median barrier, or the installation of the object to be shielded, so as to minimize the time that motorists are exposed to the possibility of collision with the shielded object, unprotected ends of barriers, or incomplete end terminals or assemblies. Also, the contractor shall minimize exposure of approaching vehicular traffic to the possibility of impact on the back of the end assembly. Unless modified in the Contract Documents, minimization shall mean seven (7) or fewer calendar days.

4. **Traffic Protection.** Traffic protection devices, such as cones, drums, lights, signs, barricades, or other articles directed by the Engineer, shall be provided and maintained under their respective pay items. These devices shall not be removed until the end assembly, including required transition pieces, is fully operational. If the end assembly is to be installed in lighted areas, or in areas to be lighted, the mentioned traffic protection articles shall also be maintained until the lighting system is operational.

606-3.02 **Cable Guide Railing.** Commencing with the first post where the rail is parallel to the edge of pavement, every sixth post in the line of guide rail shall be reflectorized (30 m spacing for reflectors) except those posts in the approach terminal and intermediate anchorage area which curve away from the shoulder. The reflector and method of attachment shall be as indicated on the standard sheet.

A. **Anchorage Unit Assemblies.** After the end posts are driven to the specified line and grade, the “clamped on” bearing angles shall be adjusted in the field to provide a full and even bearing on the underlying surface.

B. **Cable Guide Railing Tensioning.** The Contractor shall install and tension the cable guide railing as follows. Properly seat the spring compensation device and then permanently mark the unloaded position. Complete the assembly of the guide railing and set the compensating devices to a spring compression of 90 mm. Leave the springs at this setting for at least 2 weeks, then set them to the proper setting according to temperature from the data in the table on the standard sheet for Cable Guide Railing.

606-3.03 **Box Beam Guide Railing and Median Barrier.** Rail sections for tangent runs shall be at least 5.5 m long. Rail splices shall be a minimum of 457 mm from the centerline of any post.

During non-working hours, exposed approach ends (free ends) of the box beam guide railing or median barrier shall be temporarily terminated with box beam guide railing end assemblies utilizing two splice plates and eight bolts per temporary termination connection. No posts for anchorages will be required. Special temporary splice plates will be needed to adapt box beam guide railing end assemblies to box beam median barrier.
§606-3.04 Corrugated Beam Guide Railing and Median Barrier, and Heavy Post Blocked-Out Corrugated Beam Guide Railing and Median Barrier. In the erection procedures, the free end of the rail element shall not be allowed to swing free and cantilever around the mounting bolt. The free end shall be supported in a manner approved by the Engineer while the splice bolts and mounting bolts are fastened.

During non-working hours, exposed approach ends (free ends) of the guide railing or median barrier shall be dropped to the ground and pinned in a manner approved by the Engineer.

A. Corrugated Beam Guide Railing and Median Barrier. The rail elements shall be installed so the weight of the beam rests on the double nutted support bolt before the 8 mm mounting bolts are torqued. Before the final torquing, six of the 8 mm mounting bolts in the installation shall be selected at random and with a suitable torque wrench tightened to failure. The six readings shall be averaged, the six failed bolts replaced and all the mounting bolts in the installation torqued to 50% of the average value.

Support bolts shall be installed on all the guide rail posts except the three posts adjacent to the anchors.

B. Heavy Post Blocked-Out Corrugated Beam Guide Railing and Median Barrier. The heavy post blocked-out corrugated beam guide railing shall be erected from the approach end anchorage unit and down stream along the flow of traffic.

The heavy post blocked-out median barrier shall be erected from one of the anchorage sections and shall be completed as the work progresses. During non-working hours no uncompleted anchorage units or heavy posts without rail will be permitted on either heavy post blocked-out guide railing or median barrier.

For heavy post blocked-out corrugated beam guide railing connections to walls (trailing ends), the holes for the expansion anchors shall be drilled to the minimum depths and diameters shown on the plans or standard sheets or to larger values if specified by the manufacturer. The holes shall be drilled with care to avoid damage to the wall. Any damage caused by the drilling operation shall be repaired by the Contractor and to the satisfaction of the Engineer.

§606-3.05 Concrete Barrier. Unless specified otherwise in the contract documents the Contractor shall have the option of providing precast concrete barrier, cast-in-place concrete barrier, or machine formed barrier. No intermixing in any run of barrier will be permitted unless shown otherwise in the contract documents except that precast transition sections and ends may be used with cast-in-place or machine formed concrete barriers.

Half section concrete barrier shall be erected with the appropriate back-up posts and continuity plates or earth back-up as shown on the standard sheets and plans.

A. Precast Concrete Barrier

1. Placement. Immediately prior to installation, the Engineer shall inspect the sections for manufacturing defects or shipment damage. Damaged or defective sections shall be rejected or repaired in accordance with §704-05. Precast Concrete Barrier, Repair. The sections shall be placed in accordance with the contract plans and proposals.

2. Vertical Expansion Joint. Sections shall be separated by 13 mm nominal joint openings. The joint opening, at any point in the plane of the joint, shall be not less than 12 mm and no more than 13 mm. Premoulded Resilient Joint Filler conforming to the requirements of §705-07 or Joint Filler conforming to the requirements of ASTM D 1056 Grade 2B1 or 2B2 shall be placed in the joint as shown on the plans, standard sheet or as directed by the Engineer.

3. Dimensional Tolerance.

a. Cross-sectional dimensions shall not vary from the dimensions shown by more than 5 mm.
b. The barrier shall not be out of plumb by more than 5 mm.
c. Longitudinal dimensions shall not vary from the dimensions shown by more than 5 mm per 3.0 m of the barrier.
d. When checked with a 3.0 m straight edge, irregularities shall not exceed 5 mm.

B. Cast-in-Place Concrete Barrier

1. Placing. The Contractor shall have the option of placing the cast-in-place concrete barrier in monolithic form or with a horizontal construction joint between the stem and the rectangular footing.

   a. Horizontal Construction Joint Option. When the Contractor elects to use a horizontal construction joint between the stem and the rectangular footing, joint details must be prepared and submitted to the Regional Director for approval. The footing shall be placed in lengths not exceeding 18 m except when the barrier system abuts a reinforced Portland Cement concrete pavement, then it shall match the length of the pavement slab. Every third vertical joint of the barrier stem shall exactly match the joint formed in the footing.

      When the barrier abuts an unreinforced pavement slab, the vertical joint in the footing and stem shall match the pavement joint at every third pavement slab.

   b. Monolithic Barrier. When the Contractor elects to use a monolithic barrier the lengths of the sections shall not exceed 6 m except when the barrier abuts a Portland Cement concrete pavement. Then the sections shall be cast in uniform lengths so that every third joint will exactly match the transverse joint in the pavement when reinforced concrete is used and every joint when unreinforced concrete is used.

2. Joints. The sections of barrier, in monolithic barrier, and of stem in horizontal construction joint barrier shall be separated by vertical expansion joints with provisions for expansion of 13 mm at each joint. Premoulded Resilient Joint Filler conforming to the requirements of §705-07 shall be placed in the joint as shown on the plans, standard sheet, or as directed by the Engineer.

3. Forms. Forms shall be metal and of such construction that there will be minimum interference to inspection for grade and alignment. Forms shall be braced and secured adequately so that no discernible displacement from alignment or grade will occur during placement of concrete.

4. Concrete Placing and Vibrating. Concrete shall be placed in the barrier forms in accordance with the requirements of §555-3.04 Handling and Placing Concrete. Concrete shall be compacted by means of immersion type mechanical vibrators approved by the Engineer. The vibrator shall be inserted into the concrete at 300 mm intervals. The vibrators shall be of size and weight sufficient to thoroughly vibrate the entire concrete mass without damaging or misaligning the forms or reinforcement.

5. Removal of Forms and Finishing Surfaces. Forms shall be left in place for 24 hours or until, in the judgment of the Engineer, the concrete has sufficiently set so that the forms may be removed without injury to the barrier. Immediately after the forms have been removed, surfaces exposed to view shall have all projections and irregularities carefully removed and all cavities neatly filled with mortar of the proportion used in the concrete. The same brand of cement and the same kind of fine aggregate shall be used for filling cavities as was used in the original concrete mix. Surfaces repaired by plastering will not be allowed.

6. Concrete Curing. Curing of concrete median barriers shall conform to the requirements given in 555-3.08 Curing. Other methods of curing may be used only when so indicated on the plans or in the itemized proposal.

7. Reinforcement. The Contractor shall incorporate reinforcement as indicated on the standard sheets and plans. All reinforcing steel shall be epoxy coated meeting the requirements of §709-04.
8. Placement Adjacent to Cement Concrete Pavement or Shoulders. The barrier shall be separated from the cement concrete pavement or shoulder by a 13 mm wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and contain Premoulded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately 25 mm shall be provided at the top of the joint for installation of a backer rod and joint sealant. The joint sealant shall be a silicone sealant appearing on the Department’s Approved List and shall be applied in accordance with the manufacturer’s instructions.

9. Dimensional Tolerance

a. Cross-sectional dimensions shall not vary from the dimensions shown by more than 5 mm.
b. The barrier shall not be out of plumb by more than 5 mm.
c. Longitudinal dimensions shall not vary from the dimensions shown by more than 5 mm per 3.0 m of the barrier.
d. When checked with a 3.0 m straight edge, irregularities shall not exceed 5 mm.

C. Machine Formed Concrete Barrier

1. Weather Limitations. The requirements of §502-3.01 shall apply.

2. Equipment. The slipforming equipment shall be self-propelled and shall be capable of placing, consolidating and finishing concrete to the proper line and grade. The Engineer may require the Contractor to demonstrate that the specific equipment proposed for use is capable of satisfactorily placing the concrete mix. The Contractor shall furnish the manufacturer's data regarding machine operation to the Engineer.

3. Preparation of the Subbase Course. Before any concrete may be placed, the subbase course shall be compacted and fine graded to a tolerance of \( \pm 13 \text{ mm} \) of the true grade at any location under the barrier. Whenever possible, as determined by the Engineer, concrete placing operations shall not begin until the subbase course has been fine graded ahead at least 300 m.

4. Reinforcement. The Contractor shall incorporate reinforcement as indicated on the standard sheets and plans. All reinforcing steel shall be epoxy coated meeting the requirements of §709-04.

5. Placing Operations

a. Central and Transit Mixed Concrete. The provisions of §501-3.03 C and D shall apply for Central Mixed and Transit Mixed Concrete respectively, except that water may be added at the point of deposition to maintain the desired slump. The water addition may be made at any time after the beginning of the discharge until approximately two-thirds \((2/3)\) of the load, as determined by the Engineer, has been discharged. After the water addition the concrete shall be mixed at least 30 revolutions in the mixing range. When the water additions made after discharge the total number of revolutions shall not be more than 190.

b. Truck Mixed Concrete. The provisions of §501-3.03 E shall apply except that after the initial slump has been achieved, water may be added to the mixture one additional time to maintain the desired slump. The water addition may be made anytime after the beginning of discharge until approximately two-thirds \((2/3)\) of the load, as determined by the Engineer, has been discharged. After the water addition, the concrete shall be mixed at least 30 revolutions in the mixing range.

The slipforming equipment shall have as nearly a continuous forward movement as possible to provide uniform progress with stopping and starting of the equipment held to a minimum. Any edge slump resulting from slipforming operations in excess of 6 mm, as measured from the top surface of the median barrier, exclusive of edge rounding, shall be corrected before the concrete has hardened.
Concrete supply shall be sufficient to produce a continuous, completely shaped barrier. If concrete placement is interrupted for a period of time where the delay will affect the quality and structural integrity of the barrier, the contractor shall terminate his operations by one of the following procedures. The Engineer shall determine when the slipform operation is to be terminated.

Method A. Construct a cast in place expansion joint system as detailed on the standard sheets.

Method B. Remove existing unset concrete to a vertical score line with hand tools. The vertical surface resulting from the removed concrete shall remain reasonably rough and unfinished to facilitate interlock and increased bond area when concrete operations are to be resumed. The vertical surface shall be touched up with hand tools, as directed by the Engineer, to correct unacceptable voids, tears and lack of consolidation resulting from the concrete removal. The surface shall be covered with several layers of wet burlap to prevent drying. All reinforcing steel shall extend beyond the face to provide adequate lapping.

Concreting operations may resume at the terminated face when the terminated portion has achieved enough rigidity to withstand the sequence of operations it will be subjected to without sustaining damage. All loose or unacceptable concrete and material shall be removed from the terminated face as directed by the Engineer. Concrete barrier damaged as a result of the contractor's operations shall be repaired to the satisfaction of the Engineer.

Termination of slipform operations at the end of the day for an uncompleted run shall be by method A or B above.

6. Curing. The median barrier shall be cured using a clear curing compound meeting the requirements of §711-05. The compound shall be sprayed on the concrete surface immediately following the placing operation at a rate of 1 L/3.5 m².

7. Placement Adjacent to Cement Concrete Pavement or Shoulders. The barrier shall be separated from the cement concrete pavement or shoulder by a 13 mm wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and contain Premoulded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately 25 mm shall be provided at the top of the joint for installation of a backer rod and joint sealant. The joint sealant shall be a silicone sealant appearing on the Department's Approved List and shall be applied in accordance with the manufacturer's instructions.

8. Contraction Joints. Contraction joints shall be formed or saw cut normal to the pavement. The spacing shall be every 6 m, as shown on the plans or as ordered by the Engineer. The joints shall conform to the dimensions as shown on the plans or standard sheets. If the joints are saw cut, they shall be saw cut as soon as no damage to the concrete will result, with a maximum time of 8 hours. The clear curing compound shall be reapplied at the saw cut.

9. Expansion Joints. Expansion joints shall be formed normal to the pavement with Premoulded Resilient Joint Filler meeting the requirements of §705-07 and shall provide for expansion of 13 mm. The filler material shall be cut to conform to the cross section of the barrier. The expansion joints shall be located at all immovable objects (bridge substructures, etc.), where shown on the plans, and/or as directed by the Engineer. Expansion joints shall not be required at regular intervals unless shown on the plans.

10. Tolerances. All concrete barrier produced by this method shall conform to the following tolerances:

a. Placing Tolerances

(1) Bar Reinforcement Cover 0 to + 13 mm.
(2) Width (top) 0 to + 6 mm.
(3) Width (base) 0 to + 13 mm.

b. Dimensional Tolerance

(1) Cross-sectional dimensions shall not vary from the dimensions shown by more than 5 mm.
(2) The barrier shall not be out of plumb by more than 5 mm.
(3) Longitudinal dimensions shall not vary from the dimensions shown by more than 5 mm per 3.0 m of the barrier.
(4) When checked with a 3.0 m straight edge, irregularities shall not exceed 5 mm.

11. Defects. Defects are divided into two categories Minor defects and major defects. Minor defects in the barrier may be repaired in the field. Major defects shall be cause for rejection of the section, or the section shall be repaired in the manner directed by the Engineer.

a. Minor Defects. Minor defects are defined as holes, honeycombing or spalls which are 150 mm or less, in diameter, and which do not expose the outermost surface of the steel reinforcement. Surface voids 15 mm, or less, in diameter and 6 mm, or less, in depth are not considered defects and they do not require repair.

b. Major Defects. Major defects are defined as:

(1) Any defect which does not meet the definition of a minor defect.
(2) Minor defects which, in aggregate, comprise more than five percent (5%) of the surface area of the barrier section.

12. Repair. Repair of hardened concrete shall be as follows:

a. Minor Defect Repair. Repair shall be made with a material meeting the requirements of §701-04. Methods of repair shall be acceptable to the Engineer. The color of the repaired portion shall match as nearly as practicable, the color of the surrounding concrete. Repaired portions shall exactly match shape requirements. The repaired portion shall withstand a moderate blow from a 0.5 kg hammer.

b. Major Defect Repair. Major defect repair shall be preapproved by the Engineer.

13. Hand Finishing. The Contractor shall make provisions to allow hand finishing, when directed by the Engineer, on all surfaces. Hand finishing, if done shall be done immediately after the passage of the slipforming equipment. Curing compound shall be applied only after hand finishing has been completed at any particular location.

14. Transitions and Tapered End Sections. Transitions and tapered end sections shall be either cast-in-place or precast, at the Contractor’s option.”
pinning it in a manner approved by the engineer. Any rail element or component of the barrier damaged shall be replaced by the Contractor.

### §606-3.07 Resetting Guide Railing and Median Barrier (New Posts)
The construction details of §606-3.06 shall apply, except that the Contractor shall furnish and install new posts.

### §606-3.08 Removing and Storing Guide Railing, Median Barrier, and Precast Concrete Barrier
The Contractor shall remove designated existing guide railing, median barrier and precast concrete barrier and neatly store the component parts in separate piles at locations designated for future pick up by Department forces, or its designee. The work shall be done in a workmanlike manner so as to salvage all usable parts. Unusable material shall be disposed of by the Contractor.

### §606-3.09 Removing and Disposing of Guide Railing, Median Barrier, Concrete Barrier, Guide Posts, Guide Rail Posts, and Median Barrier Posts
The Contractor shall remove designated existing guide railing, median barrier, concrete barrier, guide posts, guide rail posts, and median barrier posts and remove them from the site of work. Holes shall be backfilled with a suitable material and compacted in a manner approved by the Engineer.

### §606-3.10 I-Beam Posts for Existing Highway Barrier
I-beam posts for existing highway barrier shall be installed at the locations indicated in the contract documents or where directed by the Engineer. The driving shall be in accordance with the requirements of §606-3.01 and the applicable standard sheet(s). All hardware necessary for mounting the rail elements or cable to the post shall be supplied by the Contractor. New heavy post steel block-outs shall be supplied to replace damaged or unusable block-outs. S75x8.5 posts installed as intermediate posts to reduce post spacing on corrugated beam guide railing, corrugated beam median barrier, and box beam guide railing shall not be attached to the rail element.

All reflectors, delineators, reference markers, or other items, which are to remain in place, that are damaged by the Contractor’s operations shall be replaced by the Contractor.

### §606-3.11 Retensioning Existing Gable Guide Railing
Cable guide rail shall be retensioned at the locations indicted in the contract documents and as directed by the Engineer. Retensioning shall be performed in accordance with the requirements of §606-3.02.

### §606-3.12 Resetting Anchorage Unit Assemblies and End Assemblies for Guide Rail and Median Barrier
The Contractor shall remove, store, clean and reset existing anchorage units and end assemblies for Guide Railing and Median Barrier as shown on the plans or as directed by the Engineer. The anchorage units and end assemblies shall be reset and placed in accordance with the requirements of §606-3.01 General.

Existing concrete anchors and deadman may be left in place and replaced with new ones if the top of the existing anchor or deadman is at least 150 mm below final grade and the anchor or deadman will not be an obstruction to other construction.

The Contractor shall take care so reusable parts are not damaged by his operations. Any parts damaged in handling and placing shall be replaced by the Contractor. Unusable material shall be disposed of by the Contractor.

Surface areas disturbed during the removal operations shall be reestablished, as nearly as possible, to match the adjacent surfaces to remain.

### §606-3.13 Removing and Storing Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barriers
The construction details of §606-3.08 shall apply. Excavation and backfill shall be in conformance with the requirements outlined in §606-3.01E.

Existing concrete anchors and deadman may be left in place if the top of the existing anchor or deadman is at least 150 mm below final grade and the anchor or deadman will not be an obstruction to other construction.

### §606-3.14 Removing and Disposing Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barriers
The construction details of §606-3.13 shall apply except the
Contractor shall dispose of the Anchorage Unit Assemblies and End Assemblies in a manner approved by the Engineer.

606-3.15 **Box Beam Guide Rail Transition to Concrete Barrier.** The contractor shall construct a guide rail transition from concrete barrier to box beam guide rail at the locations indicated and as detailed on the contract plans. The work shall conform to the requirements of §606-3.01.

606-3.16 **Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and Concrete Parapets.** The contractor shall construct corrugated beam guide transitions to bridge rail, concrete barrier and/or concrete parapets at the locations and as detailed on the contract plans. The requirements of §606-3.01 shall apply together with the following:

Railing shall be erected so that the rails are parallel to the roadway, except in those sections where it is necessary to vertically transition the highway barrier to the bridge railing, or barrier. Bending or curving of rail elements in order to fit alignment requirements in the field shall not be permitted. The Engineer may order some bending or curving to allow for necessary minor adjustments. The Contractor shall exercise care in attaching the guide rail to the bridge rail so as not to damage the rails, posts, or joints, or splices. Any damage to the material attributable to the Contractor's operation shall require that the material be repaired, or replaced. The decision to repair, or replace, shall rest solely with the Engineer.

606-3.17 **Rustic Barrier.** In order to develop the aesthetic property of rustic barrier to its maximum the Contractor shall remove all mill scale from the surfaces of all weathering steel that will be exposed to view from the roadway. All surfaces are to be free of mud, grease, oil and paint. When either materials or finished products are in storage or transit, all necessary precautions shall be taken to prevent water stains and other surface adulteration that will deter from ultimately achieving the uniform and sound weathering characteristics of the base metal.

Care shall be taken during the field erection of the barrier system to avoid surface scratches and gouges. The Contractor is put on notice that cleanliness is most important in obtaining the early and uniform weathered surface. Where soilage is too severe to be removed by hand cleaning, the soiled areas shall be cleaned by other methods such as power brush cleaning in a manner approved by the Engineer.

606-3.18 **Pier Protection.** Pier protection shall be installed in accordance with the standard sheets, contract documents and directions of the Engineer. The half section precast concrete barrier units shall be backed up with either fully compacted excavated material or steel backup posts except when only one method is specified or indicated in the contract documents. Steel continuity connections shall be required on the half section barrier units when back up posts are utilized.

606-3.19 **Transitions Constructed of, or with, Concrete.** Transitions constructed of concrete and the concrete elements of transitions constructed of metal components and concrete elements shall be constructed at the locations indicated in the contract documents, or those indicated by the Engineer, in accordance with these specifications, the contract documents, and the directions of the Engineer. The shapes indicated on the Standard Sheets are standard. The Deputy Chief Engineer (Design) will consider other shapes for approval.

§606-3.05 **Concrete Barrier, A. Precast Concrete Barrier and B. Cast-in-Place Concrete Barrier shall apply.**

606-4 **METHOD OF MEASUREMENT**

606-4.01 **Cable, Corrugated Beam or Box Beam Guide Railing and Median Barrier.** The quantity of guide railing or median barrier measured for payment will be the number of meters measured along the axis of the railing and between its extreme outer limits as shown on the plans and/or standard sheets or as directed by the Engineer. The quantity of shop curved guide railing or median barrier shall be the number of meters measured along the axis of the curved railing. Shop curved guide railing or median barrier is defined as that which will require shop working in accordance with the requirements of these specifications and not that curvature which may be attained by springing or bending in the field. If the
railing is anchored to a structure instead of an anchorage unit or end assembly, the railing will be measured up to the structure.

Where curved corrugated beam guide railing or median barrier is specifically called for on the contract plans or ordered in writing by the Engineer and no provision for such curved beam railing is included in the contract proposal, the quantity of railing measured for payment will be as described above plus an additional allowance of 33 1/3% of the curved lengths at a factor of 1.0 measured along the horizontal center line of the beam.

606-4.02 Anchorage Units, End Assemblies and Transitions for Guide Railing or Median Barrier. Anchorage units, end assembly units and transitions between various highway guide railing and median barrier systems will be measured by the actual number of units installed in accordance with the plans, standard sheets, manufacturer’s drawings’, manufacturer’s directions and/or as directed by the Engineer.

The payment limits for the Box Beam Guide Rail End Assembly Type III and Box Beam Median Barrier End Assembly, Type C will be separated by a distance of 15 meters extending along the end assembly from the front of the Nose Assembly to a point 15 meters removed. These payment limits apply regardless of whether the Type III End Assembly or Type C End Assembly employs crushable fiberglass elements or beam bursting type mandrels to absorb the energy of the impacting vehicle.

606-4.03 Concrete Barrier and Terminal Sections. The quantity of concrete barrier and terminal sections measured for payment will be the number of meters placed in accordance with the plans and specifications, measured along the axis of the barrier and between its extreme outer limits, unless otherwise indicated on the plans or in the proposal.

606-4.04 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier. The quantity of reset guide railing or median barrier measured for payment will be the number of meters reset in accordance with the specifications, plans and as directed by the Engineer, exclusive of anchorage units and end assemblies. If the guide railing is anchored to a structure instead of an anchorage unit or end assembly, measurement will be made up to the structure. The quantity of reset precast concrete barrier measured for payment will be the number of meters placed in accordance with the plans and specifications measured along the axis of the barrier between its extreme outer limits.

606-4.05 Resetting Guide Railing and Median Barrier (New Posts). The Method of Measurement of §606-4.04 will apply.

606-4.06 Removing and Storing Guide Railing, Median Barrier and Precast Concrete Barrier. The quantity of removed and stored guide rail and median barrier measured for payment will be the number of meters removed in accordance with the specifications, plans and as directed by the Engineer, exclusive of anchorage units and end assemblies. If the guide rail or median barrier is anchored to a structure instead of an anchorage unit or end assembly, measurement will be made up to the structure. The quantity of removed and stored precast concrete barrier measured for payment will be the number of meters removed in accordance with the specifications and plans, measured along the axis of the barrier between its extreme outer limits.

606-4.07 Removing and Disposing of Guide Railing, Median Barrier and Concrete Barrier. The quantity of guide rail and median barrier measured for payment will be the number of meters removed and disposed of in accordance with the specifications, plans, and as directed by the Engineer, exclusive of anchorage units and end assemblies. The quantity of concrete barrier measured for payment will be the number of meters removed and disposed of in accordance with the specifications and plans measured along the axis of the barrier between its extreme outer limits.

606-4.08 Removing and Disposing of Guide Posts, Guide Rail Posts, and Median Barrier Posts. The quantity to be measured for payment will be the number of posts removed and disposed of in accordance with the specifications and plans and as directed by the Engineer.

606-4.09 Resetting Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barrier. This work shall be measured by the number of anchorage units and/or end
§606 assemblies reset in accordance with the requirements of the contract documents and in a manner approved
by the Engineer.

606-4.10 Removing and Storing or Disposing of Anchorage Unit Assemblies and End
Assemblies for Guide Railing and Median Barrier. This work shall be measured by the number
of Anchorage Units or End Assemblies properly removed and stored for pick up by others or removed
and disposed of in accordance with the contract documents and to the satisfaction of the Engineer.

606-4.11 Retensioning Existing Gable Guide Railing. Method of measurement will be the
number of sections retensioned. A section shall consist of the length of cable guide rail running
between two concrete anchorage units.

606-4.12 Heavy Post Blocked-Out Corrugated Beam Guide Railing Connections to Walls
(Trailing Ends). Guide railing connections to walls will be measured by the number furnished and
installed in accordance with the plans, specifications, standard sheets, and as directed by the Engineer.

606-4.13 Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and
Concrete Parapets. Measurement will be taken as the actual number of transition units installed in
accordance with the plans and specifications.

606-4.14 Box Beam Guide Rail Transition to Concrete Barrier. Measurement will be taken as
the actual number of transition units installed in accordance with the specifications, plans and standard
sheets.

606-4.15 Pier Protection. Pier protection shall be measured by the number of meters measured along
the top centerline of the steel box beam and between the pay limits as shown on the plans and/or standard
sheets.

606-4.16 I-Beam Posts for Existing Highway Barrier. I-beam posts for existing highway barrier
will be measured by the actual number of posts installed in accordance with the contract documents and
as directed by the Engineer.

606-4.17 Transition between Concrete Sections. Transitions will be measured by the actual
number of units installed in accordance with the plans, standard sheets and/or as directed by the Engineer.

| TABLE 606-2 PAYMENT FACTORS FOR GUIDE RAIL AND
| MEDIAN BARRIER POST SPACING |
| Payment Factor | 1.0 | 1.1 | 1.3 | 1.4 | 1.6 | 1.8 | 1.9 |
| Rail Type | Post Spacing Center to Center in Millimeters |
| Cable* | 5000 | 3750 | --- | 2500 | --- | --- | 1250 |
| Box Beam | 1830 | --- | 915 | --- | --- | --- | --- |
| Corrugated Beam | 3810 | --- | --- | 1905 | 1270 | --- | 953 |
| Heavy Post Blocked | 1905 | --- | --- | --- | --- | 950 | --- |
| Out Corrugated Beam |

* For cable guide rail, the post spacing in the typical approach, terminal sections and typical
intermediate anchorage sections as indicated on the standard sheets, shall have payment factors
of 1.0.

606-5 BASIS OF PAYMENT

606-5.01 Guide Railing, Median Barrier, Concrete Barrier and Terminal Sections; Various
Types. The unit price bid per meter for the above work shall include the cost of all labor, equipment and
material necessary to complete the work, including the cost of any repairs required, and the costs of
bending any rail element to the required curvature.

Payment for guide rail and median barrier shall include the unit price bid and the measured quantity
multiplied by the payment factor for the various typical post spacings listed in Table 606-2.
Payment for box beam guide rail terminating and buried in a backslope with the posts embedded in rock shall have a payment factor of 2 for the last 6 meters.

When posts are driven through asphalt concrete or bituminous treated material, any repairs to damage paved or treated areas shall be at the Contractor's expense. Progress payments will be made when the metal railing and/or metal barrier is erected in the position and manner indicated on the standard sheets and in a manner approved by the Engineer, exclusive of bituminous repair and final alignment. Payment will be made, at the unit price bid, for 90% of the measured quantity erected. The balance of the quantity erected will be paid for upon proper repair to the bituminous surfaces and alignment of the metal railing and/or metal barrier to the specified tolerances.

606-5.02 End Assembly, End Anchorage Units and Transitions for Guide Railing and Median Barrier. The unit price bid for each end assembly, end anchorage unit or transition shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including the necessary concrete, excavation, backfill, reflectorization, object markers when required at driveways and vehicle openings, and spring cable assembly (compensating device) and/or steel turnbuckle cable end assembly required for cable guide rail.

606-5.03 Resetting; Removing and Storing; Removing and Disposing; of Guide Railing, Median Barrier and Concrete Barrier. The unit price bid per meter for the above work items shall include the cost of furnishing all labor, equipment and materials necessary to complete the work. Any materials damaged due to Contractor's operation shall be replaced by him and the cost shall be included in the price bid for this item.

Payment for resetting guide rail and median barrier shall include the unit price bid multiplied by the measured quantity multiplied by the payment factor for the various typical post spacings listed in Table 606-1, except that posts required to reduce the post spacing from the original post spacing shall be paid for under the appropriate I-beam post for existing highway barrier item.

A. Progress payments for resetting guide rail, median barrier and precast concrete barrier will be made as follows:

1. 25% of the unit price bid for the quantity of guide rail, median barrier or precast concrete barrier removed and stored in accordance with the provisions of §606.3-06 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier.
2. 65% of the unit price bid for the measured quantity of guide railing, median barrier or precast concrete barrier cleaned and reset in accordance with the provisions of §606-3.06.
3. The balance of the unit price bid for the quantity of the guide railing, median barrier or concrete barrier will be paid upon repair to the bituminous surfaces damaged by the resetting operations.

B. Progress payments for removing and disposing or storing of guide railing, median barrier or concrete barrier will be made as follows:

1. 75% of the unit price bid for the measured quantity of guide railing, median barrier or concrete barrier removed and stored or disposed of as specified.
2. The balance of the unit price bid for the measured quantity of guide railing and/or median barrier removed and stored or disposed of as specified will be paid when any voids have been backfilled and disturbed areas are reestablished to the satisfaction of the Engineer.

606-5.04 Removing and Disposing of Guide Posts, Guide Rail Posts and Median Barrier Posts. The unit price bid per post for the above work items shall include the cost of furnishing all labor, equipment and material necessary to complete the work.

606-5.05 Resetting; Removing and Storing; Removing and Disposing; of Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barrier. The unit price bid for each of these items shall include the cost of furnishing all labor, equipment and material necessary to complete the work including excavation and backfill.
§606

If the Contractor elects to install new concrete anchors, in lieu of removing and resetting the existing ones, the cost of furnishing and installing the new anchor as well as the cost for necessary adjustments to the existing one shall be included in the price bid for these items.

A. Progress payments for resetting anchorage unit assemblies and end assemblies for guide railing and median barrier will be made as follows:

1. 25% of the unit price bid for the quantity of anchorage unit assemblies and/or end assemblies removed and stored in accordance with the provisions of §606-3.12 Resetting Anchorage Unit Assemblies and End Section Assemblies for Guide Railing and Median Barrier.
2. 65% of the unit price bid for the quantity of anchorage unit assemblies and/or end assemblies cleaned and reset in accordance with the provisions of §606-3.12 Resetting Anchorage Unit Assemblies and End Section Assemblies for Guide Railing and Median Barrier.
3. The balance of the unit bid price for the quantity of anchorage units assemblies reset upon the reestablishment of surface areas disturbed.

B. Progress payments for removing and storing or removing and disposing of anchorage unit assemblies and/or end assemblies for guide railing and/or median barriers will be made as follows:

1. 75% of the unit price bid for the quantity of anchorage unit assemblies and/or end assemblies removed and stored or disposed of as specified.
2. The balance of the unit price bid for the quantity of anchorage unit assemblies and/or end assemblies removed and stored or disposed of as specified will be paid upon the establishment of surface areas disturbed.

606-5.06 Heavy Post Blocked-Out Corrugated Beam Guide Railing Connections to Walls (Trailing Ends). The price bid for each guide railing connection shall include the cost of all labor, material, equipment and the repair of any damage caused by the Contractor's operations.

606-5.07 Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and Concrete Parapets. The unit price bid per guide rail transition shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including back-up posts, connections and hardware.

606-5.08 Box Beam Guide Rail Transition to Concrete Barrier. The unit price bid per guide rail transition shall include the cost of all labor, equipment, and material necessary to satisfactorily complete the work, including back-up posts, necessary rail curvature, splices, connections and hardware.

606-5.09 Pier Protection. The price bid per meter of pier protection shall include the cost of all labor, materials and equipment necessary to complete the work. The curved box beam guide rail at each end of the assembly designed for two way traffic and on the approach end of the assembly designed for one way traffic, and the terminal sections shall be paid for under their own items.

606-5.10 I-Beam Posts for Existing Highway Barrier. The unit price bid for I-beam posts for existing highway barrier shall include the cost of furnishing all labor equipment and material necessary to complete the work. Removal of damaged posts and hardware is included in other items of work.

When posts are driven through asphalt concrete or bituminous treated material, any repairs to damaged paved or treated areas shall be at the Contractor's expense.

606-5.11 Retensioning Existing Gable Guide Railing. The unit price bid for retensioning a section of cable guide railing shall include the cost of all labor and equipment necessary to complete the work.

606-5.12 Transition between Concrete Sections. The unit price bid per concrete transition shall include the cost of all labor, equipment, and material necessary to satisfactorily complete the work, including back-up posts, connections and hardware.
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<td>Removing and Disposing Box Beam Median Barrier End Assembly--Type B</td>
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§606

606.8855 Transition Between Box Beam Median Barrier and
Single Slope Concrete Median Barrier (Rustic) Each

606.89 Guide Rail Transition Box Beam to Heavy Post
Blocked-Out Corrugated Beam Each

606.8950 Guide Rail Transition Box Beam to Heavy Post
Blocked-Out Corrugated Beam (Rustic) Each

606.9001 Transition between Standard (NJ) Concrete Barrier
and Single-Slope Concrete Barrier Each

606.9002 Transition between Wide and Normal Single Slope Concrete
Median Barrier Each

606.9401 Pier Protection (One Way) Meter

606.9402 Pier Protection (Two Way) Meter

606.9601 Median Barrier Transition Weak-Post Corrugated Beam to Heavy Post
Blocked-out Corrugated Beam Each

606.9651 Median Barrier Transition Weak-Post Corrugated Beam to Heavy Post
Blocked-out Corrugated Beam (Rustic) Each

SECTION 607 - FENCES

607-1 DESCRIPTION. This work shall consist of furnishing and erecting fencing and metal fence gates
of the type and size, and at the locations shown on the plans or as directed by the Engineer. Construction
of fencing and gates shall be done in accordance with the specifications, the standard sheets, and the
plans, and in reasonable close conformity with the lines and grades shown on the plans or established by
the Engineer.

607-1.01 Fence Types. The fence shall be designated as follows:

Optional Chain Link Fence Type I
Optional Chain Link Fence Type II
Vinyl Coated Chain Link Fence on Plastic Coated Frame
Right-of-Way Fencing

The options for Type I and Type II chain link fences shall be as follows:

**TYPE I**

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<thead>
<tr>
<th>Fabric Options</th>
<th>Frame Options</th>
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<tr>
<td>Coated Steel Fence Fabric (95% Zinc 5% Aluminum- Mischmetal Alloy)</td>
<td>Mischmetal Alloy Coating (95% Zinc 5% Aluminum)</td>
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<tr>
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<td>Galvanized Steel</td>
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<tr>
<td>Aluminum</td>
<td>Combined Coating on Steel</td>
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**TYPE II**

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<td>Combined Coating on Steel</td>
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<td>Plastic on Steel</td>
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<tr>
<td>Aluminum Coated Steel</td>
<td>Aluminum</td>
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</tbody>
</table>

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
Fence gates for Type I and Type II optional fences shall be consistent with the fabric and frame option selected for the contract. Fence frame and fabric selected shall be consistent throughout the contract except where intermixing is permitted by the Engineer.

607-2 MATERIALS. Materials shall conform to the requirements specified in the following subsections of Section 700 - Materials:

- Zinc Chromate Primer 708-04
- Aluminum Fence Fabric 710-01
- Galvanized Steel Fence Fabric 710-02
- Vinyl Coated Steel Fence Fabric 710-03
- Aluminum Coated Steel Fence Fabric 710-04
- Coated Steel Fence Fabric
  - (95% Zinc 5% Aluminum-Mischmetal Alloy) 710-05
- Steel and Iron Posts, Rails, Braces and Fittings
  - for Chain-Link Fence 710-10.03
- Aluminum Posts, Rails, Braces and Fittings
  - for Chain-Link Fence 710-11
- Plastic Coated Posts, Rails, Braces and Fittings
  - for Chain-Link Fence 710-12
- Right-of-Way Fencing 710-30

607-2.01 Portland Cement Concrete for Bases. Portland Cement concrete used for bases shall be Class A or C conforming to the requirements of Section 501 Portland Cement Concrete--General except that requirements for automated batching shall not apply.

607-2.02 Right-of-Way Fencing. The Contractor has the option of using posts and braces fabricated from either high carbon shapes of steel or pressure treated wood meeting the requirements of §710-30 Right-of-Way Fencing.

607-2.03 Fence Gates. Fence gates for Right-of-Way Fencing shall Conform to the requirements for Right-of-Way Fence Gates of §710-30. Fence gates for Chain-Link Fence shall conform to the following:

A. Gate Frames. Frames shall be constructed of tubular members welded at all corners or assembled with corner fittings. Where corner fittings are used gates shall have 10 mm nominal diameter truss rods to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 2.4 m apart. Gate leaves over 3 m long shall have a horizontal brace or a 10 mm nominal diameter diagonal truss rod. Gate leaves over 5 m shall have both a horizontal brace and a 10 mm nominal diameter truss rod.

B. Gate Fabric. Gate fabric shall conform to the requirements of the fabric used in the fence construction.

C. Gate Hinges. Hinges shall be weldable steel, cast steel or malleable iron 180° offset industrial type. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of being opened and closed easily by one person. Hinges shall be galvanized in accordance with §719-01 Type I.

D. Gate Latches. Latches, stops and keepers shall be provided for all gates. Latches shall have a plungerbar arranged to engage the center stop, except that single left gate openings with an opening of less than 3 m may use a forked latch. Latches shall be arranged for locking and the Contractor shall provide a lock with triplicate keys for each gate. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger-bar of the latch of double leaf gates. No stop is required for single leaf gates. Keepers shall consist of a mechanical device for securing the free end of the gate when in the full open position.
607-3 CONSTRUCTION DETAILS

607-3.01 General. The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of closure indicated.

When the plans require that the posts, braces, or anchors be embedded in concrete, the Contractor shall install temporary guys or braces as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys and bracing set in concrete until seven days have elapsed from the time of placing the concrete.

All posts shall be set vertically and to the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the Engineer and under the Engineer's specified conditions.

Wire or fencing of the size and type required shall be firmly attached to the posts and braces in the manner indicated. All wire shall be stretched taut and be installed to the required elevations.

At each location where an electric transmission, distribution or secondary line crosses any of the types of fences covered by these specifications, the Contractor shall furnish and install a ground conforming to the requirements of Subsection 9 of the National Electric Safety Code.

Fence shall generally follow the contour of the ground, with the bottom of fence fabric no less than 25 mm nor more than 150 mm from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

Line posts shall be spaced equidistant in the fence line at the spacing shown on the plans, standard sheets or as directed by the Engineer. End, corner, and intermediate posts shall be placed at the locations indicated on the plans, standard sheets or as directed by the Engineer, and shall be braced as shown on the plans or standard sheets. When chain link fence is on a long curve intermediate posts shall be evenly spaced so that the strain of the fence will not bend the line posts.

All end, corner, and intermediate posts shall be set plumb in concrete bases of the depth and diameter shown on the plans or standard sheets. The Contractor shall have the option of setting the line posts in concrete bases or using methods of driving and anchoring specified by the fence manufacturer and approved by the Engineer.

The concrete bases shall be rough cast in the ground around the posts. The top surfaces shall be domed to shed water and provide a neat workmanlike appearance when completed. Extensions of up 45 minutes for the allowed time for pouring the concrete will be permitted.

607-3.02 Chain-Link Fencing with Top Rail. Posts shall be set so they are equidistant with a maximum of 3 m centers.

All top rails shall pass through the base of the post caps and shall form a continuous brace from end to end of each stretch of fence. Top rail lengths shall be joined with sleeve couplings with expansion sleeves provided at 30 m intervals. Top rails shall be securely fastened to end posts by means of approved rail end connectors. Horizontal braces shall be provided at all intermediate posts, midway between the top rail and ground as shown on the plans or standard sheets.

Diagonal truss rods shall be installed with the horizontal braces as indicated on the plans or standard sheets.

Fence fabric shall be installed approximately 50 mm above the ground level and securely fastened along the bottom, and to all braces, top rails, line and pull posts, at the intervals indicated on the standard sheets by approved methods. The fabric shall be secured to all end, corner and gate posts with stretcher bars fastened to the posts, with stretcher bands spaced at a maximum of 355 mm and in a manner permitting adjustment of the fabric tension.

If the Contractor elects the option of using one piece roll-formed sections, the fence fabric shall be integrally woven into the fabric loops on the end, corner, pull and gate posts. The fabric shall be attached to the top braces and line posts as shown on the standard sheets.

607-3.03 Chain-Link Fencing with Top Tension Wire. The construction details specified in §607-3.02 Chain Link Fencing with Top Rail shall apply with the following modifications:
A. Top tension wire shall be installed as shown on the plans, standard sheets, or as directed by the Engineer.
B. All posts shall be spaced equidistant in the fence line on a maximum of 2.4 m centers.
C. Additional pull posts shall be placed at locations indicated on the plans or standard sheets. Brace assemblies shall be installed at each intermediate post as indicated on the plans or standard sheets.

607-3.04 Vinyl Coated Chain-Link Fencing on Plastic Coated Frame. The construction details specified in §607-3.02 Chain-Link Fencing with Top Rail or §607-3.03 Chain-Link Fencing with Top Tension Wire shall apply with the following addition: If any of the resin clad material specified under this item has the protective resin coating damaged so its effectiveness to prevent corrosion of the base material is impaired, the Contractor shall repair such parts by applying one coat of an approved compound of a color to match original material.

607-3.05 Aluminum Posts. Aluminum posts shall be set in accordance with requirements pertaining to fence posts of §607-3.01 General, and §607-3.02 Chain-Link Fencing with Top Rail or §607-3.03 Chain-Link Fencing with Top Tension Wire and with the following additional requirement: The portions of aluminum posts that will be in contact with the concrete bases shall be coated with Zinc Chromate Primer conforming to the requirements of §708-04. The primer shall be thoroughly dry before setting of the post in the concrete.

607-3.06 Right-of-Way. Fencing posts shall be set plumb and firm to the satisfaction of the Engineer in properly prepared post holes, as indicated on the plans or standard sheet. The concrete for post holes where required shall be placed in accordance with the requirements of §607-3.01 General.

All line posts of the type and size shown on the plans or standard sheets shall be placed equidistant in the fence line. Wood line posts shall be placed on a maximum of 4.5 m centers and metal line posts shall be placed on a maximum of 3 m centers.

Intermediate posts and post assemblies, end posts, corner posts, approach spans, and bracing shall be as shown on the plans or standard sheets.

The woven wire fencing shall be fastened to all steel line posts with at least 5 galvanized wire fasteners or clamps and to all steel end, intermediate and corner posts with aluminum wire not less than 4 mm diameter.

The woven wire fencing shall be fastened to all wood posts with either 40 mm galvanized or aluminum staples. The top and bottom wires and every other in-between wires shall be stapled, alternating the stapling of the in-between wires on successive posts.

607-3.07 Fence Gates. The Contractor shall construct metal fence gates of the type and size as indicated on the plans or standard sheets, and in the location shown or ordered by the Engineer.

607-4 METHOD OF MEASUREMENT

607-4.01 General. The quantity to be paid for all fencing exclusive of fence gates and fencing of the types listed in subsequent subsections, will be the number of linear meters of chain-link fencing measured along the top of fencing, center to center of end posts, properly furnished and installed in accordance with the plans, specifications, standard sheets and directions of the Engineer. An allowance of 3 m will be added for each end post, corner post and pull post installed in accordance with the plans, specifications, standard sheets and directions of the Engineer.

607-4.02 Right-of-Way Fencing. Right-of-Way Fencing shall be measured as the number of meters along the top of the fencing from center to center of the end posts, properly furnished and installed in accordance with the plans, specifications, standard sheets and directions of the Engineer. An allowance of 6 m will be added for each end post, corner post, intermediate post, and approach post installed in accordance with the plans, specifications, standard sheets and directions of the Engineer.

607-4.03 Fence Gates. Fence gates shall be measured as the number of complete gates furnished and erected in accordance with the specifications, plans, standard sheets and directions of the Engineer.
**607-5 BASIS OF PAYMENT**

**607-5.01 General.** The unit price bid per linear meter of fencing shall include the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work.

**607-5.02 Fence Gates.** The unit price bid for each size gate shall cover the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work and shall include all necessary clearing, grubbing, excavation and disposal, fill, concrete, gates, gate posts, lock, bracing and all other necessary materials.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>607.051X</td>
<td>Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame with Top Rail</td>
<td>Meter</td>
</tr>
<tr>
<td>607.052X</td>
<td>Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame with Top Tension Wire</td>
<td>Meter</td>
</tr>
<tr>
<td>607.16xx</td>
<td>Fence Gate with Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame</td>
<td>Each</td>
</tr>
<tr>
<td>607.19</td>
<td>Right-of Way Fencing</td>
<td>Meter</td>
</tr>
<tr>
<td>607.20xx</td>
<td>Right-of Way Fence Gates</td>
<td>Each</td>
</tr>
<tr>
<td>607.30xx</td>
<td>Optional Chain-Link Fence, Type I, with Top Rail</td>
<td>Meter</td>
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<td>607.31xx</td>
<td>Optional Chain-Link Fence, Type I, with Top Tension Wire</td>
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<td>607.32xx</td>
<td>Optional Chain-Link Fence, Type II, with Top Rail</td>
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<td>607.33xx</td>
<td>Optional Chain-Link Fence, Type II with Top Tension Wire</td>
<td>Meter</td>
</tr>
<tr>
<td>607.40xx</td>
<td>Optional Fence Gates</td>
<td>Each</td>
</tr>
</tbody>
</table>

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

**SECTION 608 - SIDEWALKS, DRIVEWAYS AND BICYCLE PATHS**

**608-1 DESCRIPTION.** This work shall consist of the construction of either a Portland Cement concrete sidewalk, an asphalt concrete sidewalk, an asphalt concrete driveway, bicycle paths, or furnishing and placing precast concrete paving, brick paving or grouted stone block paving. All work shall be in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

**608-2 MATERIALS.** Materials shall meet the requirements specified in the following subsections of section 700 - Materials:

Portland Cement 701-01  
Bituminous Materials (As specified) 702-00  
Asphalt Cement for Paving 702-02 or 702-03  
Fine Aggregates 703-01  
Coarse Aggregates 703-02  
Mortar Sand 703-03  
Cushion Sand 703-06  
Concrete Sand 703-07  
Mineral Filler 703-08  
Brick Pavers 704-08  
Stone Blocks 704-09  
Precast Concrete Driveway and Sidewalk Pavers 704-13  
Premoulded Resilient Joint Filler 705-07  
Masonry Mortar 705-21  
Wire Fabric For Concrete Reinforcement 709-02  
Water 712-01
§608-2.01 Portland Cement Concrete Sidewalk and Driveways. The material requirements and composition shall comply with the specifications for Class A concrete in §501-2 under “Portland Cement Concrete--General.” Concrete shall be proportioned in accordance with the aggregate weights specified for Class A concrete in Table 501-3, Concrete Proportions.

§608-2.02 Asphalt Concrete Sidewalks, Driveways, and Bicycle Paths. The mixture requirements for these items shall either be 9.5 mm or 19.0 mm mixtures. These mixtures shall be designed for <0.3 million ESALs and produced in accordance to Section 401 using coarse aggregate Type F9. The number of courses and course thicknesses shall be as given in Table 608 - 1, Hot Mix Asphalt Composition.

<table>
<thead>
<tr>
<th>TABLE 608-1 HOT MIX ASPHALT COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Paved Thickness</td>
</tr>
<tr>
<td>40 mm</td>
</tr>
<tr>
<td>50 mm</td>
</tr>
<tr>
<td>80+ mm</td>
</tr>
</tbody>
</table>

NOTES:
1. For the 19.0 mm mixture, the maximum thickness that can be placed in one pass is 75 mm.
2. A course shall consist of one or more separate lifts of hot mix asphalt, as directed by the Engineer, to attain the indicated thickness.

§608-2.03 Brick Paved Sidewalks and Driveways. Brick pavers shall meet the requirements of §704-08 and shall be the size(s), shape(s) and color(s) as specified in the contract documents.

A. Neoprene-Modified Asphalt Adhesive. Neoprene-modified asphalt adhesive shall consist of 2% neoprene, grade WM1, oxidized asphalt with a R & B softening point of 68°C minimum and a penetration of 80, and 10% asbestos-free fibers.

B. Mortar for Brick Paving. Mortar for brick paving shall meet the requirements outlined in §705-21 Masonry Mortar.

C. Sand-Cement Setting Bed. Sand-Cement Setting Bed shall consist of 1 part Portland Cement Type 2, §701-01 and 6 parts of Fine Aggregate, §703-01 by volume.

§608-2.04 Grouted Stone Block Paved Sidewalks and Driveways. Stone blocks shall meet the requirements of §704-09 and shall be the size(s), shape(s) and color(s) as specified in the contract documents.

A. Sand-Cement Setting Bed. Sand-cement setting bed shall consist of 1 part Portland Cement Type 2, §701-01, and 6 parts of Fine Aggregate, §703-01 by volume.

B. Mortar For Stone Block Paving. Mortar for stone block paving shall meet the requirements outlined in §705-21 Masonry Mortar.

§608-2.05 Precast Concrete Block Paved Sidewalks and Driveways. Precast Concrete Driveway and Sidewalk Pavers shall meet the requirements of §704-13 and shall be the size(s), shape(s) and color(s) as specified in the contract documents. Unless otherwise specified in the contract documents the setting bed material shall consist of hard, durable; uncoated particles of soil or rock, free from lumps of clay and all deleterious substances.

Setting Bed Material shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3 mm</td>
<td>100</td>
</tr>
<tr>
<td>2.0 mm</td>
<td>50-85</td>
</tr>
<tr>
<td>425 µm</td>
<td>20-45</td>
</tr>
<tr>
<td>75 µm</td>
<td>3-10</td>
</tr>
</tbody>
</table>
**§608-3 CONSTRUCTION DETAILS**

**608-3.01 Concrete Sidewalk and Driveways.** The general construction details for manufacturing and transporting concrete shall meet the requirements of Section 501, Portland Cement Concrete-General. Placing and curing of concrete shall meet the requirements of Section 502, Portland Cement Concrete Pavement except that when a membrane curing compound is used it shall be clear with fugitive dye unless otherwise permitted by the Engineer.

The concrete shall be placed in one course to the full depth shown in the contract documents. Wire fabric for concrete reinforcement, §709-02, shall be embedded at mid-depth in the slab. The concrete shall be finished to produce a smooth surface and then lightly broomed to a uniform texture. The edges of all sidewalk slabs shall be tooled. Unless otherwise specified in the contract documents the concrete surface shall be scored and tooled at intervals of 1.5 m.

Transverse construction joints shall extend to the full depth of the slab and shall be spaced 6 m to 8 m apart. The edges of such joints shall be finished with an edging tool having a 6 mm radius. “Saw cutting shall be in accordance with Subsection 502-2.04E.

A premoulded resilient joint filler, §705-07, shall be installed at all joints between sidewalk and curb, pavement, building, etc.

**608-3.02 Asphalt Concrete Sidewalks, Driveways, and Bicycle Paths.** The provisions under §402-3 Construction Details for Hot Mix Asphalt (HMA) Pavements, shall apply.

The sidewalks, driveways, and bicycle paths shall be constructed as indicated in the contract documents (including the Standard Sheets).

**608-3.03 Brick Paved Sidewalks and Driveways.** All brick pavers shall be laid in the pattern shown in the contract documents or as directed by the Engineer to provide a uniformly even surface. Joints shall be hand tight unless otherwise specified. No brick pavers shall be laid or grouted in freezing weather.

A dry mixture of mortar for brick paving shall be swept over the brick pavers until the joints are completely filled. The joints shall be lightly wetted with water. Brick pavers shall be cleaned of excess mortar, and joints shall be finished prior to the mortar setting up. All brick paving shall be kept moist for 4 days after filling the joints with mortar. After the 4 day curing period, removal of remaining mortar film may be accomplished by the use of a light acid wash (10% solution of hydrochloric or muriatic acid) followed by flushing clean with water or as approved by the Engineer. Care shall be taken to avoid the use of acid in areas where runoff could damage trees or other vegetation.

All brick pavers used over tree pits shall be laid in a 75 mm bed of cushion sand with sand filled joints.

**A. Brick Paved Sidewalks and Driveways (Sand Setting Bed).** Brick pavers shall be laid in a properly compacted 50 mm bed of cushion sand over the specified subbase or subgrade.

**B. Brick Paved Sidewalks and Driveways (Mortar Setting Bed).** Brick pavers shall be laid in a bed of mortar with a minimum thickness of 25 mm over the specified concrete or bituminous subbase.

**C. Brick Paved Sidewalks and Driveways (Bituminous Setting Bed).** Brick pavers shall be laid in a 20 mm thick bituminous setting bed over the specified concrete or bituminous subbase. The setting bed shall consist of asphalt cement meeting the requirements outlined in either §702-02 or §702-03 mixed with fine aggregate meeting the requirements of §703-01. The asphalt cement shall be 7.0% of the total batch weight. The mix shall be heated to approximately 163°C. A coating of neoprene-modified asphalt adhesive shall be applied by mopping, squeegeeing or troweling over the top surface of the setting bed to provide bond under the bricks.
D. Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed). Brick pavers shall be laid on a 50 mm setting bed of sand-cement over the specified subbase. The sand-cement setting bed shall not be placed more than 4 hours prior to installing the brick paving.

E. Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed). The Contractor shall have the option of installing Brick Paved Sidewalks and Driveways by one of the following methods:

1. Bricks shall be laid on a bed of cement concrete as specified in the contract documents. The bricks shall be laid in the cement concrete while it is still fresh as approved by the Engineer and they shall be firmly positioned to provide a uniformly even surface, and a solid bedding under each brick.
2. Bricks shall be laid as provided for under “Brick Paved Sidewalks and Driveways (Mortar Setting Bed)” provided the finished surface shall conform to the lines and grades shown in the contract documents.

608-3.04 Grouted Stone Block Paved Sidewalks and Driveways. All grouted stone block pavers shall be laid in the pattern shown in the contract documents or as directed by the Engineer to provide a uniformly even surface. Joints between blocks shall be a maximum of 32 mm or as specified. No blocks shall be laid or grouted in freezing weather.

Unless otherwise approved by the Engineer, a dry mixture of mortar as specified for Brick Paved Sidewalks and Driveways, §608-2.03, shall be swept over the stone blocks until the joints are completely filled and the joints lightly wetted with water prior to the mortar setting up. All grouted stone block paving shall be kept moist for four days after filling the joints with mortar. After the four day curing period, removal of remaining mortar film may be accomplished by the use of a light acid wash (10% ± solution of hydrochloric acid) followed by flushing clean with water, or as approved by the Engineer. Care shall be taken to avoid the use of acid in areas where runoff could damage trees or other vegetation.

All blocks used over tree pits shall be laid in a 25 mm bed of cushion sand with sand filled joints.

A. Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed). Blocks shall be laid in a 75 mm bed of cushion sand over the specified subbase or subgrade.

B. Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed). Blocks shall be laid in a bed of mortar with a minimum thickness of 25 mm over the specified concrete or bituminous subbase.

C. Grouted Stone Block Paved Sidewalks and Driveways (Sand-Cement Setting Bed). Blocks shall be laid on a 50 mm setting bed of sand-cement over the specified subbase. The sand-cement setting bed shall not be placed more than 4 hours prior to installing the block paving.

D. Grouted Stone Block Paved Sidewalks and Driveways (Optional Concrete Setting Bed). The Contractor shall have the option of installing Grouted Stone Block Paved Sidewalks and Driveways by one of the following methods:

1. Blocks shall be laid on a bed of cement concrete as specified in the contract documents. The blocks shall be laid in the cement concrete while it is still fresh as approved by the Engineer and they shall be firmly positioned to provide a uniformly even surface, and a solid bedding under each stone block.
2. Blocks shall be laid as provided for under “Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed)” provided the finished surface shall conform to the lines and grades shown in the contract documents.

608-3.05 Precast Concrete Block Paved Sidewalks and Driveways. Precast Concrete Driveway and Sidewalk Pavers shall be laid in the pattern shown in the contract documents or as directed by the Engineer to provide a uniformly even surface. Joints shall be hand tight unless otherwise specified. No pavers shall be laid in freezing weather.

After the pavers are in place, an approved sand joint filler shall be swept over the pavers until the joints are completely filled.
Unless otherwise specified in the contract documents, or directed by the Engineer, the Contractor shall install the pavers in accordance with the manufacturer's recommended procedures.

Precast Concrete Block Paved Sidewalks and Driveways (Granular Material Setting Bed). Unless otherwise specified in the contract documents, Precast Concrete Driveway and Sidewalk Pavers shall be laid on a setting bed not to exceed 50 mm of uniformly compacted material placed over the specified subbase.

608-4 METHOD OF MEASUREMENT

608-4.01 Concrete Sidewalks and Driveways. Portland cement concrete sidewalks and driveways will be measured by the number of cubic meters of cement concrete necessary to construct sidewalks and driveways shown in the contract documents or as ordered by the Engineer.

608-4.02 Asphalt Concrete Sidewalks, Driveways and Bicycle Paths. Asphalt concrete sidewalks, driveways and bicycle paths will be measured by the number of metric tons of asphalt concrete furnished and incorporated in the work. Quality payment adjustments will be measured as outlined in §402-4, Method of Measurement.

608-4.03 Brick Paved Sidewalks and Driveways. Brick paving shall be measured as the number of square meters placed as shown in the contract documents or as ordered by the Engineer.

608-4.04 Grouted Stone Block Paved Sidewalks and Driveways. Grouted stone block paving shall be measured as the number of square meters placed as shown in the contract documents or as ordered by the Engineer.

608-4.05 Precast Concrete Block Paved Sidewalks and Driveways. Precast concrete paving will be measured by the number of square meters placed as shown in the contract documents, or as ordered by the Engineer.

608-5 BASIS OF PAYMENT

608-5.01 Concrete Sidewalks and Driveways. The unit price bid per cubic meter shall include the cost of preparing the subgrade, all materials, equipment and labor necessary to complete the work “including saw cutting and wire fabric reinforcement) as specified except that any necessary excavation and subbase course will be paid for under their appropriate items.

Payment at the unit bid price will be made after the concrete sidewalk or driveway, and curing application have been properly placed.

608-5.02 Asphalt Concrete Sidewalks, Driveways, and Bicycle Paths. The unit price bid per metric ton shall include the cost of preparing the subgrade and all materials, equipment and labor (including milling, cleaning surfaces, tack coat, saw cut, trueing and leveling courses, etc.) necessary to complete the work as specified except that any necessary excavation and subbase course will be paid for under their appropriate items. Payment of Quality Units will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is NOT to be altered in any manner by the bidder.

Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

608-5.03 Brick Paved Sidewalks and Driveways. The price bid per square meter shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including setting bed material, as specified except that any necessary excavation and subbase course will be paid for under their appropriate items;

608-5.04 Grouted Stone Block Paved Sidewalks and Driveways. The unit bid per square meter shall include the cost of furnishing all labor, materials and equipment necessary to complete the work,
including setting bed material, as specified except that any necessary excavation and subbase course will be paid for under their appropriate items.

### §608-5.05 Precast Concrete Block Paved Sidewalks and Driveways.

The unit price bid per square meter shall include the cost of all labor, materials and equipment necessary to complete the work, including setting bed material, except that any necessary excavation and subbase course will be paid for under their appropriate items.

**Payment will be made under:**

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<thead>
<tr>
<th>Item No.</th>
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<td>Concrete Sidewalks and Driveways</td>
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<tr>
<td>608.020101</td>
<td>Asphalt Concrete Sidewalks, Driveways and Bicycle Paths</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>608.020110</td>
<td>Plant Production Quality Adjustment to 608.020101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>608.03</td>
<td>Brick Paved Sidewalks and Driveways (Sand Setting Bed)</td>
<td>Square Meter</td>
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<tr>
<td>608.04</td>
<td>Brick Paved Sidewalks and Driveways (Mortar Setting Bed)</td>
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</tr>
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<td>608.05</td>
<td>Brick Paved Sidewalks and Driveways (Bituminous Setting Bed)</td>
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<td>608.06</td>
<td>Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed)</td>
<td>Square Meter</td>
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<td>608.07</td>
<td>Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed)</td>
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<td>608.08</td>
<td>Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed)</td>
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<td>Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed)</td>
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<td>608.11</td>
<td>Grouted Stone Block Paved Sidewalks and Driveways (Optional Concrete Setting Bed)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>608.12</td>
<td>Precast Concrete Block Paved Sidewalks and Driveways (Granular Material Setting Bed)</td>
<td>Square Meter</td>
</tr>
</tbody>
</table>

### SECTION 609 - CURB AND CURB & GUTTER

**609-1 DESCRIPTION.** Construct and place curb, and curb & gutter, and/or reset curb as specified in the Contract Documents or established by the Engineer.

**609-2 MATERIALS.** The materials shall meet the requirements of the following subsections of Section 700-Materials Details.

- Portland Cement, Type II 701-01
- Concrete Repair Material 701-04
- Concrete Grouting Material 701-05
- Anchoring Material - Chemically Curing 701-07
- Coarse Aggregate 703-02
- Concrete Sand 703-07
- Premoulded Resilient Joint Filler 705-07
- Masonry Mortar 705-21
- Stone Curb Anchor Bars 709-07
- Quilted Covers (for Curing) 711-02
- Plastic Coated Fiber Blankets (for Curing) 711-03
- Polyethylene Curing Covers (White Opaque) 711-04
- Membrane Curing Compound 711-05
- Stone Curb 714-01
- Precast Concrete Curb 714-04
- Asphalt Concrete or Hot Mix Asphalt Curb 714-06
White and Yellow Pavement Marking Paints shall meet the requirements of Section 640 - Reflectorized Pavement Marking Paints.

609-2.01 (Vacant)

609-2.02 Concrete for Cast-in-Place Concrete Curb and Curb & Gutter.

A. Conventionally Formed Curb and Curb & Gutter. The material requirements, mix preparation and manufacturing of the concrete shall conform to the requirements for Class A Concrete as specified in Section 501, Portland Cement Concrete - General.

B. Machine Formed Concrete Curb and Curb & Gutter. Use Class J Concrete as specified in Section 501, Portland Cement Concrete - General.

609-2.03 Stone Curb and Granite Curb. Stone curb shall conform to §714-01 and shall be either sandstone or bluestone. Granite curb shall conform to the requirements for granite under Stone Curb §714-01.

609-2.04 Curb Anchors. Curb anchors for cast-in-place concrete curb, and curb & gutter shall be fabricated from material conforming to the requirements for Longitudinal Joint Ties §705-14 and to the details shown on the standard sheet for concrete curb or as indicated in the contract documents.

609-2.05 Concrete for Backing and Bedding Precast Concrete Curb, Stone Curb, and Granite Curb. The Contractor shall use any Class Concrete or a concrete mix proportioned as follows:

<table>
<thead>
<tr>
<th>KILOGRAMS OF AGGREGATE PER BAG OF CEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity of Aggregate</td>
</tr>
<tr>
<td>2.60 2.70 2.80 2.90</td>
</tr>
<tr>
<td>Concrete Sand</td>
</tr>
<tr>
<td>148 153 159 165</td>
</tr>
<tr>
<td>Coarse Aggregate, CA 2 Gradation</td>
</tr>
<tr>
<td>243 252 253 271</td>
</tr>
</tbody>
</table>

609-3 CONSTRUCTION DETAILS

609-3.01 General. Curb, or curb & gutter found to be dirty, damaged or out of alignment shall be cleaned, repaired, or replaced as necessary by the Contractor to the satisfaction of the Engineer prior to final acceptance of the work. When the Contract Documents have no reference to placing curb across driveway entrances, no curb shall be placed across driveway entrances.

609-3.02 Precast Concrete Curb, Stone Curb, and Granite Curb. All precast concrete curb, stone curb, and granite curb shall be set on a 75 mm thick continuous bed of dry concrete mix, or on a 75 mm thick dry concrete mix bed at the joints as shown on the Standard Sheets and plastic concrete between the joints, or on a 75 mm minimum thick continuous bed of compacted granular material, at the Contractor's option.

Precast concrete curb, stone curb, and granite curb shall be backed up with concrete using one of the following methods depending on the type of pavement:

A. Portland Cement Concrete (Rigid) Pavement. The Contractor shall place concrete backing behind the curb at each joint. The backing shall extend a minimum of 300 mm on both sides of the joint. The minimum height of the concrete backing shall be one half of the concrete pavement thickness and shall be measured from the bottom of the curb.

B. Hot Mix Asphalt (Flexible) Pavement. The Contractor shall place a continuous concrete backing behind the curb. The minimum height of the concrete backing shall be 255 mm or to the top of the hot mix asphalt pavement, whichever is greater, measured from the bottom of the curb.

Precast curb and stone curb with and without sawed ends, not on structure, shall be butted together with no mortar between the joints.
§609

When the curb is set next to a concrete (rigid) pavement, grout conforming to §701-04 Concrete Repair Material or §705-21 Masonry Mortar shall be placed in the joint formed between the curb and the pavement. The grout shall extend from the bottom to the top of the pavement slab.

Before proceeding with any further work adjacent to the curb, the curb shall be backfilled with material approved by the Engineer and the backfill material shall be thoroughly tamped.

609-3.03 Stone Curb and Granite Curb - Bridge Type. The requirements of §609-3.02 shall apply with the following modifications:

A. Unless special construction details are called for in the contract documents, Type A and Type T2 curbs, when not on structures, shall be set true to line and grade on a concrete bedding.
B. Types F1, G1, M, R1, R2, S and T1 curbs shall be set in full mortar beds on structures. Excess mortar which extrudes around the curb shall be struck off flush with the front face of the curb and the top surface of the roadway.
C. Anchor bars for stone and granite bridge curb shall be installed where and as indicated in the contract documents.

All curb on structures shall be fitted together allowing 6 mm full mortared joints finished flush with exposed curb surfaces. Curb surfaces shall be cleaned of excess mortar to the satisfaction of the Engineer.

Mortar used for bedding and filling of joints shall conform to §705-21 Masonry Mortar or §701-04 Concrete Repair Material.

609-3.04 Cast-In-Place Concrete Curb and Curb & Gutter. Cast-in-place concrete curb and curb & gutter shall either be conventionally formed or machine formed to the size and shape shown on the standard sheets or as indicated in the contract documents.

Curb anchors, as required on the standard sheets or the contract documents, shall not be coated with materials which impair bonding. Curb anchors shall be installed a minimum of 300 mm from the ends of a pavement slab. Curb anchors for new concrete pavement, when placed simultaneously with pavement concrete, shall be placed by equipment which can demonstrate to the satisfaction of the Engineer placement of the anchors in accordance with these specifications. Curb anchors, when not placed simultaneously with pavement concrete, shall be placed rigidly secured by chairs or other supports to prevent displacement of the anchors when pavement concrete is placed. Curb anchors for existing concrete pavement shall be inserted into holes drilled in the side of the existing concrete pavement. The holes shall be thoroughly cleaned and filled with Concrete Grouting Material §701-05 or Anchoring Materials - Chemically Curing §701-07 immediately before placing the curb anchor. The curb anchor shall be securely supported in position until the grout has hardened.

Curing of the curb and curb & gutter shall comply with the requirements of §502-3.11 Curing, except that a clear membrane curing compound with fugitive dye conforming to the requirements of Membrane Curing Compound §711-05 may be used in lieu of the white pigmented membrane.

A. Conventionally Formed Curb and Curb & Gutter

1. Forms. Forms shall be free from warp and of such construction that there will be no interference to inspection for grade and alignment. All forms shall extend to the full curb depth and be secured so no displacement will occur during the placement of concrete.

2. Casting Segments. Curb and curb & gutter shall be cast in segments having a uniform length of approximately 3 m. The joints between segments shall not exceed 6 mm in width. When curb and curb & gutter is constructed next to concrete pavement, the curb and curb & gutter joints shall line up with the pavement joints or additional joints shall be provided in the curb and curb & gutter which line up with the pavement joints.

3. Expansion Joints. Expansion joints shall be 18 mm wide and contain Premoulded Resilient Joint Filler §705-07. The filler shall be cut to conform to the cross section of the curb and curb & gutter.
Expansion joints shall be located at all immovable objects (bridge structures, etc.), adjacent to expansion joints in the pavement, and where shown in the contract documents or directed by the Engineer. Expansion joints will not be required at regular intervals unless otherwise shown in the contract documents.

4. Concrete Placing and Vibrating. Concrete shall be placed in the forms in accordance with the applicable requirements of §555-3.04 and shall be compacted with an immersion type mechanical vibrator. The vibrator shall be of a size and weight capable of thoroughly vibrating the concrete without damaging or misaligning the forms. The forms shall be left in place until the concrete has hardened sufficiently to permit removal without damage to the curb and curb & gutter. The front form may be removed before the other forms to facilitate finishing the curb and removal of the joint dividers. After removal of the forms, the exposed faces of the curb and curb & gutter shall be immediately rubbed to a uniform surface. No plastering will be permitted.

B. Machine Formed Concrete Curb and Curb & Gutter. The equipment proposed for use by the Contractor shall demonstrate, to the satisfaction of the Engineer, the capability of placing the concrete in accordance with these specifications.

When machine forming, the Contractor may provide additional width of curb without any other change in shape or dimension, if provided by the Contractor at no additional cost to the State. If the Contract Documents or the Engineer require no curb be placed across driveway entrances or the Contract Documents have no reference to placing curb across driveway entrances, the Contractor may continue placing curb across driveway entrances but the curb placed across driveway entrances, excluding transitions, must be cut out and the concrete disposed in a manner approved by the Engineer.

Any curb and curb & gutter placed outside the tolerance of 12 mm of the established line or 6 mm of the established grade shall be removed and replaced by the Contractor.

1. Crack Control Joints. Crack control joints shall be formed or saw cut to a width of 3 mm minimum, 6 mm maximum and to a depth of 38 mm. The cut or formed joints shall extend slightly below the surface of the adjacent pavement and shall be spaced at 3 m intervals. When the curb, and curb & gutter is constructed next to concrete pavement, the curb and curb & gutter joints shall line up with the pavement joints or additional joints shall be provided in the curb and curb & gutter which line up with the pavement joints. The saw cut or formed joints shall be left unfilled.

2. Expansion Joints. Expansion joints shall be 18 mm wide and contain Premoulded Resilient Joint Filler §705-07. The filler shall be cut to conform to the cross section of the curb and curb & gutter.

The expansion joints shall be located at all immovable objects (bridge structures, etc.), adjacent to expansion joints in the pavement, where shown in the contract documents, or directed by the Engineer. Expansion joints shall not be required at regular intervals unless otherwise shown in the contract documents.

609-3.05 (Vacant)

609-3.06 Optional Curb. Under optional curb, the Contractor shall have the option of placing precast concrete curb, or cast-in-place concrete curb, or granite curb. Precast concrete curb or granite curb shall be placed in accordance with the requirements of §609-3.02. Cast-in-place curb shall be placed in accordance with the requirements of §609-3.04. No intermixing of curb will be allowed without the Engineer's written permission.

609-3.07 Hot Mix Asphalt Curb. Hot mix asphalt curb shall conform to the construction requirements of §402-3, except as follows:

A. Preparation of Mixture. The hot mix asphalt for curb shall be mixed in a batch type bituminous concrete mixing plant. The additive as specified in §714-06 shall be introduced into the
pugmill within an accuracy of ± 0.1% of the total batch weight. The additive may be introduced through a mineral filler feed system only if the above delivery tolerance can be maintained. The dry mixing time shall be a minimum of 15 seconds after the complete introduction of aggregates and additive into the pugmill. The wet mix time shall be a minimum of 45 seconds.

**B. Preparation of Surface.** When hot mix asphalt curb is constructed on a freshly laid hot mix asphalt surface, the curb shall be laid only on a clean dry surface. When curb is to be laid on a cured or aged concrete base, hot mix asphalt pavement, or performance grade binder treated base, the surface shall be thoroughly swept and cleaned by compressed air. The surface shall be thoroughly dried and, immediately prior to placing of the hot mix asphalt mixture, shall receive a tack coat of asphalt emulsion, Material Designation 702-3001 as specified in Table 702-5. The tack coat shall be applied at a rate of 0.15 to 0.50 L/m². The tack coat shall be prevented from spreading to areas outside of the area to be occupied by the curb.

**C. Placing.** Hot mix asphalt curb shall be constructed by machine to the size and shape shown on the standard sheets.

The machine shall be capable of placing the hot mix asphalt in accordance with these specifications to the satisfaction of the Engineer. Prior to placement, the Contractor shall demonstrate to the satisfaction of the Engineer the machine meets the following requirements:

1. The machine shall be self propelled and capable of forming curb which is uniform in texture, shape, and density.
2. The weight and the material extrusion rate of the machine shall be such that the required compaction is obtained without the machine riding above the bed on which curbing is constructed.

When short sections of hot mix asphalt curb or sections with short radii are required, the Engineer may permit construction by other means, as long as the resulting curb conforms to the curb produced by machine.

**D. Painted Hot Mix Asphalt Curb.** When painted hot mix asphalt curb is specified, it shall be painted yellow or white in accordance with the Manual of Uniform Traffic Control Devices. The paint shall be placed in accordance with the following:

1. After a curing period of not less than 72 hours, exposed surfaces of the curbing shall be sprayed or hand brushed with two coats of pavement marking paint, yellow or white as required. Each coat of paint shall be applied at the rate of 1 L per 16 m of curb.
2. The curb shall be clean and free of all foreign matter before painting. Paint shall be applied only when the air temperature is above 10°C and rising. Paint shall not be applied when there is reasonable expectation of rain. In the event the first or final coat of paint is rain damaged, as determined by the Engineer, the Contractor shall clean and repaint the curb at no additional cost to the State.

**609-3.08 Resetting Curb.** Care shall be taken in removing the curb to be reset so that there will be no unnecessary breakage. All curb damaged in removing, hauling, storing, or resetting shall be replaced by the Contractor.

The curb shall be reset, in accordance with the requirements of §609-3.02 or §609-3.03 for resetting bridge type curbs, to the lines and grades specified in the contract documents.

**609-4 METHOD OF MEASUREMENT.** All curb and curb & gutter placed and curb reset under these specifications will be measured by the number of linear meters, rounded to the nearest tenth of a meter. The measurement will be taken along the top front arris line of full height, transition and terminal sections. The measurement will be taken along the top front arris line of curb reveals across driveway entrances only when placed and not removed.

**609-5 BASIS OF PAYMENT**
§609

609-5.01 Concrete Curb, Curb & Gutter, Stone Curb, Granite Curb, Optional Curb. The unit price bid per meter shall include the cost of all labor, materials, curb anchors, equipment, and excavation to, in accordance with these specifications, place, backfill, grout and caulk the curb, curb & gutter. When select backfill is specified, the select backfill shall be paid under its respective items. No additional payment will be made to the Contractor when more than the minimum width of curb is placed. No additional payment will be made to the Contractor when curb is placed across driveway entrance, to facilitate concrete machine forming operations, and removed.

609-5.02 Stone Curb and Granite Curb - Bridge Type. The unit price bid per meter shall include the cost of furnishing all labor, equipment, and materials including concrete bedding, mortar for stone and granite curbs, chemically curing anchoring materials, and stone and granite curb anchors required to bed and place stone and granite bridge curb, in accordance with these specifications.

609-5.03 Hot Mix Asphalt Curb. The unit price bid per meter shall include the cost of furnishing all labor, materials, and equipment to prepare the surface for curb placement, and place the curb. If painted hot mix asphalt curb is specified, the Contractor shall also include the cost of preparing the curb for painting, furnishing the paint, and applying the paint.

Progress payments will be made after the curb has been constructed to the shape and size shown on the standard sheet and/or plans. Payment will be made, at the unit price bid, for 90% of the quantity properly constructed exclusive of painting. The balance of the quantity will be paid for upon completion of the work.

609-5.04 (Vacant).

609-5.05 Resetting Curb. The unit price bid per meter shall include the cost of furnishing all labor, equipment, and materials to remove, haul, store and reset curb, in accordance with these specifications. In addition, the unit price shall also include any re-dressing of tops and joints of bridge type curb, as directed by the Engineer, and replacement of curb damaged by the Contractor's operations.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>609.01XX</td>
<td>Stone Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.02XX</td>
<td>Granite Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.03XX</td>
<td>Granite Bridge Curb* (Various Types as indicated)</td>
<td>Meter</td>
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<tr>
<td>609.035X</td>
<td>Stone Bridge Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.04XX</td>
<td>Cast-in-Place Concrete Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.05XX</td>
<td>Cast-in-Place Concrete Curb &amp; Gutter* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.08XX</td>
<td>Precast Concrete Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.0901</td>
<td>Optional Curb (Precast Concrete Type PVF150</td>
<td>Meter</td>
</tr>
<tr>
<td></td>
<td>or Cast-In-Place Concrete Type VF150 or Granite Type C)</td>
<td></td>
</tr>
<tr>
<td>609.0902</td>
<td>Optional Curb (Precast Concrete Type PM100</td>
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<tr>
<td></td>
<td>or Cast-In-Place Concrete Type M100 or Granite Type E100)</td>
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</tr>
<tr>
<td>609.0903</td>
<td>Optional Curb (Precast Concrete Type PT100</td>
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<tr>
<td></td>
<td>or Cast-In-Place Concrete Type T100)</td>
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<td>609.15</td>
<td>Resetting Existing Curb</td>
<td>Meter</td>
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<tr>
<td>609.21XX</td>
<td>Painted Hot Mix Asphalt Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
<tr>
<td>609.22XX</td>
<td>Unpainted Hot Mix Asphalt Curb* (Various Types as indicated)</td>
<td>Meter</td>
</tr>
</tbody>
</table>

* Refer to Standard Pay Item Catalog for full Item Number and Description.

SECTION 610 - TURF AND WILDFLOWER ESTABLISHMENT

610-1 DESCRIPTION. The work covered by this section includes work necessary to establish and care for turf and wildflowers.
610-1.01 Applying Soil Amendments. The work consists of furnishing and placing soil amendments as specified at the locations indicated in the contract documents or where directed by the Engineer.

610-1.02 Establishing Turf. The work consists of preparing ground surfaces for seeding; furnishing and installing fertilizer, seed, mulch, and mulch anchorage on areas indicated in the contract documents or where directed by the Engineer. The work also consists of producing a satisfactorily established turf and caring for the turf as specified. The work may also include furnishing and applying limestone as specified in the contract documents.

610-1.03 Establishing Wildflowers. The work consists of preparing ground surfaces for seeding; furnishing and installing seed, mulch and mulch anchorage on areas indicated in the contract documents or where directed by the Engineer; and caring for and establishing the work specified.

610-2 MATERIALS

610-2.01 Applying Soil Amendments. The materials shall meet the requirements of the following subsections of section 700-Materials Details and/or as further specified in the contract documents.

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>Limestone</td>
<td>713-02</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>713-03</td>
</tr>
</tbody>
</table>

610-2.02 Establishing Turf. The materials shall meet the requirements of the following subsections of section 700-Materials Details and/or as further specified in the contract documents.

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limestone</td>
<td>713-02</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>713-03</td>
</tr>
<tr>
<td>Hay or Straw</td>
<td>713-18</td>
</tr>
<tr>
<td>Mulch anchorage</td>
<td>713-12</td>
</tr>
<tr>
<td>Seeds</td>
<td>713-04</td>
</tr>
<tr>
<td>Wood fiber</td>
<td>713-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Variety</th>
<th>Wt. of Pure Live Seed Per m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Fescue (Festuca rubra)</td>
<td>Commercial</td>
<td>6.0 g</td>
</tr>
<tr>
<td>Perennial Ryegrass (Lolium perenne)</td>
<td>Commercial</td>
<td>3.4 g</td>
</tr>
<tr>
<td>White Clover (Trifolium repens)</td>
<td>Commercial</td>
<td>Max. 25% hard seed 0.6 g</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10.0 g</td>
</tr>
</tbody>
</table>

610-2.03 Establishing Wildflowers. The materials shall meet the requirements of the following subsections of section 700-Materials Details and/or as further specified in the contract documents.

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeds</td>
<td>713-04</td>
</tr>
<tr>
<td>Straw</td>
<td>713-19</td>
</tr>
</tbody>
</table>

610-3 CONSTRUCTION DETAILS

610-3.01 Applying Soil Amendments. Fertilizer and/or limestone shall be evenly spread over the surface of the soil in the areas described in the contract documents or where directed by the Engineer. The rates of application shall be as specified in the contract documents. Any method of application that will insure an even distribution will be acceptable. When hydraulic application is used the minimum rate of water shall be 0.5 L/m² unless otherwise specified in the contract documents.
610-3.02 Establishing Turf

**A. Rates.** Application rates for turf establishment materials shall be specified in the contract documents. When no rates for establishing turf are specified in the contract documents, the following shall apply:

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td>90 g/m²</td>
</tr>
<tr>
<td>Seed</td>
<td>10 g pure live seed/m²</td>
</tr>
<tr>
<td>Mulch</td>
<td>0.5 kg/m²</td>
</tr>
<tr>
<td>Mulch Anchorage</td>
<td>Manufacturer's recommended rate</td>
</tr>
</tbody>
</table>

**B. Limitations.** The contractor shall notify the Engineer at least 2 working days before the start of any seeding operation and shall not begin the work until the Engineer has given permission. When sodding and turf establishment are to be done in the same general areas, the sodding shall be done first, and equipment used during turf establishment shall not damage the sodded areas.

**C. Inoculation of Leguminous Seeds.** All seeds of leguminous plants requiring inoculation shall be inoculated prior to mixing or sowing unless otherwise specified or approved or unless accompanied by a certificate of preinoculation. When seeds requiring inoculation are to be sown dry, the inoculant shall be applied in accordance with its accompanying instructions and the seeds allowed to dry sufficiently for proper handling. Seeds shall be sown within thirty hours after this treatment. When seeds requiring inoculation are to be sown by water pressure, the inoculant may be added to the water and seed mixture, together with limestone and/or fertilizer as specified, providing the pH of the solution does not exceed 8.

**D. Ground Preparation and Seeding.** All turf establishment areas shall be approved by the Engineer prior to seeding. Areas to be seeded with turf seeds shall be maintained at approved grades and irregularities that will hold water shall be eliminated. Weed growth that, in the Engineer's judgment, may adversely affect germination or growth shall be removed or controlled as approved or as directed by the Engineer prior to seeding. Limestone, fertilizer and seeds in the amounts specified shall be evenly distributed on the areas to be seeded. All mechanical equipment used for soil preparation for seeding shall be as approved. Equipment shall pass parallel to the contours unless otherwise approved except that crawler tractors shall pass at right angles to the contours.

Establishing turf shall be done using Method No. 1, unless Method No. 2 is specified. Regardless of the method used, the finished surface of any area that is seeded shall not be rougher, more uneven or have more or larger stones, clods, roots, or other foreign materials than the area it adjoins. In built up and residential areas handraking will usually be necessary to produce the required smoothness and uniformity, particularly where grading and turf establishment is to be adjacent to lawns.

**Method No. 1.** Areas to be seeded shall be scarified sufficiently to break up the surface crust immediately before seeding except where, in the judgment of the Engineer, the ground is already loose and friable as immediately following grading. Where topsoil is not specified, all loose stones and other objects over 50 mm in greatest dimension, or other sizes as specified, shall be removed and disposed of as approved. All embedded stones and other objects protruding more than 50 mm above the surface, or other heights specified, shall also be removed and disposed of as approved. Where topsoil is specified the maximum loose stone size shall be 50 mm or as otherwise specified under §613-2. Unless otherwise specified in the contract documents, only limestone and/or fertilizers may be mixed together with the seeds (including legume inoculants when required) immediately before sowing. Any method of sowing that does not injure the seeds in the process of spreading will be acceptable.

**Method No. 2.** Areas to be seeded shall be harrowed, disked, or otherwise completely pulverized to a state of tillage acceptable to the Engineer. All stones and other undesirable material over 25 mm in greatest dimension or other sizes as specified shall be removed and disposed of as approved. Fertilizer and/or limestone as specified shall be uniformly distributed...
on the area to be seeded. Seeds shall be distributed uniformly by any approved method that does not injure the seeds in the process of spreading. Following distribution, seeds shall be incorporated into the soil to a depth not exceeding 5 mm by raking, rolling brush or chair harrowing, or any other approved method.

**E. Mulching.** Mulch shall be spread uniformly in a continuous blanket of sufficient thickness to hide the soil from view, taking care not to over apply. Mulch may be spread by hand or by machinery. Mulch shall not be spread before seeding turf unless otherwise approved or directed. Anchorage for hay and/or straw mulch is required unless otherwise specified in the Contract Documents. Mulch and mulch anchorage shall be applied separately from seeds unless otherwise specified in the Contract Documents. When use of wood fiber mulch is specified, it shall be spread in accordance with the manufacturer’s instructions and/or recommendations.

**F. Liability.** When the Engineer determines that any seeded area has failed for any reason to produce a satisfactorily established turf after a suitable period of time has elapsed, the Contractor shall repeat all the work required by the Section until a satisfactory growth of turf has been established. Any work to be corrected shall be at the Contractor's expense. The contract will not be accepted until a satisfactory turf has been established.

**G. Care During Construction.** The Contractor shall care for seeded turf areas until final acceptance of the contract. Care shall consist of providing protection against traffic by providing approved warning signs or barricades; and shall consist of repairs to any seeded turf areas damaged by wind, water, fire, traffic or other causes. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be re-fertilized, reseeded and remulched as specified herein.

**Method No. 1.** The Contractor shall mow all turf establishment areas seeded on 1 on 3 or flatter slopes unless otherwise specified or directed by the Engineer. Such turf areas shall be mowed to a height of 100 mm when growth reaches 200 mm and thereafter as directed by the Engineer.

**Method No. 2.** The Contractor shall mow all turf establishment areas seeded under Method No. 2 to a height of 75 mm after initial growth reaches 125 mm, and then once a week thereafter unless otherwise approved. Clippings from the first mowing shall be removed.

**610-3.03 Establishing Wildflowers**

**A. Rates.** Application rates for wildflower establishment materials shall be as specified in the contract documents.

**B. Limitations.** The contractor shall notify the Engineer at least 2 working days before the start of any seeding operation and shall not begin the work until the Engineer has given permission.

**C. Inoculation of Leguminous Seeds.** Shall be as required under §610-3.02 C. Inoculation of Leguminous Seeds.

**D. Ground Preparation and Seeding.** All wildflower establishment areas shall be approved by the Engineer prior to seeding. Areas to be seeded with wildflower seeds shall be maintained at approved grade sand irregularities that will hold water shall be eliminated. Weed growth that, in the Engineer's judgment, may adversely affect germination or growth shall be removed or controlled as approved or as directed by the Engineer prior to seeding. Seeds in the quantities specified shall be evenly distributed on the areas to be seeded. All mechanical equipment used for soil preparation or seeding shall be as approved and shall pass parallel to the contours unless otherwise approved except that crawler tractors shall pass at right angles to the contours. Areas to be seeded shall be scarified sufficiently to break up the surface crust immediately before seeding except where the ground is already loose and friable as immediately following grading. All stones and other objects over 50 mm in greatest dimension or other sizes as specified shall be removed and disposed of as approved. Any
method of sowing that does not injure the seeds in the process of spreading will be acceptable. The finished surface of any area that is seeded shall not be rougher, more uneven or have more or larger stones, clods, roots, or other foreign materials than the area it adjoins.

**E. Mulching.** Mulch shall be spread uniformly in a continuous blanket of sufficient thickness to hide the soil from view, taking care not to over apply. Mulch may be spread by hand or by machinery. Mulch shall not be spread before seeding turf unless otherwise approved or directed. Anchorage for hay and/or straw mulch is required unless otherwise specified in the Contract Documents. Mulch and mulch anchorage shall be applied separately from seeds unless otherwise specified in the Contract Documents. When use of wood fiber mulch is specified, it shall be spread in accordance with the manufacturer’s instructions and/or recommendations.

**F. Liability.** When the Engineer determines that any seeded area has failed for any reason to produce a satisfactorily established growth of wildflowers after a suitable period of time, the Contractor shall reseed such areas in the same manner as specified in the contract until a satisfactorily established growth of wildflowers has been established. Any work to be corrected shall be at the Contractor's expense. The contract will not be accepted until a satisfactory growth of wildflowers has been produced.

**G. Care of Wildflowers During Construction.** The Contractor shall care for the seeded wildflower areas until final acceptance of the contract or as required under §610-3.04. Care of wildflowers shall consist of keeping the wildflowers in a healthy growing condition by watering, controlling weeds, and by any other necessary operations. Care shall also consist of providing protection against traffic by providing approved warning signs or barricades, and shall consist of repairs to any seeded wildflower area damaged by wind, water, fire, traffic or other cause. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall be reseeded and remulched as specified herein. The Contractor shall mow wildflower establishment areas once a year in the autumn after the seed heads have matured, as approved by the Engineer for the duration of the contract.

**610-3.04 PERIOD OF ESTABLISHMENT FOR WILDFLOWERS.** The Period of Establishment for Wildflowers shall begin immediately following the satisfactory completion of all the wildflower seeding as confirmed in writing by the Engineer. The Contractor shall be required to continue the work specified under §610-3.03 G. Care of Wildflowers During Construction for a period of one year or until the contract is complete, whichever is later.

In the event the Contractor requests acceptance of the contract and the “Period of Establishment” is not yet completed, the State, if approved by the Commissioner, may pay the Contractor monies retained under provisions of Section 38 Subdivision 7 of the Highway Law upon receipt of a certified check or securities as are listed in Subdivision 3 of Section 139 of the State Finance Law, in the amount of at least double the value of the completed work under “Period of Establishment”. For the purpose of determinations for contract acceptance prior to completion of the work under “Period of Establishment”, the value of the work required under “Period of Establishment”, including necessary reseeding, shall be considered as a sum equal to 10% of the price bid for the item of Establishing Wildflower unless otherwise specified.

When all work in the contract excepting §610-03, Establishing Wildflowers, has been completed and accepted, the Contractor agrees to procure and maintain for the duration and purposes of any such work of establishment, and at the Contractor's expense, insurance for liability for damages imposed by law, in insurance companies authorized to do such business in the State covering all such operations, whether performed by the Contractor or subcontractors.

Before commencing any such work, the Contractor agrees to furnish to the Commissioner a certificate or certificates of insurance, in a form satisfactory to the Commissioner, showing that the Contractor has complied with this provision as to insurance, which certificate or certificates shall provide that the policies shall not be changed or cancelled until 30 days written notice has been given to the Commissioner.

The kind and amounts of insurance are as specified under §611-3.06 Period of Establishment.
At the conclusion of the Period of Establishment the Contractor shall remove any trash or debris from the wildflower planting area. Areas that, in the judgment of the Engineer, have failed to produce an established growth of wildflowers shall be noted for reseeding in accordance with the contract specifications.

This requirement shall not prevent the release of the retained monies as herein defined at the expiration of the Period of Establishment but a certified check or securities, as previously described, equal to at least double the value of any uncompleted work will be required. No work other than re-grading to establish condition of the area, reseeding and remulching will be required after the conclusion of the Period of Establishment for Wildflowers.

610-4 METHOD OF MEASUREMENT

610-4.01 Applying Soil Amendments. Applying soil amendments will be measured as the number of kilograms of soil amendments that have been acceptably applied.

610-4.02 Establishing Turf. Establishing turf will be measured as the number of square meters of surface area that have been satisfactorily seeded.

610-4.03 Establishing Wildflowers. Establishing wildflowers will be measured as the number of square meters of surface area that have been satisfactorily seeded.

610-5 BASIS OF PAYMENT

610-5.01 Applying Soil Amendments. The unit price bid per kilogram shall include the cost of all labor, equipment, materials and incidentals, including water necessary to complete the work as specified.

610-5.02 Establishing Turf. The unit price bid per square meter shall include the cost of all labor, equipment, materials and incidentals, including water necessary to complete the work as specified.

610-5.03 Establishing Wildflowers. The unit price bid per square meter shall include the cost of all labor, equipment, materials and incidentals, including water and watering necessary to complete the work as specified.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Applying Soil Amendments</td>
<td>Kilogram</td>
</tr>
<tr>
<td>610.0203</td>
<td>Establishing Turf</td>
<td>Square Meter</td>
</tr>
<tr>
<td>610.03</td>
<td>Establishing Wildflowers</td>
<td>Square Meter</td>
</tr>
</tbody>
</table>

SECTION 611 - PLANTING

611-1 DESCRIPTION. This work consists of furnishing, planting and caring for plants as specified in the contract documents. This work shall include all care of planting operations and establishment necessary to complete the work as specified.

611-2 MATERIALS

611-2.01 Plants. Trees, shrubs and vines, groundcovers and special plants shall be as specified under §713-06 and as further specified in the contract documents. The Contractor shall be responsible for furnishing the vendor with a copy of the appropriate contract documents containing the plant material specifications.

611-2.02 Planting Materials. Topsoil, organic materials, fertilizer, mulch and materials for the protection of plants shall be specified under §713, Landscape Development Materials and as further specified in the contract documents.

       Water shall be specified under §712-01 Water.
§611-3 CONSTRUCTION

611-3.01 General

A. Planting Season. The planting seasons shall be as specified in the contract documents. No planting shall be done when the soil is frozen or otherwise in an unsatisfactory condition for working as determined by the Engineer.

B. Obstructions below Ground. The Contractor shall verify the locations of underground tanks, utilities and other nonmovable obstructions. Where nonmovable obstructions are encountered, the plant pits shall be relocated, as directed by the Regional Landscape Architect.

C. Delivery. The Contractor shall notify the Engineer at least two full working days before intended delivery of plants or planting materials, to the site. The Engineer shall be furnished legible copies of the certificates of inspection of plant materials as specified in §713-06 and a copy of the invoice for each shipment showing point of origin, sizes, quantities, sizes, and kinds of materials supplied. Plants which fail to meet the specifications, as determined by the Regional Landscape Architect, will be rejected. All rejected plants shall be promptly removed from the project site.

D. Storage. All plants shall be properly protected from damage and drying out. Such protection shall include the time when the plants are in transit, being handled or in temporary storage. Bare root plants not planted immediately shall be puddled and heeled in. The bundles of heeled in plants shall be opened and the plants shall be spaced separately. The roots of the heeled in plants shall have their earth balls protected by earth, mulch or straw, or they may be heeled in. All plants not planted immediately shall be watered as approved by the Regional Landscape Architect.

611-3.02 Ground Preparation

A. Layout. Locations for plants and outlines of areas to be planted shall be staked or marked out on the ground by the Contractor to the satisfaction of the Regional Landscape Architect before any plant pits or plant beds are dug.

B. Undesirable Material. When rock, construction debris or other undesirable materials is encountered while digging, the materials shall be removed to the depth and width necessary to obtain the specified plant pit diameter and depth, or the plant pit may be relocated as directed by the Regional Landscape Architect.

C. Plant Pit Diameter. The minimum plant pit diameter shall bear the following relationship to the diameter of the root spread or root balls of the plants to be planted in them, unless otherwise specified in the contract documents.

<table>
<thead>
<tr>
<th>Root Spread/Root Ball Diameter</th>
<th>Plant Pit Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 0.6 m</td>
<td>Twice the root spread or root ball diam.</td>
</tr>
<tr>
<td>from 0.6 m to 1.2 m</td>
<td>Equal to the root spread or root ball diam. plus 0.6 m</td>
</tr>
<tr>
<td>over 1.2 m</td>
<td>One and one half times the root spread or root ball diam.</td>
</tr>
</tbody>
</table>

The sides of the plant pits shall be loose and friable at the time of planting.

D. Plant Pit Depth. The depth of all plant pits shall allow the root ball to sit on undisturbed subgrade unless otherwise specified in the contract documents. Pit depth for bare root plants shall be as specified in the contract documents.

E. Planting Beds. Plants in planting beds shall either be planted in individual plant pits, or the entire planting bed shall be excavated and backfilled with planting soil as specified in the contract.
documents. Existing vegetation shall be removed from all planting beds as specified in the contract documents or as directed by the Regional Landscape Architect.

**F. Drainage.** Where an impervious layer of soil is encountered during the excavation of plant pits or beds, all such soil shall be removed to a depth as approved by the Engineer and the pits or beds shall be backfilled with acceptable planting soil.

**G. Planting Soil.** Planting soil shall be unamended existing soil excavated from the plant pit unless one of the following alternates is specified elsewhere in the contract documents.

1. **Alternative 1.** Amended existing soil excavated from the plant pit.
2. **Alternative 2.** Unamended approved topsoil.
3. **Alternative 3.** Amended approved topsoil thoroughly premixed with specified soil amendments at the specified rates.

When specified, fertilizer shall be applied within the plant saucers or over the plant beds, unless otherwise specified in the contract documents.

**H. Disposal of Excess Soil.** Excess soil shall be removed immediately and disposed of in disposal areas designated in the contract documents or at an on-site or off-site location, consistent with law, rule or regulation, and as approved by the Engineer.

611-3.03 Setting Plants

**A. General.** All plants shall be set plumb at such a level that they bear the same relation to the surface of the surrounding ground as they bore to the ground from which they were dug. Planting soil shall be carefully backfilled into plant pits in layers not to exceed 0.1 meter in depth, and shall be tamped to prevent voids and settling before additional planting soil is placed. Thorough watering shall accompany backfilling of planting soil unless otherwise approved. A saucer shall be formed around each plant pit as specified in the contract documents.

**B. Balled Plants.** Following placement in the plant pit, balled plants shall have all natural burlap cloth, ropes, wire baskets, twine, and nonbiodegradable woven and nonwoven fabrics completely removed from the upper one third (⅓) sides and top of the root ball to a maximum depth of 0.5 meter. There is no requirement to remove the fabric or basket from the bottom of the root ball.

**C. Container Grown Plants.** Container grown plants shall be removed from their containers. Roots which are matted or entangled shall be straightened or cut and removed. Encircling roots shall be cut in a vertical direction.

**D. Bare Root Plants.** Roots of bare root plants shall be properly spread out in a radial position and planting soil shall be carefully worked in among them. All dead, broken, frayed and twisted roots shall be cleanly cut off.

**E. Wrapping.** When wrapping is specified in the contract documents, the wrapping material shall be a single layer of burlap bandage or paper. The wrapping shall extend from the ground line to the height of the first branch, and be wound spirally upwards from the ground line, overlapping 40 mm. The wrapping shall be securely tied in place with biodegradable twine at 0.4 meter intervals, or by other means approved by the Regional Landscape Architect.

**F. Staking, Guying and Anchoring.** No tree shall be staked, guyed or anchored, unless otherwise specified in the contract documents. When staking is specified, stakes shall be placed in the plant pit prior to backfilling.

**G. Pruning.** Plants pruned before their arrival will be rejected unless such pruning is specified in the contract documents. Pruning at the time of planting shall be limited to the removal of dead,
§611

conflicting and broken branches; and to other pruning consistent with good horticultural practice unless otherwise specified in the contract documents or as directed by the Regional Landscape Architect.

**H. Mulching.** Where mulching is specified, it shall completely cover the area of the plant pit or planting bed to the depth specified in the contract documents. Mulch shall be placed at the time of planting.

**611-3.04 Restoration.** Areas disturbed by the planting operations shall be restored by disposing of excess soil, stones and rubbish such as twine, pruned limbs, tree wrap, containers, burlap and wire baskets as approved by the Engineer. Existing turf areas disturbed by planting operations shall be restored to a satisfactory condition which may include topsoil, regrading, fertilizing, seeding and mulching. All waste material generated as a result of the work shall be properly disposed of in accordance with law, rule or regulation, and in a manner approved by the Engineer.

**611-3.05 Care of Planting.**

**A. General.** Care of planting shall begin immediately after each plant is planted and shall continue until the final acceptance of the contract and as required under §611-3.06, Period of Establishment. Care of planting shall consist of keeping the plants in a healthy growing condition by watering, weeding, cultivating, pruning, tightening of guys if staked, remulching, applying approved antidesiccants and pesticides, and by other operations as necessary.

**B. Care of Planting Work Schedule.** The Contractor shall prepare and submit a Care of Planting Work Schedule to the Engineer for approval. The schedule shall identify how and when all other work specified under §611-3.05 Care of Planting will be accomplished. Exceptions to the approved schedule shall be subject to advance written approval of the Engineer.

**C. Watering.** All plants shall be watered at the directed times and at the rates specified in the contract documents, or as ordered by the Engineer. Each watering shall provide not less than 20 L of water per plant pit. Payment for the furnishing and applying of water shall be as stated in §611-5 Basis of Payment.

**D. Weeding.** All plant pits and planting beds shall be maintained weed free by methods approved by the Regional Landscape Architect.

**E. Remulching.** All plant pits and planting beds shall be remulched as necessary to maintain the required depth specified in the contract documents.

**F. Pruning.** All dead, injured or diseased wood shall be removed in accordance with good horticulture practice and as approved by the Regional Landscape Architect.

**G. Remedial Measures.** In the event of the threat of serious damage from insect or diseases, the plants shall be treated by preventative or remedial measures according to good horticultural practice as approved or as directed by the Regional Landscape Architect.

**H. Antidesiccants.** When specified in the contract documents, plants shall be sprayed with an antidesiccant meeting the requirements of §713-08, Materials for the Protection of Plants. The antidesiccant shall be applied according to the manufacturer's recommendations to thoroughly cover all above ground parts.

**I. Removal and Replacement.** At the conclusion of the essential portion of the planting work all plants shall be in a healthy, unimpaired and undamaged condition as determined by the Regional Landscape Architect. All plants that are dead, missing, or in an unhealthy or badly impaired condition, as determined by the Regional Landscape Architect, shall be removed and replaced with
new, healthy plant material as specified. All planting to be completed or replaced shall be planted not later than the next succeeding planting season as specified in the contract documents.

611-3.06 Period of Establishment

A. General. The Contractor shall be required to continue the work specified under §611-3.05 Care of Planting for a period of one year following the satisfactory completion of all of the planting on the contract as confirmed in writing by the Engineer, or for the duration of the contract, whichever is later. The Period of Establishment applies to all planting unless otherwise specified.

B. Period of Establishment Work Schedule. The Contractor shall prepare and submit a Period of Establishment Work Schedule to the Engineer. The schedule shall describe how and when all work specified under §611-3.06 A. General shall be accomplished. The schedule shall be approved by the Engineer prior to the beginning of the Period of Establishment.

C. Contract Acceptance. In the event the Contractor requests acceptance of the contract and the Period of Establishment is not yet complete, the State, if approved by the Commissioner, may pay the Contractor monies retained under provisions of Section 38 subdivision 7 of the Highway Law upon receipt of certified check or securities as are listed in subdivision 3 of section 139 of the State Finance Law, in the amount of at least double the value of the uncompleted work under Period of Establishment.

For the purpose of determinations for contract acceptance prior to completion of the work under “Period of Establishment,” the value of the work required under “Period of Establishment,” including necessary replacement, shall be considered as a sum equal to 10% of the price bid for the item of planting unless otherwise specified.

D. Insurance. When all contract work excepting Section 611 Planting, has been completed and accepted, the Contractor agrees to procure and maintain insurance for the duration and purposes of any such work of establishment, at no additional expense to the State.

E. Requirements. At the conclusion of the Period of Establishment the Contractor shall remove all stakes, guy wires and tree wrappings unless otherwise approved. All plants in an unhealthy or badly impaired condition, as determined by the Regional Landscape Architect, shall be removed and replaced or removed and noted for replacement at the next succeeding planting season.

F. Conclusion of the Period of Establishment. These requirements shall not prevent the release of the retained monies as herein defined at the expiration of the Period of Establishment. However, a certified check or securities, as previously described, equal to at least double the value of any uncompleted work will be required. No work other than replacement will be required after the conclusion of the Period of Establishment.

611-4 METHOD OF MEASUREMENT. Planting will be measured as the number of plants of each kind, size or quality as set forth in the contract documents which are counted in place as having been completed and accepted.

611-5 BASIS OF PAYMENT. The unit price bid for each plant of each kind, size or quality, as set forth in the contract, which has been acceptably planted shall include the cost of all labor, equipment, materials and incidentals, including watering and planting soil to complete the work specified.

Furnishing water and watering plants as required under §611-3.05 Care Of Planting will be paid for under the pay item for Watering Vegetation when this item is specified in the contract documents. No separate payment will be made for water used in the initial planting operation, as required in §611-3.03A. No separate payment will be made for water used during the Period of Establishment.

Progress payments for work satisfactorily performed in the excavation and backfilling of plant pits and plant beds may be made in amounts not to exceed twenty percent (20%) of the unit price bid for the respective plants.
§611

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>611.0101XY</td>
<td>Planting - Major Deciduous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.0201XY</td>
<td>Planting - Minor Deciduous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.0301XY</td>
<td>Planting - Coniferous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.0401XY</td>
<td>Planting - Deciduous Shrubs</td>
<td>Each</td>
</tr>
<tr>
<td>611.0501XY</td>
<td>Planting - Evergreen Shrubs</td>
<td>Each</td>
</tr>
<tr>
<td>611.0601XY</td>
<td>Planting - Vines &amp; Groundcovers</td>
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</tr>
<tr>
<td>611.0701XY</td>
<td>Planting - Special Plant Materials</td>
<td>Each</td>
</tr>
</tbody>
</table>

Refer to the Contract Proposal for full item number and full description.

SECTION 612 - SODDING

612-1 DESCRIPTION.  This work shall consist of preparing the sod bed including topsoil, furnishing, delivering, placing, and caring for sod in the locations shown and specified in the contract documents.

612-2 MATERIALS.  Materials for sodding shall meet the following requirements.

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>712-01</td>
</tr>
<tr>
<td>Topsoil</td>
<td>713-01</td>
</tr>
<tr>
<td>Sod</td>
<td>713-14</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>As specified in the contract documents. Where not specified, fertilizer shall be 713-03 Type No. 1 or as approved by the Engineer.</td>
</tr>
</tbody>
</table>

612-3 CONSTRUCTION DETAILS.

612-3.01 Limitations.  The Contractor shall notify the Engineer at least two working days before beginning to place sod.  The Contractor shall not begin the work until written permission from the Engineer has been received.

No frozen sod shall be placed nor shall sodding be done when the ground surface is frozen.  When frost or excessive moisture exist that will prevent satisfactory results from being obtained for any stage of work, the Engineer will stop the work and it shall be resumed only when allowed by the Engineer.

612-3.02 Procuring Sod.  The Contractor shall exercise maximum care to retain the soil existing on the roots of the sod during transporting, handling and transplanting operations.  Dumping or dropping of sod from vehicles will not be permitted.  Sod shall be planted within twenty-four hours from the time of harvesting, unless it is tightly rolled, or stored roots-to-roots.  All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing.  The maximum period of time from harvesting to planting shall not exceed forty-eight hours.  Sod that is stored on the project site prior to planting shall meet the moisture requirements of §713-14 at the time of planting.

612-3.03 Ground Preparation.  There shall be a minimum of 50 mm of topsoil under all sod unless otherwise specified.  The subgrade of areas to be sodded shall be excavated and firmed to a sufficient depth below the finished grade of the sod to accommodate the tamped or rolled thickness of topsoil and sod.

Fertilizer shall be applied at a rate of 6 grams of nitrogen per square meter unless otherwise specified in the contract documents.

Fertilizer applied under this work shall be uniformly mixed with the topsoil to a depth of at least 50 mm before the sod is laid, unless otherwise specified or approved.

612-3.04 Finished Grade for Sod.  When laid in strips adjacent to paths, pavements, drain inlets and other structures, the finished sod surface shall be flush with surface of the adjacent soil and the adjacent structures.  Sod laid in drainage ways, and areas to be continuously or solidly sodded shall meet the finished grades as shown in the contract documents.  Grades shall be formed with special care at the junction of drainage ways.
612-3.05 Placing Sod. The soil on which the sod will be laid shall be moist. The soil shall be watered prior to sodding, if so directed. The sod shall be laid smoothly, edge to edge and all openings shall be plugged with sod. In drainage ways and where continuous or solid sodding is indicated and/or specified in the contract documents, the sod shall be laid with the longest dimension parallel to the contours. Sodding shall start at the base of slopes and progress upwards in continuous parallel rows.

Vertical joints between sides shall be staggered. Immediately after laying, sod shall be pressed firmly into contact with the sod bed by tamping, rolling, or by any other method that will eliminate air pockets, provide true and even surfaces, ensure knitting and protect all exposed sod edges, but without damaging or displacing the sod or deforming the finished sod surface. At the time of placing, the sodded areas shall be watered evenly and at a rate of 20 liters per square meter.

612-3.06 Anchoring. Sod shall be firmly anchored in all drainage ways, on slopes 1 on 2 or steeper, and wherever else specified or directed. Sod shall be anchored immediately after tamping. All anchors shall be driven flush to the ground.

612-3.07 Finishing. Excess sod or excess soil resulting from the sodding operation shall be disposed of by the Contractor. Excess soil shall not be left to form a ridge adjacent to the sodded area or sodded strips.

612-3.08 Care During Construction. The Contractor shall care for the sodded areas until all work on the entire contract has been completed and accepted. When necessary, such care shall consist of providing protection against traffic by warning signs or barricades. In locations where mowing is specified, the grass shall be mowed until the acceptance of the Contract to a height of 75 mm when the growth reaches a height of 125 mm or as directed.

All sod shall be watered at weekly intervals for a minimum of four weeks following installation and in accordance with §615-3.01, unless otherwise specified or directed. Additional watering shall be performed if specified in contract documents. When watered, sufficient water shall be applied to wet the sod at least 50 mm into the sod bed. Watering shall be done in a manner that will not cause erosion or other damage to the finished surfaces. Any surfaces that have settled, become gullied or otherwise damaged shall be repaired at the Contractor’s expense to re-establish the grade and conditions of the soil prior to sodding and shall then be re-fertilized and re-sodded as specified under this work.

612-3.09 Period of Establishment. When the Engineer decides that any area that has been sodded fails for any reason to produce a satisfactory turf after a suitable period of time has elapsed, the Contractor shall re-sod such areas in the same manner as specified in the contract until a satisfactory turf has been established. Any work to be corrected shall be at the Contractor’s expense. The contract will not be accepted until a satisfactory turf has been produced unless the work necessary to assure satisfactory turf will be done under the provisions of an uncompleted work agreement.

612-4 METHOD OF MEASUREMENT. Sodding including top soil bed will be measured as the number of square meters of surface area that have been acceptably completed.

612-5 BASIS OF PAYMENT. The unit price bid per square meter shall include the cost of all labor, equipment, materials, including topsoil placed under the sod, water used during planting, and necessary excavation, equipment and incidentals necessary to acceptably complete and care for the work as specified. When the quantity of sod is equal to or less than 400 square meters, the watering necessary to establish the sod after planting shall be included in the price bid for sodding including top soil bed. When the quantity of sod exceeds 400 square meters, the watering, except initial watering at time of planting, shall be paid for under the watering vegetation item in the Contract.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>612.01</td>
<td>Sodding including Top Soil Bed</td>
<td>Square Meter</td>
</tr>
</tbody>
</table>
SECTION 613 - TOPSOIL

613-1 DESCRIPTION. This work shall consist of furnishing and placing topsoil in conformance with the lines, grades and thicknesses shown in the contract documents or as designated by the Engineer.

613-2 MATERIALS. Topsoil shall conform to the requirements §713-01, Topsoil. Unsuitable material from required excavations, that meets these requirements, is acceptable.

613-3 CONSTRUCTION DETAILS

613-3.01 Preparation of Areas to be Topsoiled. The subsoil within the areas to be covered by topsoil shall be graded so that the completed work after topsoil is placed, shall conform to the specified lines and grades. Where specified or directed, the Contractor shall scarify or till the surface of the subsoil before the topsoil is placed to permit bonding the topsoil with the subsoil. Tillage by diskng, harrowing, raking or other approved methods shall be accomplished in such a manner that depressions and ridges formed by tillage shall be parallel to the contours.

613-3.02 Placing and Spreading of Topsoil. Topsoil in an unworkable condition due to excessive moisture, frost or other conditions shall not be placed until it is suitable for spreading. Topsoil shall be placed on the designated area and spread to the specified thickness. After the topsoil is spread, all large stiff clods, rocks, roots or other foreign matter shall be cleared and disposed of by the Contractor as approved so that the finished surface will be acceptable for subsequent work such as seeding, sodding, mulching or planting.

613-3.03 Restoration. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding. Surplus topsoil shall be used to flatten embankment slopes or placed in other locations approved by the Engineer.

613-4 METHOD OF MEASUREMENT. Topsoil quantities shall be in cubic meters, computed from payment lines shown on the plans or standard sheets, except where revised payment lines are established by the Engineer prior to performing the work.

613-5 BASIS OF PAYMENT. The unit price bid shall include the cost of furnishing all equipment, labor and materials required to complete the work as specified.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</thead>
<tbody>
<tr>
<td>613.0101</td>
<td>Topsoil</td>
<td>Cubic Meters</td>
</tr>
</tbody>
</table>

SECTION 614 - CARE, THINNING AND REMOVAL OF TREES

614-1 DESCRIPTION. This work shall consist of care of trees, selective thinning and tree removal as specified.

614-1.01 Care of Trees. The work shall be performed on existing trees shown in the contract documents or designated by the Engineer and shall include one or both of the following operations, or as specified: Pruning; Fertilizing.

614-1.02 Selective Thinning. The work shall consist of felling specifically identified trees, disposing of all wood and debris, and will usually require topping, limbing, stump removal and restoration as shown in the contract documents, in the proposal or as directed.

614-1.03 Tree Removal. The work shall consist of felling trees, disposing of all wood and debris, and may require topping, stump removal and other work as shown in the contract documents or as directed by the Engineer.
614-2 MATERIALS

614-2.01 Care of Trees. Mulch, and other special materials shall be as specified in the contract documents. Fertilizer shall be §713-03, Type 3, 10-6-4, unless otherwise specified. Water shall be as specified under §712-01. Materials for the protection of plants shall be as specified under §713-08.

614-2.02 Selective Thinning. Pesticides §713-13 for basal treatment of stumps shall be as specified.

614-2.03 Tree Removal. The materials for backfilling the stump holes and for establishing grass on the stump hole areas shall be as specified or as approved.

614-3 CONSTRUCTION DETAILS

614-3.01 Care of Trees

A. Equipment. Workers shall not be permitted to climb trees with climbing spurs but they shall employ accepted tree climbing methods. All tools used and methods employed shall be as approved except that no anvil type pruners will be permitted. The cutting surfaces of all tools, ladders, ropes, soles of workers shoes and other objects coming into contact with the tree shall be washed with an approved disinfectant at the start of any work on a tree to prevent the spread of plant diseases when ordered by the Engineer.

B. Pruning. When pruning is specified, the quantity of trees as shown in the contract documents shall be pruned of undesirable wood and the resulting crown shaped to the natural habit of the kind of the tree and as approved. Any and all branches interfering with or hindering the healthy growth of the tree shall be removed. All diseased branches and all dead branches 25 mm or more in diameter shall be removed. Any branch which may be partly dead, yet has a healthy lateral branch at least one-third the diameter of the parent branch shall be removed beyond the healthy branch. All branches less than 5 meters above any part of the roadway or interfering with sight distance or signs shall be removed as directed. All stubs or improper cuts resulting from former pruning shall be removed. All cuts shall be cleanly made with sharp tools as close to the parent trunk or limb as possible without disturbing the callus collar. All large bark wounds shall be scar traced in accordance with good horticultural practice to the satisfaction of the Engineer. All existing nails, spikes, wire or other materials found driven into or fastened to the trunk or branches shall be removed or if approved they shall be cut flush in a manner to permit complete healing over.

C. Fertilizing. When fertilizing is specified, the quantity of trees shown in the contract documents shall be fertilized as specified for Method No. 1, No. 2 or No. 3.

Method No. 1. Holes shall be made in the earth about 400 mm deep and 400 mm apart, and located in the outer two-thirds (as measured on the radius) of the circular area lying under the limits of the tree branches. The holes shall be made with a crowbar, soil auger, pneumatic equipment or other approved tools and care shall be taken to avoid injury to the roots. Fertilizer shall be applied at the rate specified and shall be evenly distributed over the area to be fertilized by placing equal amounts of fertilizer in the lower 300 mm of each hole.

Method No. 2. Fertilizer shall be applied at the rate specified with sufficient water pressure to saturate the soil for the area and depth of the tree roots. Standard high pressure power tree spraying equipment with a valve controlled pipe used as a jet irrigator or other approved equipment may be used.

Method No. 3. Fertilizer rate and method of application shall be as specified in the contract documents.

D. Cleanup and Disposal. All trunks, branches, rubbish and debris resulting from the work shall be removed and disposed of by the Contractor as specified in §201-3.03, Disposal.
614-3.02 Selective Thinning. All trees and shrubs to be removed will be designated by the Engineer either by separate marking, marking in sample areas, or otherwise, to guide the Contractor on the scope and detail of the work. All stumps shall be cut to a height of about 150 mm above the ground unless otherwise specified or approved. An approved pesticide shall be applied to all live stumps in accordance with the manufacturer's recommendations. An approved dye shall be added to the pesticide mixture to identify treated stumps and stubble.

Care shall be taken in the felling of trees and the operation of equipment to prevent injury to trees and shrubs which are to be preserved. All injuries to the limbs, bark and roots of such plants shall be repaired as directed by the Engineer.

Selective thinning work shall be completed in any area before any planting or seeding work is begun in that area unless otherwise approved.

All wood, stumps, brush and other debris resulting from the work shall be disposed of as specified in §201-3.03, Disposal.

614-3.03 Tree Removal

A. General. No tree shown in the contract documents or listed for removal under this section shall be cut until it is approved by the Engineer. All work involving public utilities shall be coordinated with the respective utility company.

All trees shall be “topped” and “limbed” before felling unless otherwise approved.

Stumps of trees removed under this item and existing stumps listed for removal shall be grubbed, ground or cut as specified. Stumps shall include all visible wood and roots and shall be grubbed, ground or cut to the depth specified below the average grade or as directed by the Engineer. All stump holes shall be backfilled with the specified or approved materials compacted to the satisfaction of the Engineer within one week after start of work on the tree. The work of establishing grass on the stump hole areas shall be performed as specified or approved.

If, in the opinion of the Engineer, unsafe tools, equipment or methods are employed, work shall be stopped until such unsafe conditions have been corrected.

B. Disposal of Wood. The requirements of §201-3.03, Disposal, shall apply.

C. Liability. The Contractor shall protect and shall be liable for injuries to all plants, curbs, pavements, structures, utility lines and other features on the highway right-of-way and adjacent property. Replacements and restoration shall be as approved by the Engineer.

614-4 METHOD OF MEASUREMENT

614-4.01 Care of Trees. Care of trees shall be measured by the number of trees of each size group as set forth in the contract which are counted in place as having been completed and accepted.

614-4.02 Selective Thinning. Selective thinning shall be measured by the number of square meters satisfactorily completed.

614-4.03 Tree Removal. Tree removal shall be measured by the number of trees of each size group which have been satisfactorily removed. All trees shall be measured before they are cut. Measurements shall be made 1.4 meters (commonly referred to as D.B.H. - Diameter Breast High) above the ground. Removal of Existing stumps shall be measured by the number of stumps which have been satisfactorily removed.

614-5 BASIS OF PAYMENT

614-5.01 Care of Trees, Selective Thinning and Tree Removal. Payment for each item of work will be based on the unit price bid, which payment shall constitute full compensation for all labor, materials, equipment and incidentals necessary to complete the work as specified.
When trees and their respective stumps are specified in the contract documents for removal, payment for each tree removal shall include the work required for removal of the respective stump.

Removal of existing stumps shall be paid for separately.

Tree removal on an each basis shall be limited to those trees specifically listed for removal in the proposal or designated by the Engineer to be removed under this item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>614.01xx</td>
<td>Care of Trees</td>
<td>Each</td>
</tr>
<tr>
<td>614.02</td>
<td>Selective Thinning</td>
<td>Square Meter</td>
</tr>
<tr>
<td>614.03xx</td>
<td>Tree Removal</td>
<td>Each</td>
</tr>
</tbody>
</table>

NOTE: xx denotes serialized pay item.

SECTION 615 - LANDSCAPE MISCELLANEOUS

615-1 DESCRIPTION. This work shall include watering plants, shrubs, ground covers, vines and other plants as specified in the contract documents. This work shall also include other landscape development items as specified in the contract documents, applicable standard sheets and in accordance with the specifications.

615-2 MATERIALS

615-2.01 Watering Vegetation. The materials shall meet the requirements of the following subsection of section 700-Materials Details.

Water 712-01

615-3 CONSTRUCTION DETAILS

615-3.01 Watering Vegetation. Water shall be applied in such a manner that the required volume of water will be provided without damage to plants, mulch, stakes, plant saucers, sod or other areas to be watered. Damage resulting from watering operations shall be repaired at the Contractor's expense.

615-4 METHOD OF MEASUREMENT

615-4.01 Watering Vegetation. This work will be measured in kiloliters of water applied. The quantity applied will be determined from approved meters, or by measurement in tanks or tank trucks of predetermined capacity.

615-5 BASIS OF PAYMENT

615-5.01 Watering Vegetation. The unit price bid shall include the cost of furnishing and applying water, all labor, equipment and incidentals necessary to satisfactorily complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>615.03</td>
<td>Watering Vegetation</td>
<td>Kiloliter</td>
</tr>
</tbody>
</table>

SECTIONS 616 AND 617 (VACANT)

SECTION 618 - BITUMINOUS MATERIAL

618-1 DESCRIPTION. Under this work the Contractor shall furnish and place bituminous material of the type and quantity specified on the plans or in the specifications.
§618-2 MATERIALS. The bituminous materials shall meet the requirements of the following subsections of Section 700 - Materials:

- Paving Asphalt (AC-2.5) 702-0100
- Paving Asphalt (AC-5) 702-0200
- Paving Asphalt (AC-10) 702-0300
- Paving Asphalt (AC-15) 702-0400
- Paving Asphalt (AC-20) 702-0500
- Misc. Asphalt Cement (85-100) 702-0600
- Misc. Asphalt Cement (18-60) 702-0700
- Rapid Curing Liquid Asphalt (RC-30) 702-10
- Rapid Curing Liquid Asphalt (RC-70) 702-11
- Rapid Curing Liquid Asphalt (RC-250) 702-12
- Rapid Curing Liquid Asphalt (RC-250 with additive) 702-13
- Rapid Curing Liquid Asphalt (RC-800) 702-14
- Rapid Curing Liquid Asphalt (RC-800 with additive) 702-15
- Medium Curing Liquid Asphalt (MC-30) 702-20
- Medium Curing Liquid Asphalt (MC-70) 702-21
- Medium Curing Liquid Asphalt (MC-250) 702-22
- Medium Curing Liquid Asphalt (MC-250 with additive) 702-23
- Medium Curing Liquid Asphalt (MC-800) 702-24
- Medium Curing Liquid Asphalt (MC-3000) 702-25
- Asphalt Emulsion (RS-1) 702-3001
- Asphalt Emulsion (RS-2) 702-3101
- Asphalt Emulsion (HFRS-2) 702-3102
- Asphalt Emulsion (MS-2) 702-3201
- Asphalt Emulsion (HFMS-2) 702-3301
- Asphalt Emulsion (HFMS-2h) 702-3401
- Asphalt Emulsion (HFMS-2s) 702-3402
- Asphalt Emulsion (SS-1) 702-3501
- Asphalt Emulsion (SS-1h) 702-3601
- Cationic Asphalt Emulsion (CRS-1) 702-4001
- Cationic Asphalt Emulsion (CRS-2) 702-4101
- Cationic Asphalt Emulsion (CMS-2) 702-4201
- Cationic Asphalt Emulsion (CMS-2h) 702-4301
- Cationic Asphalt Emulsion (CSS-1) 702-4401
- Cationic Asphalt Emulsion (CSS-1h) 702-4501
- Asphalt Emulsion Tack Coat 702-90

618-3 CONSTRUCTION DETAILS. The construction details for the application of bituminous materials specified in sections 401, 402, 403, 405, 407 and 410 shall apply.

618-4 METHOD OF MEASUREMENT. The quantity to be paid for will include the number of liters measured at a temperature of 16°C and incorporated in the work as directed by the Engineer.

618-5 BASIS OF PAYMENT. The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to incorporate the bituminous material in the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>618.01</td>
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<tr>
<td>618.02</td>
<td>Paving Asphalt (AC-5)</td>
<td>Liter</td>
</tr>
<tr>
<td>618.03</td>
<td>Paving Asphalt (AC-10)</td>
<td>Liter</td>
</tr>
<tr>
<td>618.04</td>
<td>Paving Asphalt (AC-15)</td>
<td>Liter</td>
</tr>
<tr>
<td>618.05</td>
<td>Paving Asphalt (AC-20)</td>
<td>Liter</td>
</tr>
</tbody>
</table>
618.06  Misc. Asphalt Cement (85-100)  Liter
618.07  Misc. Asphalt Cement (18-60)  Liter
618.10  Rapid Curing Liquid Asphalt (RC-30)  Liter
618.11  Rapid Curing Liquid Asphalt (RC-70)  Liter
618.12  Rapid Curing Liquid Asphalt (RC-250)  Liter
618.13  Rapid Curing Liquid Asphalt (RC-250 with additive)  Liter
618.14  Rapid Curing Liquid Asphalt (RC-800)  Liter
618.15  Rapid Curing Liquid Asphalt (RC-800 with additive)  Liter
618.16  Rapid Curing Liquid Asphalt (RC-3000)  Liter
618.20  Medium Curing Liquid Asphalt (MC-30)  Liter
618.21  Medium Curing Liquid Asphalt (MC-70)  Liter
618.22  Medium Curing Liquid Asphalt (MC-250)  Liter
618.23  Medium Curing Liquid Asphalt (MC-250 with additive)  Liter
618.24  Medium Curing Liquid Asphalt (MC-800)  Liter
618.25  Medium Curing Liquid Asphalt (MC-3000)  Liter
618.3001  Asphalt Emulsion (RS-1)  Liter
618.3101  Asphalt Emulsion (RS-2)  Liter
618.3102  Asphalt Emulsion (HFRS-2)  Liter
618.3201  Asphalt Emulsion (MS-2)  Liter
618.3301  Asphalt Emulsion (HFMS-2)  Liter
618.3401  Asphalt Emulsion (HFMS-2h)  Liter
618.3402  Asphalt Emulsion (HFMS-2s)  Liter
618.3501  Asphalt Emulsion (SS-1)  Liter
618.3601  Asphalt Emulsion (SS-1h)  Liter
618.4001  Cationic Asphalt Emulsion (CRS-1)  Liter
618.4101  Cationic Asphalt Emulsion (CRS-2)  Liter
618.4201  Cationic Asphalt Emulsion (CMS-2)  Liter
618.4301  Cationic Asphalt Emulsion (CMS-2h)  Liter
618.4401  Cationic Asphalt Emulsion (CSS-1)  Liter
618.4501  Cationic Asphalt Emulsion (CSS-1h)  Liter
618.90  Asphalt Emulsion Tack Coat  Liter

SECTION 619 - MAINTENANCE AND PROTECTION OF TRAFFIC

619-1 DESCRIPTION

619-1.01 General. This work shall consist of maintaining traffic and protecting the public from damage to person and property within the limits of and for the duration of the contract.

619-1.02 Basic Maintenance and Protection of Traffic. Traffic shall be maintained over a reasonably smooth traveled way which shall be so marked by signs, delineators, guiding devices and other methods that a person who has no knowledge of conditions may safely and with a minimum of discomfort and inconvenience ride, drive or walk, day or night, over all or any portion of the highway and/or structure under construction where traffic is to be maintained. All work shall conform to the requirements of the M.U.T.C.D. The basic maintenance and protection requirements shall be as follows:

A. Surface. Maintain the surface condition of the traveled way so it is consistent with the appropriate speed limit.

B. Drainage. Maintain the drainage facilities and other highway elements, old or new, including those on detours.

C. Bus Stops. Maintain existing bus stops so bus passengers are reasonably accommodated.

D. Pedestrian Traffic. Provide adequate protection for pedestrian traffic during all phases of construction.
E. Intersecting Highways. Provide ingress and egress to and from intersecting highways, homes, business and commercial establishments.

F. Dust Control and Spillage. Control dust and keep the traveled way free from materials spilled from hauling equipment. This shall also apply to dust control and spilled material resulting from the Contractor's operations in the areas outside the contract limits.

G. Flagger. Provide the necessary traffic control equipment and flaggers for adequate traffic control.

H. Repairs. Make the necessary repairs to existing pavement and structure wearing surfaces as required to provide a reasonably smooth roadway where vehicle operation is maintained.

I. Responsibility to the Public. Protect the public from damage to person and property which may result directly or indirectly from any construction operation.

J. Schedule. Schedule work to keep to a minimum, and consistent with the physical requirements of the contract, the amount of existing pavement and/or facilities that are destroyed or substantially torn-up at any one time. Unless otherwise indicated on the plans or in the proposal the length of existing facility destroyed shall not exceed two kilometers, nor shall any part be closed to traffic during seasonal shutdown periods, unless the Contractor has submitted and the Engineer has approved a detailed schedule of operations reflecting a proposal to the contrary.

K. Snow and Ice Control. Maintain the traveled way in such a condition and conduct operations in such a manner that snow and ice may be readily controlled by others as and when necessary, and in such a manner that proper drainage is provided for the melting of snow in the banks resulting from normal plowing. This shall include, but not be limited to, the cutting of weeps through banked or accumulated snow to provide proper drainage of surface runoff into the highway ditches and/or culverts. The Contractor shall not, however, be responsible for snow and ice control on the pavement or shoulders.

L. Delineation and Guiding Devices. Provide and maintain delineation and channelization devices which shall include delineators, plastic drums, cones, temporary curb 300 x 300 mm and smaller exposed section, and other similar materials or methods acceptable to the Engineer.

The installation, moving and removing of any such delineators or channelization devices together with removal of existing pavement markings shall be included in the work.

M. Project Site Patrol. The Contractor shall provide personnel to patrol the contract area as necessary to ensure that conditions on the site are adequate for public safety and convenience at all times. The Contractor is placed on notice that maintenance and protection of traffic over a highway during construction is considered as important as the construction itself. The Contractor shall, therefore, at all times conduct the operations in a manner to ensure the convenience of all travelers and the abutting property owners and their safety as well as the safety of the Contractor's own employees.

Such conduct shall include, but not be limited to: ensuring that all construction materials and equipment are removed from the work site during non-working hours, or are protected in such manner that they shall not constitute a traffic hazard; conducting the operations in such a manner as to minimize the amount of time during which fixed objects and steep side slopes are without guide rail protection; conducting shoulder construction and paving operations in such a manner as to minimize the period of time the traveling public is exposed to sharp dropoffs; and not allowing workers to park personal vehicles in the shoulder area on roads with operating speeds less than 70 km/h and within ten meters of the traveled way on other roads, unless protected by barrier.

N. Shadow Vehicle. For purposes of these specifications, a shadow vehicle is defined as a slowly moving or stopped vehicle operating or placed in a traffic lane, or adjacent thereto, upstream of a
construction work zone. The purpose of shadow vehicles is to guide traffic around a construction work area or to reduce the possibility of harm to workers in the work area. Shadow vehicles shall be required when shown on the plans or for all slowly moving work areas in travel lanes, except where the travel lane is closed to traffic by barrier, barricades, plastic drums, arrow panels, flagpersons or cones. Slowly moving work areas are those which move at a speed of 2km/h or more but at least 25km/h less than the legal speed limit. Shadow vehicles shall weigh 8200 kg to 9100 kg. Ballast may be used to bring a lighter weight vehicle up to the indicated weight. Shadow vehicles shall be equipped with Mobile Construction Zone Impact Attenuators, §712-06 and one Type B Arrow Panel as described in the M.U.T.C.D. On roads with posted speed limits of 65 mph within 335 meters upstream of the shadow vehicle, or whenever indicated on the plans or in the proposal, the Mobile Construction Zone Impact Attenuator shall be listed as a National Cooperative Highway Research Report 350 Test Level 3 device on the Approved List. On other roads the attenuator shall meet the requirements of NCHRP 350 Test Level 3 or Test Level 2, NCHRP 230, or other testing protocol as stated in §712-06.

619-1.03 Construction Signs, Temporary Box Beam Barrier, Temporary Concrete Barrier, Construction Barricades, and Lighting for Construction Barricades. The Contractor shall furnish, install, move, and maintain construction signs, temporary box beam barrier, temporary concrete barrier, construction barricades, and lighting for construction barricades where shown on the plans or when ordered by the Engineer, and in accordance with the M.U.T.C.D.

619-1.04 Temporary Structures and Approaches. The Contractor shall construct, move or remove, as directed, temporary structures, approaches, detours, pavements and necessary appurtenances.

619-1.05 (Vacant).

619-1.06 Short-Term Pavement Markings. Short-term pavement markings are intended for use on any new pavement or milled surface until the subsequent pavement course is placed or the final pavement markings are installed. The Contractor shall furnish, apply and when so ordered, remove short-term pavement markings where shown on the plans, or directed by the Engineer, in accordance with these specifications.

619-1.07 Temporary Traffic Signals. The Contractor shall furnish, install, move, remove and maintain temporary traffic signals and necessary components where indicated on the plans or as directed by the Engineer. The temporary traffic signals and necessary components that are furnished by the Contractor shall remain the property of the Contractor.

619-1.08 Mailboxes. During construction, the Contractor shall maintain in a usable condition and location specified by U.S. Postal requirements, postal route mailboxes serviced from motor vehicles.

619-1.09 Opening Highway to Traffic Prior to Contract Acceptance. This work includes the maintenance and protection of traffic on any portion of pavement, structure, or ramp directed in writing by the Regional Director to be opened to traffic prior to contract acceptance and on which traffic was not specified to be maintained and protected during construction. Pavement sections on new locations which are indicated to be used in the maintenance of traffic plan or which are requested by the Contractor to be used to maintain traffic, shall not fall in this category.

619-1.10 (Vacant).

619-1.11 Duration of Contract. The duration of the contract, for the purpose of this work, shall be from the date any work is started on the contract, including moving in equipment, signs, offices, shops and the like, until the date the contract is officially accepted.

619-1.12 Maintain Traffic Signal Equipment. The Contractor shall maintain in proper operation, existing, relocated, modified or newly installed traffic signals indicated in the contract documents or directed by the engineer for the period specified in the contract documents.
619-1.13 Flashing Arrow Board. Furnish, install, maintain and remove Flashing Arrow Board warning devices in accordance with plans, NYS Manual of Uniform Traffic Control Devices or the directions of the Engineer. Flashing arrow boards are intended for use as temporary traffic warning devices during construction and obstruction periods, and under this item the Contractor shall provide Flashing Arrow Boards made necessary by the operations. The number and type required shall be the number and type necessary, in accordance with the criteria given below, to satisfactorily guide traffic through the construction. The actual number will depend on the Contractor’s sequence of operations.

619-1.14 Construction Zone Pavement Markings. The Contractor shall furnish, apply, maintain and remove construction zone pavement markings conforming to the NYSMUTCD at the locations, and in accordance with the patterns, indicated in the contract documents or directed by the Engineer. These pavement markings are intended for use in detours, temporary pavement realignments and crossovers, lane shifts and closures, and other temporary traffic patterns associated with the construction activities.

619-1.15 Maintenance and Protection of Traffic During Nighttime Operations. Nighttime operations consists of work specifically scheduled to occur after sunset and before sunrise. In addition to the requirements of basic maintenance and protection of traffic, additional requirements for maintenance and protection of traffic during nighttime operations shall be as follows:

A. Traffic Control Supervision. The Contractor shall provide a full-time traffic control supervisor for nighttime operations with adequate training, experience, and authority to implement and maintain all traffic control operations. The traffic control supervisor must be approved by the Engineer based on a written request by the Contractor detailing the training and experience of the traffic control supervisor. The traffic control supervisor shall be assisted by a full-time traffic control crew equipped with a suitable vehicle or vehicles and a mobile communications system consisting of radios or cellular phones. The duties and responsibilities of the traffic control supervisor shall be included in the plan of nighttime operations. During setup and removal of lane closures and other traffic control setups, the traffic control supervisor and crew shall be assisted by additional workers as necessary.

B. Plan of Nighttime Operations. Thirty days prior to the start of night work, the contractor shall submit a written plan for nighttime operations to the Engineer. The plan shall detail all aspects of the traffic control setup; lighting plans; the functions, responsibilities and identities of the traffic control supervisor and crew; and other details as necessary. It shall include a contingency plan identifying foreseeable problems and emergencies that may arise, and the approach that will be used to address them. This plan shall be revised and updated by the contractor as necessary during the progress of the work to accommodate actual conditions on the project.

C. Project Site Patrol. During nighttime operations, the traffic control supervisor and crew shall constantly patrol the contract area to ensure that conditions on the site are adequate for public safety and convenience at all times, to ensure worker safety from intrusions into the worksite, and to ensure that the provisions for maintenance and protection of traffic in the contract documents and in the plan for nighttime operations are adhered to. The traffic control crew shall maintain and adjust signs, channelizing devices, area lighting and other traffic control devices as necessary.

D. Waiver of Requirements. When the work does not require closure of an active lane, roadway, or ramp and when no construction operations occur adjacent to active traffic lanes; the requirements for a full-time traffic control supervisor and full-time project site patrol shall be waived. However, the contractor shall provide a competent supervisor and workers to install, maintain, adjust, and remove traffic control devices as required by the work operations. The details of the supervision and site patrol to be provided under this waiver shall be included in the plan of nighttime operations.

E. Trained Flaggers. All flaggers used in nighttime operations shall be formally trained in flagging operations. This training may consist of ATSSA (American Traffic Safety Services Association), Union, or trade association training, or training by an individual who has received
formal training from a recognized program or agency in work zone traffic control. Prior to the start of work, the contractor shall provide the Engineer with a written summary of training for each individual flagger. When requested by the Engineer, flaggers shall demonstrate their competency in flagging procedures. Flaggers not thoroughly competent in flagging procedures to the satisfaction of the Engineer shall be replaced at once.

**F. Emergency Flares.** A supply of emergency flares shall be maintained by the Contractor for use in the event of unanticipated situations such as traffic accidents, equipment breakdowns, failure of lighting equipment, etc.

619-1.16 (Vacant)

619-1.17 Temporary Rumble Strips. Work shall consist of installing, maintaining, and removing temporary rumble strips in construction work zones at the locations shown in the contract documents or as directed by the Engineer.

619-2 MATERIALS. All materials used shall comply with the requirements of the appropriate subsections of Section 700, Materials, or as established by this section, the applicable standard sheets or the plans.

619-2.01 Existing Pavement Repair. Existing pavements shall be kept in repair using materials compatible with the pavement. In general, plant-mixed bituminous concrete is suitable for all pavement surfaces. Material other than plant-mixed bituminous concrete may be used if approved by the Engineer.

619-2.02 Construction Signs, Other Signs, and Sign Covers. Rigid sign panels may be aluminum, fiberglass, galvanized steel, or plywood, except that sign panels placed on Type III Breakaway Barricades shall be aluminum.

Rigid lightweight plastic may also be used for sign panels, but not for panels larger than 1200 X 1200 mm. The rigid lightweight plastic substrate shall consist of at least two parallel surfaces of plastic separated by plastic foam or stiffener/spacers. A single piece plastic extrusion simulating this construction will also be acceptable. External stiffeners may be used to prevent warping and excessive flexing, or to attach the panel to posts. If through bolting is used to attach the panel to stiffeners, or to attach the panel directly to the posts, the bolt heads shall be provided with clear washers to minimize obscuring the legend. The rigid lightweight plastic substrate, plus any external stiffeners, shall not have a combined mass of more than 6 kg/m2.

On rigid panels, all colors of sign faces, except orange, shall be reflectorized and meet the requirements of §730-05 Reflective Sheeting, Materials Designation 730-05.02 (Class B). When orange signs on rigid panels are specified they shall be fabricated using reflectorized fluorescent orange colored sheeting meeting Materials Designation 730-05.04 (Class D).

Flexible sign panels shall be a solid, orange colored, durable elastomeric material. Flexible sign panels fabricated from mesh will not be allowed.

Flexible signs shall be orange in color and a reasonable visual match to Munsell Book Notation 2.5 YR 5.5/14. The orange color flexible panels shall be approved by the Engineer prior to use. Flexible sign panels need not be reflectorized.

Black sign characters shall be non-reflective, and shall conform to the requirements of §730-13 ReflectORIZED Sign Characters (Type V).

White sign characters shall meet the requirements of either §730-12 ReflectORIZED Sign Characters (Type IV) or §730-13 ReflectORIZED Sign Characters (Type V).

Covers used to inactivate unneeded signs shall match the size and shape of the sign and shall cover the entire sign face. More than one layer of fabric may be required to prevent legibility of the sign legend to be covered. The covers shall be a heavy duty, opaque material; and dark green, brown, or black, in color. The sign cover shall be attached to the sign in a secure manner using straps or other means approved by the Engineer. The finished sign covers shall be neat in appearance, with all fasteners secured on the backside of the sign face.
619-2.03 Delineators, Temporary Box Beam Barrier, Temporary Concrete Barrier, Construction Barricades, Lighting for Construction Barricades, Tubular Markers, and Short-Term Pavement Markings. Delineators, barricades, lighting for construction barricades, short-term pavement markings, tubular markers and similar materials shall meet the requirements of these specifications and shall be in accordance with the plans, applicable standard sheets and the M.U.T.C.D. No materials or methods which will cause damage to any pavement or paving course that will be retained shall be employed in the removal of pavement markings.

Tubular markers shall meet the requirements of §730-09 Tubular Markers for Construction Zone Channelization. Tubular markers and cones purchased after October 1, 1998 shall be certified by their manufacturers or vendors as complying with NCHRP 350 testing requirements. The basis for such certifications shall be full or simplified crash testing or satisfactory in-service performance of identical or similar devices.

Temporary box beam barrier shall meet the requirements of box beam median barrier as specified in §710-21 Box Beam Guide Railing and Median Barrier. After the removal of the barrier, the pavement repairs shall be made in accordance with the applicable requirements of Section 402 - Hot Mix Asphalt (HMA) Pavements or Section 502 Portland Cement Concrete Pavement.

Temporary concrete barriers shall conform to the dimensions, joint connections, materials details, and anchoring details shown on the standard sheet or approved material details. The barrier sections shall be precast concrete units. The Manufacturer shall certify that the temporary concrete barrier units conform to the details shown on the standard sheet or approved materials details.

The details for temporary concrete barrier shown on the standard sheet or approved materials details are standard. Designs, other than those shown on the standard sheet or the approved materials details, may be proposed and, if found acceptable, they will be placed on the approved list. No variation in the method of connecting the units together will be approved unless evidence that the temporary concrete barrier, with the proposed joint system, has been successfully crash tested by a recognized testing agency. The test vehicle shall be smoothly redirected without showing any evidence of penetrating or vaulting. The tests shall be conducted in accordance with NCHRP 350 under the following criteria:

1. Test vehicle shall be the 2000P
3. Impact speed 100 km/h.

In no case shall the tested deflection of the barrier exceed 400 mm.

The cross sectional dimensions shown on the standard sheet shall be used in all cases without variation.

The Engineer will inspect the temporary concrete barrier sections upon delivery to the project site for conformance to specifications. Any barrier sections having damage and/or defects in the concrete and/or joint connections will be rejected by the Engineer when, in the Engineer's judgement, the performance of the barriers will be affected.

The temporary concrete barrier sections shall form a smooth and continuous barrier when joined together. Any sections damaged or misaligned while in service shall be corrected or replaced to the satisfaction of the Engineer.

When reflectorization is required by the M.U.T.C.D. reflective sheet material shall be used and it shall conform to §730-05, Reflective Sheeting, Material Designations 730-05.02 (Class B) or 730-05.03 (Class C), except where glass or plastic buttons are used as delineators. Construction barricades, cones and drums may be reflectorized with reflective sheeting conforming to the requirements of §730-05, Reflective Sheeting, Materials Designation 730-05.01 (Class A). All traffic cones 700 mm in height, when used after dark, shall have two (2) white horizontal stripes of reflective material near the tip. The reflective material shall conform to the requirements of §730-05 Reflective Sheeting, Class A, B or C. The upper stripe shall be 150 mm wide with its upper edge 75 to 100 mm below the top of the cone. The lower stripe shall be 100 mm wide with its upper edge 50 mm below the upper stripe.

When reflectorization is not required, any paints utilized shall be of an exterior type conforming to the appropriate Highway Color Tolerance Chart PR Colors No. 1 through No. 6. These requirements must be maintained throughout the period of the contract with repair or replacement made by the Contractor as necessary.
Short-term pavement markings shall consist of reflectorized pavement marking paints, removable reflectorized pavement marking tape, non-removable reflectorized pavement marking tape, or removable raised reflectorized pavement markers. Removable reflectorized pavement marking tape and raised reflectorized pavement markers shall be selected from the Department's Approved List of “Removable Reflectorized Pavement Markings”. Pavement marking paints shall meet the material requirements of Section 640 Reflectorized Pavement Marking Paints. Non-removable pavement marking tape shall be specifically designed for use as a pavement marking and shall be approved by the Engineer prior to application. All line segments shall be not less than 100 nor more than 150 mm in width and the colors shall be as specified in the M.U.T.C.D.

619-2.04 Temporary Structures and Approaches. When specific details are shown on the plans for temporary structures, the materials specified shall be used, except that substitutions or alterations may be permitted if approved by DCES. Mill inspection will not be required for structural steel furnished under this item. Certified copies of the manufacturer's test results shall be submitted to the Engineer. When specific details are not shown on the plans, the Contractor shall assume all liability and responsibility for determining that all materials required conform to the current AASHTO specifications for Highway Bridges unless otherwise approved by the DCES. Used material shall not be furnished for Fracture Critical Members. Excluded from this provision are pedestrian and pre-engineered (fabricated) proprietary structures.

619-2.05 Temporary Traffic Signals. All span wire, inductance loop wire, shielded lead-in cable, traffic signal cable, and other wire used for temporary traffic signals shall be new material meeting the applicable requirements of §680-2 of the Standard Specifications.

All other equipment for temporary traffic signals shall meet the requirements of §680-2 of the Standard Specifications except for the following modifications:

A. Used Equipment. Used equipment in good operating condition may be furnished to provide the required operation of the signals.

B. Manufacturer's Certification. Manufacturer's certification of compliance will not be required.

C. Signal Controller. The signal controller may be either solid state or electro-mechanical.

D. Traffic Signal Heads. The material and painting requirements of §724-04 Traffic Signal Heads, shall not apply except that the signal head housing shall be made of aluminum alloy and shall be painted with an exterior dark green enamel paint or epoxy powder coating.

E. Conflict Monitor. Means shall be provided to prevent the signal from displaying indications which will result in two or more conflicting traffic movements being permitted simultaneously.

619-2.06 Type III Construction Barricades. Type III construction barricades shall meet the requirements of the following specifications:

A. Barricade Frames. Barricade frames for Type III construction barricades shall meet the requirements of the following specifications:

1. PVC Pipe Barricade Frames for Alternate “A” and “B”. PVC Pipe barricade frames shall be fabricated from plastic pipe conforming to the following table:
### TABLE OF ACCEPTABLE MATERIALS FOR PVC PIPE BARRICADES

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<tr>
<th>NPS DESIGNATION</th>
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<th>*SDR RANGE</th>
<th>FITTINGS</th>
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<td>D2665 OR D2466</td>
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<td>3</td>
<td>D2665</td>
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<td>D2665 OR D2466</td>
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<tr>
<td>3-½ **</td>
<td>D2241</td>
<td>21.0 TO 41.0</td>
<td>D2466</td>
</tr>
<tr>
<td>4 **</td>
<td>D2241</td>
<td>21.0 TO 64.0</td>
<td>D2665 OR D2466</td>
</tr>
<tr>
<td>4</td>
<td>D2665</td>
<td>---</td>
<td>D2665 OR D2466</td>
</tr>
<tr>
<td>4</td>
<td>D2729</td>
<td>---</td>
<td>D2729</td>
</tr>
</tbody>
</table>

* SDR (Standard Dimension Ratio) as specified in the various A.S.T.M. Designations.

** NPS 3-½ OR 4 A.S.T.M. D2241 SDR 21 to SDR 26 shall be used on barricades which are extended for sign mounting. These pipes shall not be used on other barricades.

All joints in Alternate “A” shall be glued with a solvent cement compatible with the pvc pipe chosen by the Contractor. All joints in Alternate “B” shall be free to separate upon vehicle impact. Pipes and fittings shall be tied together with a braided nylon rope as shown on the Standard Sheet.

### 2. Metal Barricade Frames for Alternate “M”

Barricade frames for Alternate “M” shall be either perforated or unperforated steel conforming to one of the following:

- 12 Ga. ASTM A653M Grade A
- 14 Ga. ASTM A1011 Grade 50

The brackets shall be fabricated from 6 mm plate conforming to ASTM A653M Grade A or ASTM A1011 Grade 50.

The bolts shall be ASTM F568 Class 4.6 and the nuts shall be ASTM A563M Grade 0. Both the nuts and the bolts shall be galvanized in accordance with the requirements of §719-01 Type II.

The Contractor may at its option supply ungalvanized square steel tube and brackets. However, any rust which may, as determined by the Engineer, impair the collapse of the barricade upon impact may result in the rejection of the barricade unit.

### 3. Polyethylene Barricade Frames for Alternate “C”

Base and upright for the Alternate “C” barricade shall consist of molded medium density polyethylene tubing meeting the requirements of ASTM D1248-IIA3. The angled brace shall consist of extruded high density PE meeting the requirements of ASTM D1248-IIIA4. Polyethylene tubing and miscellaneous hardware shall be of the dimensions and sizes indicated on the standard sheets. All joints in the PE components shall have tight friction fits designed to withstand normal wind and construction site conditions but to separate on impact.

### B. Panels for Rails or Signs

Barricade rails and signs mounted on the barricade shall be aluminum or high density polyethylene (HDPE) panels. Aluminum rail and sign panels shall be 0.635 and 3.2 mm thick respectively and shall conform to the requirements of §730-01 Aluminum Sign Panels. HDPE panels shall be 3.2 mm nominal thickness and shall conform to the requirements of ASTM D1248-IIIA5.

The three rails of the barricade shall have 150 mm wide reflectorized orange and white diagonal stripes sloping at an angle of 45°. The stripes shall slope downward toward the side on which traffic is to pass. The reflective sheeting for the stripes shall conform to the requirements of §730-05 Reflective Sheeting, Materials Designation 730-05.01 (Class A) or 730-05.02 (Class B) or 730-05.03 (Class C) at the Contractor's option.

### 619-2.07 Maintain Traffic Signal Equipment

All traffic signal hardware including but not limited to wire, cable, conduit, pullboxes, switchpacks, modules and relays, signal heads, poles, and pedestrian push buttons used to maintain proper operation shall meet the applicable requirements of §680-2 materials. Parts and materials which are to continue in operation beyond the contract duration shall be new.
619-2.08 Flashing Arrow Board. The Flashing Arrow Boards shall be trailer mounted self contained units or, with permission of the Engineer, truck mounted self-contained units. Flashing Arrow Boards shall display a flashing symbol consisting of flashing yellow lights arranged on a panel to form an arrow.

The arrow panel shall consist of 1200 X 2400 mm rectangular solid panel finished in non-reflective black, and shall be mounted so that the bottom of the panel is a minimum of 2.1 m above the roadway. The arrow indication shall cover the entire area of the panel, and shall be composed of lamp units with five lamps in the arrowhead and five lamps in the shaft.

Lamps shall be arranged and controlled to provide the following mode selections: Left Arrow, Right Arrow, Left and Right Arrow, and Caution. In the three directional modes, the lamps in the shaft next to the arrow point shall not illuminate. The caution mode shall consist of either two pairs of alternately flashing lamps arranged in a pattern that does not indicate direction, or four lamps simultaneously flashing in each of the four corners of the board. The rear face of the arrow panel shall contain one or more clear lamps to indicate that the arrow board is operating properly. Arrow panel operation controls shall be mounted in a lockable enclosure.

The lamps shall flash at a rate of not less than 25 nor more than 40 flashes per minute with a minimum lamp “on time” of at least 50 percent of the cycle. The lamps shall be recess mounted or alternatively equipped with an upper hood of not less than 180 degrees. The lamps shall be equipped with an automatic solar cell controlled dimming switch activated at a level of approximately five candelas. The solar cell dimming switch shall be equipped with a delay to prevent undesirable actuation from car lights. The dimming voltage to the lamps shall be manually controllable over a five to twelve volts effective range.

Flashing Arrow Boards shall be powered by line voltage, diesel motor generator system, or by a solar charged battery system. Boards powered by diesel motor generator system shall be capable of sustained operation for 72 continuous hours at normal operating voltage. Solar charged arrow boards shall be capable of continuous operation on battery power only for the same period at normal operating voltage.

The flashing arrows of diesel or line powered boards shall be legible at a minimum distance of 1600 meters on a bright sunny day or a clear night. The flashing arrows of solar charged boards shall be clearly legible continuously from any point on the traveled way or shoulder from the beginning of the lane closure taper to an upstream distance of 500 meters on a bright sunny day or a clear night.

619-2.09 Plastic Drums. Plastic Drums may be used for channelization devices, provided they are of the proper size and reflectorized as indicated in the M.U.T.C.D. Plastic drums purchased after October 1, 1998 must be certified by their manufacturers or vendors as complying with NCHRP 350 testing requirements. The basis for such certifications shall be full or simplified crash testing or satisfactory in-service performance of identical or similar devices. The plastic drums shall have provisions for the installation of ballast (weights) or retainer rings to prevent the drums from blowing over due to wind loading. The ballast or retainer rings must be designed to separate from the drum on impact. The ballast shall be located at or near ground level and consist of bagged sand, or other material approved by the Engineer, weighing no more than 22 kilograms. The sand shall be contained in waterproof closed bags or in a waterproof compartment of the device specifically designed for the purpose. For two-piece drums, only the base shall be detachable no more than 100 mm above the pavement. For one-piece drums, the base shall be elongated to accept ballast on one or more sides. No open or top metal drums will be permitted.

619-2.10 Construction Zone Pavement Markings. These markings shall consist of reflectorized pavement marking paints, removable reflectorized pavement marking tape, or removable raised reflectorized pavement markers. Pavement marking paints shall meet the material requirements of §640-2. Removable reflectorized pavement marking tape and raised reflectorized pavement markers shall meet the requirements of §727-02 and shall be selected from the Department's Approved list of "Removable Reflectorized Pavement Markings." All longitudinal line segments shall be not less than 100 mm nor more than 150 mm in width and colors shall be as specified in the MUTCD and shown on the plans.

The type of pavement marking material to be supplied shall be as required by the pay item. In the case of the "Optional Construction Zone Pavement Markings" pay items, the Contractor may select the type of material to be used from the choices permitted in the preceding paragraph, except that reflectorized pavement marking paint shall not be used on any top pavement course that is to remain
place without overlaying at the completion of the project, except where the location of those markings coincide with final painted pavement markings. Raised reflectorized pavement markers shall not be used to simulate marking letters or symbols.

619-2.11 High-Visibility Apparel.

A. Protective Helmets. Protective helmets shall meet current OSHA standards for impact, electrical shock, and burn protection. Protective helmets used during nighttime operations shall be equipped with a minimum of 7500 mm$^2$ of reflective tape on all four sides (i.e., 25 mm by 75 mm strip - 1875 mm$^2$ per side). Protective helmets for flaggers shall be orange.

B. Construction Apparel. Construction Apparel shall consist of a vest, shirt, or jacket; orange, fluorescent orange, yellow, fluorescent yellow, yellow-green, fluorescent yellow-green or combination of these colors meeting the requirements of the MUTCD.

C. Nighttime Apparel. Nighttime Apparel shall consist of a vest, shirt, or jacket; orange, fluorescent orange, yellow, fluorescent yellow, yellow-green, fluorescent yellow-green or combination of these colors meeting the requirements of ANSI 107 Class 2.

D. Traffic Control Apparel. Traffic Control Apparel shall consist of a vest, shirt, or jacket; fluorescent orange with fluorescent yellow-green striping bands or fluorescent yellow-green with fluorescent orange striping bands, placed both horizontal and vertical, meeting the requirements of ANSI 107 Class 2. The striping bands shall be approximately 120 mm wide with retroreflective strips. Retroreflective strips shall consist of two 25 mm wide retroreflective strips being 50 mm apart in the center of the fluorescent striping band material or a single 50 mm wide in the center of the fluorescent striping band material.

619-2.12 (Vacant)

619-2.13 (Vacant)

619-2.14 (Vacant)

619-2.15 (Vacant)

619-2.16 (Vacant)

619-2.17 Temporary Rumble Strips.

A. Raised Asphalt Rumble Strips. Raised asphalt rumble strips shall be formed from Type 5 (Shim Course) or Type 7 (Top Course) hot mix asphalt (HMA) meeting the requirements of Section 403, Hot Mix Asphalt (HMA) Pavements for Municipalities or a 9.5 mm hot mix asphalt meeting the requirements of Section 402, Hot Mix Asphalt (HMA) Pavements. Asphalt Emulsion Tack Coat shall be used to adhere the rumble strip to the existing pavement. Raised asphalt rumble strips shall have a width measured in the direction of traffic of between 150 mm and 225 mm and have a final compacted thickness of 10 mm ± 3 mm.

B. Raised, Removable-Tape Rumble Strips. Removable-tape rumble strips shall be formed from black, nonreflectorized, removable pavement-marking tape. Raised, removable-tape rumble strips shall have a minimum width measured in the direction of traffic of 150 mm, with sufficient layers of tape such that each finished rumble strip has a thickness of 10 mm ± 3 mm.

C. Raised, Preformed Rumble Strips. Raised, preformed rumble strips shall be manufactured specifically as temporary rumble strips. Raised, preformed rumble strips shall have a minimum width measured in the direction of traffic of 100 mm, with a thickness of between 6 mm and 13 mm.
D. Saw-cut Rumble Strips. Saw-cut rumble strips shall have a width measured in the direction of traffic of 100 mm ± 13 mm. The depressions shall have a rectangular cross section with a depth of 10 mm ± 3 mm.

E. Milled-in Rumble Strips. Milled-in rumble strips shall have a nominal width measured in the direction of traffic of 150 mm. The depressions shall have a semicircular, concave cross section with a depth of 10 mm ± 3 mm.

F. Removing Temporary Rumble Strips. Rumble strip depressions shall be filled in with Type 5 (Shim Course) or Type 7 (Top Course) hot mix asphalt (HMA) meeting the requirements of Section 403, Hot Mix Asphalt (HMA) Pavements for Municipalities or a 9.5 mm hot mix asphalt meeting the requirements of Section 402, Hot Mix Asphalt (HMA) Pavements.

619-3 CONSTRUCTION DETAILS

619-3.01 Basic Maintenance and Protection of Traffic. Under this work, the Contractor shall maintain and protect traffic in accordance with the following:

A. General. The Contractor shall generally provide a traveled way suitable for two lanes of moving traffic, or more lanes if shown on the plans, or in the proposal. The traveled way shall be kept reasonably smooth and hard at all times, and shall be well drained and free of potholes, bumps, irregularities and depressions that hold or retain water. Construction operations shall be conducted to insure a minimum of delay to traffic. Stopping traffic for more than five minutes shall not be permitted unless specifically authorized in writing by the Engineer. The necessary equipment and personnel to attain and maintain a satisfactory riding surface shall be available and used as needed at all times when work is under way and when work is temporarily suspended for any period of time. Special attention to maintenance of a satisfactory traveled way shall be given during weekends, holidays and the winter season.

B. Cleaning of Highways. The Contractor shall keep the traveled way free of foreign objects such as spilled earth, rock, timber and other items that may fall from transporting vehicles. Materials spilled by or dropped from the undercarriage of any carrying vehicle used in the Contractor's hauling operations along or across any public traveled way both within and outside the contract limits shall be removed immediately.

C. Dust Control. Dusty conditions resulting from the Contractor's operations shall be corrected by the use of calcium chloride and/or water. Water used as a dust palliative shall be distributed uniformly over a minimum width of 2400 mm by the use of suitable spray heads or spray bar.

   Nothing in these specifications shall preclude the use of a dust palliative which has been evaluated and found to be environmentally compatible and is used in conformance with any conditions placed on its use. This use shall be at no additional cost to the State and as approved by the Engineer. A list of acceptable dust palliatives is available from the Director, Geotechnical Engineering Bureau or a Departmental Soils Engineer.

D. Traffic Control. Whenever it becomes necessary to maintain traffic on one lane, the Contractor shall provide adequate traffic controls. The Contractor shall employ a sufficient number of competent flaggers and/or temporary traffic signals to control one lane traffic and areas where construction equipment is operating in potential conflict with public traffic, regardless of the volume of traffic or the sight distance. Flaggers shall wear orange protective helmets and Traffic Control Apparel. Flaggers shall direct traffic in conformance with the MUTCD. Stop/Slow Paddles meeting the requirements of the MUTCD shall be used as the standard signaling device for flagging operations where one or more flaggers are controlling a single stream of traffic, or two alternating streams of traffic proceeding in opposite directions. Signal flags may be substituted where display of the STOP and SLOW faces may be inappropriate or misleading, or in other situations, with the approval of the Engineer.
§619

E. Drainage. The Contractor shall devote particular attention to all drainage facilities, keeping them fully operative at all times. Ditches shall be provided at all times, even during grading operations and periods of accumulated plowed snow, to adequately drain the traveled way and the remainder of the right-of-way areas.

F. Ingress and Egress. The Contractor shall provide and maintain, at all times, safe and adequate ingress and egress to and from intersecting highways, homes, business and commercial establishments at existing or at new access points, consistent with the work, unless otherwise authorized by the Engineer. The Contractor will not be responsible for snow removal from driveways or entrances. On highways on which motor bus service is maintained, the Contractor shall provide suitable areas or locations for the loading and unloading of passengers. The existing pavement, at improved intersecting streets, shall not be disturbed without prior consent of the Engineer.

G. Channelization, Delineation, Pavement Edge Drop-off Protection. The Contractor shall furnish, erect, move, maintain and remove delineators, channelizing devices, and traffic barrier as required by the contract documents and as directed by the Engineer. In areas where grading is being done, a safe and easily traveled roadway shall be properly marked at all times either by the use of delineation and channelizing devices or flaggers. Where private driveways, pedestrian or handicapped facilities exist, the entire access area shall be kept safe and smooth for convenient ingress and egress. Any area determined by the Engineer to be particularly hazardous shall be marked by the use of flashing warning lights conforming to the requirements of the MUTCD in addition to the channelizing or delineation devices.

1. Channelization. Channelizing devices shall be provided as shown in the plans and proposal, or as required by the Engineer, to physically separate traffic from the portion of roadway not available for travel, and to mark the limits of the roadway that is available for travel.

Channelizing devices shall consist of cones, plastic drums, tubular markers, Type III Barricades, or vertical panels. The design and usage of these devices shall conform to the requirements of the MUTCD.

The placement and spacing of these devices in tapers shall not exceed the values given in the MUTCD. Along pavement edge drop-offs, placement and spacing shall be in accordance with Table 619-1 of these specifications. At locations other than tapers and pavement edge drop-offs, unless specific placement and spacing of devices is shown in the contract documents, the placement and spacing between devices shall be selected by the Contractor subject to the Engineer's approval. The spacing shall be sufficiently close to clearly indicate the intended path through the work zone and the portions of the roadway not available for use. If, after deployment of the selected devices, the Engineer is not satisfied that the spacing and placement is sufficient, the Engineer may direct that a different spacing be used.

All channelizing devices shall be maintained upright, in proper alignment and orientation, and kept clean at all times. If ballast is used to maintain alignment and position of the devices, it shall consist of dry sand or other material approved by the Engineer, and placed at ground level. The sand shall be contained in waterproof closed bags or in a waterproof compartment of the device specifically designed for the purpose. Under no circumstances shall ballast be placed on top of a drum or at any point above ground level on any of these devices. If plastic drums are used, they shall be two-piece devices with detachable bases or one-piece devices with elongated bases provided to hold the ballast. In the case of one-piece devices, the ballast shall be placed on the side from which traffic approaches. In no case will the use of steel drums or open-top plastic drums be permitted. Where warning lights are attached to the channelization devices, a bolt, nut and washer shall be used for the attachment as recommended by the manufacturer, and the battery should be located at ground level.

2. Delineation. If post-mounted delineators are used, they shall be securely mounted and placed in accordance with the requirements of the MUTCD. They shall be placed only behind curbing or to mark the outside limits of usable shoulders. Post-mounted delineators are not required to be installed behind channelizing devices, but such an installation is not prohibited. Other delineators for mounting on traffic barriers or other purposes may be circular or rectangular in shape and
shall be constructed of reflective sheeting having a minimum area of 12,900 square millimeters or a reflective button having a minimum diameter of 75 mm.

3. Drop-off Protection. For drop-offs within three meters of the travel lanes, except bridge drop-offs or other drop-offs in excess of 1.8 m deep, the Contractor shall provide traffic protection in accordance with the provisions of Table 619-1, “Required Protection for Pavement-edge Drop-offs” and its accompanying notes, unless otherwise shown in the Contract documents. In all cases, construction operations shall be conducted so as to minimize to the extent practicable the time, depth, and length of drop-offs to which motorists are exposed. At the close of work each day, the Contractor shall provide the treatment shown in Table 619-1. At the time a drop-off condition first occurs, the protection treatment shall be installed based on the anticipated number of days the traffic will be exposed to the drop-off. The anticipated exposure time shall be determined by the Contractor, subject to verification by the Engineer. If at any time subsequent to installation of the protection treatment, the Engineer determines that the anticipated exposure time is likely to increase such that additional protection is required, that increased protection shall be installed as soon as practicable, and it shall be based on the revised anticipated exposure time measured from the first day the drop-off condition existed. In addition, “LOW SHOULDER” or “NO SHOULDER” signs, as appropriate, shall be used for all drop-offs within 1.5 m of the shoulder edge. For long drop-offs, these signs shall be placed beyond intersections and at spacing not exceeding 300 meters. For drop-offs less than 50 mm deep, the “LOW SHOULDER” sign will not be necessary after edge lines are installed.

If a ramp is required by Table 619-1, it shall be constructed from the pavement surface to the surface of the excavated area using a slope not steeper than the slope shown in the table. Ramp material shall be erosion resistant, fully compacted, and compatible with the material in the excavated area. At the Contractor's option, a preformed ramp may be used provided it is adequately anchored to the underlying course. Unless indicated otherwise in the plans or permitted in writing by the Engineer, channelizing devices or positive barrier used to protect drop-offs shall not intrude into the travel way to the extent that they reduce available lane width to less than 3 meters on roadways with actual operating speeds of 70 km/h or less or 3.35 m on all other roadways. Channelizing devices may be placed in the drop-off area only for depths of up to 150 mm if their placement on the roadway would reduce lane widths below the values specified above. For drop-offs deeper than 150 mm, the channelizing devices must be placed entirely on the pavement.

If the Contractor's operations are scheduled or delayed such that positive barrier is required by Table 619-1, or if the Contractor chooses, with written approval from the Engineer, to provide a positive barrier in lieu of the treatment shown in Table 619-1, the barrier shall be installed at no additional cost to the State. The positive barrier shall meet all the requirements of the Standard Specifications and Standard Sheets for temporary concrete barrier. (Box Beam Guide Railing or Heavy Post Blocked-Out Corrugated Beam Guide Rail may be used if approved in writing by the Engineer and the distance from the back of the rail to the drop off is at least 1.2 m for the corrugated beam rail and 1.5 m for the box beam.) Any anticipated or proposed use of positive barrier by the contractor shall require submittal of a plan for approval by the Regional Director. The plan shall include barrier type, location, terminal and end treatment, and any necessary traffic control devices such as signing, barricades, channelizing devices etc in accordance with the MUTCD. The contractor shall construct his plan under the following guidelines.

Approach ends of positive barrier shall be flared at the taper rate shown in Table 619-2. When operating speeds are over 65 km/h, an approved safety terminal or sand barrel array will be required on approach ends of temporary concrete barrier when the offset from the edge of traveled way to end of the full section barrier is less than 3.7 m. In traversable medians, gores and other areas where impacts on a tapered concrete end section could allow vehicles to penetrate into opposing or adjacent lanes of traffic, the use of the tapered concrete end section is prohibited. Box beam and heavy post blocked-out corrugated beam guide rail shall be anchored with the appropriate end assemblies and anchorage units shown on the standard sheets for these systems. Alternate methods of terminating positive barrier such as connecting to existing barrier or shielding behind other barrier will be considered for approval. If a work zone crash cushion is used, any work zone crash cushion purchased after 10/1/98 must comply with NCHRP 350. The
test level shall be as indicated in §712-06. Work zone crash cushions purchased before 10/1/98 may be phased out as they complete their normal service life.

**H. Signs**

1. **Control and Authority.** All existing highway signs, markers, delineators and their supports (authorized by the Department of Transportation) within the contract limits shall remain under the control and jurisdiction of the Engineer and shall be maintained for the duration of the contract by the Contractor if directed by the Engineer. Any signs not authorized by the Department of Transportation, shall be removed from the right-of-way if ordered by the Engineer.

2. **Maintenance of Route Marker Signs.** Route marker signs shall be maintained by the Contractor during construction. Should relocations be necessary at various stages of construction, they shall be in conformance with the M.U.T.C.D. and the directions of the Engineer to locations visible to traffic. Appropriate directional signing shall also be used in conjunction with route marker signs.

3. **Storage of Existing Signs, Markers and Delineators.** The Contractor, when ordered, shall remove existing signs, markers and delineators and their supports which interfere with the construction operations; store, protect, clean and replace them on the contract as directed to locations approved by the Engineer. Signs, markers and delineators not to be replaced, shall be cleaned and delivered to the Engineer as directed. Signs, markers and delineators lost or damaged because of negligence on the part of the Contractor, shall be replaced at the Contractor's expense.

### TABLE 619-1 REQUIRED TREATMENT FOR PAVEMENT EDGE DROP-OFFS

<table>
<thead>
<tr>
<th>Depth of Drop-off (mm.)</th>
<th>Anticipated Exposure Time (Calendar Days)</th>
<th>AADT, 7500 Operating Speed 70 km/h</th>
<th>Operating Speed &gt; 70 km/h</th>
<th>AADT, 7500 and all Freeways and Expressways Operating Speed 70 km/h</th>
<th>Operating Speed &gt;70 km/h</th>
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</thead>
<tbody>
<tr>
<td>50</td>
<td>7</td>
<td>30</td>
<td>45</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>to 150</td>
<td>8 to 60</td>
<td>30 / 1:1</td>
<td>60 / 1:1</td>
<td>15 / 1:1</td>
<td>30 / 1:1</td>
</tr>
<tr>
<td>150</td>
<td>≤7</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>to 600</td>
<td>8 to 60</td>
<td>15</td>
<td>60 / 1:3</td>
<td>30 / 1:3</td>
<td>60 / 1:3</td>
</tr>
<tr>
<td>600</td>
<td>≤7</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>to 600+</td>
<td>8 to 60</td>
<td>30 / 1:3</td>
<td>60 / 1:3</td>
<td>30 / 1:3</td>
<td>Positive Barrier</td>
</tr>
<tr>
<td>600+</td>
<td>30 / 1:3</td>
<td>60 / 1:3</td>
<td>30 / 1:3</td>
<td>60 / 1:3</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. The table shows spacing for drums or Type III barricades. The spacing shall be halved if other channelizing devices are used. Type III barricades may be used instead of drums, if space permits, but no separate payment will be made unless otherwise shown on the plans.
2. For drop-off lengths shorter than the maximum devices spacing shown in Table 619-1, or for drop-offs at intersections, the device spacing shall be shortened to provide adequate channelizing as directed by the Engineer.
3. Two flashing warning lights shall be used at the beginning of each work zone drop-off.
4. The ramp from the pavement surface to the excavated area shall not exceed the slope shown in the Table. Cases where no slope is shown, no sloped ramp is required.
5. Whenever it is not practicable in the opinion of the Engineer to achieve the desired ramp slope shown in the Table, the flattest practicable ramp shall be constructed and the device spacing shall match the 7 day spacing, except positive barrier shall be required for drop-offs exceeding 600 mm on roadways with traffic volumes exceeding 7500 vehicles per day.
6. At the Contractor's option, required 1:3 ramps may be flattened to 1:4 and device spacing increased to 60 meters.
7. For drop-offs located more than 3 meters from the edge of the travel lane, ramping shall not be required and the minimum required spacing for drums and Type III barricades shall be 30 meters. (15 meters for alternate devices). Drums or Type III Barricades spaced at 15 meters or other approved devices spaced at 15 meters may be substituted for positive barrier. Signs and flashing warning lights shall be provided as required in this Section for drop-offs greater than 150 mm.

8. For winter shutdown periods, the Contractor shall restore the roadway to the normal operating condition whenever possible. If this cannot be achieved, a compacted 1:4 ramp shall be provided at all pavement edge drop-offs. If a 1:4 ramp cannot be provided, a positive barrier shall be required, unless otherwise directed by the Regional Construction Engineer, at no additional cost to the State.

9. For drop-offs exceeding 600 mm in depth for exposure times of 7 days or less, and when an offset of at least 600 mm cannot be provided from the edge of travel lane to the drop-off, alternate traffic control plans may be required by the Engineer.

<table>
<thead>
<tr>
<th>OPERATING SPEED (km/h)</th>
<th>50</th>
<th>65</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPER RATE FOR TEMPORARY CONCRETE BARRIER</td>
<td>8:1</td>
<td>11:1</td>
<td>14:1</td>
<td>16:1</td>
<td>18:1</td>
<td>20:1</td>
</tr>
<tr>
<td>TAPER RATE FOR BOX BEAM OR HEAVY POST CORRUGATED BEAM</td>
<td>7:1</td>
<td>9:1</td>
<td>11:1</td>
<td>12:1</td>
<td>13:1</td>
<td>15:1</td>
</tr>
</tbody>
</table>

I. Existing Pavement Markings. The Contractor shall remove, as soon as practicable, existing pavement markings where indicated on the plans, in the proposal or where ordered by the Engineer. This shall include any pavement markings that are added during the course of the work. If darkness or inclement weather interferes with removal operations, such operations should be accomplished during the next daylight period or as soon thereafter as weather conditions permit. The method of removal is subject to the approval of the Engineer. Obliterated markings shall be unidentifiable as pavement markings under day or night, wet or dry conditions. Overlaying existing stripes with black paint or asphalt does not meet the requirements of covering, removal or obliteration; however, the use of removable, nonreflective, preformed tape is permitted where markings need to be covered temporarily. Grinding, sandblasting, etc., must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist.

J. Exposed Guide Railing, Median Barrier, and Bridge Railing Ends. During non-work hours, when traffic is being maintained on the facility, all exposed approach ends (free ends) of guide railing, median barrier, and bridge railing shall be marked with a reflectorized drum and temporarily terminated. Corrugated beam guide railing and median barrier, and heavy post blocked out corrugated beam guide railing and median barrier shall be temporarily terminated by having the exposed approach ends (free ends) dropped to the ground and pinned in a manner approved by the Engineer. The approach ends of box beam guide railing, median barrier and bridge railing shall be temporarily terminated with box beam guide railing end assemblies utilizing two splice plates and the proper number of bolts per connection. No posts for anchorages will be required. Special temporary splice plates will be needed to adapt box beam guide railing end assemblies to box beam median barriers.

619-3.02 Construction Signs, Reflectorized Signs, and Sign Covers. The Contractor shall furnish and erect appropriate construction signs to adequately and safely inform and direct the motorist and to satisfy legal requirements. All signs shall indicate actual conditions, and shall be removed and/or relocated, or changed immediately as required in the contract documents and as directed by the Engineer. All signs shall be the property of the Contractor and shall be maintained in good condition for the duration of the contract. All signs shall be removed from the work site when the contract is accepted. Sign sizes and details shall conform to the standard sheets, MUTCD, and the contract documents. The number of signs indicated on the standard sheets, in the MUTCD, and in the contract documents are a minimum number and the contractor shall have an adequate quantity of these signs available for immediate use, as required. The Engineer may order that additional signs be used. All wood supports, and backs of plywood sign panels shall be painted with two coats of white paint. All signs shall be kept clean, mounted at the required height on adequate supports, and placed in the proper position and alignment so as to give maximum visibility. In general, sign orientation shall
conform to the MUTCD, Section 201.5, subdivision (g). All sign supports shall display the sign panel in as vertical an orientation as possible. The deviation angle from vertical shall not exceed ±5 degrees.

Signs that are erected and removed or relocated on a daily basis, or that must be frequently relocated to adjust to the location of construction operations, may be mounted on portable sign supports. Signs that are to remain at a fixed location may be supported on posts mounted in the ground. The type of sign supports used shall be selected by the contractor, subject to the approval of the Engineer. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. All supports, except those located beyond the deflection distances of guiderail or temporary barrier, or otherwise protected against impact by errant vehicles, shall meet the following safety requirements for portable and fixed supports.

A. Portable Supports. Ballast used to stabilize supports shall be bagged sand or other suitable material approved by the Engineer, and shall be located at ground level. Portable supports shall comply with one of the following:

1. Manufactured portable supports designed for the display of signs in temporary traffic area. For manufactured supports purchased after October 1, 2000, the Contractor shall obtain from the supplier, and provide to the Engineer upon request, a certification that the support meets the requirements of NCHRP 350 Test Level 2 or Test Level 3. The use of devices certified as meeting Test Level 2 shall be limited to roadways with a posted speed limit of 40 mph or less. Test Level 3 devices may be used on all roadways.
2. Wood supports of a configuration which has been satisfactorily crash tested as indicated in # 1 above.
3. Metal supports fabricated in accordance with the details shown on the standard sheet entitled “Type III Construction Barricades”.

Fabricated wood or metal supports shall not be placed on their sides unless they are placed behind a barrier or removed a safe distance from the roadway, as determined by the Engineer.

B. Fixed Supports. If stakes are used to attach the lower end of diagonal braces to the ground, they shall not protrude more than 100 mm above the ground surface. Fixed supports shall comply with one of the following:

1. Type A Sign Supports meeting the requirements of §730-24 and the applicable Materials Details may be used for sign sizes appropriate for those supports.
2. Sign posts and footings meeting the requirements of §730-20 and the applicable Standard Sheets may be used for sign sizes appropriate for those supports.
3. Wood posts, excluding any synthetic or composite wood product, may be used as follows:
   a. Wood posts up to 89 mm by 89 mm with no holes drilled.
   b. Wood posts up to 89 mm by 140 mm having 2 holes of 38 mm diameter, drilled in the direction perpendicular to the flow of traffic and located 100 mm and 450 mm above ground level. These holes shall be filled with flexible caulking.
      No more than two posts of acceptable sizes as listed above shall be located within a single 2.1 meter width, and no more than one post of acceptable size as listed below shall be located within a single 2.1 meter width.
   c. Wood posts up to 89 mm by 140 mm with no holes drilled.
   d. Wood posts up to 140 mm by 184 mm having 2 holes of 75 mm diameter, drilled in the direction perpendicular to the flow of traffic and located 100 mm and 450 mm above ground level. These holes shall be filled with flexible caulking.
      Wood posts larger than 140 mm by 184 mm shall not be used.
4. Any other support that the Contractor may select, upon submission of documentation to the Engineer demonstrating that the post selected meets the current AASHTO and NCHRP criteria for impact performance of Highway Sign Supports.
Supports for construction signs shielded by barrier or guiderail, and located beyond the deflection distance described below, do not have to conform to the above safety requirements.

<table>
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<th>TABLE 619-3  GUIDERAIL &amp; CONCRETE BARRIER DEFLECTION DISTANCES</th>
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<td>Concrete Barrier</td>
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Flexible signs will only be allowed for short-term, daytime use, for portable type signs that are deployed for use on a daily basis. They may not be used overnight, or for signs mounted on supports installed in the ground, or on portable supports that are left in place continuously for more than one work day. All flexible sign panels shall be mounted on supports with adequate bracing, so as to minimize flutter and to support the intended shape of the sign.

Intermixing reflective fluorescent orange colored signs with non-fluorescent orange colored flexible signs within the same series of signs shall not be allowed.

All construction signs shall be mounted in accordance with the MUTCD. Signs on rigid panels, except rigid lightweight plastic sign panels, shall be mounted at a minimum height of 1.5 m. Flexible sign panels, including rigid lightweight plastic sign panels, shall be mounted at a minimum height of 1.5 m, or optionally as low as 0.3 m when the following conditions are met:

A. On two lane, two-way roadways and four lane divided highways, when signs are placed on the left and the right sides of the roadway.
B. Where there will be no parked vehicles to obstruct the view.
C. When at least one advance work zone warning sign, mounted at a height of 1.5 m is located upstream of any flexible signs to alert motorists that they are entering a construction zone.
D. When the Engineer determines that the lower mounting height does not adversely affect the motorists' visibility of the sign.

If signs are temporarily covered, the cover shall be attached in a manner that completely covers the face of the sign. No adhesive shall be applied to the face of the sign, and the method of attaching the cover shall not damage the sign face. Sign covers shall be secured firmly to prevent dislodging and shall be maintained in good condition to present a neat appearance and minimize distraction to motorists traveling through the work zone. Sign covers shall contain no wording or images. Damaged covers which are determined by the Engineer to be no longer effective shall be replaced.

On limited access highways, when the normal legal speed limit is 50 MPH and higher, the Contractor shall have available at the project site, sufficient warning signs as described below, to inform oncoming traffic of a stopped, or very slow traffic condition. These signs shall be placed, moved, covered, maintained and removed in a manner directed by the Engineer.

The sign shall measure 1.2 m x 1.2 m, and letters shall be 175 mm Series D, similar to a W8-10, except it shall read "BE PREPARED TO STOP." The background color shall be fluorescent orange (Materials Designation 730-05.04, Class D). Each sign shall be mounted on a suitable portable support, and each shall be equipped with a pair of warning flags conforming to the requirements of the MUTCD, Section 294.2. Both sides of the approach shall be signed unless the median is too narrow, or if there are fewer than three lanes in the approach.
The sign shall be posted approximately 460 m upstream of the end of the queue, and when the end of the queue moves, the sign shall also be moved to maintain that spacing. If the resulting location places the sign upstream of the first warning sign for the project, the contractor shall also furnish and place an appropriate general work zone sign. The work zone sign shall be placed approximately 300 m in advance of the "BE PREPARED TO STOP" sign.

Whenever a reduced regulatory speed limit for a highway work area has been legally established by any means, the R-2 speed limit signs and, if used, the R2-10 speed zone ahead signs for the reduced speed shall be supplemented by a work zone warning panel as described below.

The work zone warning panels shall be the same width as the speed limit sign they are supplementing. They shall be 150 mm high with 75 mm Series B lettering when used with size B speed limit signs; 200 mm high with 100 mm Series B lettering when used with size C speed limit signs; 300 mm high with 150 mm Series B lettering when used with size D speed limit signs and 400 mm high with 200 mm Series B lettering when used with size E speed limit signs. The panel shall read "WORK ZONE" with black legend and fluorescent orange background (Materials Designation 730-05.04, Class D). These panels shall be placed on the same posts and immediately above the speed limit signs.

Signing advising motorists of increased fines for speeding within a highway work zone shall be installed in accordance with the contract documents on the mainline of any highway construction or maintenance work zone, or near the project limits on projects with multiple work zones, where a travel lane is closed to vehicular traffic or the speed limit within the work zone is reduced below the normally posted speed limit. If the signing is not detailed in the contract documents, it shall be installed as follows.

The “FINES DOUBLED FOR SPEEDING IN WORK ZONES” sign shall be installed upstream of the first advance warning sign. It shall not be placed between a warning sign and the condition to which it relates, or within a warning sign countdown series. To avoid the aforementioned installations, install the sign approximately 300 m upstream of the first warning sign on highways with normally posted speed limits equal to or greater than 45 mph and 100 m-150 m upstream where normally posted speed limits are under 45 mph. For long projects with multiple work zones, the sign should be installed on the same posts and immediately above the speed limit signs.

Both the work zone warning and the fines double panels shall be completely covered or otherwise removed from view when the R-2 speed limit sign is covered or removed.

Where traffic will be riding on a milled pavement, GROOVED PAVEMENT (W4-5) signs shall be installed on the approaches. On multilane highways where only one lane in a direction is milled and both lanes are open to traffic, supplement the GROOVED PAVEMENT sign with a LEFT LANE or RIGHT LANE panel below the sign. Where only an entrance or exit ramp is milled, sign the mainline with a GROOVED PAVEMENT sign and a supplemental RAMP panel. Sign all side streets approaching the milled section.
Milling operations shall be conducted to preclude the possibility of pavement runoff collecting along milled joints and creating a traffic hazard. Milling rebates resulting in longitudinal or transverse vertical faces exceeding 25 mm in height that would be exposed to traffic during nonwork hours shall be sloped or tapered by temporary patches or shims to avoid creating a traffic hazard. Where such vertical transverse faces cannot be adequately sloped or tapered, BUMP (W4-1) signs shall be installed in advance of milling rebates in accordance with the MUTCD. A W7-10 object marker shall be installed on the right side of the roadway at the rebate. On divided highways, an object marker shall be installed on both sides of the roadway. A drum with a Type B, flashing warning light may be used instead of an object marker.

Where both BUMP and GROOVED PAVEMENT signs are warranted, in nonurban areas the GROOVED PAVEMENT sign shall be installed 150 m (100 m in urban areas) upstream of the BUMP sign.

If not indicated in the contract documents, the size of the GROOVED PAVEMENT and BUMP signs shall be consistent with that of other signs within the contract limits.

619-3.03 Temporary Box Beam Barrier, Temporary Concrete Barrier, Construction Barricades, and Lighting for Construction Barricades. The Contractor shall furnish, erect, move and remove, temporary concrete barrier, construction barricades and lighting for construction barricades where and as indicated on the plans, on the standard sheets, in the M.U.T.C.D., or as directed by the Engineer. Posts and painted members or bands used to delineate drop-offs will not be considered barricades. The contractor shall provide and maintain delineation on temporary barriers. This delineation shall make the barrier visible to approaching traffic as well as traffic which is adjacent to the barrier. The contractor shall have the choice of using one, or more, of the following: Warning lights, delineators, pavement marking, reflectorized tape placed on the barrier, reflective paint, or any other device subject to the approval of the Engineer. The delineation devices shall be maintained dirt and snow free and visible throughout the term of the contract including shutdown periods.

Where indicated on the plans or in the proposal, construction barricades shall be supplemented by approved flashing or steady burning lights, as indicated.

Temporary box beam barrier shall be erected in accordance with the requirements for box beam median barrier specified in §606-3.01 and §606-3.03.

Each run, or bay, of temporary concrete barrier units shall be fastened together to form a continuous chain. After placement each successive unit shall be moved longitudinally to remove the slack in the joint between units. The units at each end of a run or bay shall be anchored as shown on the standard sheet. In order to reduce movement of the barrier on structures, areas where limited deflection is desired, or where directed by the Engineer, one of the methods shown on the standard sheet shall be used. Where shown on the plans or directed by the Engineer, the ends of the barrier run shall be fitted with an impact attenuation device or fitted with a tapered end section and flared back as directed.

Steady burning or flashing barricade lights have a minimum nominal diameter of 175 mm and shall emit yellow light. Steady burning lights may be used to supplement other channelizing devices to delineate the traveled way. Flashing lights shall not be used for delineation or channelizing purposes.

Flashing barricade lights shall be either Type A, Low Intensity, or Type B, High Intensity conforming to the requirements of section 294.3 of the M.U.T.C.D. High intensity lights shall be used where barricade lights are required to operate 24 hours per day. Low intensity lights shall be used where barricade lights are required only at night. In that event, the hours for operation of the low intensity lights shall be dusk to dawn.

Steady burning lights shall have a minimum beam intensity of 2 candelas maintained within a solid angle of 9° on each side of the vertical axis, and 5° above and 5° below the horizontal axis. The hours for operation of steady burning barricade lights shall be dusk to dawn.

619-3.04 Temporary Structures and Approaches. Temporary structures and their approaches or existing structures that are moved to provide temporary structures along with their temporary approaches shall be constructed in such a manner and sequence that interference with and inconvenience to the traveling public and the abutting owners is kept to a minimum. The Contractor shall be responsible for the workmanship, upkeep and safety of all temporary structures and approaches. All fabrication shall conform to the current AASHTO Specifications for Highway Bridges, Division II except as modified herein. Fabrication shall be performed by an AISC Category III Certified Fabricator.
When specific details are not indicated on the plans, the Contractor shall design all elements of the temporary structure and approaches including the railing system. Design shall be done in conformance with the AASHTO standard specifications for Highway Bridges which is current on the date of advertisement for bids. Design live load shall be MS 18 unless otherwise noted on the plans. Plans and design computations shall bear the stamp and signature of a Professional Engineer licensed to practice in the State of New York.

Prior to beginning construction of any structure designed by the Contractor or the Contractor's agents the Contractor shall submit detailed plans to the DCES for review and approval in accordance with §585-3.02. Such review, however, shall not relieve the Contractor of the responsibility for the adequacy and design of such temporary structures and approaches. If the Contractor proposes to construct with used materials, the Contractor's Engineer shall submit with the plans the method for documenting that all primary member material meets the design. In the absence of Mill Certification Reports, physical testing shall be performed. Excluded from this provision are proprietary structures. All welding required for the fabrication of temporary steel structures shall be performed in accordance with the provisions of the New York State Steel Construction Manual. Complete joint penetration groove welds in main material shall be radiographed as described therein. The DCES reserves the right to perform in-process fabrication inspection. The Contractor shall notify the DCES of the fabrication Schedule 10 days prior to commencement of work.

619-3.05 Tubular Markers. Tubular markers shall be installed according to the manufacturer's instructions on asphalt or concrete pavement that has been properly cleaned with a wire brush to remove all paints, dirt, oil or any substance which will interfere with the proper bond. Bonding agents shall be of sufficient amount or size to ensure proper bonding of the base to the pavement. When epoxy is used the epoxy shall be applied evenly to the bottom of the base of the marker and the base shall be pressed firmly on the pavement surface until a bead of epoxy appears around the edge. When installing the marker with a butyl pad, the pad shall cover the entire bottom of the base of the marker. Tubular markers not installed properly along the required line, as determined by the Engineer, shall be removed and reset.

Tubular markers damaged by the Contractor's operation or by traffic shall be replaced within 24 hours or as directed by the Engineer. The Engineer shall direct the Contractor to replace damaged reflective sheeting as required. This sheeting shall be removed and disposed of in an approved manner at the time as directed by the Engineer.

619-3.06 Short-Term Pavement Markings. The Contractor shall furnish, apply, maintain, and when so ordered, remove short-term pavement markings, where shown in the contract documents or where directed by the Engineer. Any pavement upon which traffic will be maintained shall be properly marked before nightfall or the end of the working day, whichever comes sooner, in accordance with this subsection.

Short-term pavement markings shall be installed and maintained in accordance with the patterns and colors indicated for pavement marking, Parts 260 to 263 of the M.U.T.C.D. or as directed by the Engineer. Where the limits of passing and no-passing zone have not been determined prior to construction, the Contractor shall allow the Engineer one week after the placement of binder or top course to determine these limits. If the Engineer codes these limits right on the pavement surface, this coding shall be preserved, by the Contractor, offset from the roadway.

Alternately, if the pay item 'Determination of No-Passing Zones and Pavement Coding' is included in the contract, this determination shall be made by the Contractor either on binder course or top course.

The following pavement marking patterns shall be installed as short-term pavement markings:

1. Yellow broken lines, partial barrier lines and full barrier lines used to separate opposing traffic flows on two-way roadways.
2. White broken lane lines to separate traffic flows in the same direction on multi-lane highways.

Stop bars, hatch lines and edge lines will not normally be required under short-term pavement markings but may be ordered by the Engineer. Broken lines may be as short as 1200 mm. Short-term pavement markings as described above, will be considered acceptable as the only pavement markings in place for periods normally not longer than fourteen (14) days, unless otherwise extended by the Engineer.
Within 14 days after paving, or the time period as extended by the Engineer, if the Contractor fails to install either the succeeding pavement course, or the final pavement markings on contracts with pay items for such, the short-term pavement markings shall be supplemented (at no additional expense to the State) with edge lines, 3 meter broken lines, stop bars, cross walks and arrows. In the event the project is to remain uncompleted over the winter, other than for staged construction when indicated, the short-term pavement markings shall be supplemented (at no additional expense to the State) by full pavement markings in accordance with the pattern indicated in the plans. If no full pavement marking pattern is given in the plans, the short-term pavement markings shall be supplemented as directed by the Engineer. The pavement markings used to supplement the minimum short-term pavement markings shall be designated as 'Temporary Pavement Markings' and use the materials as described below.

Removable tape and raised markers can be used as short-term pavement markings for solid and broken lines on any pavement course. However, on the final pavement surface, these shall be offset, if possible, from the location of the final mark in order to prevent interference with the adhesion of the final mark.

Pavement marking paint can be used as short-term pavement markings for solid and broken lines on all underlying pavement courses (ie base, binder, leveling and shim). On top course, or final pavement surface, paint may only be used if the final marking pattern is known prior to paving, and the contract does not contain durable markings (ie thermoplastic or epoxy marks). Where paint is used on the final pavement surface, it shall be applied before nightfall in the final location. If the Contractor is unable to place the final pavement marking paint before nightfall on contracts with pay items for ReflectORIZED Pavement Marking Paints (Section 640), then removable short-term pavement markings shall be installed before nightfall offset from the final location at no additional cost to the State.

Non-removable tape may be used as short-term pavement markings only for broken lines on underlying pavement courses. Non-removable tape will not be allowed to mark barrier lines on any pavement course.

If paint is used for short-term pavement markings, it shall be applied in accordance with the requirements of Section 640, ReflectORIZED Pavement Marking Paints. If tape is used, it shall be applied to a clean, dry pavement in accordance with the manufacturer's recommendations. Tape shall conform to the shape of, and adhere to the surface upon which it is applied. If raised marker units are used, they shall be of a color in accordance with the M.U.T.C.D. A raised marker unit spaced every 1500 mm may be used as a substitute for a solid line. Three raised marker units, evenly spaced 600 mm apart, may be used as a substitute for a 1200 mm long broken line. Four raised marker units, evenly spaced one meter apart, may be used as a substitute for a three meter long broken line.

Any markings, including raised markers, that fail to adhere to the pavement, become abraded, dislodged by snowplowing, or in the opinion of the Engineer become ineffective in any manner during the "period of use" shall be replaced by the Contractor at no additional expense to the State. The "period of use" shall be defined as the time from when the short-term pavement markings are first applied to the time when the markings are either paved over, the project's final markings are applied, or contract acceptance, whichever is first. After their period of use, short-term pavement markings, and temporary markings added to supplement short-term pavement markings shall be removed from the pavement by the Contractor, if ordered by the Engineer, as described in Section 635 Cleaning and Preparation of Pavement Surfaces.

In the event of sudden, unforeseen precipitation or other extraordinary situations, Do Not Pass signs may be used in lieu of short-term pavement markings for up to three consecutive calendar days on two or three lane, two-way, roadways under the following conditions:

1. The signs meet the requirements of Section 214.2 of the NYSDOT MUTCD and spaced not more than 300 meters apart.
2. The signs shall be supplemented with delineators and/or plastic drums spaced as directed by the Engineer, but not more than 60 meters apart and meeting the requirements of Section 291.2 of the NYSDOT MUTCD and §619-3.01G. of the Standard Specifications, respectively.
3. No payment will be made for the installation of Do Not Pass signs, delineators and plastic drums when necessitated by the Contractor's failure to place short-term pavement markings.

**619-3.07 Temporary Traffic Signals.** The traffic signal system shall be constructed in such a manner that interference with and inconvenience to the traveling public is kept to a minimum. The Contractor
shall maintain in proper operation, all temporary signals used for Maintenance and Protection of Traffic until approved removal. The Contractor shall be responsible for their continuous 24-hour operation except for reasonable shutdown during relocation and transfer operations.

If for any reason a signal is not functioning as required, the Contractor shall commence repair work on this signal within two hours after notification of a malfunction. The Contractor shall provide a flagger at each malfunctioning traffic signal during repair work. The flagger control shall be provided until the temporary traffic signal is restored to proper operation.

On each approach, one signal face shall be at the right side of the roadway or over the right half of the roadway. One signal face shall also be installed at the left side of the roadway or over the left half of the roadway.

The lateral distance between signal faces for each approach shall be a minimum of 2400 mm and a maximum of 8230 mm.

In the event flashing operation occurs, all signal faces shall show flashing red indications. Flashing operation of signal is considered a malfunction.

In the event the Contractor elects to use temporary traffic signals to control traffic in lieu of flaggers, the Contractor shall submit complete plans of the proposed work to the Engineer for approval at least 30 days before signals are required for the maintenance of traffic. Plans shall show type of proposed equipment, details of construction, and table of operation of the temporary signal system.

619-3.08 Mailboxes. The Contractor shall not move any mailbox which contains mail. The Contractor will advise the owner to remove such mail before the box is moved. Before acceptance of the work, any mailbox which has been disturbed or removed, shall be replaced by the Contractor in a location approved by the Engineer.

In the event the original mounting post has been lost, damaged, or is unusable, the Contractor shall furnish a similar device or mounting acceptable to the Engineer, or when directed shall furnish a galvanized pipe mounting post of 25 mm (minimum) diameter with flanged top fitting and will firmly install the new mounting and mailbox at the designated location and at the proper height in accordance with the requirements of the U.S. Postal Service and to the satisfaction of the Engineer.

619-3.09 Opening Highway to Traffic Prior to Contract Acceptance. The construction details specified in §619-3.01 through §619-3.08 shall apply when required.

619-3.10 Maintain Traffic Signal Equipment. General. Existing, relocated, modified or newly installed traffic signals identified in the contract documents or by the Engineer shall be maintained in proper operation as specified in Requirement A, B or C of this subsection as called for in the contract documents.

Proper operation shall include the maintenance of all features of the traffic signal operation in effect and operating at the time any work begins on the contract as defined in §619-1.11, Duration of Contract. Traffic actuated phases shall be maintained actuated and signals operating within signal systems shall remain in step with the remainder of the system unless otherwise approved by the Engineer. Except for emergencies, no changes in the signal operation or timing shall be made without prior approval by the Engineer. If emergency conditions dictate a change in the operation, the Engineer shall be notified accordingly by the start of the next work day. Unless otherwise approved by the Engineer, an altered signal operation must be returned to the original signal operation within 24 hours.

The Contractor shall maintain in operation all equipment including signal heads, supports, cable, wiring, existing and new span wire mounted signing, controllers, master controllers, detector systems, conflict and current monitors, relays, switch packs, and all other accessory and necessary equipment. Maintenance shall also include the repair and replacement of existing detector loops, under separate items. All parts, supplies, equipment and labor shall be furnished by the Contractor.

The Contractor shall have capable traffic signal repair personnel on call 24 hours a day, seven days a week, and shall provide to the Engineer a single telephone number for contacting them. If for any reason, a signal is not functioning properly, the Contractor shall commence work on the signal within two hours notification. If directed by the Engineer, the Contractor shall notify the appropriate police agency for traffic control operations. If the police agency cannot or will not provide traffic control, the Contractor shall provide flaggers at locations specified by the Engineer within the two hour time period. The Contractor shall continue the flagger services until the signal is in proper operation. Reflectorized
“Flagger Ahead” signs shall be used in conformance with the M.U.T.C.D. on all approaches to an intersection controlled by flaggers.

The Contractor shall, on a daily basis, provide the Engineer with a record of all maintenance calls received and responded to, as well as a record of all corrective action taken by the Contractor.

Where the Contractor is required to temporarily relocate existing traffic signals because of his construction operations, all existing equipment, fittings, wire, cable, conduit, and related materials shall be reinstalled and extended where necessary. Temporary timber poles (Class 2), guys and related material shall be furnished and installed where necessary. Temporary timber poles shall be treated with an appropriate wood preservative in accordance with the American Wood Preserver's Association Standard C2. Preservative retentions shall be appropriate for the specie when used in ground contact application.

**Requirement A.** The contractor shall maintain in proper operation, for the duration of the contract, the indicated existing, relocated, modified and newly installed signals as required by the contract documents. If such signals are to be removed, the Contractor shall be responsible for the operation and maintenance of them until their approved removal. The Contractor shall be responsible for their continuous operation except for reasonable shutdown periods authorized by the Engineer during relocation and transfer operations. All of the requirements in the “General” subsection of this specification shall apply.

**Requirement B.** All requirements of the “General” subsection shall apply except that the State shall assume operation and maintenance responsibility for the signal from the Contractor following successful completion by the Contractor of the installation/modification testing as required by §680-3.32, Tests. Assumption of operation and maintenance responsibility by the State shall not relieve the Contractor of the responsibility to provide a Manufacturer’s Warranty for the correction of defects in material or labor provided by the Contractor. However, the six month period shall be measured from the day the State assumes maintenance responsibility. The State assumption of maintenance responsibilities will not relieve the Contractor of any responsibilities for damage prior to contract final acceptance.

**Requirement C.** All the requirements of the “General” subsection shall apply except that at relocated, modified or newly installed signals, the State will assume responsibility for the following four items after successful testing as required by §680-3.32, Tests, has been completed. At existing microcomputer traffic signals, the State shall be responsible for those four items for the duration of the contract.

1. Supply and maintenance of the microcomputer assembly and software.
2. Programming of the microcomputer furnished by the State.
3. Operation or timing changes directed by the Engineer.
4. Normal (no abuse, or vandalism) equipment failures of existing, relocated, modified or new traffic signal equipment furnished by the State.

All other operational features and signal equipment shall be maintained by the Contractor in accordance with the “General” provisions of this subsection for the duration of the contract. Prior to the assumption by the State of maintenance responsibility for relocated, modified or newly installed signals, the Contractor shall maintain such signals under the “General” provisions of this specification. It shall be the Contractor's responsibility to investigate all maintenance calls as outlined in the “General” provisions. If the malfunction is in the equipment supplied by the State, the Contractor shall notify Regional Traffic and Safety personnel and, if directed by the Engineer, provide flaggers until the arrival of State maintenance personnel. Such flagging operations in excess of four hours per maintenance call shall be paid for as extra work.

Assumption of the above listed responsibilities by the State shall not relieve the Contractor of the responsibility for operation and maintenance of the signal as required by this section. Further, the Contractor will not be relieved of the responsibility to provide a manufacturer’s warranty for the correction of defects in material or workmanship provided by the Contractor. The State assumption of maintenance responsibilities will not relieve the Contractor of responsibilities for damage prior to contract final acceptance.

**619-3.11 Flashing Arrow Boards.** The Contractor shall provide Flashing Arrow Boards on multilane highways with preconstruction posted speed limits of 45 mph and higher whenever a lane is closed to
traffic and vehicles are required to merge with traffic in adjacent lanes. One Flashing Arrow Board is required for each lane closed to traffic, regardless of the duration. Flashing Arrow Boards shall also be provided at locations where posted speeds are below 45 mph when shown on the plans or when indicated in the proposal.

Flashing Arrow Boards will not be required where they would interfere with the operation of a 3 color signal or flasher or where there is an operation controlled by a signal or flagger. Flashing Arrow Boards will not be required for alignment changes or lane diversions where the number of through traffic lanes is not reduced unless specifically indicated on the plans.

Flashing Arrow Boards shall be placed in accordance with the Manual of Uniform Traffic Control Devices. They shall be used as a substitute for the W1-11B; W1-11C; W1-12B; or W1-12C large arrow sign located nearest the beginning of the taper. The arrow boards shall be mounted so that the base of the panel is at least 2.1 m above the pavement surface and properly aligned to provide optimum viewing by approaching motorists. Flashing Arrow Boards may be relocated or reoriented on a daily basis or more frequently as ordered by the Engineer.

Where the posted preconstruction speed limit on the highway is 45 mph or greater within 2.0 km upstream of the board, only diesel or line powered arrow boards shall be used, unless indicated or directed otherwise. Where the posted preconstruction speed limit is below 45 mph for at least 2.0 km upstream of the taper, diesel powered, line powered or solar charged boards shall be used as approved or as directed by the Engineer.

The Contractor shall be responsible for maintenance, repair and continuous operation of the Flashing Arrow Board until progress of work no longer requires its use, as directed by the Engineer.

619-3.12 Construction Zone Pavement Markings. All pavement markings and patterns shall be placed as shown on the plans, or directed by the Engineer, and in accordance with the MUTCD.

Except when other spacings are permitted by the plans or proposal, raised reflectorized pavement markings shall be spaced as required in this paragraph. When raised reflectorized pavement markers are used to simulate a solid line, they shall be spaced 1500 mm apart; and when these markers are used to simulate a 3 m broken line, 4 equally spaced markers shall be used, with a marker at beginning and end of each line segment. Other line patterns shall be as specified in the MUTCD. When used to supplement a solid or broken line, markers shall be spaced a maximum of 24 m on tangents and a maximum of 12 m for curves with a radius less than 860 m.

The application of pavement markings on roadways open to traffic shall be done in the direction of traffic.

When required by the Engineer, the Contractor shall establish marking line points at 9 m intervals as necessary to control the lateral position of the line.

A. Application. All pavement marking materials shall be installed in accordance with the manufacturer's instructions. In addition, pavement marking paints shall be installed according to the provisions of §640-3.

B. Maintenance of Pavement Markings. The Contractor shall be responsible for maintaining the construction zone pavement markings for the duration of the temporary traffic pattern or detour. Any marking material that fails to provide for any reason, both satisfactory daytime and nighttime delineation, in the opinion of the Engineer, shall be replaced immediately by the Contractor at no additional cost to the State. Replacement shall, as a minimum, be required for the following degrees of material loss:

1. Removable Tape. Any gap exceeding 15 m in length in a solid line, or loss of shorter segments exceeding 10 percent of the total length in any 250 m segment of solid line, or more than two consecutive segments of broken line.

2. Raised Markers. Loss of more than 2 markers used to simulate a 3 m broken line; loss of more than 3 consecutive markers used to simulate a solid line, or more than 5 percent of the markers within a 250 m segment of solid line; when used to supplement a line, loss of 2 or more consecutive markers or more than 5 percent of the markers within a 1000 m segment of solid or broken line.
3. Traffic Paint. Abrasion of the line such that more than 10 percent of the underlying pavement is visible within any segment of broken line or within any 100 m section of solid line; failure of any line to be clearly visible at night under low-beam headlamp illumination when viewed from a distance of 60 m.

If the Contractor elects to use raised pavement markers as the marking material under the optional construction zone pavement markings items, the Contractor shall be responsible for maintaining these markings in acceptable condition during winter months, including loss of markers by snow plows. The Contractor shall either replace lost markers between storms, or place an alternate marking material as allowed by this specification to maintain all markings in acceptable condition, subject to the approval of the Engineer. No additional payment shall be provided for such replacement of lost markers.

The Contractor shall not be responsible for snowplow damage or loss of raised markers provided under pay items requiring the use of these markers. In the event that such markers are damaged or lost, the Engineer shall decide whether to replace the lost markers in kind or with other marking materials at the time the loss occurs. Payment shall be provided under the appropriate item for any markers replaced, or for alternate marking materials installed.

C. Removal of Pavement Markings. Construction zone pavement markings used to delineate temporary traffic patterns shall be removed at the completion of that phase of the work and prior to the installation of the next temporary pattern, or return to the permanent pattern.

Traffic paint shall be removed by mechanical means subject to their ability to achieve satisfactory results. After removal, there shall be no paint residue or pavement scarring that conflicts with successive pavement markings under any viewing conditions - wet or dry, day or night.

Marking tapes and raised markers shall be removed, intact or in large pieces, using manual methods or a mechanical roll-up device. The use of heat, solvents or other chemicals, grinders, or blasters will not be allowed on top-course pavement that is to remain in place without overlaying, or on other pavement surfaces where subsequent temporary traffic patterns are to be placed. After removal, there shall be no resultant damage to or permanent marks or scars on the pavement surface.

Temporary adhesive residues that will eventually be worn from the pavement will be allowed to remain, providing that they are not left in a pattern that will mislead or misdirect motorists. The Engineer will be the sole determiner of misleading temporary marks.

The removal of construction zone pavement markings shall not be required from detours or other areas directed by the Engineer where they do not conflict with permanent markings at the completion of the work. Removal shall be required where it is necessary to transition pavement marking patterns on the detour into permanent markings at the completion of the detour phase.

D. Damage to Pavement Surfaces. Any damage to the finished pavement surface, any permanent marks or scars on the finished pavement surface (including remaining pavement marking material), or any adhesive residues left in a pattern that may mislead or misdirect traffic, that results from the removal of pavement markings shall be removed or repaired as directed by and to the satisfaction of the Engineer at no expense to the State, including complete removal and/or replacement of the damaged pavement section if necessary. The Engineer shall be the sole determiner of satisfactory repair.

619-3.13 Maintenance and Protection of Traffic During Nighttime Operations. In addition to the requirements of basic maintenance and protection of traffic, additional requirements for maintenance and protection of traffic during nighttime operations shall be as follows:

A. Worker Apparel. All contractors' employees involved in nighttime operations shall wear at all times protective helmets and Nighttime Apparel. All Nighttime Apparel shall be closed front and rear and in clean condition to maintain color, visibility, reflectivity, and conspicuity. Truck drivers and equipment operators shall wear Nighttime Apparel when out of an enclosed cab.
§619

B. Vehicle Protection. All vehicles and equipment in the traffic control zone shall be equipped with rotating amber beacons which shall be visible from all directions for a minimum of 300 m during daylight. Beacons shall be mounted in a manner which does not cause glare for the driver or operator.

Vehicles operating or parked on the pavement of a closed roadway or travel lane shall display 4-way flashers or beacons at all times.

Rollers shall display a 50 mm band of reflective tape on the front and rear (60 000 mm² per end minimum).

All trucks shall display a minimum of 60 000 mm² of reflective tape on the rear. Haul trucks shall display a 600 mm by 1200 mm orange reflective sign with the legend “Construction Vehicle - Do Not Follow” in black lettering on the tailgate.

All construction equipment when moving at a speed below the operating speed of traffic in an open travel lane or on a shoulder adjacent to an open travel lane shall be equipped with an amber rotating beacon and shall be followed by a chase vehicle equipped with an amber rotating beacon and 4-way flashers.

Vehicles (except for rollers) shall travel facing in the same direction as adjacent traffic in order to avoid glare and confusion to drivers.

C. Signs, Delineation and Guiding Devices. All signs, delineators and guiding devices for nighttime operations shall be kept clean and visible with good reflectivity.

Type III construction barricades shall be used whenever an entire roadway or ramp is closed to traffic.

Plastic drums or 300 mm by 600 mm vertical panels shall be used for channelizing and delineating lane closures. Oversize (900 mm) cones may be used on tangent runs beyond the completion of the lane closure tapers. Spacing shall be in accordance with the following:

<table>
<thead>
<tr>
<th>Estimated Operating Speed (km/h)</th>
<th>Maximum Spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>6.0</td>
</tr>
<tr>
<td>50</td>
<td>9.0</td>
</tr>
<tr>
<td>≥70</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Delineation at gores or intersections shall be spaced at intervals equal to one-half of the above table values and shall consist of plastic drums or 300 mm by 600 mm vertical panels except that every other device may be an oversize (900 mm) cone at the Contractor's option.

When traffic will be traveling adjacent to closed travel lanes; two plastic drums, two 300 mm by 600 mm vertical panels or two oversize (900 mm) cones shall be placed transversely in each closed lane at 225 m maximum intervals (unless a lesser spacing is shown on the plans) except where it would interfere with paving, rolling or other ongoing operations. A Type III construction barricade may be substituted at the Contractor's option. No additional payment for Type III construction barricades will be made when used for this purpose.

619-3.14 (Vacant)

619-3.15 (Vacant)

619-3.16 (Vacant)

619-3.17 Temporary Rumble Strips. Due to difficulties in patching shallow voids in hot mix asphalt pavement surfaces, saw-cut and milled-in rumble strips shall only be installed in locations where hot mix asphalt pavement will subsequently be overlaid or reconstructed.

A. Raised Asphalt Rumble Strips. The roadway surface on which the rumble strips are to be attached shall be dry, free of surface contaminants such as dust or oil, and thoroughly swept with a stiff broom. The surface temperature of the pavement shall be 8°C or greater unless otherwise authorized by the Engineer. The pavement surface shall be cleaned with compressed air just prior to tack coating and subsequent installation of the rumble strips. The strips shall be formed using a
rumble strip paver (drag box) pulled transversely across the pavement, or by hand placement
between forms fixed to the pavement. If forms are used, they shall be removed prior to compaction of
the asphalt mixture. Compaction shall be accomplished using a plate tamper or a static roller.

**B. Raised, Removable-Tape Rumble Strips.** Raised removable tape rumble strips shall be
formed by applying one or more layers of removable preformed pavement-marking tape. The tape
shall be applied to a clean, dry pavement surface in accordance with the Manufacturer’s
recommendations. The pavement surface shall be swept or cleaned with compressed air just prior to
application of the tape.

**C. Raised, Preformed Rumble Strips.** Raised preformed rumble strips shall be applied to a
clean, dry pavement surface in accordance with the Manufacturer’s recommendations. The pavement
surface shall be swept or cleaned with compressed air just prior to application of the tape.

**D. Saw-cut Rumble Strips.** Saw-cut rumble strips shall be saw cut into existing pavement using
wet cutting methods. The blade or blades shall be of such configuration that the desired dimensions of
the saw cut can be made with one pass. No spacers between blades will be allowed.

Before a work area is reopened to traffic, the pavement shall be cleaned by sweeping, flushing, or
with a stream of compressed air. Sawing slurry from the wet-sawing process shall be flushed from the
pavement surface immediately.

**E. Milled-In Rumble Strips.** Milled-in rumble strips shall be milled into existing pavement using
a rotary-type cutting head with a maximum nominal outside diameter of 600 mm. The cutting head
shall be on its own suspension system, independent from that of the power unit, to allow the head to
align itself with the slope of the pavement and/or any irregularities in the pavement surface. The
pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with no more
than 2 mm between peaks and valleys. Prior to beginning work, the Contractor shall demonstrate to
the Engineer the ability to achieve the desired surface without tearing or snagging the pavement.

Before a work area is reopened to traffic, the pavement shall be cleaned by sweeping, flushing, or
with a stream of compressed air.

**F. Removing Temporary Rumble Strips.** The Contractor shall either completely remove
raised rumble strips from the pavement or fill in the depressions from saw-cut or milled-in rumble
strips prior to the start of the winter plowing season, prior to the placement of successive pavement
courses, or as directed by the Engineer. Any damage to the pavement surface that results from the
removal of raised rumble strips shall be repaired at no additional cost to the State.

Rumble strip depressions shall be filled in with hot mix asphalt. Before they are filled, the
depressions shall be cleaned by sweeping, flushing, or with a stream of compressed air, and coated
with Asphalt Emulsion Tack Coat. The rumble strips shall be overfilled slightly and compacted using
a plate tamper or static roller so that the final compacted surface is flush with the existing pavement.

### 619-4 METHOD OF MEASUREMENT

**619-4.01 Basic Maintenance and Protection of Traffic.** Payment for Basic Maintenance and
Protection of Traffic will be made on a lump sum basis.

**619-4.02 Construction Signs.** Payment for signs will be made on a lump sum basis.

**619-4.03 Temporary Box Beam Barrier, and Temporary Concrete Barriers.** The quantity of
temporary box beam barrier, and temporary concrete barrier shall be computed by the number of meters,
measured to the nearest meter, placed in accordance with the contract documents and/or direction of the
Engineer. Temporary box beam barrier shall be measured in accordance with the requirements of §606-
4.01. Temporary concrete barrier shall be measured along the centerline of the uppermost surface.

Temporary concrete barrier installed at the option of the Contractor, or required solely by a delay in
the Contractor’s operations, shall not be included in the measurement or payment for temporary concrete
barrier.
§619-4.04 **Construction Barricades.** Barricades will be computed for payment by the number of meters measured to the one tenth, along the face of each barricade unit installed. No payment will be made for spaces between individual barricade units. Type III Construction Barricades used at the option of the Contractor in lieu of drums or other channelizing devices shall not be included in the measurement or payment for Type III Construction Barricades.

Whenever barricades are moved to a new location or the diagonal stripes are changed to allow traffic to pass on the other side of the barricade, measurement will be made in the same manner as if it were a new barricade. Minor movements of the barricade from one side of the roadway to the other side, daily replacement to the same location or rearrangement within a work area, not requiring any change in the diagonal stripes, will not be considered as movement to a new location and will not be measured as additional barricades.

§619-4.05 **Lighting for Construction Barricades.** Lighting for construction barricades (powered from electrical power line or self-powered flashers) will be computed for payment by the number of meters of barricade actually lighted. Measurement shall be made to the nearest one-tenth meter along the face of each barricade unit. No payment will be made for spaces between individual barricade units. No separate measurement will be made for the two flashing warning lights used at the beginning of each work zone drop-off, as required by these specifications.

§619-4.06 **Temporary Structures and Approaches.** Temporary structures and their respective approaches will be computed for payment on a unit price basis for each structure including its approaches.

§619-4.07 **Flashing Arrow Board.** When this work is specified to be measured as lump sum, it shall be measured on a lump sum basis, for the Flashing Arrow Boards of the required type satisfactorily furnished, installed, maintained, and removed in accordance with these specifications.

§619-4.08 **Short Term Pavement Markings.** Short Term Pavement Markings will be measured in meters along the center line of the pavement stripe and shall be based on a 100 mm wide stripe.

Measurement for striping with a plan width greater or less than the basic 100 mm, as shown on the plans or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (millimeters)} \times \text{Number of Meters} = \text{Number of Meters (100 millimeters)}
\]

No payment will be made for the length of skips in the dashed line.

If raised marker units are used, reimbursement will be made as if the substituted line were in place. For example, for three raised marker units substituted for a 1200 mm long broken line, reimbursement will be made for 1.2 meters.

§619-4.09 **Temporary Traffic Signals.** Payment for Temporary Traffic Signals will be made on a lump sum basis.

§619-4.10 **Mailboxes.** Mailboxes will be computed for payment on the basis of each mailbox moved or replaced. Where multiple mailboxes are installed on a single post, payment shall be based upon the number of mailboxes so installed.

§619-4.11 **Opening Highway to Traffic Prior to Contract Acceptance.** The additional basic maintenance and protection of traffic required for the highway opened to traffic in accordance with §619-1.09 will be computed by the lane kilometers, measured to the nearest tenth, per calendar day. The lane-kilometer per calendar days to be paid for shall not include the length of temporary connections, length of ramps, or any pavement opened for the convenience of or at the request of the Contractor.

§619-4.12 **Maintain Traffic Signal Equipment.** Maintenance of existing and new traffic signal equipment will be computed for payment on a monthly basis for each signalized intersection being maintained. Payment will be made to the nearest 1/4 month increment.
§619-4.13 Tubular Markers. This work shall be measured as the number of tubular markers furnished and installed to the satisfaction of the Engineer.

§619-4.14 Construction Zone Pavement Markings. Pavement striping will be measured by meter along the centerline of the pavement stripe, and will be based on a 100 mm wide stripe. When raised pavement markers are used to simulate or to supplement a pavement marking, they shall be measured as the number of linear meters of simulated or supplemented pavement stripe (e.g. a 3 meter longitudinal line segment is simulated by four, or more, individual marker units; the pavement striping will be measured as 3 meters, regardless of the number of markers installed).

Measurement for striping with a plan width greater than the basic 100 mm as shown on the plans or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (millimeters) } \times \text{ Number of Meters} \div 100 \text{ (millimeters)}
\]

No measurement will be made for the number of meters of gaps between broken and dotted line segments. All payments for longitudinal lines shall be made on the basis of the theoretical required plan quantity.

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: "SCHOOL" would be measured as six units. Double and triple headed arrows will be measured as a single unit, each "R" in a railroad grade crossing marking will be measured as a single unit, but the "X" in railroad grade crossing markings (MUTCD figure 263-33) will be measured by the number of meters of 100 mm stripe.

When raised pavement markers are used to supplement a pavement marking stripe, the supplemental raised pavement markers will be measured and paid separately from the appropriate pavement marking stripe.

§619-4.15 (Vacant)

§619-4.16 (Vacant)

§619-4.17 Temporary Rumble Strips. The work will be measured for payment as the number of meters of individual rumble strip, measured transverse to the direction of traffic flow, satisfactorily installed.

§619-5 BASIS OF PAYMENT

No payment will be made under Basic Maintenance and Protection of Traffic for each calendar day during which there are substantial deficiencies in compliance with the specification requirements of any subsection of this section, as determined by the Engineer, including but not limited to Basic Maintenance and Protection of Traffic, Construction Signs, Construction Barricades, Barriers, Lighting for Construction Barricades, Temporary Structures and Approaches, Short-Term Pavement Marking, Construction Zone Pavement Markings, Temporary Traffic Signals, Mailboxes, Maintain Traffic Signal Equipment and Opening Highway to Traffic Prior to Contract Acceptance, as well as Temporary Impact Attenuators, Impact Attenuators, Crash Cushions, Crash Terminals found elsewhere in the contract documents.

The amount of such calendar day non-payment will be determined by dividing the lump sum amount bid for Basic Maintenance and Protection of Traffic by the number of calendar days between the date the Contractor commences work and the date of completion as designated in the proposal, without regard to any extension of time.

Liquidated damages will be assessed for each subsequent calendar day or part thereof that a cited deficiency resulting in non-payment is not corrected or is permitted to recur.

If the Contractor fails to adequately conform to the provisions required under Construction Signs, Barriers, Temporary Impact Attenuators, Impact Attenuators, Crash Cushions, Crash Terminals, Construction Barricades, Lighting for Construction Barricades, Temporary Structures and Approaches,
Short-Term Pavement Marking, Construction Zone Pavement Markings, Temporary Traffic Signals, Mailboxes, Maintain Traffic Signal Equipment and Opening Highway to Traffic Prior to Contract Acceptance, to the degree that such failure is deemed by the Engineer to adversely affect the maintenance and protection of traffic, the above liquidated damages will be assessed in addition to any payment deductions from Basic Maintenance and Protection of Traffic for inadequate work as specified herein.

The assessment of liquidated damages will not exceed the above amount per calendar day regardless of the number of violations.

If the Contractor fails to maintain and protect traffic adequately and safely for a period of 24 hours, the Engineer shall correct the adverse conditions by any means deemed appropriate, and shall deduct the cost of the corrective work from any monies due the Contractor. The cost of this work shall be in addition to the liquidated damages and non-payment for Basic Maintenance and Protection of Traffic listed above.

However, where major nonconformance with the requirements of this specification is noted by the Engineer, and prompt Contractor compliance is deemed not to be obtainable, all contract work may be stopped by direct order of the Engineer, regardless of whether corrections are made by the Engineer as stated in the paragraph above.

619-5.01 Basic Maintenance and Protection of Traffic. The lump sum price bid for Basic Maintenance and Protection of Traffic shall include all equipment, materials and labor necessary to adequately and safely maintain and protect traffic, except as provided for in separate payment items in the proposal. However, if the Contractor elects to utilize temporary traffic signals to control traffic in lieu of flaggers, the cost of such signals together with all costs of installation, operation and removal shall be included in the price bid for Basic Maintenance and Protection of Traffic.

The cost of temporarily terminating guide railing, median barrier, or bridge rail during non-work hours shall be included in the lump sum price bid for this item.

In the event the proposal does not include a separate item of payment for Opening Highway to Traffic Prior to Contract Acceptance and the Regional Director directs, in writing, any portion of pavement, structure or ramp to be opened to traffic prior to contract acceptance and on which traffic was not specified to be maintained and protected during construction, the price bid for Basic Maintenance and Protection of Traffic shall include any and all costs for opening said portion or portions to traffic prior to contract acceptance.

In the event the contract completion date is extended, no additional payment will be made for Basic Maintenance and Protection of Traffic.

Progress payments will be made for this item in proportion to the total amount of contract work completed less any deductions for unsatisfactory maintenance and protection of traffic.

619-5.02 Construction Signs. The lump sum price bid shall include the cost of labor, equipment and material, necessary to erect, remove, relocate, protect, maintain, store or replace any construction signs required to properly sign the contract. The lump sum price bid shall also include the cost of repairing or replacing reflectorized signs, when the Engineer determines that the reflective sheeting material no longer meets the specifications.

No payment will be made under Section 619 Basic Maintenance and Protection of Traffic for each calendar day during which there are substantial deficiencies in compliance with the requirements of this specification, as determined by the Engineer. The amount of each calendar day non-payment will be determined by dividing the lump sum bid by the number of calendar days between the date the Contractor commences work and the date of contract completion, as designated in the contract proposal, without regard to any extension of time.

Liquidated damages will be assessed for each calendar day or part thereof that a cited deficiency resulting in non-payment is not corrected or is permitted to recur.

Partial payments will be made. Fifty (50) percent of the lump sum price will be paid when ten (10) percent of the contract work has been completed. The remaining fifty (50) percent will be paid proportionally in accordance with the total contract work completed, beginning with the estimate following the initial payment on this item.

619-5.03 Temporary Box Beam Barrier, and Temporary Concrete Barrier. The unit price bid per meter of temporary box beam barrier, and temporary concrete barrier shall include all material, equipment, and labor necessary to erect, maintain, and remove the required barrier, including any required
connection devices, end treatments, delineation or guiding devices, repair of pavement after removal of box beam barriers, and devices for pinning and connecting temporary precast concrete barrier units. Any movement of temporary box beam barrier or temporary concrete barrier, except movements of the concrete barrier necessary to maintain, realign, or replace damaged units will be considered as a movement to a new location and the Contractor will be entitled to payment for the movement.

After placement, payment will be made for ninety (90) percent of the quantity of temporary box beam barrier, or temporary concrete barrier furnished and erected in accordance with the contract requirements. The remaining ten (10) percent will be paid upon removal. Temporary concrete barrier installed at the option of the Contractor, or required solely by a delay in the Contractor's operations, shall not be included in the measurement or payment for temporary concrete barrier.

619-5.04 Construction Barricades. The unit price bid per meter of barricade shall include all material, equipment and labor necessary to erect, maintain and remove required barricades. Whenever barricades are moved to a new location or the diagonal stripes are changed to allow traffic to pass on the other side of the barricade, payment will be made in the same manner as if it were a new barricade. Minor movements of the barricade from one side of the roadway to the other side, daily replacement to the same location or rearrangement within a work area, not requiring any change in the diagonal stripes, will not be considered as movement to a new location and will not be paid for as additional barricades.

After placement, payment will be made for ninety (90) percent of the quantity of barricade furnished and erected in accordance with the contract requirements. The remaining ten (10) percent will be paid upon removal. Type III Construction Barricades used at the option of the Contractor in lieu of drums or other channelizing devices shall not be included in the measurement or payment for Type III Construction Barricades.

619-5.05 Lighting for Construction Barricades. The unit price bid shall include the cost of furnishing all labor, materials, equipment, and power necessary to provide, maintain, and remove Lighting for Construction Barricades. Should a barricade that is lighted be moved to a new location or the diagonal stripes be changed to allow traffic to pass on the other side of the barricade, payment shall be made in the same manner as if it were a new installation of lighting for barricades. Minor movements of barricades that are lighted, such as a movement from one side of the road to the other side or rearrangements within the same work area not requiring any change in the diagonal stripes, will not be considered as a movement to a new location. This will be true, regardless of the source of power.

After installation and demonstration of satisfactory operation, payment will be made for seventy-five (75) percent of the quantity of barricade lighting furnished and installed in accordance with the contract requirements. The remaining twenty-five (25) percent will be paid for upon removal. No separate payment will be made for the two flashing warning lights used at the beginning of each work zone drop-off, as required by this specification.

619-5.06 Temporary Structures and Approaches. The unit price bid shall include all labor, material and equipment necessary to build, move, remove, dismantle and/or store the structure specified together with all work related to construction, removing and restoring approaches.

Payment will be made at the unit price bid for each temporary structure and its approaches as follows:

Seventy-five (75) percent when the temporary structures and approaches are complete and operable.
Twenty-five (25) percent when the temporary structures and approaches or appurtenances are permanently removed.

619-5.07 Tubular Markers. The unit price bid for tubular markers shall include the cost of furnishing all labor, materials, equipment, and all incidentals necessary to complete the work in accordance with this specification and as directed by the Engineer. The unit price bid shall include the cost of replacing damaged reflective sheeting. The cost to remove and reset tubular markers due to contractor error shall be borne by the Contractor. Removal at the completion of the work or when no longer needed shall also be included in the unit bid price. Tubular markers that are in good condition may be relocated as directed by the Engineer. Whenever tubular markers are moved to a new location, payment will be made as if it were a new tubular marker.
§619

619-5.08 Short-Term Pavement Markings. The unit price bid shall include the cost of furnishing all labor, material and equipment necessary to apply, maintain and remove short-term pavement markings in compliance with the requirements of §619-3.06. A separate payment will be made each time short-term pavement markings are first applied on a pavement course in accordance with the contract requirements. No payment will be made for the application, maintenance and removal of “temporary pavement markings” required after 14 days, or for short-term pavement marking necessitated by the Contractor's failure to place the final pavement marking paint before nightfall.

No payment will be made for the installation of Do Not Pass signs, delineators and plastic drums when necessitated by the Contractor's failure to place short-term pavement markings.

619-5.09 Temporary Traffic Signal. The lump sum price bid for this item shall include the cost of all labor, materials, and equipment necessary to furnish, install, operate, maintain, move, and remove the signals for the required duration of the work. The bid price shall include the cost of electric power necessary to operate the signals until their removal is approved or ordered by the Engineer. Permanent signal control equipment will be paid for under separate contract items.

For the purposes of progress payment, the lump sum bid for the item shall be apportioned equally between the number of signals called for in the plans and proposal. If it becomes evident that a different number of temporary signals will be used, the lump sum bid should be apportioned equally between the revised number of signals and progress payments adjusted accordingly.

Payments will be made on each individual signal as follows:

Sixty (60) percent when the signal is installed and is in proper operation.
Forty (40) percent when all necessary work for this item is completed.

619-5.10 Mailboxes. The unit price for each mailbox shall include all equipment, material and labor necessary to move, maintain or replace rural route mailboxes in their final position or location. Only one payment for each mailbox will be made regardless of the number of times it is moved or replaced and shall be made when the mailbox has been placed in its final location.

619-5.11 Opening Highway to Traffic Prior to Contract Acceptance. Payment will be made for additional basic maintenance and protection of traffic as indicated in §619-1.09. The unit price bid shall include the cost of all materials, equipment and labor to provide the basic maintenance and protection of traffic.

In the event that additional signs, barricades, or other items are required to supplement the work under this item, payment shall be made upon erection as follows:

A. Where contract unit bid items, exclusive of lump sum items, cover the supplementary work ordered, payment will be made at the contract unit bid prices.
B. Where lump sum items, exclusive of the Basic Maintenance and Protection of Traffic item, or no contract unit bid items cover the supplementary work ordered, payment will be made at agreed prices or by force account.

No payment will be made under this item during any period for which the Contractor has been granted an extension of time with engineering charges and/or for which the Contractor has been assessed liquidated damages.

619-5.12 Other Work. The work required for Clearing and Grubbing, Furnishing and Applying Water, and Furnishing and Applying Calcium Chloride for dust control, and for placing bituminous plant mixed material for patching existing pavement, or where specifically ordered by the Engineer or as shown on the plans shall be paid for under their respective pay items. During the winter period when plant mixed bituminous material is unavailable the material used for patching shall be a suitable “winter mix” approved by the Materials Bureau. Payment for the bituminous patching material used, regardless of the type, will be made under the top course roadway paving item.

No payment will be made for any bituminous concrete determined by the Engineer to be necessary as a result of the Contractor's failure to complete paving operations prior to the weather and seasonal limitations, pursuant to §402-3.01. Also, no separate payment will be made for interim pavement markings, applied, maintained, or removed pursuant to §619-3.06 Short Term Pavement Markings.
Whenever any of the above items do not appear in the contract, payment for the work equivalent to such item will be included in the lump sum price bid for Basic Maintenance and Protection of Traffic.

619-5.13 (Vacant).

619-5.14 Maintain Traffic Signal Equipment. The unit bid price per signalized intersection per month shall include the cost of all labor, materials and equipment necessary to perform the work with the exception of inductance loop replacement which will be paid for separately. The cost of the electric power shall be the responsibility of the original maintaining agency. No payment will be made during any period for which the contractor has been granted an extension of time with engineering charges.

619-5.15 Flashing Arrow Board. The lump sum amount bid for this work shall include the cost of all material, equipment, labor, maintenance, and electrical power necessary to complete this work in a manner approved by the Engineer.

Progress payments will be made for this work in proportion to the total amount of contract work completed.

619-5.16 Construction Zone Pavement Markings. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to install, maintain, and remove pavement markings as required by §619-3.12. No payment shall be made under these items for short term pavement markings installed to meet the requirements of §619-3.06. When raised pavement markers are used to supplement a pavement marking stripe, payment shall be made for each item.

The non-payment and Liquidated Damage provisions of §619-5 Basis of Payment - General shall apply to these items of work.

Progress payments will be made. Quantities will be measured for payment when the pavement striping is satisfactorily installed and payment will be 75%. The remaining 25% will be measured for payment following satisfactory removal of the pavement striping.

619-5.17 Temporary Rumble Strips. The unit price bid for temporary rumble strips shall include the cost of all labor, materials and equipment necessary to complete the work. Payment will include the cost of pavement cleaning, hot mix asphalt, or other materials used to form or fill in the rumble strips, and tack coat. Progress payments will be made at the unit price bid for 75 percent of the quantity after installation. The remaining 25 percent will be paid upon removal.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>619.01</td>
<td>Basic Maintenance and Protection of Traffic</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.02</td>
<td>Construction Signs</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.0303</td>
<td>Flashing Arrow Boards</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.0413</td>
<td>Type III Construction Barricades</td>
<td>Meter</td>
</tr>
<tr>
<td>619.0502</td>
<td>Lighting for Construction Barricades</td>
<td>Meter</td>
</tr>
<tr>
<td>619.06*</td>
<td>Temporary Structures and Approaches</td>
<td>Each</td>
</tr>
<tr>
<td>619.10</td>
<td>Mailboxes</td>
<td>Each</td>
</tr>
<tr>
<td>619.1101</td>
<td>Opening Highway to Traffic Prior to Contract Acceptance</td>
<td>Lane Kilometer-Calendar Day</td>
</tr>
<tr>
<td>619.13</td>
<td>Temporary Traffic Signals</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.1611</td>
<td>Maintain Traffic Signal Equipment (Requirement A)</td>
<td>Intersection Month</td>
</tr>
<tr>
<td>619.1612</td>
<td>Maintain Traffic Signal Equipment (Requirement B)</td>
<td>Intersection Month</td>
</tr>
<tr>
<td>619.1613</td>
<td>Maintain Traffic Signal Equipment (Requirement C)</td>
<td>Intersection Month</td>
</tr>
<tr>
<td>619.17</td>
<td>Temporary Concrete Barrier</td>
<td>Meter</td>
</tr>
<tr>
<td>619.18</td>
<td>Temporary Box Beam Barrier</td>
<td>Meter</td>
</tr>
<tr>
<td>619.2001</td>
<td>Tubular Markers White Tape</td>
<td>Each</td>
</tr>
<tr>
<td>619.2101</td>
<td>Construction Zone Pavement Marking Stripes(Optional)</td>
<td>Meters</td>
</tr>
<tr>
<td>619.2102</td>
<td>Construction Zone Pavement Marking Letters(Optional)</td>
<td>Each</td>
</tr>
<tr>
<td>619.2103</td>
<td>Construction Zone Pavement Marking Symbols(Optional)</td>
<td>Each</td>
</tr>
<tr>
<td>619.2104</td>
<td>Construction Zone Pavement Marking Stripes</td>
<td></td>
</tr>
</tbody>
</table>
§ 619

- Removable Tape
- Removable Tape
- Removable Tape
- Removable Tape
- Removable Tape
- Removable Tape

Each
Each
Meters
Meters
Meter

* Refer to the Standard Contract Pay Item Catalog for full Item Number and full description.

SECTION 620 - BANK AND CHANNEL PROTECTION

620-1 DESCRIPTION. This work shall consist of furnishing all plant, labor, equipment, and materials to place a protective covering of erosion-resistant material on embankment slopes, streambanks, at culvert inlets or outlets on bottoms and side slopes of channels, at structure foundations, and at other locations shown on the plans or as directed by the Engineer. The work shall be done in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer.

620-1.01 Stone Filling. Stone filling shall consist of well graded stone placed as protective material on stream-banks, in channels and elsewhere, as required.

620-1.02 Dry Rip-Rap. Dry rip-rap shall consist of stone fitted and placed on streambanks or in channels in order to provide protection against erosion.

620-1.03 Grouted Rip-Rap. Grouted rip-rap shall consist of stone similar to dry rip-rap but with all spaces between the stones filled with cement grout.

620-1.04 Bedding Material. Bedding material shall consist of granular material placed in a layer, where required, on the ground surface prior to placing stone filling or rip-rap. The purpose of the bedding material is to prevent underlying finer materials from passing into and through the stone filling or rip-rap.

620-1.05 Concrete Block Paving. Concrete block paving shall consist of concrete blocks placed on embankment slopes under structures as protection against erosion.

620-1.06 Gabions. Gabions shall consist of open wire mesh baskets, filled with stones.

620-2 MATERIALS

620-2.01 Soundness Approval. The soundness of all material used for stone filling or rip-rap shall be approved on the basis of a geologic evaluation in accordance with the control procedure in effect on the date of advertisement for bids. Prior to the evaluation, the Contractor shall stockpile the material. Where the State elects to conduct soundness tests, stone filling or rip-rap will be rejected if it exceeds 10% loss, by weight, after 10 cycles of the magnesium sulfate soundness test.

620-2.02 Stone Filling. The gradation of materials furnished for use as stone filling shall be as specified in Figure 620-1, and will be accepted or rejected based on a visual examination of the material by the Engineer. Figure 620-2 is incorporated to assist the Engineer and the Contractor to evaluate the gradation of materials considered for use as Stone Filling and Rip-Rap.

620-2.03 Dry Rip-Rap. In addition to meeting the requirements set forth in §620-2.01, dry rip-rap shall consist of stones shaped as nearly as practicable in the form of right rectangular prisms. At least fifty
percent, by weight, of the stones shall weigh in excess of 150 kg each, and the remainder of the stones shall weigh from 50 to 150 kg each. One dimension of each of the stones furnished shall be at least equal to the thickness of the rip-rap as shown on the plans.

The gradation of materials furnished for use as dry rip-rap will be accepted or rejected based on a visual examination of the material by the Engineer.

§620-2.04 Grouted Rip-Rap. The requirements for the stone used for grouted rip-rap shall be the same as stated in §620-2.03.

The grout shall consist of one part cement conforming to the requirements for Portland Cement Type 2, §701-01 and three parts fine aggregate, conforming to the requirements for Concrete Sand in §703-07.

§620-2.05 Bedding Material. Bedding material shall be composed of crushed stone, crushed air-cooled blast furnace slag, or gravel, free of soft, nondurable particles, organic material, and thin or elongated particles. Bedding material shall be stockpiled.

   Bedding material shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percent by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm</td>
<td>100</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>15 to 60</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>0 to 25</td>
</tr>
<tr>
<td>425 µm</td>
<td>0 to 10</td>
</tr>
</tbody>
</table>

The procedure for acceptance or rejection of these materials shall be as described in the appropriate Soil Control Procedure (SCP) Manual.

**FIGURE 620-1 STONE FILLING GRADATION REQUIREMENTS**

<table>
<thead>
<tr>
<th>Stone Filling Item</th>
<th>See Notes</th>
<th>Stone Size 1</th>
<th>Percent of Total by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>2, 3, 4</td>
<td>Smaller than 200 mm</td>
<td>90 - 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Larger than 75 mm</td>
<td>50 - 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smaller than 2.0 mm</td>
<td>0 - 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lighter than 50 kg</td>
<td>90 - 100</td>
</tr>
<tr>
<td>Light</td>
<td>2, 3, 4</td>
<td>Larger than 150 mm</td>
<td>50 - 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smaller than 12 mm</td>
<td>0 - 10</td>
</tr>
<tr>
<td>Medium</td>
<td>2, 4</td>
<td>Heavier than 50 kg</td>
<td>50 - 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smaller than 150 mm</td>
<td>0 - 10</td>
</tr>
<tr>
<td>Heavy</td>
<td>2, 4, 5</td>
<td>Heavier than 300 kg</td>
<td>50 - 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smaller than 150 mm</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Stone sizes, other than weights, refer to the average of the maximum and minimum dimensions of a stone particle as estimated by the engineer.
2. Materials shall contain less than 20 percent of stones with a ratio of maximum to minimum dimension greater than three.
3. Air-cooled blast furnace slag, cobbles or gravel having at least one fractured face per particle are acceptable substitutes for stone under these items, provided that the soundness and gradation requirements are met.
4. Materials shall contain a sufficient amount of stones smaller than the average stone size to fill in the spaces between the larger stones.
5. Heavier gradings of this item may be required on some projects, in which case the requirements will be stated on the plans or in the proposal.
### 620-2.06 Concrete Block Paving

The concrete block shall comply with the requirements for Concrete Block (Slope Paving), §704-04. The block shall have the following nominal dimensions:

<table>
<thead>
<tr>
<th>Specified Masses and Sizes</th>
<th>APPROXIMATE SHAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 kg d = 475 mm</td>
<td></td>
</tr>
<tr>
<td>150 kg d = 400 mm</td>
<td></td>
</tr>
<tr>
<td>75 kg d = 300 mm</td>
<td></td>
</tr>
<tr>
<td>50 kg d = 260 mm</td>
<td></td>
</tr>
<tr>
<td>200 mm 23 kg</td>
<td></td>
</tr>
<tr>
<td>150 mm 9 kg</td>
<td></td>
</tr>
<tr>
<td>d = 600 mm d = 400 mm</td>
<td></td>
</tr>
<tr>
<td>d = 475 mm d = 340 mm</td>
<td></td>
</tr>
<tr>
<td>d = 400 mm d = 340 mm</td>
<td></td>
</tr>
<tr>
<td>d = 400 mm d = 300 mm</td>
<td></td>
</tr>
<tr>
<td>d = 440 mm d = 475 mm</td>
<td></td>
</tr>
<tr>
<td>d = 550 mm d = 475 mm</td>
<td></td>
</tr>
<tr>
<td>d = 600 mm d = 475 mm</td>
<td></td>
</tr>
<tr>
<td>d = 700 mm d = 550 mm</td>
<td></td>
</tr>
<tr>
<td>d = 50 kg d = 200 mm</td>
<td></td>
</tr>
<tr>
<td>d = 340 mm d = 18 kg</td>
<td></td>
</tr>
<tr>
<td>11 kg 45 kg 11 kg</td>
<td></td>
</tr>
<tr>
<td>5 kg 18 kg 5 kg</td>
<td></td>
</tr>
<tr>
<td>3 kg 7 kg 7 kg</td>
<td></td>
</tr>
<tr>
<td>d = 260 mm d = 11 kg</td>
<td></td>
</tr>
<tr>
<td>d = 340 mm d = 45 kg</td>
<td></td>
</tr>
<tr>
<td>d = 400 mm d = 11 kg</td>
<td></td>
</tr>
<tr>
<td>d = 440 mm d = 7 kg</td>
<td></td>
</tr>
<tr>
<td>d = 550 mm d = 7 kg</td>
<td></td>
</tr>
<tr>
<td>d = 50 kg d = 3 kg</td>
<td></td>
</tr>
<tr>
<td>d = 400 mm d = 11 kg</td>
<td></td>
</tr>
<tr>
<td>d = 440 mm d = 5 kg</td>
<td></td>
</tr>
<tr>
<td>d = 550 mm d = 3 kg</td>
<td></td>
</tr>
<tr>
<td>d = 50 kg d = 3 kg</td>
<td></td>
</tr>
</tbody>
</table>

The standard dimensions of the block shall be the specified nominal dimension minus 10 mm. The maximum permissible variation in dimensions of individual units from standard dimensions shall be not more than 3 mm. The size of block used shall be consistent throughout any continuously paved area, and only one nominal length shall be used in any contract. All units shall be sound and free from cracks or other defects that would interfere with the proper placing of the blocks or impair the strength, permanence and appearance of the construction.

Cushion sand for concrete block paving shall conform to the requirements for cushion sand set forth in §703-06. Grout, where used, shall consist of one part Portland Cement Type 2, conforming to the requirements of §701-01, and two parts Mortar Sand, conforming to the requirements of §703-03.

### 620-2.07 Gabions

The materials used in this work shall conform to the requirements of the following subsection of Section 700 - Materials.

Gabions 712-15

### 620-3 CONSTRUCTION DETAILS

#### 620-3.01 General

The ground surface on which bank or channel protection is to be placed shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. All soft or spongy material shall be removed to the depth shown on the plans or as directed by the Engineer and replaced with approved material. Filled areas shall be compacted in accordance with applicable provisions of §203-3.12, Compaction. Protection for structure foundations shall be provided as early as the foundation construction permits. The type of protection shall be placed in accordance with these specifications and the contract documents.

#### 620-3.02 Stone Filling

Stone filling shall be placed in a manner that will produce a reasonable well-graded mass of stone with smaller stone fragments filling the space between the larger ones, so as to result in the minimum practicable percentage of voids. The final section of stone filling shall be in conformance with the lines, grades, and thicknesses shown on the plans. Stone filling used for bank or channel protection shall be placed to its full course thickness in one operation, unless otherwise directed by the Engineer or specified in the special provisions, and in such a manner that the underlying material will not be displaced or worked into the layer of stone filling. Placement of stone upon finished bedding material, when used, shall be carefully controlled to avoid disruption and damage to the layer of bedding.
material. The stone shall be so placed and distributed that there will be no pockets of uniform size material.

The desired distribution of the various sizes of stone throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing; or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to secure the specified results. When stone filling is dumped under water, methods shall be used that will minimize segregation.

620-3.03 Dry Rip-Rap. The stones shall be placed so that the dimension approximately equal to the layer thickness is perpendicular to the slope surface and that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest stones shall be placed at the bottom of the slope. The dry rip-rap shall be properly aligned and placed so as to minimize void spaces between the adjacent stones. The spaces between the stones shall be filled with spalls of suitable size.

620-3.04 Grouted Rip-Rap. The procedure of placing the stones shall be the same as described in §620-3.03, Dry Rip-Rap, except that the space between stones shall be filled with grout rather than spalls. Material upon which the grouted rip-rap is laid shall not be allowed to occupy the space between the stones.

When the stones are in place, the spaces between them shall be completely filled with grout and the surface of the stones cleaned to remove accumulation of grout. Rip-rap shall not be grouted in freezing weather. The grouted rip-rap shall be kept moist for seven days after grouting. A suitable curing compound may be employed, if approved by the Engineer.

The Engineer may direct that occasional spaces be left ungrouted for relief of hydrostatic pressure. The ungrouted spaces shall be chinked with spalls of suitable size.

620-3.05 Bedding Material. Where called for on the plans or directed by the Engineer, stone filling and dry rip-rap shall be placed on bedding material. The bedding material shall be placed on the prepared area to the full specified thickness of each layer in one operation, using methods which will not cause segregation of particle sizes. Contamination of bedding material by natural soils or other materials shall be prevented at all times. Bedding material that becomes contaminated shall be removed and replaced with uncontaminated bedding material at no expense to the State.

620-3.06 Concrete Block Paving. Blocks shall be laid on a 75 mm bed of cushion sand in running bond with the long dimension transverse to the slope and all joints tight. Blocks shall be thoroughly rammed in place to provide a uniformly even surface and solid bedding under each block.

In the areas where grouting is called for, the concrete block shall be laid in running bond with the length parallel to the slope and with 6 mm joints. Following the laying of blocks, in the area to be grouted, sufficient mortar sand shall be spread over the surface and swept into the joints to fill the latter to 100 mm from the surface. The block shall be wetted to the satisfaction of the Engineer before any grout is placed. The joints shall be filled with grout from the bottom flush with the top of the block.

After grouting has been completed and the grout has sufficiently hardened, the blocks shall be wetted, covered and cured with curing covers for the first seven days after grouting. Grout shall not be poured during freezing water.

620-3.07 Gabions. Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 150 mm spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every 100 mm. Empty gabion units shall be set to line and grade as shown on the plans. For structural integrity wire ties or connecting wire shall be used to join the gabions together along the perimeter of all contact surfaces according to the manufacturer's instructions. Internal tie wires shall be uniformly spaced and securely fastened in each outside cell of the structure in accordance with the manufacturer's instructions or where ordered by the Engineer. When gabions are being placed as slope protection the cross-connecting wire may be deleted if order by the Engineer.

A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.
The gabions shall be filled with stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. After a gabion has been filled, the lid shall be bent over until it meets the side and edges. The lid shall then be secured to the sides, ends, and diaphragms with the wire ties or connective wire in the same manner described above for assembling.

**620-4 METHOD OF MEASUREMENT**

**620-4.01 Stone Filling, Dry Rip-Rap, Gabions, Grouted Rip-Rap and Bedding Material.** The quantity to be paid for under each of these items shall be the number of cubic meters computed from the payment lines shown on the plans, or as directed by the Engineer.

**620-4.02 Concrete Block Paving.** The quantity to be paid for under this item shall be the number of square meters computed from the payment lines shown on the plans, or as directed by the Engineer.

**620-5 BASIS OF PAYMENT**

**620-5.01 Stone Filling, Dry Rip-Rap, Gabions, Grouted Rip-Rap and Bedding Material.** The unit price bid per cubic meter for each of these items shall include the costs of furnishing all materials, labor and equipment necessary to satisfactorily complete the work, except that any necessary excavation will be paid for under its appropriate pay item.

**620-5.02 Concrete Block Paving.** The unit price bid per square meter for this item shall include the costs of furnishing all materials, labor and equipment necessary to satisfactorily complete the work, except that any necessary excavation will be paid for under its appropriate pay item.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>620.02</td>
<td>Stone Filling (Fine)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.03</td>
<td>Stone Filling (Light)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.04</td>
<td>Stone Filling (Medium)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.05</td>
<td>Stone Filling (Heavy)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.06</td>
<td>Dry Rip-Rap</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.07</td>
<td>Grouted Rip-Rap</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.08</td>
<td>Bedding Material</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.09</td>
<td>Concrete Block Paving</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.10</td>
<td>Galvanized Gabions</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>620.11</td>
<td>P.V.C. Coated Galvanized Gabions</td>
<td>Cubic Meter</td>
</tr>
</tbody>
</table>

**SECTIONS 621 AND 622 (VACANT)**

**SECTION 623 - SCREENED GRAVEL, CRUSHED GRAVEL, CRUSHED STONE, CRUSHED SLAG**

**623-1 DESCRIPTION.** This work shall consist of furnishing and placing, as shown on the plans or directed by the Engineer, screened gravel, crushed gravel, crushed stone, or crushed slag.

**623-2 MATERIALS.** The materials shall meet the requirements of §703-02, Coarse Aggregates, unless otherwise indicated, and shall be furnished in the sizes or combination of sizes indicated on the plans or ordered by the Engineer.

**623-3 CONSTRUCTION DETAILS.** Screened gravel, crushed gravel, crushed stone or crushed slag shall be placed on the plans or as directed by the Engineer.

**623-4 METHOD OF MEASUREMENT**
§623-4.01 Measurement by Weight. The quantity to be paid for shall be the number of metric tons, loose measure, incorporated into the work conforming to the requirements of these specifications and in accordance with the lines, grades, and cross-sections shown on the plans or as directed by the Engineer.

§623-4.02 In-Place Measure. The quantity to be paid for shall be the number of cubic meters of material placed, measured in the completed work, within the payment lines, as shown on the plans or as ordered by the Engineer.

§623-5 BASIS OF PAYMENT. The unit price bid shall include costs of all labor, material and equipment necessary to properly complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>623.01 M</td>
<td>Screened Gravel (By Weight)</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>623.02 M</td>
<td>Crushed Gravel (By Weight)</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>623.03 M</td>
<td>Crushed Stone (By Weight)</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>623.04 M</td>
<td>Crushed Slag (By Weight)</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>623.10 M</td>
<td>Screened Gravel (In-Place Measure)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>623.11 M</td>
<td>Crushed Gravel (In-Place Measure)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>623.12 M</td>
<td>Crushed Stone (In-Place Measure)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>623.13 M</td>
<td>Crushed Slag (In-Place Measure)</td>
<td>Cubic Meter</td>
</tr>
</tbody>
</table>

SECTION 624 - PAVED GUTTERS

§624-1 DESCRIPTION. This work shall consist of the construction of asphalt concrete, precast, conventionally formed or machine formed Portland Cement concrete, or cobblestone gutters in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

§624-2 MATERIALS

§624-2.01 Asphalt Concrete Gutters. The materials for hot mix asphalt gutters shall meet the requirements specified for a 9.5 mm mixture designed for <0.3 million ESALs using coarse aggregate Type F9.

§624-2.02 Conventionally Formed Concrete Gutters. The materials and manufacture of concrete for this work shall meet the requirements for Class A concrete specified in Section 501 Portland Cement Concrete--General.

§624-2.03 Precast Concrete Gutters. Precast concrete gutters shall comply with the requirements of §714-07, Precast Concrete Gutters.

§624-2.04 Cobble Gutters. Cobble gutters shall be made of rounded “Hardheads,” 150 mm to 255 mm in diameter.

§624-2.05 Machine Formed Concrete Gutter. The material requirements, mix preparation and manufacturing of concrete shall comply with the requirements for Class I concrete, as specified in Section 501 Portland Cement Concrete-General.

§624-3 CONSTRUCTION DETAILS

§624-3.01 Asphalt Concrete Gutters. Except as provided below, the construction requirements shall meet those of §402-3, Construction Details for Hot Mix Asphalt (HMA) Pavements.
A. Preparation of Bed. The location of the gutter shall be properly excavated and graded to conform with the gutter cross-section and line and grade. The excavated area shall be firm and dry before laying the gutter.

B. Placing. The asphalt concrete may be placed by handwork or by a paving machine approved by the Engineer. The gutter shall be uniform in texture, shape and density. The asphalt may be placed in a single layer providing that the section, line and grade after compaction are determined satisfactory by the Engineer.

C. Sealing. After compaction, the finished surface of the gutter shall be sealed by an application of bituminous material, 702-3001, in the quantity and manner directed by the Engineer.

624-3.02 Conventionally Formed or Machine Formed Concrete Gutters. Concrete gutters shall be either conventionally formed or machine formed to the size and shape shown on the standard sheets.

A. Conventionally Formed Gutters.

1. General. Unless otherwise indicated, concrete gutters shall be constructed in 2.4 m sections of the shapes and types shown on the plans and/or standard sheet. A steel separation plate 3 mm thick and cut to fit the section shall be used in each joint and removed as the concrete hardens. or the gutter may be constructed in alternate sections. 24 hours to elapse before the construction of the intermediate sections. Excess concrete shall be screeded off perpendicular to the line of the gutter.

   All construction joints shall be poured full with material meeting the requirements of 702-0700. Miscellaneous Asphalt Cement.

2. Curing. Curing of the gutters shall comply with the requirements of §502-3.11, Curing. Minimum curing periods for the various types of curing materials shall comply with the requirements of Table 502-3. A clear membrane curing compound may be used in lieu of a white-pigmented membrane.

B. Machine Formed Gutter. The machine forming requirements of concrete curb as specified under §609-3.03 shall apply except that contraction joints shall be formed or scored every 2440 mm to depths sufficient to produce weakened planes in the concrete.

624-3.03 Precast Concrete Gutters. The location of the gutter shall be excavated and graded to conform with the gutter cross-section and line and grade. Gutter sections shall be placed to line and grade on a firm and dry subgrade.

   All joints shall be poured full with material meeting the requirements of 702-0700, Asphalt Filler.

624-3.04 Cobble Gutters. The largest stones shall be selected and set along the inner edge and the center of the gutter. All stones shall be embedded in mortar composed of one part Type 1 or 2 cement, §701-01, and two parts of §703-07, Concrete Sand. All stone shall be laid to line and grade, with close joints, by skilled workmen using regular paving tools. The stones shall then be thoroughly rammed in place and brought to a uniform surface.

   The joints shall be made of the same mortar as described above. The mortar shall completely fill the joints after being tamped.

624-4 METHOD OF MEASUREMENT

624-4.01 Asphalt Concrete Gutters. The quantity of asphalt gutters to be paid for will be measured by the number of metric tons of asphalt concrete furnished and placed in accordance with the plans, specifications and requirements of the Engineer. Quality payment adjustments will be measured as outlined in §402-4, Method of Measurement.
624-4.02 Conventionally Formed or Machine Formed Concrete Gutters. The quantity to be paid for under this work will be the number of square meters of exposed surface of concrete gutters placed in accordance with the plans and as specified by the Engineer. No reduction in the number of square meters will be made to account for drainage structure frames and grates, or any other obstruction placed within the gutter section.

624-4.03 Precast Concrete Gutters. The quantity to be paid for under this item will be the number of meters of gutter (laying length) placed in the work in accordance with the plans and specifications.

624-4.04 Cobble Gutters. The quantity of cobble gutters to be paid for under this work will be the number of square meters of exposed surface laid in accordance with the plans or as directed by the Engineer.

624-5 BASIS OF PAYMENT

624-5.01 Asphalt Concrete Gutters. The unit price bid per metric ton of asphalt concrete shall include the cost of furnishing all materials including the asphalt cement, the mixing, transporting, grading, placing, rolling and all equipment and labor necessary to complete the work including all necessary excavation below the finished surface, exclusive of any undercutting or excavation for special bedding materials. Payment of Quality Units will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

624-5.02 Conventionally Formed or Machine Formed Concrete Gutters. The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including all necessary excavation below the finished surface exclusive of any undercutting or excavation for special bedding materials.

624-5.03 Precast Concrete Gutters. The provisions of §624-5.02 shall apply.

624-5.04 Cobble Gutters. The provisions of §624-5.02 shall apply.

Payment will be made under:

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<th>Item No.</th>
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Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

SECTION 625 - SURVEY OPERATIONS, ROW MARKERS, & PERMANENT SURVEY MARKERS

625-1 DESCRIPTION

625-1.01 Project Survey and Stakeout. Under this work the Contractor shall do all necessary surveying required to construct all elements of the project as shown on the plans and specified in the proposal and specifications, and to protect all boundary and survey markers which are either shown on the plans or discovered on the project site. This work shall include but not be limited to stakeout, layout, and
§625

Elevations for the highway, structures, forms, pile layouts and appurtenances as shown and required, consistent with the current practices of the Department, and shall be performed by competently qualified personnel acceptable to the Engineer. This shall also include all work necessary to preserve the location of all existing boundary or right of way and survey markers which should not be in direct conflict with the work to be performed under the contract, as well as all private property monumentation which is in direct conflict with the work to be performed under the contract. Where railroad relocation or alteration is done by force account by the railroad or by the Contractor, all necessary surveying is to be done as part of this work as directed by the Engineer. All survey stake-out shall proceed immediately following the award of the contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. All survey control work shall be done in accordance with the Department’s “Surveying Standards & Procedures Manual”.

625-1.02 Right of Way Markers. Under this work, the Contractor shall locate, furnish, place and certify right-of-way markers at the locations indicated on the plans or where shown on right-of-way maps or where directed by the Engineer, in accordance with the details shown on the appropriate Standard Sheet, these specifications, and the directions of the Engineer. The Contractor shall verify with the Engineer, their use of the most current Right of Way Acquisition Maps to determine the appropriate locations of the proposed markers.

625-1.03 Permanent Survey Markers. Under this work the Contractor shall furnish and place permanent survey markers at locations indicated on the plans or as directed by the Engineer, and in accordance with the details shown on the appropriate standard sheet.

625-2 MATERIALS

625-2.01 Project Survey and Stakeout. All stakes, reinforcing steel, and any other material necessary to perform the work satisfactorily, shall be provided by the Contractor.

All stakes used shall be of a type approved by the Engineer. All reinforcing steel shall be a minimum diameter 16 mm bar, 1 meter length, and Grade 300 or 420. It shall be the Contractor's responsibility to maintain stakes in their proper position and location at all times.

625-2.02 Concrete Right of Way Markers. Concrete right-of-way markers shall conform to the requirements of §712-05, Precast Concrete Right-of-Way Markers.

625-2.03 Steel Pin and Cap Right-of-Way Markers. Reinforcing steel used for the shank shall conform to ASTM A615, Grade 300 or Grade 420. It shall be epoxy coated for its entire length in accordance with the coating application requirements of §705-14 Longitudinal Joint Ties or §709-04 Epoxy Coated Bar Reinforcement, Grade 420.

The cap shall be aluminum or a corrosion resistant aluminum alloy. The cap shall weigh a minimum of fifty grams and fasten to the shank by means of threading or force fitting.

A commercial grade Silicone Sealant shall be used between the cap and the shank. Zinc Chromate Primer, §708-04 shall be applied to all aluminum or aluminum alloy surfaces to be in contact with cement concrete.

Concrete Grouting Material §701-05 shall be used to anchor the Steel Pin and Cap Type Markers into rock.

625-2.04 Permanent Survey Markers. The concrete shall meet the requirements of Class A Concrete in Section 501, Portland Cement Concrete-General, except that the requirements for inspection facilities, automated batching controls and recordation do not apply. The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete. The cap shall be provided by the Contractor as specified by the standard sheet.
625-3 CONSTRUCTION DETAILS

625-3.01 Project Survey and Stakeout. The Contractor shall trim trees, brush and other interfering objects, not inconsistent with the plans, from survey lines in advance of all survey work to permit accurate and unimpeded work by its own stake-out survey crews and the Department's survey crews.

The location and length shown on the plans for pipe and structural plate culverts shall be considered to be approximate. The ordered length of culverts will be determined by the Engineer after the Contractor accurately stakes the proposed culvert in the planned location as approved by the Engineer and after appropriate and necessary engineering study.

The exact position of all work shall be established from survey control points which are shown on the plans and/or modified by the Engineer. Any error, apparent discrepancy or absence in or of data shown or required for accurately accomplishing the stake-out survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall place two offset stakes or references at each center line station and at such intermediate locations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the correct center line station number, offset and cut or fill so as to permit the establishment of the exact centerline location and elevation during construction. If markings become faded or blurred for any reason the markings shall be restored by the Contractor and at the request of the Engineer. The Contractor shall locate and place all cut, fill, slope, fine grade or other stakes and points, as the Engineer may direct for the proper progress of the work. All control points shall be properly guarded and flagged for easy identification.

Drainage structures shall be staked out by the Contractor at the locations and elevations shown on the plans or specified by the Engineer.

The Contractor shall also accurately establish the center line of bearings for bridge abutments and piers, by setting special hubs or reference points as directed by the Engineer, so located and protected to insure their remaining undisturbed until such time as they are no longer needed. The Contractor shall accurately mark the location of anchor bolts to be installed, establish the elevation of bearing surfaces and check bearing plates to insure installation at their exact elevation. Before the erection of structural steel is started the Contractor shall verify by accurate field measurements the locations, both vertically and horizontally, of all bearings and shall assume full responsibility for the fabricated structural steel fitting the substructure as constructed.

All required Rights-of-Way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stake-out survey, and prior to any construction work beginning on the affected properties. Rights of way and easement limits shall only be set, and property lines reset, by or under the direction of a Licensed Land Surveyor or exempt Professional Engineer (as permitted under Section 7209(m) of the NYS Education Law), who is licensed and registered to practice in New York State. The Contractor shall supply proof to the Engineer that such work is being performed by or supervised by a Licensed Land Surveyor or exempt Professional Engineer and all control has been established in accordance with the Department’s “Surveying Standards & Procedures Manual”.

Reference points, base lines, stakes and bench marks for borrow pits shall be established by the Contractor.

The Contractor shall ensure that prior to beginning work, all existing property and survey monuments (including right of way markers) which are adjacent to work areas and may be disturbed during construction shall be properly tied into fixed reference points or located from prime project control, before beginning work in that area. Reference ties (3 or 4 minimum) or field location notes shall be neatly recorded and made available to the Engineer upon request. If any property line and/or survey monuments are disturbed by the Contractor, they shall be reset under this item prior to the conclusion of the contract by either reuse of the original marker or by use of reinforcing steel, as directed by the Engineer. All work connected with tying off monuments and/or resetting them shall be performed by or under the direction of a Professional Land Surveyor or exempt Professional Engineer, who is licensed and registered to practice in New York State.

Information on installed right-of-way markers and permanent survey markers shall be neatly recorded on certification forms provided by the Engineer. The permanent survey marker forms include project information, as-built State Plane Coordinate values, control line and centerline station and offset to marker, distance and direction to adjacent markers, the elevation of the marker, and a sketch which shows the relative positions to the control line points, 3 or 4 physical ties to the markers, and a north arrow. The
right of way marker forms include project information and control line (proposed and as-built) station and offset to the marker. The as-built location of all markers shall be recorded to the nearest millimeter and located from prime project control to a minimum accuracy of one part in twenty thousand. These locations shall be certified by a Professional Land Surveyor or exempt Professional Engineer who is licensed to practice in New York State. The certification forms shall be delivered to the Engineer within 30 calendar days of setting the markers, which then will be forwarded to the Regional Land Surveyor.

The Contractor shall be responsible for the accuracy of the work and shall maintain all reference points, stakes, etc. throughout the life of the contract. Damaged or destroyed points, bench marks or stakes, or any reference points made inaccessible by the progress of the construction shall be replaced or transferred by the Contractor. Any of the above points, which may be destroyed or damaged shall be transferred by the Contractor before they are damaged or destroyed. All control points shall be referenced by ties (3 or 4 minimum) to acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer immediately. All stake-out survey work related to highway control shall be referenced to the center line shown on the plans. All computations necessary to establish the exact position of the work from control points, shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be neatly made available to the Engineer upon request and shall become the property of the State and delivered to the Engineer not later than the date of acceptance of the contract.

The Engineer may check all or any portion of the stake-out survey work or notes made by the Contractor. Any necessary correction to the work shall be made immediately by the Contractor. Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.

Prior to the final cross-section survey of the project by the Engineer, the Contractor shall reestablish center line or base line points and stationing as required by the Engineer.

Prior to the final cross-section survey of any borrow pits by the Engineer, the Contractor shall reestablish base line points and stationing, as well as any necessary bench marks as required by the Engineer.

The Contractor will not be required or permitted to take the preconstruction or final cross-sections that are used for payment purposes.

During the progress of the construction work the Contractor will be required to furnish all of the surveying and stake-out incidental to the proper location by line and grade for each phase of the work. For paving and any other operation requiring extreme accuracy, the Contractor will re-stake with pins or other acceptable hubs located directly adjacent to the work at a spacing directed by the Engineer.

Just prior to completion of the contract, the Contractor shall reestablish if necessary and retie all control points as permanently as possible and to the satisfaction of the Engineer.

625-3.02 Right of Way Markers. The Contractor shall set right-of-way markers at the time the Engineer directs them to be placed. Placement shall be made from a closed traverse within Second-Order, Class II (1 part in 20,000) accuracy, and in accordance with the Department’s “Surveying Standards & Procedures Manual”. The right-of-way markers shall be set at the locations specified by the Engineer and as shown on the appropriate Right of Way Acquisition Maps. This work shall be performed by, or under the direction of, a Professional Land Surveyor or an exempt Professional Engineer who is licensed and registered to practice in New York State. The Licensed Land Surveyor or exempt Professional Engineer shall certify the as-built position of each marker on the appropriate form provided by the Engineer. The scheduling for installation of Right of Way Markers shall be approved by the Engineer prior to their installation.

Right-of-Way markers shall be installed in accordance with the Standard Sheets, these specifications, and in accordance with the directions of the Engineer. If the Steel Pin ROW Marker is used, prior to placing the cap on the bar, the cap shall be filled 2/3 full of silicone sealant and then fastened to the bar by threading or by force fit. During the driving operation for the Steel Pin Right-of-Way Marker, the lettering on the cap shall be protected by the use of a metal sleeve or cushion block. The marker shall be driven so that the cap is flush with the ground surface.

When located in rock, right-of-way markers shall be installed as shown on the Standard Sheet. For Steel Pin Right-of-Way Markers, the surface of the aluminum cap to be in contact with the concrete grout shall be thoroughly coated with §708-04 Zinc Chromate Primer or an alternate material approved by the Materials Bureau.
All right-of-way markers shall be properly guarded and flagged for easy identification during construction. The Contractor shall be responsible for maintaining and protecting right-of-way markers during construction. Any new or existing markers disturbed or damaged prior to contract acceptance shall be replaced by the Contractor at no expense to the State.

625-3.03 Permanent Survey Markers. The markers shall be constructed as shown on the applicable standard sheet and placed where directed by the Engineer. Upon completion of installation, the survey markers shall be located from a closed traverse within Second-Order, Class II (1 part in 20,000) accuracy, which has been established in accordance with the NYSDOT “Surveying Standards & Procedures Manual”. This work shall be performed by, or under the direction of, a Professional Land Surveyor or an exempt Professional Engineer licensed and registered in New York State. The Contractor shall provide the Engineer with completed forms which are certified by a Licensed Land Surveyor or exempt Professional Engineer and which lists the precise as-built location of each survey markers. Certification forms are available from the Engineer. The scheduling for installation of Survey Markers shall be approved by the Engineer prior to their installation. The sequential numbering required on the permanent survey marker caps is to coordinated with the Engineer and the Regional Land Surveyor.

625-4 METHOD OF MEASUREMENT

625-4.01 Project Survey and Stakeout. Payment will be made at the lump sum price bid for this work. Monthly payments will be made under this work in proportion to the amount of work done as determined by the Engineer.

625-4.02 Right of Way Markers. The number of right-of-way markers to be paid for under this work shall be the number placed and certified in accordance with the plans, right-of-way maps, or directions of the Engineer. Payment will be made upon proper installation of the marker, receipt of the certification form by the Engineer, and approval of the certification by the Regional Land Surveyor.

625-4.03 Permanent Survey Markers. The number of permanent survey markers to be paid for under this work shall be the number placed and certified, in accordance with the plans or as directed by the Engineer. Payment will be made upon proper installation of the marker, receipt of the certification form by the Engineer, and approval of the certification by the Regional Land Surveyor.

625-5 BASIS OF PAYMENT

625-5.01 Project Survey and Stakeout. The price bid shall include the cost of furnishing all labor, instruments, materials and equipment necessary to satisfactorily complete the work.

625-5.02 Right of Way Markers. The unit price bid per each shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, except that all survey control necessary for stakeout and certification shall be included under the contract item for Survey and Stakeout.

625-5.03 Permanent Survey Markers. The unit price bid per each shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, except that all survey control necessary for stakeout and certification shall be included under the contract item for Survey and Stakeout.

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<td>Permanent Survey Markers</td>
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SECTION 630 - BARRICADES

630-1 DESCRIPTION. This work shall consist of furnishing and erecting in accordance with the appropriate standard sheet, permanent type barricades for highway or highway-railroad installations at the locations indicated on the plans or as directed by the Engineer.

630-2 MATERIALS. Materials shall meet the requirements of the following subsections of Section 700 - Materials.

<table>
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<th>Section</th>
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<tr>
<td>Galvanized Steel Barrier Posts</td>
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<tr>
<td>Corrugated Beam Guide Railing and Median Barrier</td>
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630-2.01 Barricades (All Permanent Types). Rails shall conform to §710-20 Corrugated Beam Guide Railing and Median Barrier, and to the details indicated on the appropriate standard sheet.

Posts shall be steel W150 x 22 or wood 150 mm x 205 mm (nominal) as indicated in the proposal and in accordance with the details shown on the appropriate standard sheet for Highway Barrier and Highway Railroad Barricade. All metal posts shall conform to §710-14 Galvanized Steel Barrier Posts.

630-3 CONSTRUCTION DETAILS

630-3.01 Barricades (All Permanent Types). Posts shall be set as shown on the plans, the applicable standard sheet, or as directed by the Engineer, and shall be set true to the line and grade and on a firmly tamped base.

Rails shall be erected in such a manner as to produce a smooth appearance, and approximately parallel with the grade of the ground surface. Bolts shall be drawn tight and shall extend 6 mm to 12 mm beyond the nuts unless otherwise permitted by the Engineer.

630-4 METHOD OF MEASUREMENT

630-4.01 Barricades (All Permanent Types). The quantity to be measured for payment under this work will be the number of meters of barricade outside to outside of end posts plus an allowance of 1.2 m for each complete terminal assembly including all rails as specified on the plans.

630-5 BASIS OF PAYMENT

630-5.01 Barricades (All Permanent Types). The unit price bid per meter shall include the cost of all labor, equipment and material necessary to complete the work including inspection and testing information required as well as painting, excavating and backfilling. Any required signs will be paid for separately under the appropriate payment item.

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SECTION 631 (VACANT)

SECTION 632 - CRIBBING

632-1 DESCRIPTION

632-1.01 General. This work shall consist of all the work required for furnishing and placing precast concrete cribbing or metal bin-type retaining walls including all excavation and filling in the manner
specifying the contract documents or by the Engineer. Other types of cribbing not shown on the standard sheets may be furnished and placed, if approved by the DCES.

632-1.02 Definitions. The following general definitions shall be used in conjunction with this section:

- **A. Unit.** Any single piece used to construct precast concrete cribbing or metal bin-type retaining walls. For precast concrete cribbing the work unit shall include but not be limited to, stretchers, headers (both closed and open face), coping, bearing blocks, full sections, half sections, end sections, and leveling footings. For metal bin-type retaining walls the word unit shall include, but not be limited to, stringers, spacers, columns, column caps, stringer stiffeners and base plates.

- **B. Bin.** Any volumetric space which is designated to be filled with backfilling material, as defined in this section, and is enclosed on all four sides by precast concrete cribbing units, or metal bin-type retaining wall units.

- **C. Wall.** A series of units to form bins connected in unbroken sequence so that, when filled with backfill material, they will act as a single entity (i.e., a retaining wall).

632-2 MATERIALS

632-2.01 Unit Materials. Materials shall meet the requirements specified in the following subsections of Section 700 - Materials:

- Precast Concrete Cribbing 704-06
- Premoulded Resilient Joint Filler 705-07
- Metal Bin-Type Retaining Wall 715-11

632-2.02 Backfill. Backfill Material shall conform to the material requirements for either Stone Filling (Fine), as specified in §620-2.01 and 620-2.02, or Select Granular Fill and Select Structure Fill as specified in §203-2.01 and 203-2.02C.

632-3 CONSTRUCTION DETAILS

632-3.01 Precast Concrete Cribbing.

- **A. Excavation.** Excavation shall be conducted in accordance with the applicable requirements of Section 206, Trench, Culvert and Structure Excavation, and the details specified in the contract documents. Prior to erection of the cribbing, the foundation shall be inspected and approved by the Engineer.

- **B. Erection.** All units shall be assembled and handled in accordance with the manufacturer's instructions and the contract documents. In the event of a conflict between the contract documents and the manufacturer's instructions, the Engineer shall decide which course to follow. During erection, any units damaged beyond repair shall be removed and replaced, by the Contractor, with approved units. The Contractor shall use precast leveling footings. Cast-in-place leveling footings will not be permitted.

- **C. Backfill.** Immediately prior to backfilling, the Engineer shall inspect units for damage. Units, which are determined by the Engineer to be damaged beyond repair, shall be rejected. Rejected units shall be replaced by the Contractor. Filling the interior of the bins and behind the walls shall progress simultaneously with the erection of the units and the material shall be placed as specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables.

- **D. Contractor Responsibility.** Movement of construction equipment and all other vehicles and loads over and adjacent to walls shall be done at the Contractor's risk. Any damage to bins and units
§632

from any cause whatsoever shall be repaired or replaced by the Contractor in a manner satisfactory to the Engineer.

632-3.02 Metal Bin-Type Retaining Walls. The provisions specified in §632-3.01, Precast Concrete Cribbing, shall apply with the following additions and modifications:

The ends of all stringers and spacer units shall be bolted to corner columns by means of connecting channels.

In the construction of a wall on a curve, the proper curvature for the face shall be obtained by the use of shorter stringers in the front or rear units of walls as designed on the plans or by the Engineer.

The wall height and depth may be varied, but not to exceed the maximum dimension shown for the design selected. Two or more wall designs may be incorporated in the same wall by the use of standard split columns to make the connections on the step-back.

632-4 METHOD OF MEASUREMENT

632-4.01 Cribbing or Retaining Wall. Cribbing or retaining wall shall be measured by the number of square meters of the front wall face computed between the payment lines shown on the plans or between payment lines established, in writing, by the Engineer.

632-4.02 Excavation and Disposal of Excavated Material for the Installation of Cribbing or Retaining Wall. Excavation and disposal of excavated material shall be measured by the number of cubic meters of material measured in its original position between the payment lines shown on the plans or between payment lines established, in writing, by the Engineer.

632-4.03 Backfill for the Installation of Cribbing or Retaining Wall. Backfill shall be measured by the number of cubic meters of material, computed between the payment lines shown on the plans or between payment lines established in writing by the Engineer. Deductions for the volume of units of precast concrete cribbing will be made. No deduction will be made for the volume of a metal-bin unit.

632-5 BASIS OF PAYMENT

632-5.01 Cribbing or Retaining Wall. The unit price bid shall cover the cost of furnishing all materials, labor, and equipment necessary to complete the work including leveling footings required for precast concrete wall units, and the replacement or repair of any materials damaged by the Contractor's operations.

632-5.02 Excavation and Disposal of Excavated Material for the Installation of Cribbing or Retaining Wall. The unit price bid shall include the cost of all labor, material and equipment necessary to complete the work.

632-5.03 Backfill for the Installation of Cribbing or Retaining Wall. The unit price bid shall include the cost of all materials, labor, and equipment necessary to complete the work. No direct payment will be made for any loss of material which may result from compaction, foundation settlement, erosion, or any other cause; the cost of such losses shall be included in the price bid for this work. The cost of adding water for compaction of backfill shall be included in the price bid unless the item “Applying Water” is included in the proposal.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>632.0101</td>
<td>Concrete Cribbing (Stretcher and Header Type)</td>
<td>Square Meter</td>
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<tr>
<td>632.0102</td>
<td>Concrete Cribbing (Precast Concrete Wall Unit Type)</td>
<td>Square Meter</td>
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<tr>
<td>632.02</td>
<td>Metal Bin-Type Retaining Wall</td>
<td>Square Meter</td>
</tr>
<tr>
<td>632.0501</td>
<td>Excavation for Concrete Cribbing (Stretcher and Header Type)</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>632.0502</td>
<td>Excavation for Concrete Cribbing (Precast Concrete Wall Unit Type)</td>
<td>Cubic Meter</td>
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<td>632.0503</td>
<td>Excavation for Metal Bin-Type Retaining Wall</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>632.0601</td>
<td>Backfill for Concrete Cribbing (Stretcher and Header Type)</td>
<td>Cubic Meter</td>
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SECTION 633 - CONDITIONING EXISTING PAVEMENT PRIOR TO HOT MIX ASPHALT (HMA) OVERLAY

633-1 DESCRIPTION. Cleaning, sealing, and filling joints and cracks in the existing pavement, removal and repair of deteriorated pavement sections, stress-relieving pavement repairs, and cleaning the existing pavement and shoulders prior to the application of a new HMA course.

633-2 MATERIALS. Use materials conforming to the requirements of the specifications listed below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
<td>Hot Mix Asphalt True &amp; Leveling</td>
<td>401 and 402</td>
</tr>
<tr>
<td>Hot Mix Asphalt Shim</td>
<td>401</td>
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<tr>
<td>Asphalt Filler</td>
<td>702-0700 (Table 702-2, Miscellaneous Asphalt Cements)</td>
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<tr>
<td>Asphalt Emulsions</td>
<td>Tables 702-5 and 702-6</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>703-01</td>
</tr>
</tbody>
</table>

633-3 CONSTRUCTION DETAILS

633-3.01 Cleaning Existing Pavement and/or Shoulders. Clean existing pavement and shoulder surfaces to be overlaid, including ruts and depressions, by the use of mechanical sweepers, hand brooms, or other means until the surfaces are free of all material which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be approved by the Engineer prior to use.

Remove all debris from the pavement and shoulders surfaces and dispose of in an appropriate manner. Keep the pavement and shoulders clean until the overlay operations are completed. Cleaning of shoulders is required only when the shoulder surface is constructed of Portland Cement Concrete (PCC), Hot Mix Asphalt (HMA) or a surface treatment thereon.

633-3.02 Cleaning, Sealing and/or Filling Joints and Cracks. If the existing pavement requires stress relieving repairs, complete these repairs in accordance with §633-3.05, Stress Relieving Pavement Repairs, prior to joint and crack repair work.

Use a compressed air stream of at least 550 kPa measured at the source, to clean all unsealed and inadequately sealed joints and cracks. Clean all joints and cracks in the pavement of all dirt and loose material to a depth equal to a minimum of twice the crack or joint width, by holding the cleaning jet 25 mm above the pavement surface. Old joint and crack sealer remaining after such cleaning operation need not be removed. Keep the joint and cracks clean until the sealing, filling, and paving operations are completed.

Joints and cracks less than 6 mm are not required to be cleaned or sealed. Seal joints and cracks in the existing pavement from 6 mm to 25 mm wide with an asphalt filler. To ensure that space will be available for expansion of the asphalt filler when the HMA is paved over the joint or crack, do not fill the joint or crack completely to the surface. Blot with fine aggregate, if required, to prevent tracking the bituminous material over the pavement surface.

Fill joints and cracks greater than 25 mm wide with HMA Shim or an approved cold, plant-mixed stockpile patching material.

633-3.03 Removal and Repair of Deteriorated HMA Pavement Sections. Remove and dispose of deteriorated HMA pavements to sound material, such that all excavated sides are vertical. Use a chipping hammer meeting the requirements of §580-3.02, Removal of Structural Concrete, a milling machine equipped with a means to suppress airborne particles, or by other appropriate means. If a chipping hammer is used, first sawcut the pavement around the perimeter of the designated repair area to the anticipated repair depth.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas.
only when the ambient temperature is 7°C or greater. The minimum HMA placement temperature shall be 120°C.

If the total depth of the patch is greater than 75 mm, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 75 mm. When placing HMA in multiple lifts, thoroughly compact the lower lifts with a mechanical tamper. For the top lift, thoroughly compact with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 6 mm above the existing surface.

633-3.04 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections.
Remove loose, broken, or spalled PCC pavements to sound material, but not exceeding a depth of 75 mm. Use a chipping hammer meeting the requirements of §580-3.02, Removal of Structural Concrete, a milling machine equipped with a means to suppress airborne particles, or by other appropriate means. If a chipping hammer is used, first sawcut the pavement around the perimeter of the designated repair area to the anticipated repair depth not to exceed 75 mm. Dispose of all the removed PCC material in an appropriate manner.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas only when the ambient temperature is 7°C or greater. The minimum HMA placement temperature shall be 120°C.

If the total depth of the patch is greater than 75 mm, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 75 mm. When placing HMA in multiple lifts, thoroughly compact the lower lifts with a mechanical tamper. For the top lift, thoroughly compact with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 6 mm above the existing surface.

633-3.05 Stress Relieving Pavement Repairs. Unless indicated otherwise in the contract documents, the pressure relief joint shall be a minimum of 5.0 meters longitudinally and the full width of the pavement, including the curb, and gutter, if any. If an existing transverse joint is within the pressure relief joint repair, remove the existing transverse joint by a minimum of 300 mm. Saw cut the transverse lines of the designated repair area full depth to produce a neat cut. Remove the PCC pavements with minimum disturbance to the subbase. Dispose of all the removed PCC material in an appropriate manner.

Level and recompact the subbase, prior to the placement of the HMA.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas only when the ambient temperature is 7°C or greater. The minimum HMA placement temperature shall be 120°C.

Compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 75 mm. Thoroughly compact each lift with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 6 mm above the existing surface.

633-4 METHOD OF MEASUREMENT

633-4.01 Cleaning Existing Pavement and/or Shoulders. The quantity measured will be the number of square meters of existing pavement and/or shoulder surfaces cleaned.

633-4.02 Cleaning, Sealing, and/or Filling Cracks. The quantity measured will be on a lump-sum basis for work satisfactorily completed.

633-4.03 Cleaning, Sealing, and/or Filling Joints. The quantity measured will be on a linear meter basis for work satisfactorily completed.

633-4.04 Removal and Repair of Deteriorated HMA Pavement Sections. The quantity measured will be the number of square meters of existing pavement surface removed and repaired.
633-4.05 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections. The quantity measured will be the number of square meters of existing pavement surface removed and repaired.

633-4.06 Stress Relieving Pavement Repairs. The quantity measured will be the number of square meters of existing pavement surface removed and repaired.

633-5 BASIS OF PAYMENT

633-5.01 Cleaning Existing Pavement and/or Shoulders. The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

633-5.02 Cleaning, Sealing, and/or Filling Cracks. The lump sum price bid for this item shall include the cost of all labor, materials, and equipment necessary to complete the work.

633-5.03 Cleaning, Sealing and/or Filling Joints. The unit price bid for this item shall include the cost of all labor, materials, and equipment necessary to complete the work.

633-5.04 Removal and Repair of Deteriorated HMA Pavement Sections. The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

633-5.05 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections. The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

633-5.06 Stress Relieving Pavement Repairs. The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>633.11</td>
<td>Cleaning Existing Pavement and/or Shoulder</td>
<td>Square Meter</td>
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<tr>
<td>633.12</td>
<td>Cleaning, Sealing and/or Filling Cracks</td>
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<tr>
<td>633.13</td>
<td>Cleaning, Sealing and/or Filling Joints</td>
<td>Linear Meter</td>
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<tr>
<td>633.14</td>
<td>Removal and Repair of Deteriorated HMA Pavement</td>
<td>Square Meter</td>
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<td>633.15</td>
<td>Removal and Repair of Loose, Broken, or Spalled PCC Pavement</td>
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<tr>
<td>633.16</td>
<td>Stress Relieving Pavement Repairs</td>
<td>Square Meter</td>
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SECTION 634 (VACANT)

SECTION 635 - CLEANING AND PREPARATION OF PAVEMENT SURFACES FOR PAVEMENT MARKINGS

635-1 DESCRIPTION. This work shall consist of cleaning and preparing portland cement and bituminous pavement surfaces for the application of reflectorized pavement marking materials. Examples of pavement markings requiring this item include, but are not limited to, reflectorized thermoplastic, preformed, and epoxy type marking materials.

635-2 MATERIALS. Materials and equipment for cleaning and preparing pavement surfaces may be selected by the Contractor, except that they will be approved by the Engineer and shall conform to all applicable Local, State or Federal law, regulation or codes.

635-3 CONSTRUCTION DETAILS

635-3.01 General. The work required to clean and prepare pavement surfaces shall be performed in accordance with these specifications, the contract documents and to the satisfaction of the Engineer.
Before any work is begun, a schedule of operations shall be submitted for the approval of the Engineer. When the work is conducted under traffic, the Contractor shall supply all necessary flags, markers, signs, and other devices to maintain and protect traffic.

Whenever grinding, waterblasting, dry sandblasting or other operations are performed, the work shall be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist. When these operations are completed the pavement surface shall first be power broomed and then blown off with compressed air to remove residue and debris resulting from the cleaning work. All such debris that remains on the roadway, including broken parts from cleaning equipment, shall be removed and disposed of in a manner satisfactory to the Engineer.

The Contractor shall conduct removal and cleaning work in such a manner as to minimize airborne dust, and similar debris so as to prevent a hazard to motor vehicle operation or nuisance to property.

Care shall be taken on bituminous and portland cement concrete surfaces when performing removal and cleaning work to prevent damage to transverse and longitudinal joint sealers.

Unless otherwise specified in the contract documents the area(s) and quantity of cleaning work will be determined by the Engineer at the job site when the contract is in progress. In addition the Engineer will have the authority of increasing the work area as the project continues.

635-3.02 Limits of Work. Cleaning and surface preparation work shall be confined to the surface area specified for the application of pavement marking materials; or the surface area of existing pavement markings that are specified for removal on the plans, or as directed by the Engineer.

Surface preparation work includes cleaning for lines or cleaning for letters and symbols. Lines will be meant to include: broken line; dotted line; channelizing line; barrier lines; stop lines; crosswalk line and crossbars.

When lines are cleaned, the area of preparation will be the width of the new pavement marking, or existing line, plus twenty five (25) millimeter on each side. When letters and symbols are cleaned the area of preparation will be sufficiently large to accommodate the new marking, or to remove the existing marking.

635-3.03 Cleaning Concrete Curing Compounds. On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed.

The extent of the blasting work shall be to clean and prepare the concrete surface such that:

A. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
B. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
C. All remaining curing compound is intact; all loose and flaking material is removed.
D. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

635-3.04 Cleaning Existing Pavement Markings. Existing pavement markings shall be cleaned for the purpose of:

A. Preparing the pavement surface for the application of new pavement markings in the same location as the existing markings.
B. To remove existing markings that are in good condition which, if allowed to remain, will interfere with or otherwise conflict with newly applied marking patterns.

It shall be understood that in this context cleaning means the removal of an existing marking. It is not intended that all deteriorated existing pavement markings be removed. Example: If a new marking is applied to an unmarked “gap” in a broken line and the existing broken line pattern is worn or deteriorated, as determined by the Engineer, to the extent that it is not misleading or confusing to the motorist, the existing markings do not require removal.
Pavement markings shall be cleaned to the extent that 95% to 100% of the existing marking is removed. Removal operations shall be conducted in such a manner that no more than moderate color and/or surface texture change results on the surrounding pavement surface. When waterblasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed. Waterblasting shall not be allowed for cleaning markings requiring replacement within the same day as removal as specified under §635-3.05.

The determination of acceptable removal will be made by judgement of the Engineer and will be guided by the Department's pictorial standards of acceptable marking removal. Pictorial standards are available from the Materials Bureau.

§635-3.05 Replacement of Pavement Markings. The Contractor shall not remove existing pavement markings and leave the highway unmarked overnight.

If traffic is to be maintained overnight on highways where the existing markings have been removed either the permanent type marking(s) as called for in the contract documents, or short-term pavement markings, shall be applied before the end of the working day for the following conditions.

1. Yellow broken lines, partial barrier lines and full lines used to separate opposing traffic flows on two-way roadways.
2. White broken lane lines to separate traffic flows in the same direction on multi-lane highways.

In the event of sudden, unforeseen precipitation or other extraordinary situations, Do Not Pass signs shall be used on two or three lane, two-way roadways, in accordance with §619-3.06 Short-Term Pavement Markings.

All other pavement marking patterns on both two way and multi-lane highways shall be applied within 14 calendar days using the project's permanent markings.

The Contractor may apply the permanent white and yellow broken line in the gaps between the existing broken line, before the existing broken line is removed, when the Engineer determines that the existing broken line will not be misleading to traffic.

If short-term pavement markings are placed, they shall be applied and conform to the requirements of §619-3.06. Short-term Pavement Markings will be considered acceptable for periods not longer than fourteen (14) days.

If within 14 days after removal the Contractor fails to install the project's permanent pavement markings, temporary pavement markings shall be applied and maintained in accordance with §619-3.06 Short-Term Pavement Markings.

All short-term and temporary pavement markings shall be cleaned from the pavement in accordance with this specification, at the time that the project's permanent markings are installed, or as directed by the Engineer. Signs shall be removed as ordered by the Engineer.

The work of furnishing, applying, maintaining and cleaning short-term and temporary markings shall be performed by the Contractor at no additional expense to the State.

§635-4 METHOD OF MEASUREMENT. Surface cleaning and preparation of pavement surfaces for lines will be measured in meters along the centerline of the prepared surface and will be based on a nominal 100 mm wide line. Measurement for cleaning surfaces for line widths greater than the nominal 100 mm will be made by the following method:

Nominal Existing Width of Line (millimeters) x Length (meters) / 100 (millimeters)

No payment will be made for the additional 25 mm of cleaning on each side of the line required by §635-3.02.

No payment will be made for cleaning the number of meters of unmarked gaps between broken or dotted line segments.

Cleaning and preparation of letters and symbols on pavement surfaces will be measured by each unit cleaned. A unit will consist of one letter or one symbol. Example: “STOP” would be measured as four units.
The Engineer will adjust the quantities of these items as required to meet field conditions. This may result in substantial increases or decreases of the proposal quantities.

§635-5 BASIS OF PAYMENT. The accepted quantities of cleaned pavement surface will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost of maintaining and protecting traffic during the cleaning work will be included in the price bid. No payment will be made under this item for the removal of pavement markings required under §635-3.05.

Payment will be made under:

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<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
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<tr>
<td>635.0203</td>
<td>Cleaning and Preparation of Pavement Surfaces-Letters</td>
<td>Each</td>
</tr>
<tr>
<td>635.0303</td>
<td>Cleaning and Preparation of Pavement Surfaces-Symbols</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 636 (VACANT)

SECTION 637 - ENGINEER'S OFFICE AND LABORATORY BUILDING

637-1 DESCRIPTION. This work shall consist of providing, furnishing and maintaining an Engineer's Office and a Field Laboratory Building for the exclusive use of and occupancy by the Department and Consultant field engineers. It shall be the responsibility of the Contractor to install and maintain the Engineer's Office in compliance with all applicable building, safety, and health regulations and/or laws. The Contractor shall maintain all facilities and furnished equipment in good working condition. The office shall be cleaned weekly, or as required by the Engineer.

637-1.01 Engineer's Office (Type A, B, C, D or E). The Contractor shall supply for the Engineer's use a building or mobile trailer, (specified at Type A, B, C, D or E), which shall be erected at a location selected by the Engineer and shall be separate from any building used by the Contractor.

637-1.02 Laboratory Building. The Contractor shall supply mobile building(s) or trailer(s) for use as field laboratories for soils and materials testing. As work progresses on the contract, the laboratory shall be moved by the Contractor to follow the work, at such times and to the locations approved or designated by the Engineer.

637-1.03 Furnishing Existing Facilities and Buildings. The Contractor may furnish equivalent facilities in existing buildings provided such facilities and building(s) are located to provide convenient service and provided that the building location(s) and facilities are approved by the Regional Director in writing.

637-1.04 Concrete Cylinder Curing Box. This work shall consist of furnishing, prior to placement of any structural concrete, an approved concrete cylinder curing box.

637-1.05 CHAMP® Management System. This work consists of software purchase and training of Contractor personnel in the use of the CHAMP® software. CHAMP® is specifically designed to monitor conformity with Federal and State Disadvantaged/Minority/Women's Business Enterprise (D/M/WBE), Equal Employment Opportunity (EEO), and training laws, rules and regulations.

637-2 MATERIALS

637-2.01 General Construction. Each Engineer's Office or Field Laboratory shall be an approved and weatherproof building or mobile trailer of the type specified in the contract documents. The structure shall have a minimum ceiling height of 2.13 meters and shall be provided with weatherproof windows and weatherproof doors each equipped with adequate locking devices. Each window shall have a minimum area of 0.75 square meters, shall be screened and of a type that will open and close to provide adequate ventilation.
637-2.02 General Requirements for all Engineer's Offices.

A. Lighting. Electric light, non-glare type luminaires to provide a minimum illumination level of 1000 lux at desk height level.

B. Heating and Cooling. Adequate equipment to maintain an ambient air temperature of 21°C ± 3°.

C. 35mm Camera. Autofocus operation with “red-eye reduction” and “easy film loading” features. A soft storage/carry case shall be provided. The camera functions shall include the following.

- Automatic and motorized film advance and rewind
- Automatic adjustment for DX coded films
- Film speeds ISO 100 through 400
- Built in flash with automatic sensor
- Date stamp on each picture

The supply of batteries shall be replenished by the Contractor as required by the Engineer. Film and film processing will be the responsibility of the State.

D. Typewriter with stand. A standard electric office size with pica type and a stand with casters.

E. Telephone. A separate phone for the exclusive use of Department and Consultant personnel. The phone shall have modular jacks at the wall and phone and be adaptable to electronic communications. An extension telephone, of a type and location as required by the Engineer, with a minimum 7 meter cord shall also be provided. The number of telephones, each with an extension, to be provided is specified for each type of office.

F. Potable Water. From a local municipal water line and/or bottled water with refrigerator unit - hot/cold water.

G. Adding Machine. Tape type registering to at least ten digits, four function. The number of adding machines to be provided is specified for each type of office.

H. First Aid Kit. The Contractor shall keep the kit properly stocked with appropriate first aid supplies at all times.

I. Toilet. A separately enclosed room, properly ventilated and complying with applicable sanitary codes. The Contractor shall provide all lavatory amenities, necessary paper and soap products, hot and cold running water and a flush-type toilet. Any other toilet will not be acceptable unless as ordered by the Engineer (A.O.B.E.).

J. Locker. A metal or wood locker, with lock, of sufficient size for storage of surveying instruments and testing equipment.

K. Refrigerator. A standard electric cold storage type providing a minimum storage space of approximately 0.09 m^3.

L. Fire Extinguisher. Non-toxic dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B and Class C fires with a minimum rating of 2A: 10B: 10C. 1 per room.

M. Fire Resistant Cabinet. Fire resistant, 4 drawer, legal size file cabinet with lock and 2 keys, meeting the requirements for “Insulating Filing Devices, Class 350-1 Hour (D)” of ANSI/UL 72 or the Class D rating of the original Underwriters Laboratories specification for insulated filing devices. The number of cabinets to be provided is specified for each type of office.
N. Thermometer. A minimum -- maximum celsius thermometer.


P. Photocopying Machine. Desk top, heavy duty, electric, dry process photocopying machine. The machine shall be capable of copying 216 mm x 279 mm, 216 mm x 355 mm, 279 mm x 432 mm sheets. An adequate supply of 75 gram per square meter copy paper in the three (3) sizes shall be provided. The supply of copy paper shall be replenished by the Contractor as required by the Engineer.

Q. Signs/Bulletin Board. The Contractor shall furnish and install necessary signs to locate and identify the Project Engineers Office. The sign shall be installed at the location or locations directed by the Engineer. The panel material may be of any material permitted under §619-2.02, Construction Signs. The panel shall be 900 mm high by 1200 mm wide with white legend on green background with the phrases as positioned and described below.

The letters in the phrase “FIELD OFFICE” shall be 150 mm C series with the top of the letters 150 mm below the top of the panel. The letters in the phrase “PROJECT ENGINEER” shall be 150 mm B series with the top of the letters 450 below the top of the panel. The letters in the phrase “N.Y.S. DEPT. OF TRANSPORTATION” shall be 38 mm E series with the top of the letters 750 mm below the top of the panel. All phrases shall be centered horizontally on the panel.

If erected at a location where the sign might be struck by passing traffic, as determined by the Engineer, the sign support shall be a breakaway type. Payment for the sign and its supports shall be included in the price for the Engineer's Office.

The Contractor shall also furnish and install a 1.2 m x 2.4 m weatherproof Bulletin Board in front of or adjacent to the Project Engineers Office. This Board may also be attached to the Office on an outside wall which is easily accessible and clearly visible.

R. Stove. The Contractor shall furnish an electric, propane or bottle gas stove adequate for rapid drying of soil samples, including all necessary fuel or electrical supply and all maintenance necessary for continued operation. Size of the stove shall be approved by the Engineer. Stove will be necessary when excavation, embankment, and/or culverts and storm drains are included in a project and a laboratory building is not included.

S. Tack Board. Cork Tack Boards (0.6 m x 1.2 m) mounted on a wall of each room.

T. Bookcase. A self-standing 3 shelf metal bookcase. 1 per room. (Approximate size 1.2 m high, 1.2 m wide, 0.3 m deep.)


V. Parking Area. The Contractor shall provide/furnish a paved or hard surfaced (gravel or bankrun material) parking area adjacent to the building where the Engineers Office is located. The number of spaces to be provided is specified for each type of office. Each space shall measure 2.75m by 5.50m.

W. Mailbox. Standard mailbox (with post if necessary) or post office box shall be provided.

X. Coat Rack. A metal or wooden coat rack capable of holding at least 4 coats. 1 per room.

Y. Telephone Answering Device. A FCC approved automatic answering device capable of recording outgoing messages of 60 second duration and receiving a minimum of 40 incoming messages of 60 seconds duration. The unit shall include a message mark so you can hear new messages without erasing old messages. The unit shall include remote programming of playback, backspace, and outgoing message re-record. The unit shall include computer generated voice marking of time and day of each message received. The unit shall allow for the retrieval of messages without a remote beeper unit or shall include a number of remote control units as ordered by the Engineer (A.O.B.E.).
Z. Telephone FAX Machine, with a dedicated telephone line (in addition to the telephone line(s) specified in Table 637-1 and meeting the following requirements:

<table>
<thead>
<tr>
<th>DOCUMENT SIZE</th>
<th>216 mm X 279 mm both transmit and receive with transmit speed less than 20 seconds per page</th>
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</thead>
<tbody>
<tr>
<td>COMPATIBILITY</td>
<td>Group G3</td>
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<tr>
<td>RESOLUTION</td>
<td>Standard, with 16-Shade Gray Scale</td>
</tr>
<tr>
<td>RECEIVING</td>
<td>Automatic</td>
</tr>
<tr>
<td>DOC FEEDER</td>
<td>Automatic 5 Sheets</td>
</tr>
<tr>
<td>AUTO DIALER</td>
<td>10 Phone Number Memory with automatic redial and on-hook dialing</td>
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<td>TRANSMIT TERMINAL</td>
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</tr>
<tr>
<td>IDENTIFICATION</td>
<td>Page number, Sender's Phone Number and Name</td>
</tr>
<tr>
<td>OUTPUT DOCUMENT SEPARATOR</td>
<td></td>
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</tbody>
</table>

An adequate supply of fax paper shall be provided. The supply of fax paper shall be replenished by the Contractor as required by the Engineer.

637-2.03 General Requirements for Engineer's Offices, Types B, C, D and E only (Not Type A)

1. Freestanding Microcomputer System Workstation with a 1.50 m long by 0.75 m wide work surface and height of 0.70 m. The workstation shall include an adjustable shelf approximately 0.30 m wide and no less than 0.75 m long. This workstation shall be fully assembled.
2. Ergonomic Microcomputer Workstation Chair w/arms, five (5) legs w/casters and adjustable from approximately 0.4 m to 0.6 m height by pneumatic gas cylinder. This chair shall be fully assembled.
3. Antistatic Tabletop Mat for the Microcomputer System Workstation with an approximate size of 0.75 m long by 0.60 m wide.
4. Ergonomic and height adjustable “wrist rest” keyboarding support
5. Calculator. The device shall be capable of executing normal engineering/surveying calculations and have sufficient memory to accept and execute programs of at least 200 lines or steps. The device shall also be capable of printing the results of calculations and programs, storing programs resident in the device on a magnetic medium for later use, and accepting preprogrammed software. The Contractor shall supply the preprogrammed software capable of performing normal surveying computations and the printing paper. The supply of printing paper shall be replenished by the Contractor as required by the Engineer. Instruction manuals for the calculator and software shall also be provided.

637-2.04 Specific Requirements for all Engineer's Offices (Type A, B, C, D, and E).

A. Engineer's Office Type A. In addition to the general requirements, Type A shall provide a minimum of 18 square meters of floor space with one outside door and four windows. The office shall be partitioned to provide two rooms with an adjoining door. The smaller room shall not be less than 6 square meters in floor area and shall contain at least one of the four windows. The furnishings shall be as indicated in Table 637-1 of this Section.

B. Engineer's Office Type B. In addition to the general requirements, Type B office shall provide a minimum 30 square meters of floor space with two outside doors and six windows. The office shall be partitioned to provide two rooms with an adjoining door. The smaller room shall be not less than 9 square meters in floor area and shall contain two of the six windows. The furnishings shall be as indicated in Table 637-1 of this Section.

C. Engineer's Office Type C. In addition to the general requirements, Type C office shall provide a minimum 42 square meters of floor space with two outside doors and six windows. The office shall be partitioned to provide three rooms with adjoining doors. The smaller rooms shall be
not less than 9 square meters in floor area and shall contain two of the six windows. The furnishings shall be as indicated in Table 637-1 of this Section.

D. Engineer’s Office Type D. In addition to the general requirements, Type D office shall provide a minimum of 66 square meters of floor space and shall be partitioned to provide four rooms: three small rooms and one large room with adjoining doors. The smaller rooms shall be not less than 9 square meters in area, and shall each contain two windows. Two outside doors and at least eight windows will be the total required. The furnishings shall be as indicated in Table 637-1 of this Section.

If two mobile trailer units are provided, they shall be joined in parallel fashion and shall have two weatherproof doorways or archways between units A.O.B.E. A minimum of two (2) outside doors shall still be required, and arranged so as to facilitate emergency access.

| Table 637-1 Specific Requirements for Offices |
|---------------------------------------------|---|---|---|---|---|
| Office Type                                | A | B | C | D | E |
| Office Desks not less than 0.75 m X 1.5 m  | 1 | 3 | 4 | 7 | 8 |
| each with Drawers and Locks               |  |   |   |   |   |
| Office Chairs                             | 4 | 6 | 8 | 16| 18 |
| Fire Resistant Cabinet, 4-Drawer as specified in §637-2.02M | 1 | 2 | 3 | 4 | 6 |
| Drafting-type Tables, approximately 0.9 m by 1.8 m and supported by brackets and legs | 1 | 2 | 2 | 3 | 4 |
| Drafting stools                           | 2 | 4 | 4 | 6 | 8 |
| Vertical filing plan rack for 6 sets of plans each | 1 | 0 | 0 | 0 | 0 |
| Vertical filing plan rack for 12 sets of plans each | 0 | 1 | 1 | 2 | 3 |
| Roll File Unit each with twelve 0.15 m X 0.15 m compartments for twelve cross-section rolls each 0.60 meters long | 0 | 1 | 1 | 1 | 2 |
| Office table, not less than 0.9 m X 1.8 m each | 1 | 1 | 2 | 3 | 4 |
| Metal storage cabinet with four adjustable shelves, tumbler lock and two keys (approx. size 1.80 m high, 0.90 m wide, 0.45 m deep) | 0 | 1 | 1 | 1 | 2 |
| Adding Machine as specified in §637-2.02G | 1 | 1 | 2 | 2 | 3 |
| Telephone lines with extensions as specified in §637-2.02E | 1 | 1 | 2 | 2 | 2 |
| Parking lot spaces as specified in §637-2.02V | 5 | 5 | 6 | 8 | 10 |

E. Engineer’s Office Type E. In addition to the general requirements, Type E office shall provide a minimum of 85 square meters of floor space, a maximum of 130 square meters of floor space, and shall be partitioned to provide four rooms: two small rooms and two large rooms each with adjoining doors. The smaller rooms shall be not less than 11 square meters in area and shall each contain two windows. Two outside doors and at least twelve windows will be required. The furnishings shall be as indicated in Table 637-1 of this Section.

If two mobile trailer units are provided, they shall be joined in parallel fashion and shall have two weatherproof doorways or archways between units A.O.B.E. A minimum of two (2) outside doors shall still be required, and arranged so as to facilitate emergency access.

637-2.05 Minimum requirements for Field Laboratories.

A. Area. Floor space of 9 square meters.

B. Windows. Three windows.

C. Doors. One door with lock and two sets of keys.

D. Floor Covering. Linoleum, tile or other serviceable finish.

E. Sink. A sink at least 0.90 meters long by 0.60 meters wide by 0.45 meters deep, equipped with water faucet and drain line.
F. Counter. A work counter next to sink at least 0.6 meters long by 0.6 meters wide.

G. Table. A heavy duty work table not less than 2.50 meters long by 0.75 meters wide by 0.90 meters high.

H. Cabinet. A storage cabinet or locker at least 0.6 meters square by 1.8 meters high, equipped with at least four shelves, lock and two keys.

I. Fire Resistant Cabinet. Two drawer as specified in §637-2.02M.

J. Desk. A desk or writing table with chair.

K. Pedestal. A heavy wooden block for soil compaction tests, nominally 0.25 meters square by 0.30 meters high. (Soils Lab. only.)

L. Stove. As specified in §637-2.02R.

M. Lighting. Electric lighting and not less than three convenient outlets. Electric service shall be for not less than 20 amperes, 115 VAC. Where an electric hotplate or stove is provided under (L) above, service shall be increased over 20 amperes by an amount equal to the rating of the device listed on the nameplate.

N. Potable Water. Potable water supplied from an existing system or from an external 200 liter (minimum) gravity-feed storage tank connected to the sink faucet.

O. Heater. A space heater with the necessary fuel and outside vent, if required.

P. Fire Extinguisher. As specified in §637-2.02L.

637-2.06 Concrete Cylinder Curing Box. The materials shall meet the requirements of §735-01, Concrete Cylinder Curing Box.

637-2.07 CHAMP® Management System. The CHAMP® management system is comprised of software products marketed under the trademark of CHAMP®. The Contractor is responsible for having computer equipment meeting the minimum requirements for operating the software as specified by an approved vendor. The Contractor shall install vendor issued upgrades and maintain the software to ensure data submissions are made using the most recent approved version of the software.

637-3 CONSTRUCTION DETAILS

637-3.01 General Requirements. The buildings shall be fully equipped and made available for use and occupancy by the Department personnel as well as comparable personnel employed by a Consultant prior to the start of any contract work. Such use and occupancy shall be made available after the work has been accepted by the Department as directed in writing by the Regional Director.

All buildings shall be maintained in good condition and appearance by the Contractor for the designated period after which all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location, the areas cleaned, loamed and seeded if required and left in a neat and acceptable condition.

The Contractor shall be responsible, until use and occupancy of the Engineer's office and Laboratory building is relinquished by the State, for any and all damage, direct or indirect, of whatever nature, occurring to the property of the State of New York, property of the Department's personnel, property of the Department's Consultant representative, including other employees of the Consultant assigned to this office, which is kept in the Engineer's Office and Laboratory Building. Non-State owned or employee property shall only be those items used by appropriate personnel in the performance of project-related
work activities. Such property shall be replaced within 30 days of the reported damages and would include any loss caused by, but not limited to, fire, theft, vandalism or malicious mischief.

The Engineer shall provide the Contractor a detailed list of items, with corresponding dollar values, belonging to the State of New York, the Department's personnel, the Department's Consultant representative, and the Consultant's employees at least once every three months but not more than once a month. The Contractor shall not be responsible for items kept in the Engineer's office that are not on this list.

637-3.02 Concrete Cylinder Curing Box. The Contractor shall furnish the Engineer a concrete cylinder curing box and two locks with two keys for each lock. The locks shall fit each securing latch of the curing box. This concrete cylinder curing box shall remain exclusively available to the Engineer at the location selected by the Engineer. The Contractor shall relocate to any new location directed by the Engineer, repair or replace, if necessary, paint, clean and otherwise maintain the concrete cylinder curing box for the duration of the contract. The Contractor shall also provide and maintain all necessary utility connections to operate the curing box.

The concrete cylinder curing box will remain the property of the Contractor and shall be removed from the site of the work upon completion of the contract.

637-3.03 CHAMP® Management System. After contract award and prior to notice to proceed, the contractor shall, if necessary, purchase CHAMP® software and become proficient in its use. The vendor(s) approved to market the software and provide or coordinate training are listed on the Department website at www.dot.state.ny.us/oecd/champ.html or are available from the Office of Equal Opportunity Development & Compliance. Training costs will only be reimbursed for training obtained from an approved vendor. There is a NYSDOT CHAMP® user guide available for download at www.dot.state.ny.us/oecd/ceieb.html. The Contractor and subcontractors shall retain the CHAMP® software upon completion of the contract with the understanding that the Contractor and subcontractors will employ this copy of the CHAMP® software on all subsequent contracts with the Department.

A. Software. From an approved marketing vendor, the Contractor shall, if necessary:
- Purchase one copy of the CHAMP® Contractor Module (CM) to support the contractor's import of contractor and subcontractor payroll data, compliance monitoring and creation of required CHAMP® reports;
- Purchase copies of the CHAMP® Subcontractor Module (SM) to support the manual data entry of payroll data by subcontractors in instances where subcontractors do not own CHAMP® CM or SM and cannot create a CHAMP® compatible import file from their company payroll system;
- Copies shall be distributed to and retained by the subcontractor.

B. Training. From an approved vendor of CHAMP® training, the Contractor shall, if necessary:
- Obtain CHAMP® training.

637-4 METHOD OF MEASUREMENT

637-4.01 Engineer's Office (Type A, B, C, D and E). Payment will be made for each month (to the nearest 0.25 month increment), of availability for occupancy by the field engineers during the period of the contract. Payment will begin the first month that the office is fully equipped, serviced as specified, and made available for occupancy. Monthly payments will continue until the date of acceptance of the contract. When directed in writing by the Regional Director, payment for each month's occupancy after the date of acceptance will be made as part of the final estimate. Failure of the Contractor to supply all documents required to complete the final estimate may result in a non-payment during this delaying period. This non-payment will be in the form of a charge to the Contractor as further stated in §637-5 of this Specification. Monthly payments may be terminated on a specified date prior to acceptance of the contract by written notification by the Regional Director that such office will no longer be required on the contract.

No payment will be made for occupancy and services during the periods of contract extension of time where Engineering Charges are assessed, except that, in such cases, payment for each month's occupancy
after the date of acceptance will be made as part of the final estimate when directed in writing by the Regional Director.

637-4.02 Laboratory. Payment will be made for each building or trailer furnished under this work as follows: Seventy-five (75%) of the amount bid will be paid when the building or trailer equipped as specified has been placed on the work site and fully operative. The remaining twenty-five percent (25%) will be paid when the Engineer estimates the contract to be ninety percent (90%) complete, on a dollar basis.

637-4.03 Concrete Cylinder Curing Box. Concrete cylinder curing boxes will be measured by the number of units furnished and installed and actually used in accordance with these specifications.

637-4.04 CHAMP® Management System. The work will be measured for payment on a Dollars-Cents basis. The unit price shown in the proposal for this item will be considered as the price bid, and shall not be altered in any manner. Should the amount shown be altered, the new figure will be disregarded and the original price will be used to determine the total amount bid for the contract.

637-5 BASIS OF PAYMENT

637-5.01 Engineer's Office (Type A, B, C, D, and E). The unit price bid per month shall include the cost of all labor, material, equipment, ground rental and utility charges necessary to complete the work.

No payment will be made under Engineer’s Office for each calendar day during which there are deficiencies in compliance with the requirements of any subsection of this specification. The first calendar day shall commence 24 hours after notice to the Contractor of such a deficiency. This non-payment shall be deducted from the Contractor's next estimate as a charge to Contractor on the item. The amount of such calendar day non-payment will be determined by dividing the unit price bid per month by 30.

If the cited deficiencies exceeds 72 hours or are permitted to recur, liquidated damages will be assessed at twenty percent (20%) of the daily liquidated damages rate for each subsequent calendar day or part thereof that a cited deficiency resulting in non-payment, as prescribed herein, is not corrected.

637-5.02 Laboratory. The price bid for each building or trailer shall include the cost of furnishing all labor, materials and equipment necessary to erect, relocate and remove the building or trailer as directed by the Engineer, together with all fuel, water, ground rental, or other expenses incidental thereto.

637-5.03 Concrete Cylinder Curing Box. The unit price bid for each box shall include the cost of all labor, material, equipment, ground rental, relocation, repair or replacement, painting, cleaning, maintenance, and utility charges necessary for operation.

637-5.04 CHAMP® Management System. The Department will reimburse the Contractor for the purchase of CHAMP® software and fifty percent (50%) of the training cost at an approved vendor for Contractor employees upon submission of original receipts. No payment will be made for computer hardware required to run the CHAMP® software. No payment will be made for software, training and/or fees paid or reimbursed by another source (i.e., another Department contract or another state/municipality that requires CHAMP® use). No payment will be made for software maintenance fees subsequent to initial purchase.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
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<tr>
<td>637.01</td>
<td>Laboratory Building</td>
<td>Each</td>
</tr>
<tr>
<td>637.03</td>
<td>Concrete Cylinder Curing Box</td>
<td>Each</td>
</tr>
<tr>
<td>637.0502</td>
<td>Engineer's Office-Type A</td>
<td>Month</td>
</tr>
<tr>
<td>637.0602</td>
<td>Engineer's Office-Type B</td>
<td>Month</td>
</tr>
<tr>
<td>637.0702</td>
<td>Engineer's Office-Type C</td>
<td>Month</td>
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SECTION 638 - WHITE SYNTHETIC RESIN BINDER CONCRETE

638-1 DESCRIPTION. This work shall consist of the construction of white synthetic resin binder concrete pavement in accordance with these specifications and in reasonably close conformity with lines and grades shown on the plans or established by the Engineer.

638-2 MATERIALS. The materials shall meet the requirements of §402-2, Materials, except as modified below.

638-2.01 Aggregates. The requirements of §703-05, Fine Aggregate for White Portland Cement Concrete, shall apply except that the gradation shall meet the general limits described in §638-2.05, Mix Design. A sample of the white aggregate will be obtained by the Department from the stockpile located at the mixing plant and submitted to the Materials Bureau at least 10 days prior to the production of the mix for color approval by the Director, Materials Bureau. Unless otherwise approved by the Regional Director, the material shall be stockpiled in advance and in sufficient quantity to complete the work. Any additions to the stockpile or apparent contamination of the aggregate, as determined by the Engineer, will require submission of samples to the Materials Bureau for evaluation and approval by the Director, Materials Bureau.

638-2.02 Mineral Filler. Mineral Filler, if required in the mix to meet gradation requirements shall be hydrated lime.

638-2.03 Binder. The binder shall conform to the requirements of §702-70. The synthetic resin binder shall be supplied by a manufacturer appearing on the Department's Approved List of Synthetic Resins. When the one component binder is used, the binder shall be available 10 days prior to production of the mix so representative samples of the binder can be obtained by the Engineer and tested by the Materials Bureau for conformance to §702-70.

638-2.04 Pigment. The pigment shall conform to the requirements of §712-16, Pigment for Colored Synthetic Resin Binder Concrete.

638-2.05 Mix Design. The job mix formula stating the proposed aggregate gradation, binder and pigment contents shall be prepared by the synthetic resin binder concrete producer according to the requirements of §401-2.01, Hot Mix Asphalt Designs, except for the modifications in this specification.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>General Limits (1) % Passing</th>
<th>Job Mix % Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3 mm</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>90–100</td>
<td>±5</td>
</tr>
<tr>
<td>850 µm</td>
<td>42–68</td>
<td>±7</td>
</tr>
<tr>
<td>425 µm</td>
<td>20–50</td>
<td>±6</td>
</tr>
<tr>
<td>180 µm</td>
<td>10–22</td>
<td>±3</td>
</tr>
<tr>
<td>75 µm</td>
<td>6–12</td>
<td>±2</td>
</tr>
<tr>
<td>Synthetic Binder Content (2)</td>
<td>7.0–8.0</td>
<td></td>
</tr>
<tr>
<td>Pigment (1,3)</td>
<td>2.3–2.7</td>
<td></td>
</tr>
<tr>
<td>Mix and Placing Temperature</td>
<td>120°C–160°C</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. Based on total aggregate weight.
2. Based on total mix weight.
3. The pigment shall be considered as mineral filler passing the 75 µm sieve.
**638-2.06 Tack Coat.** The tack coat shall be supplied by a manufacturer appearing on the Department's Approved List of Synthetic Resins. The tack coat shall conform to the requirements of §702-71. The tack coat material shall be available 10 days prior to production of the mix so representative samples of the tack coat can be obtained by the Engineer and tested by the Materials Bureau for conformance of §702-71.

**638-3 CONSTRUCTION DETAILS.** Except as provided in this specification, the construction requirements shall meet those of §402-3, Hot Mix Asphalt (HMA) Pavements - Construction Details.

**638-3.01 Weather Limitations.** The requirements for top course mixes in §402-3.01, Weather and Seasonal Limitations, shall apply.

**638-3.02 Preparation of Mixture.** The mixing plant shall meet the requirements of §401-3.08 unless otherwise approved by the Director, Materials Bureau. Before the pugmill is allowed to produce white synthetic resin binder concrete, it shall be thoroughly cleaned by charging a minimum of two (2) successive batches of hot dry aggregate into the pugmill and mixing each batch for a minimum of four (4) minutes. In addition, the first batch of white synthetic resin binder concrete produced, after a change from normal asphalt concrete production, shall not be incorporated into the work. Such batches shall be at least fifty (50) percent of the rated pugmill capacity. This batch may also be used for the first material passed through the paver as described in §638-3.04, Paving. The white aggregate shall be introduced into the pugmill, between the limits of 120°C to 180°C and the temperature of the synthetic resin binder (one component) shall be maintained between the limits of 130°C and 150°C. When the binder is added directly into the pugmill in cold, prepackaged units (two components), the temperature of the aggregate may be increased accordingly to meet the specified mix temperature, but shall not exceed 220°C. For either method of binder addition, the resulting mix temperature shall be in the range of 120°C to 160°C.

The pigment, resin chips, plasticizing oil and hydrated lime shall be added to the pugmill in whole bag units. If the pigment and/or hydrated lime is not delivered from the manufacturers as whole units, the Contractor may weigh and repackage in a manner approved by the Engineer so that the pigment and/or hydrated lime may be added as whole units. The hydrated lime may be added in a manner approved by the Engineer, if difficulties are encountered in maintaining the specified mix temperature when adding the hydrated lime directly to the pugmill.

Batching and mixing requirements for the White Synthetic Resin Binder Concrete are as follows:

**A. One Component Binder.** After the hot aggregate is discharged into the pugmill, add the pigment and hydrated lime in whole bag units as required and dry mix for a minimum of 15 seconds. After the dry mix the synthetic resin binder should be added and wet mixed for a minimum of 45 seconds.

**B. Two Component Binder.** After the hot aggregate is discharged into the pugmill add resin chips in whole bag units as required. This should be immediately followed by the addition of the hydrated lime in whole bag units and dry mixed for 30 seconds. Following the dry mix add the plasticizing oil and pigment in whole bag units in that order and wet mix for 30 seconds after all components are in the pugmill.

Any increase in pigment content above that specified on the job mix formula for the convenience of mixing shall be made at no additional cost to the Department. The pigment content may be increased within the general limits, as directed by the Engineer, to obtain a satisfactory color during production.

**638-3.03 Preparation of Surface.** All surfaces to be paved shall be thoroughly cleaned of all foreign material, including membrane curing compound of Portland Cement concrete pavement, prior to the placing of the pavement. A tack coat, consisting of a uniform application of rapid curing synthetic resin liquid, §702-71, shall be applied at a uniform rate between 0.15 to 0.25 liters per square meter over the areas to be paved. The tack coat shall be applied with either a paint roller or spray unit to assure uniform application. The tack coat shall not be poured onto the pavement surface for application. After the tack
coat application, curing time shall be sufficient to permit the coating to become tacky before paving. No traffic shall be permitted on the tack coated surface.

638-3.04 Paving. The mix shall be laid between the temperatures of 120° to 160°C as specified by the Engineer. All areas of uniform width of 1.2 meters or more shall be paved with an approved paving machine. Areas of narrow or variable width may be placed without a paver but in a manner approved by the Engineer. All paving edges shall be formed in a manner approved by the Engineer to obtain a true edge. The equipment including trucks, paving machine rollers and tools which come in contact with the white synthetic resin binder concrete shall be thoroughly cleaned before use. In addition, the paving machine shall be cleaned of excess asphalt by spraying with solvent. This shall be directly followed by the passage and subsequent wastage of at least one (1) metric ton of the white material. The material may be from the same batch used to clean the pugmill.

638-3.05 Compaction. Provisions of §402-3.07 Compaction shall apply except that a minimum of two passes of a nominal 9 metric ton steel wheel tandem roller shall be used for compaction. The edge forms shall be removed prior to applying the second roller pass. This shall be done as expeditiously as possible so that the second roller pass is completed while the mat is still hot. Forms used for the formation of transverse drainage troughs shall be kept in place until the completion of all rolling operations. Narrow areas which are subject to overstressing with a 9 metric ton roller may be rolled with a small roller as approved by the Engineer. The paving edge forms shall be removed prior to applying the final roller pass with the small roller as previously described for the 9 metric ton rollers. The use of a pneumatic tire roller will not be required for this item.

638-4 METHOD OF MEASUREMENT. The quantity of white synthetic resin binder concrete shall be measured by the number of metric tons of compacted material in place.

638-5 BASIS OF PAYMENT. The unit price bid per metric ton of white synthetic resin binder concrete shall include the cost of all materials, equipment and labor necessary to complete the work including the synthetic resin binder, pigment and tack coat.

Payment will be made under:

<table>
<thead>
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<td>638.0104</td>
<td>White Synthetic Resin Binder Concrete</td>
<td>Metric Ton</td>
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SECTION 639 (VACANT)

SECTION 640 - REFLECTORIZED PAVEMENT MARKING PAINTS

640-1 DESCRIPTION. Under this work, the Contractor shall furnish and apply painted reflectorized pavement marking paint at the locations and in accordance with the patterns indicated on the plans or as directed by the Engineer, and in accordance with the NYSMUTCD and these specifications.

640-2 MATERIALS. Reflectorized pavement marking paints shall be selected from the Department’s Approved List of White and Yellow Reflectorized Pavement Marking Paints. Project acceptance will be based on the appearance of an approved brand name on the container label.

All paints shall conform to Federal, State, and local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation.

Reflective glass beads shall conform to §727-05 Glass Beads for Reflectorized Pavement Marking Paints.

Details for obtaining Approved List status are available from the Materials Bureau.

640-3 CONSTRUCTION DETAILS

640-3.01 General. All pavement markings and patterns shall be placed as shown in the contract documents and in accordance with the New York State Manual of Uniform Traffic Control Devices.
Before any pavement marking work is begun a schedule of operations shall be submitted to and approved by the Engineer.

When pavement markings are applied under traffic, the Contractor shall provide all the necessary flags, signs, cones, shadow vehicles, flashing arrow boards, etc. to maintain and protect traffic, to protect the work operation, and to protect the painted pavement markings until thoroughly dry and serviceable. No additional payment will be made for these items. The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of normal flow of traffic shall not be allowed.

The Contractor shall be responsible for cleaning the pavement, to the satisfaction of the Engineer, of dust, dirt, and other foreign material which may be detrimental to the adhesion of the paint film.

When necessary, the Contractor shall establish marking line points at nine (9) meter intervals throughout the length of the pavement or as directed by the Engineer.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled paint, and paint applied in unauthorized areas.

**640-3.02 Application of Pavement Markings.** Painted pavement markings shall be applied with either atomizing or airless type striping equipment. The striping equipment may be either truck mounted or hand operated, and shall be equipped with glass bead dispensing equipment. The striping equipment shall be compatible with and suitable for the application of the type of paint being used.

At the time of paint application, the pavement surface and ambient temperature shall not be less than 10°C, the relative humidity shall not exceed 85%, and the pavement surface shall be dry. Painted pavement markings shall not be applied during periods of rain or if rain is imminent. Waterborne type paints shall not be applied if rain is expected within 4 hours after the paint application.

Paint shall be applied in strict accordance with the manufacturer’s recommendations for use. In no case shall the paint be heated above 65°C.

The painted pavement markings shall be uniformly applied to the pavement surface at the minimum specified wet film thickness. Immediately following paint application reflective glass beads shall be uniformly applied to the wet paint film at the rate of 0.75 kg/L of paint. The applied pavement markings shall have clean-cut edges, and true and smooth alignment.

On pavements where traffic is to be maintained and the final marking pattern is known, reflectorized pavement marking paint shall be applied before nightfall or before the end of the working day, whichever comes sooner. If the Contractor is unable to apply these final pavement markings, where traffic is to be maintained, then Short-Term Pavement Markings meeting the requirements of §619-3.06 shall be installed using removable reflectorized pavement markings, offset from the location of the project’s final pavement markings, at no additional cost to the State.

**640-4 METHOD OF MEASUREMENT.** Pavement striping will be measured in linear meters along the centerline of the pavement stripe and shall be based on a 100 mm wide stripe. Measurement for striping with a plan width greater or less than the basic 100 mm as shown in the contract documents or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (Millimeters) } \times \text{ Meters} \\
100 \text{ Millimeters}
\]

No payment will be made for the number of meters of gaps in between the dashed lines. Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Examples: “SCHOOL” will be measured as six units. Double and triple headed arrows will each be measured as a single unit. The “X” in railroad grade crossing markings (MUTCD figure 263-33) will be measured by meter of 100 mm stripe.

**640-5 BASIS OF PAYMENT.** The accepted quantities of pavement markings will be paid for at the contract unit price bid, which shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the painting operations shall be included in the price bid. The application of Short-Term Pavement Markings, necessitated by the Contractor’s failure to apply the required Reflectorized Pavement Marking Paints, shall be at no additional cost to the State.
§640

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
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<tr>
<td>640.11</td>
<td>Yellow Paint Reflectorized Pavement Stripes - 0.38 mm</td>
<td>Meter</td>
</tr>
<tr>
<td>640.12</td>
<td>White Paint Reflectorized Pavement Letters - 0.38 mm</td>
<td>Each</td>
</tr>
<tr>
<td>640.13</td>
<td>White Paint Reflectorized Pavement Symbols - 0.38 mm</td>
<td>Each</td>
</tr>
<tr>
<td>640.20</td>
<td>White Paint Reflectorized Pavement Stripes - 0.51 mm</td>
<td>Meter</td>
</tr>
<tr>
<td>640.21</td>
<td>Yellow Paint Reflectorized Pavement Stripes - 0.51 mm</td>
<td>Meter</td>
</tr>
<tr>
<td>640.22</td>
<td>White Paint Reflectorized Pavement Letters - 0.51 mm</td>
<td>Each</td>
</tr>
<tr>
<td>640.23</td>
<td>White Paint Reflectorized Pavement Symbols - 0.51 mm</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 641, 642 AND 643 (VACANT)

SECTION 644 - OVERHEAD SIGN STRUCTURES

644-1 DESCRIPTION

644-1.01 General. Under this work the Contractor shall fabricate, furnish and erect sign structures for overhead signs in accordance with the contract documents.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all overhead sign structures in accordance with §106-01 Sources of Supply.

644-1.02 Definitions. Overhead Sign Structures (OSS) are structures with vertical supports and horizontal arms or chords used to support signs over any portion of the roadway, including the shoulders. Span Wire Assemblies supporting overhead signs, and structures supporting both traffic signal equipment and overhead signs are covered under Section 680, Traffic Signals. Bridge fascia mounted signs, where the signage is intended for the under roadway, are also not covered in this Section.

OSS are classified into the following three standard types (See Figure 644-1).

A. Single Arm Cantilever. Single (horizontal) arm supported by a single (vertical) post.
B. Trussed Arm Cantilever. Two trussed arms supported by a single post. (If the arms are not trussed, the structure shall be classified as Non-Standard).
C. Span. Single span, four-chord (quad-chord) superstructure supported by trussed end posts.

OSS that fall outside these categories are Non-Standard. This includes butterfly structures, multi-span structures, structures that are a combination of span and cantilevers, and all other overhead sign structures not included in §644-1.02.

644-2 MATERIALS

644-2.01 Steel for Sign Structures. Steel for component parts of sign structures shall meet the requirements of the New York State Steel Construction Manual and the following:

All material greater than 13 mm thick shall meet the Charpy V-Notch toughness requirements of §715-01, Structural Steel. Chords, cantilevered arms, end posts, base plates, end and face plates for cantilever arm to post connections, and flange splice plates shall be considered main members. Diagonals, struts and gusset or tab plates shall be considered secondary members. Upon receipt at the fabrication plant, all main member material shall be traceable to a mill test report and traceability shall be maintained throughout the duration of the fabrication.

All main member material thickness shall be a minimum of 6 mm.
§644

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006

Single-Arm Cantilever Structure

Single-Arm Butterfly Structure

Trussed-Arm Cantilever Structure

Trussed-Arm Butterfly Structure

Single Span Structure
FIGURE 644-1

A. **Pipe.** Pipe shall meet the requirements of one of the following specifications:

- ASTM A 53, Welded and Seamless Steel Pipe, Grade B, Type E or S.
- ASTM A 500, Welded and Seamless Steel Pipe, Grade B (Rounds Only)
- ASTM A 252, Welded and Seamless Steel Pipe, Grade 2 or 3, provided that the chemical certifications meet the requirements for ASTM A 53, Grade B, Type E or S.
- API 5L American Petroleum Institute Specification 5L, Grade B

In addition to the above material requirements, all pipe used for welded applications shall have a maximum Carbon Equivalency (CE) of 0.40 using the following equation:

\[
CE = %C + \frac{%Mn}{6} + \frac{%Cu}{40} + \frac{%Ni}{20} + \frac{%Cr}{10} - \frac{%Mo}{50} - \frac{%V}{10}
\]

B. **Structural Steel.** Structural steel for structural shapes, plates, and bars shall meet the requirements of §715-01, Structural Steel, and the ASTM Specification noted on the contract documents. Cutting and drilling shall be done in such a manner that the resulting surfaces are free from any gouges or burrs.

C. **Anchor Bolts, Nuts and Washers.** Anchor bolts, nuts and washers shall meet the requirements of the following:

- ASTM F 1554, Grade 55 with Supplementary Requirement S4, Charpy Impact Requirement
Anchor bolts, nuts, and washers shall be galvanized in accordance with the requirements of Materials Detail 719-01 Type II, Galvanized Coatings and Repair Methods - Zinc Coating (Hot Dip) on Iron and Steel Hardware. Anchor bolts shall be the Unified Course Thread Series with Class 2A threads, and shall be galvanized full length. Nuts shall be Grade A, Heavy Hex.

D. **High Strength Steel Bolts, Nuts and Washers.** Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of §715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of §719-01, Galvanized Coatings and Repair Methods. Additionally, the Contractor shall provide documentation that the zinc coated fastener assemblies have satisfied the requirements of ASTM A 325M Section 6.2, R.C. testing.

Fasteners in main members shall be sampled and tested in accordance with Section 1001.5 of the New York State Steel Construction Manual, with the exception that the waiver for lot sizes less than 20 bolts shall not apply.

E. **U-Bolts.** U-Bolts shall conform to material specification ASTM F 1554, Grade 36, and shall be galvanized in accordance with the requirements of Type II of §719-01, Galvanized Coatings and Repair Methods.

F. **Galvanizing.** All steel shall be galvanized in accordance with §719-01 Type I, except as noted above in §644-2.01 C, D & E. Galvanizing shall provide a minimum coating of 127 µm. All welding, cutting and drilling shall be done prior to galvanization, and all bolting shall be done after galvanization, except as approved by the Engineer.

G. **Acceptance.** All steel furnished shall be documented in accordance with the requirements of §715-01 Basis of Acceptance.

644-2.02 Concretex. All overhead sign structure foundations shall meet the requirements of Class A concrete in Section 501, Portland Cement Concrete - General. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

All precast concrete overhead sign structure foundations shall meet the requirements of §704-03, Precast Concrete - General.

644-3 CONSTRUCTION DETAILS

644-3.01 Drawings. Shop drawings shall be required for all OSS in the contract documents. The Contractor must submit shop drawings in accordance with the requirements of Section 2 in the New York State Steel Construction Manual.

644-3.02 Fabrication. All fabrication, inspection, transportation and erection shall be performed in accordance with the requirements of the New York State Steel Construction Manual.

A. **Storage of Materials.** Structural material shall be stored in a manner that will protect the materials from deformation, surface deterioration and accumulations of dirt, oil, or other foreign matter.

B. **Straightening Materials.** Prior to fabrication in the shop, all deformed structural materials shall be properly straightened by methods which are non-injurious. Sharp kinks and bends, and deep dents shall be cause for rejection.

C. **Anchor Bolts.** Where anchor bolts have been or are being set under a separate contract, the Contractor shall check the size, location, and spacing of anchor bolts before fabricating the structure.

D. **Pole Markings.** A Sign Structure Identification Number (SIN) shall be attached to the post using white numbers on a green background. The background shall be Green, Class A, Engineer Grade reflective sheeting as described in §730-05, Reflective Sheeting, and shall be 300 mm wide by 150 mm high, with the corners cut to a 40 mm radius. The numbers shall be cut out from White,
§644

Class A, Engineer Grade reflective sheeting and shall be 75 mm high. The sheeting and numbers shall be applied in accordance with the manufacturer’s recommendations. The numbers shall be placed on the right near post, 45 degrees from the viewing direction of traffic, approximately 1.8 m above the base plate, so as to be visible to the traveling public. For structures spanning more than one direction of traffic, or structures that span non-contiguous travel lanes, two posts shall be marked to facilitate identification by inspectors.

The following information shall be stamped into the base plate in 12 mm letters to such a depth as to be clearly visible through subsequent galvanizing:

<table>
<thead>
<tr>
<th>Required Information</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer’s name or logo</td>
<td>ABC Fabricating</td>
</tr>
<tr>
<td>Month and year of manufacture</td>
<td>06/2003</td>
</tr>
<tr>
<td>D Number</td>
<td>D123456</td>
</tr>
<tr>
<td>SIN Number</td>
<td>SIN 12345</td>
</tr>
</tbody>
</table>

For span type structures the marked base plate shall correspond to the marked posts, except that only one end of the span must be marked.

**E. High Strength Bolts.** Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.3b of the New York State Steel Construction Manual.

Fasteners shall be inspected after installation in accordance with Section 1001.4 of the New York State Steel Construction Manual. The inspection shall apply to a minimum of 10% of the connections randomly throughout the entire span of the structure.

All holes for high strength bolts in main members shall be made in accordance with Section 613 of the New York State Steel Construction Manual. This requirement also includes all secondary members that are welded to main members.

**F. Quality.** Fabricators shall be certified in accordance with the American Institute of Steel Construction’s Quality Certification Program in the Simple Steel Bridge Structures Category, or an equivalent program acceptable to the DCES.

**G. Inspection.** Provisions for shop inspection shall be in accordance with the New York State Steel Construction Manual.

**H. Assembly.** All OSS shall be fully assembled in the fabrication shop to ensure proper fitup.

**I. Acceptance For Shipping.** Each section of a sign structure shall bear the QA inspector’s mark of acceptance prior to shipping.

644-3.03 Transportation. Sign structures (including posts and post assemblies) shall be shipped by flat bed trailer or other similar means. Structures shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage from occurring during transportation. The use of any device which does not support the member for its entire length, as described below, shall not be permitted. This prohibition includes, but is not limited to, dolly wheels and pole trailers.

Sections less than 15.0 m in length shall be, at a minimum, supported at the midspan and end points. Sections 15.0 m and longer shall be, at a minimum, supported at the ends and at the quarter points.

Adhering to these requirements does not relieve the Contractor of the responsibility for damage to the structure en route.

644-3.04 Excavation. All excavation shall conform to Section 206, Trench, Culvert and Structure Excavation.
Excavation shall not be performed until immediately before installation of the footings, or any other appurtenances. The excavated material shall be placed in a location or locations selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to avoid interference with surface drainage. All surplus excavated material shall be removed and disposed of by the Contractor as specified in §203-3.08, Disposal of Surplus Excavated Materials.

Excavation shall be backfilled as specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables.

The outline of all areas to be removed in sidewalks, driveways, and pavement shall be saw cut to a depth of at least 75 mm prior to removal. Cuts shall be neat and true along score lines with no shatter outside the removal area. Damaged saw cut areas shall be recut.

Pavement, shoulder, sidewalks, curbs, driveways, lawns, plants and other such features shall be replaced in kind with material of equal quality or as shown in the contract documents. For transverse sidewalk, curb or gutter cuts in concrete the entire square or section shall be removed and replaced with the same kind and quality of material. For longitudinal cuts in concrete sidewalks only the area removed between sawcuts shall be replaced unless specified otherwise in the contract documents.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter or driveway is broken or damaged by this work, the entire square, section or slab shall be removed and replaced with the same kind and quality of material, at no additional cost to the State.

644-3.05 Concrete Foundations. Foundations shall be constructed as shown in the contract documents. The Contractor shall establish the location and elevation of foundation, prior to the start of construction, based on the information shown in the contract documents and data derived from field surveys. Locations and elevations will be verified by the Engineer prior to the start of construction.

The Contractor has the option, unless specifically disallowed in the contract documents, to use either Drilled Shafts or Rectangular Footings for Overhead Sign Structures, if both types are detailed in the contract plans. When both foundation types are detailed and permitted, the Department has prepared the contract documents based on the presumed less expensive foundation type. If the Contractor elects to change from one type of foundation to the other under this option, it shall be done at no additional cost to the State. The Contractor shall notify the Engineer of the decision to change foundation type.

Excavation for these items shall be as specified in §644-3.04. All concreting operations shall conform to Section 555, Structural Concrete. Reinforcing steel shall conform to Section 556, Reinforcing Steel for Concrete Structures.

The allowable tolerance from verticality for the drilled shaft or pedestal shall be 2.5%. The allowable tolerance for the top of shaft elevation or pedestal elevation shall be +6 mm, -0 mm.

Stripping of forms and subsequent loading of foundations shall be in accordance with §555-3, in Table 555-1, under “Pier Columns”. Placing the sign panels on an overhead sign structure is assumed to be equivalent to placing superstructure loads on a bridge.

A. Drilled Shafts for Overhead Sign Structures. Work under this item shall consist of the layout and construction of Drilled Shaft foundations for Overhead Sign Structures. This work may require rock drilling, installing rock sockets, dewatering, the use of temporary casing, slurry, or other means necessary to keep the hole open. Formwork shall be required for the portion of the shaft above finished grade.

Holes for drilled shafts shall be pre-augered. Precaution shall be taken to protect the holes from collapse. Holes shall contain no free water, nor any loose material at the time of concrete placement. The holes shall be filled with Class A concrete placed in direct contact with the soil. Casing, if used, shall be removed prior to concrete placement. Precast shafts shall not be permitted.

B. Rectangular Footings for Overhead Sign Structures. Work under this item shall consist of the layout and construction of conventional rectangular spread footings, either cast-in-place or precast. This work may require the use of protective sheeting.

644-3.06 Erection of Sign Structures

A. Methods and Equipment. Before starting work, the Contractor shall submit details of the method of erection and types of equipment he proposes to use, to the Engineer for review and
approval. Approval shall not relieve the Contractor of the responsibility for the safety of the methods or equipment, or for damage to the structures due to overloading.

**B. Handling and Storage.** Structural members shall be loaded, moved, and unloaded in a manner that prevents stresses in excess of those provided for by the structure design. Permanent distortion, or other damage attributable to the Contractor's operations, shall be cause for rejection.

Members stored either in the fabricator's storage area, or at the work site, or at other storage areas, shall be supported off the ground in a manner that will not allow distortion, or other damage to occur.

**C. Lifting.** Erection of overhead sign structures shall be done in accordance with §107-05P. **Lifting.** Lift Plans are required, and shall be provided in accordance with §107-05P.3. Nylon slings, or an equivalent approved by the Engineer, shall be used for all lift operations. Picking points for the superstructure portion of span type OSS shall be made at the panel points that are closest to the third points of the span, in order to ensure that no members are overstressed during lift operations. Two picking points, one at each end, shall be used for the superstructure portion of cantilever OSS.

Picking shall be made by wrapping the entire cross section of the structure. When alternate pick points are used, supporting calculations shall be submitted in accordance with §107-05P.5. **Lift Operations.** However, lifting by chains or by individual members shall not be permitted.

**D. Field Inspection.** All sign structures shall be visibly inspected, and components shall be clean prior to erection. Damage that is attributable to the Contractor's operations shall be cause for rejection. Damage includes, but is not limited to, bends, kinks, dents, cracks and pits. Rejected structures, or components, shall be removed from the work site and repaired, or replaced as required by the DCES. All work relating to the repair or replacement, of defective structures, or components, shall be done at no additional cost to the State.

**E. Anchor Bolts.** The following procedure shall be used for placing and tightening anchor bolts:

1. Anchor bolts shall be carefully set to the proper location, alignment, and elevation by using templates. Templates shall be as detailed in the contract documents, and shall be used at both the top and bottom of the anchor bolt pattern. Bottom templates shall be cast into the footing. Top templates shall be placed near the top of the anchor bolts so as not to interfere with concrete operations, and shall be left in place for 24 hours after concrete placement. Undamaged top templates may be reused.

2. Anchor bolts shall be set vertical, within 2.5%, and shall not be realigned by bending to fit the base plate. Anchor bolts that do not fit the base plate, or anchor bolts that are more than 2.5% out of plumb, shall be rejected. The Contractor may propose a remediation method for rejected anchor bolts, subject to the approval of the Engineer. Rejected anchor bolts, and the concrete they are embedded in shall be replaced by new materials at no cost to the State.

3. The exposed portion of the anchor bolts shall be cleaned with a wire brush. The leveling nuts and washers under the base plate shall be threaded onto the anchor bolts, leaving a gap between the top of concrete and the bottom of the leveling nuts of no more than one anchor bolt diameter, and no less than 10 mm.

4. The post(s) alone, without the arms attached, shall be placed on the leveled anchor bolts and washers. Posts shall not be raked back to account for camber. The base plate shall bear directly and evenly on the washers and leveling nuts.

5. Beeswax, or the equivalent, shall be applied to the bearing face and the threads inside the top nut. The top anchor bolt nuts and washers shall then be placed and tightened by hand. All cleaning and lubricating shall be done immediately prior to nut placement and tightening. Top nuts and leveling nuts shall be checked for full bearing against the base plate, and any loose nuts shall be tightened by hand. The top nuts shall then be snug tightened using 20 - 30% of the torque values listed in Table 644-1. The snugging sequence shall be as shown in Figure 644-2. The leveling nuts shall then be similarly checked for snug tightness, using 20 - 30% of the values listed in Table 644-1.

6. Fully tighten all top nuts according to the torques listed in Table 644-1. The tightening sequence shall be as shown in Figure 644-2. There shall be no rotation of the leveling nut during this procedure.
7. An additional nut shall be installed and tightened against the top nut to lock the installation. This lock nut shall be prepared and tightened as defined in 5.) and 6.) above. There shall be no rotation of the lower top nut during this procedure.

<table>
<thead>
<tr>
<th>TABLE 644-1</th>
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<tbody>
<tr>
<td><strong>Anchor Bolt</strong></td>
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<tr>
<td><strong>Size (Metric)</strong></td>
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<tr>
<td>M36</td>
</tr>
<tr>
<td>M42</td>
</tr>
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<td>M56</td>
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<tr>
<td>M64</td>
</tr>
</tbody>
</table>

**FIGURE 644-2**

**F. Bolting.** Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of §715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of §719-01, Galvanized Coatings and Repair Methods. Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. Any gaps between the faying surfaces after snug tightening that exceed 1 mm shall not be considered in full contact and shall be cause for rejection. The Contractor may propose remediation measures subject to approval by the DCES. Rejected components shall be replaced or repaired at no cost to the State. Bolts shall not be fully tightened before said tolerances are checked. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.3b of the New York State Steel Construction Manual.

Fasteners shall be inspected after installation in accordance with Section 1001.4 of the New York State Steel Construction Manual.

**G. Welding.** Field welding shall not be permitted on any part of the structure, except as approved by the DCES.
**H. Galvanized Metal Repair.** The Contractor shall repair any damage to galvanized surfaces in conformance with the field repair requirements specified in §719-01, Galvanized Coatings and Repair Methods, except that zinc paint applied by the spray method shall not be permitted.

**644-4 METHOD OF MEASUREMENT**

**644-4.01 Sign Structure.** The work will be measured as the number of sign structures installed without sign panels.

**644-4.02 Drilled Shafts for Overhead Sign Structures.** The payment quantity shall be the concrete volume shown for the shaft in the table in the contract documents, multiplied by the number of drilled shafts in the contract, unless the Engineer orders a modification to the details shown in the contract documents. If the Engineer orders a modification to the details shown in the contract documents, the payment quantity shall be the volume of concrete ordered by the Engineer. If the Engineer orders a change from a drilled shaft to a rectangular footing, an order-on-contract shall be negotiated. No adjustment shall be made for the Contractor’s election to use a rectangular footing, unless the Engineer orders a change to the details shown in the contract documents.

**644-4.03 Rectangular Footing for Overhead Sign Structures.** The payment quantity shall be the concrete volume shown for the footing and pedestal in the table in the contract documents, multiplied by the number of footings in the contract, unless the Engineer orders a modification to the details shown in the contract documents. If the Engineer orders a modification to the details shown in the contract documents, the payment quantity shall be the volume of concrete ordered by the Engineer. If the Engineer orders a change from a rectangular footing to a drilled shaft, an order-on-contract shall be negotiated. No adjustment shall be made for the Contractor’s election to use a drilled shaft, unless the Engineer orders a change to the details shown in the contract documents.

**644-4.04 Anchor Bolts.** The payment quantity shall be the mass shown in the anchor bolt table in the contract documents times the number of bolts installed.

**644-5 BASIS OF PAYMENT**

**644-5.01 Sign Structure.** The unit price bid for each structure for supporting sign panels shall be compensation in full for fabricating, furnishing and erecting the structure complete as specified including upright support(s), span and/or cantilever arm or truss assemblies, diagonal bracing, all necessary hardware, nuts, bolts, and washers, and all other material, equipment and labor necessary to properly complete the work as shown in the contract documents and called for in the specifications. Footings and anchor bolts shall be paid for under separate items or will be furnished by others.

The cost of all shop drawings, prints and reproducible prints required by the New York State Steel Construction Manual shall be included in the unit price bid for this item.

**644-5.02 Foundations for Overhead Sign Structures.** The unit price bid per cubic meter shall include the excavation, any protective system(s) required to ensure the safety of the workers and the public, dewatering, backfill (select granular backfill or concrete), formwork, concrete, bar reinforcement for concrete, excavation and backfilling of test holes, conduit and fittings, restoration of surfaces in kind, disposal of excess excavated material, and saw cutting.

**644-5.03 Anchor Bolts.** The unit price bid per kilogram shall include the furnishing and installing the anchor bolts and all necessary hardware, including galvanizing, as shown in the contract documents and called for in the specifications. This includes the anchor bolts, all templates used to ensure the proper alignment of the anchor bolt system, all nuts, and all washers necessary to complete the work as shown in the contract documents.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>644.11</td>
<td>Anchor Bolts</td>
<td>Kilogram</td>
</tr>
</tbody>
</table>
644.20  Drilled Shaft for Overhead Sign Structures  Cubic Meter
644.30  Rectangular Footing for Overhead Sign Structures  Cubic Meter
644.41xxxyy  Single Arm Cantilever Sign Structure  Each
644.42xxxyy  Trussed Arm Cantilever Sign Structure  Each
644.43xxxyy  Single Span Sign Structure  Each
644.44nn  Non-Standard Sign Structure  Each

NOTE:
1. xx, yy and nn denote serialized pay items. See §101-02, Definition of Terms, under “Specifications”.
2. xx denotes span or arm length in meters. For Single Arm and Trussed Arm Cantilever Sign Structures, xx varies from 04 to 16 in whole number increments. For Single Span Sign Structures, xx varies from 15 to 65 in 5 meter increments.
3. yy denotes sign area in square meters. For Single Arm Cantilever Sign Structures, yy is 03, 05 or 08 square meters. For Trussed Arm Cantilever Sign Structures, yy varies from 05 to 30 in 5 square meter increments. For Single Span Sign Structures, yy varies from 30 to 90 in 30 square meter increments.

SECTION 645 - SIGNS

645-1 DESCRIPTION. This work shall consist of fabricating, installing and covering traffic sign panels, sign support systems, sign posts, and illuminated sign panels in accordance with the contract documents, standard sheets, the MUTCD and as directed by the Engineer.

645-2 MATERIALS.

645-2.01 General. Materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing:

Wood Preservative - Water Borne 708-31
Stress Graded Timber and Lumber 712-14
Stainless Steel Connecting Products 715-16
Rubber Impregnated Woven Cotton-Polyester Fabric 728-01
Rubber Impregnated Random Fiber Pad 728-02
Aluminum Sign Panels 730-01
Reflective Sheeting 730-05
Reflectorized Sheeting Sign Characters (Type IV) 730-12
Reflectorized Sheeting Sign Characters (Type V) 730-13
Stiffeners, Overhead Brackets, and Miscellaneous Hardware 730-22
Fiberglass Reinforced Plastic Sign Panels 730-23
Type A Sign Supports 730-24
Type B Sign Posts 730-25
Breakaway Bases and Hinge Assemblies 730-26
U-Bolts ASTM F1554, Grade 36

645-2.02 Sign Panels. Fabrication of all components shall produce a finished sign panel. Holes may be punched or drilled. Edges shall be smooth and true and free from burrs or ragged breaks. Sign panels shall be fabricated as shown on the standard sheets. Details for signs that are not shown on the standard sheets shall be similar to the closest shown sign blank size. All sign panels shall be clearly marked in the lower right corner on the back of the sign panel to show the Contract Number and the installation date (month/year). Markings shall be a minimum of 25 mm high and shall be permanently engraved, labels attached with pressure-sensitive adhesives, marked with an indelible ink or paint, or established by another method approved by the Engineer. U-Bolts used to attach sign panels to overhead sign structures shall be Type II galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods.

A. Ground-Mounted Sign Panels (MUTCD Codes R, P, W and M). Panels for Ground-Mounted MUTCD Codes R, P, W and M signs shall be aluminum alloy 2.5 mm thick meeting the requirements of §730-01, Aluminum Sign Panels. Fiberglass Reinforced Plastic Sign Panels, 3.5
mm thick, meeting the requirements of §730-23 Fiberglass Reinforced Plastic Sign Panels, may be used for sign panels up to 1.2 m X 1.2 m.

B. Ground-Mounted Sign Panels (MUTCD Codes G and I) and Overhead-Mounted Sign Panels. Sign panels for ground mounted MUTCD Codes G and I signs and Overhead-Mounted Sign Panels shall be aluminum alloy 3 mm thick meeting the requirements of §730-01, Aluminum Sign Panels.

C. Reflective Sheeting. Reflective sheeting materials used on sign panels shall conform to the requirements of §730-05 Reflective Sheeting. Type I (Class A) sheeting may be used on tourist and motorist services signs. Type III (Class B) sheeting shall be used on regulatory, warning, route marker, and guidance signs unless specified otherwise below.

Type I (Class A) sheeting shall be used whenever brown reflective sheeting is specified, and may be processed by a sign fabricator in its shop. The legend for a sign with brown background shall be made by applying cut-out letters or symbols of Type I (Class A) yellow sheeting.

1. High-Visibility Sheeting. Signs with the following MUTCD codes shall be fabricated using Type IX (Class E) sheeting: R1-1, R1-2, R1-3, R3-1, R3-2, R3-3, R3-15, and R3-16.

2. High-Visibility Fluorescent Yellow Sheeting. Signs with the following MUTCD codes shall be fabricated using Type IX (Class E) fluorescent yellow sheeting for the yellow portion of the sign face, and the appropriate nonfluorescent Type IX (Class E) color for the remainder of the sign face: W1-11, W1-12, W1-13, W1-14, W2-18, W3-22, W3-23, and W3-25.

3. High-Visibility Fluorescent Yellow-Green Sheeting. Signs with the following MUTCD codes shall be fabricated using Type IX (Class E) fluorescent yellow-green sheeting for the yellow portion of the sign face, and the appropriate nonfluorescent Type IX (Class E) color for the remainder of the sign face: R2-7, R2-8, W5-1, W5-3, W5-6, W6-1, W6-3, and W6-4.

Signs with the following National MUTCD codes shall also be fabricated using Type IX (Class E) fluorescent yellow-green sheeting for the yellow portion of the sign face, and the appropriate nonfluorescent Type IX (Class E) color for the remainder of the sign face: W16-1, W16-2a, W16-7P, and W16-9P.

D. Sheeting Sign Characters. Characters include letters, numerals, route shields, symbols, and borders. Characters shall be the size, series and color specified in the MUTCD and as specified in the contract documents. Only Type IV or Type V Characters, as appropriate, shall be used. White legends and borders shall be formed with directly-applied Type IV Characters. Interstate shields for signs shall be either demountable panels or directly-applied panels with Type V reverse-screened characters. Sign face characters and background shall be reflective, but black portions of a sign face shall not be reflective.

E. Sign Face Layouts. Sign face shape, color, dimensions, and characters shall be in accordance with:

1. MUTCD.
2. National MUTCD.
3. Standard Highway Signs Book - FHWA.
4. Standard Alphabets for Highway Signs and Pavement Markings (Metric Edition) - FHWA.

Standard sign face layouts for MUTCD Codes R, P, W and M sign panels are shown in the MUTCD. Sign face layouts for MUTCD Codes G and I sign panels will be available as Supplemental Information Available to Bidders. After contract award, two copies of the sign face layouts will be provided to the Contractor. The Contractor shall verify dimensions on the sign face layouts prior to fabrication.
F. **Sign Structure Bearing Pads.** Type A Sign Structure Bearing Pads shall be made from Rubber Impregnated Woven Cotton-Polyester Fabric. Type B Sign Structure Bearing Pads shall be made from Rubber Impregnated Random Fiber Pad

645-2.03 **Type A Sign Posts.** Type A sign posts shall be selected from the Department's Approved List of Type A Sign Supports. The standard strength (i.e., moment capacity) of a Type A sign post shall be 2800 N\(\cdot\)m, although weaker or stronger posts may be substituted.

A. **Type A Sign Posts With Extra Embedment.** Type A sign posts with extra embedment (more than 1 m) shall meet the requirements of the Materials Details for Type A Sign Supports.

B. **Soil Plates for Type A Sign Posts.** Type A sign posts with soil plates shall meet the requirements of the Materials Details for Type A Sign Supports.

C. **High-Capacity Type A Sign Posts.** High-Capacity Type A sign posts are defined as any Type A sign post system shown in the Materials Details for Type A Sign Supports that has a total combined capacity for the entire two- or three-post system higher than 10600 N\(\cdot\)m. The Contractor shall calculate the design moment of the sign panel, and select an appropriate High-Capacity Type A sign post system capable of resisting that moment, subject to the Engineer's approval.

645-2.04 **Type B Sign Posts.** Type B sign posts shall be fabricated in accordance with the requirements of §730-25 *Type B Sign Posts.*

A. **Rustic Type B Sign Posts.** Rustic Type B sign posts shall be ungalvanized weathering steel meeting the requirements of ASTM A588M or A242M.

B. **Breakaway Bases and Hinge Assemblies.** Breakaway bases and hinge assemblies shall be fabricated in accordance with the requirements of §730-26 *Breakaway Bases and Hinge Assemblies.*

645-2.05 **Concrete Foundations.** Cast-in-place concrete for foundations shall meet the requirements of Class A concrete in Section 501, *Portland Cement Concrete-General.* Precast concrete foundations shall meet the requirements of §704-06 *Precast Concrete Cribbing.* The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department. The Contractor may submit a mix at least equivalent to Class A Concrete for approval by the Engineer.

645-2.06 **Breakaway Wooden Sign Posts.** Breakaway wooden sign posts shall be either Grade 2 Southern Yellow Pine or Grade 2 Douglas Fir-Larch, surfaced four side (S4S) as designated by the National Design Specification (NDS) for Wood Construction, and meeting the requirements of §712-14 *Stress Graded Timber and Lumber.* The bending stress (Modulus of Rupture) shall not be less than 27000 kPa using the clear wood properties of ASTM D2555. Posts shall be pressure treated in accordance with §708-31 *Wood Preservative - Water Borne,* dried to a maximum moisture content of 15% before and after pressure treating. The embedded portion of each post shall be sealed to 50 mm above the ground surface or above the steel tube insert, with a heavy coat (0.3 mm dry film thickness) of an emulsified asphalt conforming to AASHTO M140.

All 89 mm x 140 mm posts shall have two 38 mm diameter breakaway holes drilled through the center of the post parallel to the sign face 100 mm and 450 mm above grade and filled with flexible caulk. All 140 mm x 190 mm posts shall have two 75 mm diameter breakaway holes drilled through the center of the post parallel to the sign face 100 mm and 450 mm above grade and filled with flexible caulk. Nails and fasteners shall be stainless steel meeting the requirements of §715-16. Cuts and holes made at the contract site shall be field treated with copper naphthenate having a minimum 2% metallic solution, in accordance with AWPA Standard M4. Breakaway holes shall be field treated with copper naphthenate before filling with flexible caulk.

645-2.07 **Pole-Mounted Sign Support Systems.** Bands, brackets, hardware, and fasteners necessary to mount signs on traffic signal poles, street lighting poles or other poles shall be stainless steel.
§645

Bands shall be a minimum of 20 mm x 0.5 mm. Other methods of attachment may be substituted with prior approval of the Engineer.

645-2.08 Illuminated Signs. Illuminated Sign Panels shall be aluminum alloy 3 mm thick meeting the requirements of §730-01, Aluminum Sign Panels. All materials necessary to illuminate the sign panels shall be as shown in the contract documents.

645-2.09 Sign Covering Material. Material used to cover sign panels shall be of an opaque, porous, and windproof fabric. Plastic, mesh, translucent or transparent materials will not be allowed. The covering material shall be a single neutral color, except orange or yellow, and shall not contain any wording or images.

645-3 CONSTRUCTION DETAILS

645-3.01 General. Sign panels, overhead panels, overhead vertical brackets, vertical and horizontal Z-bars, sign support systems, sign posts, breakaway bases and hinge assemblies, and foundations for Type B sign posts shall be constructed in accordance with the contract documents, standard sheets, MUTCD and materials details. Sign locations shown in the contract documents are approximate, and the exact location for each sign will be approved by the Engineer in the field.

The Contractor shall erect new signs and remove existing signs in such a manner that the traveling public is provided all necessary regulatory, warning, and guidance information at all times. Certain items may be designated to be performed prior to other items of work.

An inspection installed signs will be made in the daylight for color, reflectivity, location, vertical post alignment, visibility, and appearance. The installed signs will also be inspected at night for color, orientation and reflectivity, traits which will be more conspicuous at night.

A. Wind Loads. The wind pressures given on the standard sheets have been calculated according to the procedure in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1994). All wind loading shall be adjusted for height, drag, and gusting in accordance with AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1994). Allowable sign areas shall be reduced when the sign centroid height is at an elevated site condition (e.g., an overpass) where the influence of the ground on the wind is reduced. For example, a sign centroid between 8.84 m and 14.94 m above the existing ground would result in a 37.5% increase in wind pressure (refer to the section “Loads” in aforementioned AASHTO Specifications).

<table>
<thead>
<tr>
<th>TABLE 645-1 WIND LOAD CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Type A</td>
</tr>
<tr>
<td>Post</td>
</tr>
<tr>
<td>Type B</td>
</tr>
<tr>
<td>Post</td>
</tr>
</tbody>
</table>

NOTE: Panel centroid height measured above the surrounding terrain.

645-3.02 Sign Panels. Sign panels shall be installed as shown on the standard sheets or as shown in the contract documents. Nominal widths are based on a conversion factor of 25 mm per inch in accordance with §200.8 of the MUTCD. Layout of sign panels and assemblies shall be as shown in the contract documents. Aluminum Overhead Mounted Sign Panels shall be separated from steel overhead sign structures in order to prevent corrosion by a Type A Sign Structure Bearing Pad or a Type B Sign Structure Bearing Pad as shown in the contract documents.
§645

645-3.03 **Type A Sign Posts.** The Contractor shall install Type A sign posts individually or in groups to provide the required moment resistance. Type A sign posts with Extra Embedment, and Soil Plates for Type A sign post, shall be installed where extra embedment depth and/or soil plates are required. High-Capacity Type A sign posts shall also be installed where extra moment capacity is required.

The number of Type A sign posts indicated in the contract documents is based on the information available during design. The number and strength of Type A sign posts installed shall be based on conditions at the final sign location approved by the Engineer. The Contractor shall determine the required moment resistance for the Type A sign post(s) due to the wind loads indicated in §645-3.01A. Wind Loads, and propose an appropriate number and strength of Type A sign posts for the approval of the Engineer. The Contractor shall submit the approved Materials Details, and any computations, to the Engineer, and install the required number of Type A sign posts subject to the following criteria:

1. For signs with a nominal width greater than 750 mm, at least two posts are required, except that the nominal 750 mm x 750 mm diamond panel and the nominal 900 mm wide "YIELD" panel require only one post.
2. The maximum number of posts installed within a 2.13 m path shall be as described on the approved Materials Details.
3. For single flanged channel post installations only, the required moment resistance for the post shall be increased by 25% to account for torsional shear. The Materials Details include this adjustment.

645-3.04 **Type B Sign Posts.** The Contractor shall install Type B sign posts, breakaway bases, hinge assemblies and foundations in accordance with the details shown on the standard sheets or the manufacturer's approved materials details.

The Type B sign post type, size and number shown in the contract documents are based on the information available during design. The sign post type, size and number to be installed by the Contractor shall be based on conditions at the final location approved by the Engineer. The Contractor shall determine the required moment resistance for the Type B sign post(s) based on the wind loads indicated in §645-3.01A. Wind Loads and verify the sign post type, size, number, hinge capacity and 2.13 m wheel path criteria for the approval of the Engineer. The Contractor shall submit any computations to the Engineer.

The Contractor may install breakaway type bases under the contract pay item for nonbreakaway type posts provided that nonslotted hinge plates are used on both flanges and the installation is outside the clear zone or otherwise protected.

**A. Rustic Type B Sign Posts.** Rustic Type B sign posts shall be installed in the same manner as Type B sign posts.

**B. Breakaway Bases and Hinge Assemblies.** Breakaway bases and hinge assemblies shall be installed in accordance with the standard sheets or the manufacturer's approved materials details.

When breakaway bases and hinge assemblies are used with rustic Type B sign posts, the breakaway bases and hinge assemblies shall be installed as follows:

1. The front (approach) flange hinge plate of rustic Type B sign posts shall be installed as shown on the contract drawings, except that an additional galvanized steel flat washer shall be installed on all four bolts between each post and the slotted hinge plate to assure proper slippage.
2. All miscellaneous visible galvanized steel hardware, except in the vicinity of the hinge plate slots, shall be painted with Weathered Brown Guide Rail Paint.

645-3.05 **Concrete Foundations.** Concrete foundations shall be constructed in accordance with the Materials Detail Sheets and contract documents. Upon completion of the sign installation the Contractor shall restore the area to its original state.
TABLE 645-2 ALLOWABLE SIGN AREAS ON 2 BREAKAWAY WOODEN POSTS

<table>
<thead>
<tr>
<th>Wooden Post Section (mm)</th>
<th>Embedment (m)</th>
<th>97 km/h Wind Velocity Height to Panel Centroid (m)</th>
<th>113 km/h Wind Velocity Height to Panel Centroid (m)</th>
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<tbody>
<tr>
<td>89 x 89</td>
<td>1.5</td>
<td>1.36</td>
<td>0.96</td>
</tr>
<tr>
<td>89 x 140</td>
<td>1.8</td>
<td>3.26</td>
<td>2.30</td>
</tr>
<tr>
<td>140 x 190</td>
<td>2.1</td>
<td>8.65</td>
<td>6.10</td>
</tr>
</tbody>
</table>

NOTE: For 1 post, reduce allowable sign areas by 60%.
For 3 posts, increase allowable sign areas by 50%.
For 3 posts, outer posts shall be separated by more than 2.4 m.

645-3.06 Breakaway Wooden Sign Posts. Breakaway wooden sign posts shall be installed in accordance with Table 645-2, Allowable Sign Areas on 2 Breakaway Wooden Posts and Materials Details.

Each sign stringer to post attachment shall be bolted completely through the post using two 10 mm diameter stainless steel bolts with nuts and washers. Posts shall use a concrete foundation as noted in Subsection 645-2.05 in this specification, with a steel tube insert or be backfilled with compacted cushion sand or stone screening, as noted in the Materials Detail Sheets and contract documents.

645-3.07 Pole-Mounted Sign Support Systems. Pole-Mounted Sign Support Systems shall consist of stainless steel bands and brackets which shall be firmly attached to the pole in accordance with the standard sheets and/or manufacturer's instructions. Each horizontal Z-Bar stiffener shall be banded to the pole. Sign panels without Z-Bars shall be attached to the pole with two bands.

Where ground-mounted signs are to be mounted on traffic signal or street lighting poles, they and their mountings shall be designed to withstand the wind loadings shown in Table 645-1. Each horizontal Z-Bar stiffener (stringer) shall be firmly attached to the pole.

645-3.08 Illuminated Signs. Illuminated sign panels shall be installed as shown in the contract documents. All work on the illumination system shall be performed in accordance with the National Electrical Code and the requirements of the local utility. Electrical circuits shall be tested by the Contractor for insulation resistance and ground resistance in accordance with the requirements below.

Testing equipment shall be supplied by the Contractor and the tests shall be performed in the presence of the Engineer.

A. Insulation Resistance Test. Each circuit including ballasts and protective devices shall be insulation tested using an insulation tester according to manufacturers instructions. The Contractor shall compute a polarization index by dividing a ten-minute reading by a one-minute reading. The polarization index shall be greater than 4.0 for acceptance of new circuits, and greater than 2.0 for acceptance of existing circuits. The lighting system shall be properly grounded and disconnected while this test is conducted.

B. Ground Resistance Test. A ground test shall be performed by the Contractor using an earth tester with resolution to a minimum of 0.1 ohm. The test shall be performed, and the results interpreted, according to manufacturer's instructions. Readings of 5.0 ohms or less will be required for acceptance.

C. Functional Test. After satisfactory completion of all other tests, a functional test shall be performed consisting of not less than ten consecutive days of satisfactory operation. If unsatisfactory performance of any component of the lighting system is discovered during this time, the condition shall be corrected and the Engineer may require the test repeated until ten days of continuous satisfactory operation is obtained.

Temporary shutdowns caused by power interruption or vehicle impact will not constitute discontinuity of the functional test.
645-3.09 Covering Signs. Signs shall be covered to eliminate noncurrent, conflicting, or unneeded information. The cover shall be held in place and positioned so that none of the sign face shows. More than one layer of fabric may be required to prevent legibility of the sign legend to be covered.

The cover shall be folded over the top and bottom of panel edges, but not on the sides, and secured to the back of the sign panel. Tape shall not be attached to the face of the sign panel nor shall holes be drilled in the sign panel or posts. Coverings that work loose shall be resecured by the Contractor at no additional expense to the State. The cover shall remain in place until the sign is no longer in conflict with current conditions.

645-4 METHOD OF MEASUREMENT

645-4.01 General. (VACANT)

645-4.02 Sign Panels. The work will be measured as the number of square meters measured to the nearest 0.01 square meter of sign panel satisfactorily covered or installed.

The area of each panel will be measured as the area shown on the standard sheets. For sign panels not shown on the standard sheets, the area will be measured as the product of length and width, with no reduction for rounded corners. When sign panels are mounted back-to-back, each panel face will be measured separately.

645-4.03 Type A Sign Posts. The work will be measured as the number of Type A sign posts required, which is the greater of either:

1) the number of posts required based on the width of the sign; or,
2) the number of posts of standard strength (2800 N•m moment capacity) required to resist the moment due to wind load.

A. Type A Sign Posts With Extra Embedment. The work will be measured as the number of Type A sign posts with extra embedment satisfactorily installed with these modified bases.

B. Soil Plates for Type A Sign Posts. The work will be measured as the number of soil plates for Type A sign posts satisfactorily installed on either standard Type A sign posts, or on Type A sign posts with extra embedment.

C. High-Capacity Type A Sign Posts. The work will be measured as the number of high-capacity Type A sign posts satisfactorily installed. Post systems in which two posts are combined to function as a single post, such as the back-to-back flanged channel or the telescoping square tube, are measured as one post.

645-4.04 Type B Sign Posts and Rustic Type B Sign Posts. The work will be measured as the number of Type B sign posts or rustic Type B sign posts satisfactorily installed. When the Engineer directs that a different size Type B sign post be installed at a location that is called for in the contract documents, and there is no contract pay item in the contract for the directed post, the original quantity shall be multiplied by the following factor: kg/m of directed post divided by kg/m of original post.

645-4.05 Concrete Foundations. The work will be measured as the number of concrete foundations for Type A Sign Posts, High-Capacity Type A Sign Posts, or Breakaway Wooden Sign Posts with steel tube inserts satisfactorily installed.

645-4.06 Breakaway Wooden Sign Posts. The work will be measured as the number of breakaway wooden sign posts satisfactorily installed.

645-4.07 Pole-Mounted Sign Support System. The work will be measured as the number of pole-mounted sign support systems satisfactorily installed. A pole-mounted sign support system is defined as the hardware necessary to mount a single sign panel on an existing pole, regardless of the number of bands used.
§645

645-4.08 Illuminated Sign Panels. The work will be measured as the number of square meters measured to the nearest 0.01 square meter of illuminated sign panel satisfactorily installed.

645-4.09 Covering Sign Panels. (Vacant).

645-5 BASIS OF PAYMENT

645-5.01 General. The unit price bid for all items shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work.

645-5.02 Sign Panels. The unit price bid for sign panels shall include the panels, horizontal and vertical stiffeners (Z-Bars), vertical overhead brackets to mount sign panels to overhead structures, and fasteners and miscellaneous hardware necessary to complete the work. The cost of sign panels that are to become part of larger signs (e.g., route shields on large guide signs) shall be included in the unit price bid for the main panel.

645-5.03 Type A Sign Posts. The unit price bid for Type A sign posts, Type A sign posts with extra embedment, soil plates for Type A sign posts, and high-capacity Type A sign posts shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

645-5.04 Type B Sign Posts. The unit price bid for Type B sign posts shall include the posts, breakaway base and hinge assemblies, and concrete footings. Breakaway bases provided in lieu of nonbreakaway posts at the Contractor's option will be paid for at the bid price for nonbreakaway bases.

645-5.05 Concrete Foundations. The unit price bid for Concrete Footing for Type A, High-Capacity Type A or Breakaway Wooden Sign Posts with steel tube inserts shall include the cost of furnishing all labor, materials and equipment necessary to install the footing and hardware.

645-5.06 Breakaway Wooden Sign Posts. The unit price bid for breakaway wooden sign posts shall include the posts and backfill if required.

645-5.07 Pole-Mounted Sign Support Systems. The unit price bid for pole-mounted sign support systems shall include the cost of furnishing all labor, materials and equipment necessary to install the sign panel on an existing pole, regardless of the number of bands used.

645-5.08 Illuminated Sign Panels. The unit price bid for illuminated sign panels shall include the work required under §645-5.02 Sign Panels, and all luminaires, bulbs, ballasts, wiring, conduit, and fittings from a point just above the footing to the most extreme luminaire. The unit price bid for illuminated sign panels shall also include the cost to energize and test the illuminated sign panel. The cost of energy necessary to illuminate sign panels before final contract acceptance shall be borne by the Contractor. The cost of controllers will be paid separately.

645-5.09 Covering Sign Panels. The unit price for covering sign panels shall include the work required for covering permanent signs: covering construction signs will be paid under Construction Signs.

Payment will be made under:

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<th>Item Description</th>
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<tr>
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<td>Ground-Mounted Sign Panel MUTCD Codes R, P, W, and M</td>
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<th>Panel Width (Nominal)</th>
<th>ASTM XX Type</th>
<th>Panel Width (Nominal)</th>
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<td>Up to 450 mm</td>
<td>11 IX</td>
<td>Up to 450 mm</td>
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<tr>
<td>02 I/III</td>
<td>451 to 750 mm</td>
<td>12 IX</td>
<td>451 to 750 mm</td>
</tr>
<tr>
<td>03 I/III</td>
<td>751 to 1625 mm</td>
<td>13 IX</td>
<td>751 to 1625 mm</td>
</tr>
<tr>
<td>04 I/III</td>
<td>Greater than 1625 mm</td>
<td>14 IX</td>
<td>Greater than 1625 mm</td>
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</table>
§645

645.72 Overhead-Mounted Sign Panels, MUTCD Codes R, P, W and M  Square Meter
645.73 Ground-Mounted Sign Panels, MUTCD Codes G and I  Square Meter
645.74 Overhead-Mounted Sign Panels, MUTCD Codes G and I  Square Meter
645.75 Tourist and Motorist Service Sign Panels  Square Meter
645.76 Illuminated Sign Panels  Square Meter
645.77 Covering Sign Panels  Square Meter
645.78 High-Visibility Overhead-Mounted Sign Panel
   MUTCD Codes R, P, W, and M  Square Meter
645.81 Type A Sign Posts  Each
645.8104 Type A Sign Posts with Extra Embedment  Each
645.8105 Soil Plate for Type A Sign Post  Each
645.8106 High-Capacity Type A Sign Posts  Each
645.8107 Concrete Footing for Type A, High-Capacity Type A or
   Breakaway Wooden Sign Posts With Steel Tube Inserts  Each
645.82 Breakaway Wooden Sign Posts  Each
645.8XYZZ Type B Sign Posts  Each

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<tr>
<th>X</th>
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<th>YY Section</th>
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<td>01 Nonbreakaway</td>
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<td>4</td>
<td>Rustic</td>
<td>02 W150X14</td>
<td>02 Bidirectional Breakaway</td>
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<td>03 Omnidirectional Breakaway</td>
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645.85 Pole-Mounted Sign Support System (Band Mounting)  Each

SECTION 646 - DELINEATORS, REFERENCE MARKERS AND SNOWPLOWING MARKERS

646-1 DESCRIPTION. This work shall consist of furnishing and installing delineators, reference markers and snowplowing markers in accordance with the N.Y.S.M.U.T.C.D., Reference Marker Manual, standard sheets, plans or as ordered by the Engineer.

646-1.01 Delineators. Delineators are reflective units placed on supports along the highway to serve as driving aids.

646-1.02 Reference Markers. Reference markers are panels with a legend, placed at approximately 161 meter intervals along the highway, to provide a numerical location reference.

646-1.03 Snowplowing Markers. Snowplowing markers are reflective units installed along the highway to identify guardrail sections for snowplow operators.

646-2 MATERIALS. Materials for delineators, reference markers and snowplowing markers shall meet the requirements of the following subsection of Section 700 Materials except as provided for below:

Galvanized Coating and Repair Methods  719-01
Aluminum Sign Panels  730-01
Reflective Sheeting  730-05
   (Materials Designations 730-05.02 and 730-05.03)
Acrylic Plastic Reflex Reflectors for Delineators  730-10
Sign Posts and Footings  730-20
Flexible Delineator Posts  730-21
Stiffeners, Overhead Brackets
   and Miscellaneous Hardware  730-22.
§646

646-2.01 Posts. Posts shall be fabricated from galvanized steel as shown on the standard sheets and/or plans, or an approved flexible post meeting the requirements of §730-21 Flexible Delineator Posts.

646-2.02 Reflective Material. Delineators and snowplowing markers shall be fabricated from either Reflective Sheeting, Material Designations 730-05.02 (Class B) or 730-05.03 (Class C), or from Acrylic Plastic Reflex Reflectors. On any one contract all of the delineators must be fabricated from the same material and all of the snowplowing markers must be fabricated from the same material, but the material may differ between the delineators and the snowplowing markers.

Reference markers shall be fabricated from Reflective Sheeting, Materials Designation 730-05.02 (Class B).

646-2.03 Aluminum Panels. Aluminum panels for delineators, reference markers and snowplowing markers shall be of aluminum alloy 6061-T6 in accordance with the standard sheets.

646-2.04 Fasteners. Fasteners shall be fabricated from stainless steel, galvanized steel or aluminum as shown on the standard sheets.

646-2.05 Brackets. Mounting brackets shall be fabricated from either aluminum alloy 6061-T6 or galvanized steel or polycarbonate (0.080) as shown on the standard sheets.

646-2.06 Corrosion Protection. All steel surfaces shall be prevented from coming in direct contact with the aluminum brackets by means of either an approved mastic or 3 mm thick pad placed between the dissimilar metals.

646-3 CONSTRUCTION DETAILS

646-3.01 Fabrication. Delineators and snowplowing markers shall be fabricated as shown on the standard sheets. Reference markers shall be fabricated as shown on the standard sheets from reflective sheeting with the legends applied by reverse silk screening and/or directly applied reflective characters using green background and white letters. Legend content shall be as shown on the plans.

646-3.02 Location. Delineators shall be installed at the locations and spacing as shown on the plans or as ordered by the Engineer. Directional orientation, arrangement, number and color of reflector units, at any given location shall be as shown on the plans.

Reference markers shall be installed at approximately 161 meter intervals along the highway. The Contractor will be given the location of each marker.

Snowplowing markers and supplementary snowplowing markers shall be installed at the locations shown on the plans or as ordered by the Engineer.

646-3.03 Erection. Delineators, reference markers and snowplowing markers are to be erected on posts, brackets, existing posts and structures in the manner shown on the standard sheets.

646-3.04 Inspection. After the installation of delineators, reference markers and snowplowing markers, an inspection by the Engineer shall be made in the day time for proper location, line and grade, vertical post alignment and visibility. They shall also be inspected at night for improper orientation, specular reflection and other defects more conspicuous at night. All apparent defects disclosed after the day and night inspections shall be corrected by the Contractor to the satisfaction of the Engineer and the cost thereof shall be included in the Contractor's unit price bid.

646-3.05 Damage. When delineators and markers are installed on walls, bridges, existing posts, poles or structures, care shall be taken so as not to damage the appearance or structural features of the existing facilities. All damaged features shall be repaired or replaced, at no additional cost, to the satisfaction of the Engineer.
646-3.06 Marker Relocation. The existing markers shall be carefully removed and stockpiled above ground in a neat and skilled manner, to the satisfaction of the Engineer, by the Contractor at the site or sites within the R.O.W. limits as designated by the Engineer. Care shall be exercised in removing the markers to prevent damage to any part of the reflectorized panels. All markers so damaged shall be replaced at the Contractor's expense.

The contractor shall remove and dispose of all existing posts or hardware used only for the support of the existing markers.

Markers removed shall be re-erected on new posts, brackets, or bands at the locations called for on the plans or specified by the Engineer.

646-4 METHOD OF MEASUREMENT. Delineators, reference markers and snowplowing markers shall be measured as the number of complete markers and/or delineators furnished and installed. In the event a section of highway is under construction by others and reference markers cannot be installed, they will be measured as the number of marker panels furnished only.

Relocated markers shall be measured as the number of markers relocated in accordance with these specifications and in a manner approved by the Engineer.

646-5 BASIS OF PAYMENT. The unit price bid shall include the cost of all materials, equipment and labor necessary to satisfactorily complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</thead>
<tbody>
<tr>
<td>646.0601</td>
<td>Delineator, Single Unit, One Way on Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0602</td>
<td>Delineator, Single Unit, Back to Back on Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0603</td>
<td>Delineator, Single Unit, Two Way on Post</td>
<td>Each</td>
</tr>
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<td>646.0604</td>
<td>Delineator, Single Unit, Three Way on Post</td>
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<td>646.0605</td>
<td>Delineator, Single Unit, Four Way on Post</td>
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<td>646.0606</td>
<td>Delineator, Double Unit on Post</td>
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</tr>
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<td>646.0607</td>
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<td>Each</td>
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<td>646.0609</td>
<td>Delineator, Single Unit, Back to Back, Band or Bracket Mounted</td>
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<td>646.0610</td>
<td>Delineator, Single Unit, Two Way, Band or Bracket Mounted</td>
<td>Each</td>
</tr>
<tr>
<td>646.0611</td>
<td>Delineator, Single Unit, Three Way, Band or Bracket Mounted</td>
<td>Each</td>
</tr>
<tr>
<td>646.0612</td>
<td>Delineator, Single Unit, Four Way, Band or Bracket Mounted</td>
<td>Each</td>
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<tr>
<td>646.0623</td>
<td>Delineator, White, Single Unit, One Way on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0624</td>
<td>Delineator, White, Single Unit, Back to Back, on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0625</td>
<td>Delineator, White, Double Unit on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0633</td>
<td>Delineator, Yellow, Single Unit, One Way on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0634</td>
<td>Delineator, Yellow, Single Unit, Back to Back, on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0635</td>
<td>Delineator, Yellow, Double Unit on Flexible Post</td>
<td>Each</td>
</tr>
<tr>
<td>646.0701</td>
<td>Reference Marker, 1.2 m Mounting Height</td>
<td>Each</td>
</tr>
<tr>
<td>646.0702</td>
<td>Reference Marker, 2.1 m Mounting Height</td>
<td>Each</td>
</tr>
<tr>
<td>646.0703</td>
<td>Reference Marker, Band or Bracket Mounted</td>
<td>Each</td>
</tr>
<tr>
<td>646.0704</td>
<td>Reference Marker, On Existing Post</td>
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</tr>
<tr>
<td>646.0705</td>
<td>Reference Marker, Furnish Panel Only</td>
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<td>646.0801</td>
<td>Snowplowing Marker, Single Unit</td>
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<tr>
<td>646.0802</td>
<td>Snowplowing Marker, Double Unit</td>
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</tr>
<tr>
<td>646.0803</td>
<td>Supplementary Snowplowing Marker</td>
<td>Each</td>
</tr>
<tr>
<td>646.09</td>
<td>Marker-Relocation</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 647 - REMOVING, STORING AND RELOCATING SIGNS

647-1 DESCRIPTION. This work shall include the removal, or removal and storage, or relocation of existing State signs and/or sign structures designated on the plans or specified by the Engineer. The sign components shall include sign panels, stringers, vertical brackets, miscellaneous hardware used solely for the support of the designated sign panels, upright supports, bracing and structures.
§647  MATERIALS. All materials used in this work shall meet the requirements of §645-2.

§647-3 CONSTRUCTION DETAILS

§647-3.01 Removal of Signs. Existing traffic signs requiring removal, but not storage, shall become the property of the Contractor and shall be removed from the work site in a neat and skillful manner to the satisfaction of the Engineer.

§647-3.02 Removal and Storage of Signs. Existing traffic signs shall be removed and stockpiled off the ground in a neat and skillful manner, to the satisfaction of the Engineer, by the Contractor at the site or sites within the R.O.W. limits as approved by the Engineer.

§647-3.03 Removal of Concrete Sign Footings. All concrete sign footings shall be completely removed, or if allowed by the Engineer, shall be cut to a depth of 0.3 meters below existing ground and be replaced with suitable material as specified by the Engineer.

§647-3.04 Relocation of Signs. Existing sign panels shall be removed and stockpiled off the ground in a neat and skillful manner by the Contractor to the satisfaction of the Engineer, at the site or sites within the R.O.W. limits as designated by the Engineer. Care shall be exercised in removing the sign panels to prevent damage to any part of the reflectorized sign face or characters, or the existing stringers or stiffeners. Any damage shall be repaired or the damaged part replaced to the satisfaction of the Engineer at the Contractor's expense.

Existing sign posts shall become the property of the Contractor and shall be removed from the work site in a neat and skillful manner.

The Contractor shall erect new sign posts and mount the existing sign panels at the locations shown on the plans or specified by the Engineer. The requirements of §645-3, Construction Details, shall apply to this work.

§647-4 METHOD OF MEASUREMENT. The quantity to be paid for will be the number of completely removed or relocated installations having sign areas of the following sizes:

- Size A: 0.0 to 1.0 Square Meters
- Size B: 1.1 to 2.0 Square Meters
- Size C: 2.1 to 4.0 Square Meters
- Size D: 4.1 to 10.0 Square Meters
- Size E: Over 10.0 Square Meters
- All Overhead Sign Panels (Any Size)

§647-5 BASIS OF PAYMENT. The unit price bid for removing or removing and storing or relocating an existing installation shall be compensation in full for the furnishing of all labor, equipment, and materials necessary described in this section.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>647.01</td>
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<td>Each</td>
</tr>
<tr>
<td>647.02</td>
<td>Removal of Signs - Size B (1.1 to 2.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.03</td>
<td>Removal of Signs - Size C (2.1 to 4.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.04</td>
<td>Removal of Signs - Size D (4.1 to 10.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.05</td>
<td>Removal of Signs - Size E (Over 10.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.06</td>
<td>Removal and Storage of Signs Size A (0.0 to 1.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.07</td>
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<td>647.08</td>
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<td>647.09</td>
<td>Removal and Storage of Signs Size D (4.1 to 10.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.10</td>
<td>Removal and Storage of Signs Size E (Over 10.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.11</td>
<td>Relocating Signs Size A (0.0 to 1.0 S.M.)</td>
<td>Each</td>
</tr>
<tr>
<td>647.12</td>
<td>Relocating Signs Size B (1.1 to 2.0 S.M.)</td>
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<td>647.13</td>
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</tr>
<tr>
<td>647.14</td>
<td>Relocating Signs Size D (4.1 to 10.0 S.M.)</td>
<td>Each</td>
</tr>
</tbody>
</table>
SECTION 648 - SUBSURFACE EXPLORATIONS

648-1 DESCRIPTION. This work shall consist of furnishing equipment, drilling for soil and rock samples, and preparing a driller's log in accordance with these specifications and the direction of the Engineer.

648-2 MATERIALS. Materials for this work shall meet the requirements of the following Subsections of Section 700 - Materials Details:

Drill Rigs                      732-01
Drive Pipe                     732-02
Casing                         732-03
Samplers                       732-04
Thin-Walled Sample Tubes       732-05
Coring Bits                    732-06
Sample Storage Bags            732-07
Sample Jars                    732-08
Jar Cartons                    732-09
Boulder and Rock Core Boxes    732-10
Open Well Piezometers          732-11
Grout                          732-12

648-3 CONSTRUCTION DETAILS

648-3.01 General. This work shall consist of furnishing equipment, clearing of all drill holes in accordance with New York State Department of Public Service Rule 753, drilling for soil and rock samples, back filling all drill holes to the satisfaction of the Engineer, and preparing a driller's log in accordance with these specifications. Any proposed variation from the methods and techniques in the specifications shall be submitted in writing by the Contractor to the Engineer who shall forward the proposal to the Director of the Geotechnical Engineering Bureau for review. Approval, if granted, will be based on the decision of the Director of the Geotechnical Engineering Bureau as to the capabilities of the proposed variation to provide satisfactory samples and subsurface information. If granted, this approval will remain in force only so long as all conditions set forth in the approval are met and satisfactory results are obtained. In the event unsatisfactory results are obtained, the approval will be withdrawn and all remaining work shall be completed in accordance with this specification. Boring work shall not commence until all equipment stated in the proposal is on the project and approved. In addition, the following shall apply:

A. Furnishing equipment for Making Borings. The Contractor shall furnish the number of drill rigs, conforming to §732-01, stated in the proposal or work order, maintain this equipment, and remove it from the site at the time indicated by the Engineer. All equipment shall be acceptable to the Engineer.

B. Driller's Logs. The forms for the driller's logs, Form 282e, will be furnished by the State and shall have the following information legibly printed on them by the Contractor:

Region
County
Contractor Name
§648

Contract Number
Project Identification Number (PIN)
Project Name
Date Started and Finished
Hole Number
Weight and Fall of Hammer (Casing)
Weight and Fall of Hammer (Sampler)
Casing and Sampler Size
Inspector Name (Regional Geotechnical Engineer on Log)
Structure Name/Number
Penetration Records (Blows on Casing, Drive Pipe and Sampler)
Sample numbers

Groundwater Data
   Depth at which drill water was first used
   Depth at which groundwater was first encountered
   Depth to groundwater at the beginning and end of each day's operation

Rock Core
   Length of Run
   Percent Recovery
   Number of Pieces
   Depth Core Obtained
   Size of Core Obtained
   Type of Core Barrel

All pertinent remarks and comments

The hole designation on the final log and sample containers should reflect the actual method of progressing the hole. Any change in hole designation (due to an alternate hole progression method) shall be forwarded to the Engineer in writing in a timely manner.

Provide all measurements and dimensions in metric units on the final log.

Ensure that the completed driller's log is signed by the drill rig operator, the drill rig inspector, and the Chief Inspector.

Deliver the samples and a copy of the completed driller's log to the location indicated in the Contract documents, between the hours of 8:00 A.M. and 3:00 P.M., within five working days following completion of the hole, except holidays. In addition, deliver another copy of the completed driller's log to the Departmental Geotechnical Engineer. Submit the original copy of the completed driller's log to the Engineer.

C. Groundwater Determinations. The level at which groundwater is first encountered in the borings shall be noted. Water level readings shall be taken at the end of each day after the last sample has been taken and the sample and rods have been removed. No soil shall be left in the casing at the end of the day. Do not fill the casing with water unless there is a need to compensate for a condition such as running sand. Measure and record the change in water level when resuming work. Capped borings shall be vented. Groundwater levels shall be measured before and after the casing or drive pipe is pulled. Each water level reading shall be recorded showing the date and time the reading was made, the depth of the drive pipe or casing, and the depth to water. Any loss or gain of water in the boring, except that caused by deliberately introducing water and/or inserting or removing tools, shall be recorded. This record shall show the date and time the loss or gain is noted, the depth of the casing and the depth to water. The height of artesian rise shall be recorded.

All water level readings and related data shall be recorded on the boring logs under “Remarks”. If necessary, additional forms shall be used for recording groundwater data.

Artesian pressures shall be permanently sealed at the elevation at which they were encountered. This seal shall be satisfactory to the Engineer before casing is removed from the hole.
§648-3.02 Split Barrel Samples

A. Progressing the Hole. The hole shall be progressed by advancing flush-joint casing, flush-coupled casing, or extra-strength drive pipe by driving or drilling, or where permitted, by a drilling mud process or by using a hollow flight auger. When driven casing is used a 136.3 kg (± 3 percent) hammer falling freely 450 mm shall be used. Actuate the hammer by means of a rope and cathead, or by automatic hammer, when casing or drive pipe is driven.

Casing refusal shall be considered as 300 blows for less than 300 mm of penetration. When refusal is encountered, the casing shall be cleaned and a sample shall be attempted, if no sample is recovered, coring will commence.

Prior to sampling, the drill hole shall be cleaned to the sampling elevation by using equipment that will not disturb the material to be sampled. Bottom discharge bits, including samplers, will not be allowed. A roller bit may be used as a clean out tool if it is of a type that deflects water to the sides rather than downward into the material to be sampled. The Engineer may order a new roller bit at any time he deems the one in use to be unacceptable. “N” size drill rods or larger shall be used in 76.2 mm or larger inside diameter casing.

The Engineer shall be advised of the time of the last sampling operation so he may be present when the hole is measured for payment purposes.

B. Sampling. Samples shall be taken at every change in stratum but in no case at intervals greater than 1.5 m. Continuous sampling may be directed by the Engineer. The sampler shall be placed on the bottom of the cleaned out hole and then driven 450 mm with a 136.3 kg (±3 percent) hammer falling freely 450 mm. Actuate the hammer by means of a rope and cathead, or by automatic hammer. When the Standard Penetration Test (SPT) is required, use equipment and procedures conforming to ASTM D1586-84, except as modified by this specification.

The number of blows required to drive the sampler each increment of 150 mm shall be recorded. If refusal is encountered before the desired sample length is attained, and the sampler proves to have no recovery, the sampler shall be removed from the hole and core drilling started; however, if refusal is encountered and the material retained represents the best obtainable sample as determined by the Engineer, the hole may be progressed to the next sample elevation or change in soil strata. Refusal shall be 50 hammer blows for less than 150 mm of penetration for the 136.3 kg hammer. When the SPT is used, refusal shall be as defined in ASTM D1586-84.

When a recovery of less than 150 mm of sample in a split barrel sampler is retrieved, the sampler shall be re-driven at the same elevation in an attempt to obtain more material. Only the first set of blows shall be recorded on the boring log, but a note shall be included under “Remarks” indicating that a second sampling attempt was made. The Engineer may direct that a basket or other spring type retainer be used on any or all sampling attempts. Flap or trap valves will only be used when specifically directed by the Engineer. When sampling material below the water table, the hole shall be kept full of fluid during the removal of tools to prevent flowback, unless otherwise directed by the Engineer.

All samples, regardless of the amount of recovery, shall become the property of the State and shall be packaged, transported and delivered in accordance with this specification.

C. Marking, Packaging and Transporting Sample. Samples shall be placed in tied plastic storage bags placed in jars conforming to §732-08 in such a manner so as to maintain the natural structure of the sample. The jar shall be labeled to show the project name, PIN, sample number, hole number, and the depths from which the sample was taken. Jars shall be placed in cartons conforming to §732-09. Samples must be protected from freezing or extreme heat. The samples shall be delivered by the Contractor to the location indicated in the Contract documents between the hours of 8:00 A.M. and 3:00 P.M., within five working days following completion of the hole, excepting holidays.

If samples are not delivered in a timely manner, work will be suspended until the samples have been delivered as required by the contract.
§648

648-3.03 Thin-Walled Tube Samples

A. Progressing the Hole. The hole shall be a minimum of 100 mm in diameter. Drilling mud may be used if permitted in writing by the Engineer. Hollow stem augers will not be allowed. The hole shall be cleaned using methods and equipment which will not disturb the soil to be sampled. Bottom discharge bits, including samplers, will not be allowed.

The 50 mm of soil directly above the sampling elevation shall be removed with a clean-out jet auger without the use of water. “N” size drill rod or larger shall be used.

B. Sampling. Thin-walled tube samples shall be taken in the strata designated by the Engineer. Samples shall be recovered with a stationary piston type sampler or a hydraulically operated piston sampler, modified to accept the thin-walled tubes specified in §732-05. Samplers with piston rods extending to the ground surface must be provided with clamps which positively lock the piston against upward travel during lowering of the sampler until the sampling depth is reached. During the press the piston rods shall be locked in a stationary position to eliminate any movements either up or down. In addition, the sampler shall also be provided with positive locks to secure the piston rods prior to removal of the sampler after penetration.

At the elevation to be sampled, the tube shall be pressed into the soil with a continuous motion a distance of 450 mm. Care must be taken to allow air and water to flow freely through the vent thus preventing compression of the soil sample. After pressing to the required depth and waiting for 5 minutes, the sampler shall be carefully rotated and removed from the hole.

During the removal of the sampler the hole shall be kept full of fluid. Before the thin-walled tube is removed from the piston, the piston rod shall be backed off to admit air past the flattened threads to break the vacuum. For other approved types of equipment, the necessary vacuum breaking measures shall be taken. The length of sample in the tube and also the distance pressed, shall be measured and recorded.

Should a thin-walled sample not be retained, a 50 mm driven sample shall be taken.

The bottom of the sample shall be carefully squared off at least 25 mm back from the end of the tube and a wax seal, approximately 25 mm thick, shall be poured in the bottom end of the tube. The soil at the top of the tube shall be carefully squared off and a wax seal, approximately 15 mm thick, shall be poured. Any space remaining between the top or bottom of the sample tube and the wax seal shall be filled with sawdust or paper after the wax has hardened. Wax will be furnished by the Geotechnical Engineering Bureau. The ends of the tubes shall be sealed with snugly fitting plastic caps which shall be secured in place with friction tape. Wax shall not be placed on the outside of the tube. Labels shall be placed on the tube below center and secured with strips of tape.

C. Marking, Packaging and Transporting Samples. Thin-walled tubes shall be labeled to show the Project Identification Number, Location, hole number, sample number, and depths from which the sample was taken. The samples shall be handled, stored and transported using care to prevent the samples from being subjected to freezing, drying, jarring and any other disturbance. The tubes properly packaged shall be stored and transported in an upright position at all times. The tubes shall be delivered by the Contractor to:

New York State Department of Transportation
Geotechnical Engineering Bureau
State Campus, Building 7
1220 Washington Avenue
Albany, New York 12232

between the hours of 8:00 A.M. and 3:00 P.M., within five working days after obtaining the tubes, excepting holidays.
§648

**D. Acceptance.** Thin-walled tubes having less than 300 mm of undisturbed recovery will be unacceptable for payment unless in the judgment of the Engineer, based on a recommendation by the Director of the Geotechnical Engineering Bureau, the actual recovery represents the best available. Thin-walled tubes which have been frozen will be unacceptable for payment. Samples that are not taken in accordance with the specification, or that are not properly sealed, or transported may be rejected.

648-3.04 Rock Core Samples

**A. Progressing the Hole.** The hole shall be progressed through the overburden in accordance with §648-3.02A until refusal is encountered. Continuous core drilling shall then be progressed in boulders and ledge rock at locations and to depths determined by the Engineer.

**B. Sampling.** Core shall be drilled using a double tube, swivel type core barrel. If at any time the core barrel is withdrawn more than 30 mm, the core barrel shall be removed from the hole and the core removed from the barrel.

**C. Marking, Packaging and Transporting Samples.** Rock cores shall be labeled in accordance with the current Geotechnical Engineering Bureau Drawing entitled “Proper Labeling of Rock Cores.” They shall be placed in core boxes constructed in accordance with the current Geotechnical Engineering Bureau Drawing entitled “Core Box - AX, BX, HX, NX Sizes” and delivered to the Department's Regional Office or to a location designated in the proposal within 2 weeks after completion of the hole.

**D. Acceptance.** Rock core recoveries of less than 85 percent of each run will be considered unacceptable unless, in the judgment of the Engineer, all obtainable state-of-the-art equipment and methods have been used and actual recovery represents the best obtainable.

648-3.05 Open Well Piezometer

**A. Progressing the Hole.** A 100 mm nominal diameter cased drill hole shall be progressed to the depth specified on the contract documents. Equipment conforming to the requirements contained in §732-01 shall be used.

**B. Installing the Well Pipe.** The open well piezometer shall be assembled to form a continuous pipe as recommended by the manufacturer or as directed by the Engineer. The open well piezometer shall be placed in the hole as shown in the Open Well Piezometer drawing to the elevation or depth specified in the contract documents or as directed by the Engineer. No grout, debris or other foreign material shall enter the PVC pipe during the installation.

**C. (Vacant).**

**D. Placing the Bentonite Seal.** After the final sand placement the steel casing shall be withdrawn an additional 300 mm and the bentonite pellets placed to form a 300 mm thick seal.

**E. Grouting and Casing Removal.** The hole shall be grouted from the bottom using the mix found at the end of this subsection or in proportions approved by the Engineer. The contractor shall withdraw the casing. As the casing is being withdrawn, the level of grout shall be maintained within 1.5 m of the top of the hole at all times. The PVC pipe shall not be allowed to move vertically while withdrawing the casing.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>NYSDOT SPECIFICATION REQ.</th>
<th>PROPORTION BY VOL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORTLAND CEMENT TYPE 1 OR 2</td>
<td>§701-01</td>
<td>2 PARTS</td>
</tr>
<tr>
<td>WATER</td>
<td>§712-01</td>
<td>12 PARTS</td>
</tr>
<tr>
<td>BENTONITE (ground to pass a 75 µm mesh sieve)</td>
<td>N/A</td>
<td>1 PART</td>
</tr>
</tbody>
</table>
F. Finishing. Wait 18 hours for the grout to cure. If the grout bleeds or shrinks, the hole shall be backfilled with sand to within 300 mm of the top of the hole. The manhole shall be mortared over the top of the open well piezometer as shown in Open Well Piezometer drawing.

648-3.06 Bore Hole Grouting. Prior to placing the grout, the sides of the boring shall be supported to the satisfaction of the Engineer using casing or some other positive means. The Contractor shall mix the grout in the following proportions, by volume:

<table>
<thead>
<tr>
<th>Component</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite</td>
<td>1 PART</td>
</tr>
<tr>
<td>Dry Cement</td>
<td>12 PARTS</td>
</tr>
<tr>
<td>Water</td>
<td>18 PARTS</td>
</tr>
</tbody>
</table>

or in proportions approved by the Engineer. After the boring is cleaned out, a grout pipe shall be placed to the bottom of the hole and grout pumped through the pipe to completely fill the boring for the full depth of the boring. After grouting, the casing shall be removed, and the boring topped off with grout. All mixing and placing operations shall be performed to the satisfaction of the Engineer.

648-4 METHOD OF MEASUREMENT

648-4.01 Furnishing Equipment for Making Borings. The quantities to be paid for will be the number of drill rigs, including barges, platforms and support vessels where required on water, specified in the proposal or work order, and for additional drill rigs ordered on the project by the Engineer. Payment will not be made for any drill rig that does not work at least 75 percent of the total working time computed from the date of actual commencement of the work to the final completion date, except for additional drill rigs ordered to the project by the Engineer.

648-4.02 Split Barrel Sample. The quantity to be paid for will be the number of acceptable samples obtained.

648-4.03 Thin-Walled Tube Sample. The quantity to be paid for will be the number of acceptable samples obtained.

648-4.04 Rock Core Drilling. The quantity to be paid for will be the number of linear meters drilled from which acceptable core was obtained. Measurement for payment shall be made in the presence of the Engineer.

648-4.05 Drill Hole (65 mm and 100 mm diameter). The quantity to be paid for will be the number of linear meters of boring progressed in overburden, less a deduction equal to the specified sampling interval for each unacceptable sample. Measurement shall be made from the surface elevation where the boring starts (including top of bridge deck or the water surface if working from a floating platform) at each hole. Measurement for payment shall be made in the presence of the Engineer.

648-4.06 Open Well Piezometer. The quantity to be paid for will be the number of linear meters of PVC pipe satisfactorily installed in accordance with this specification, measured from the top of the pipe to the bottom of the slotted screen.

648-4.07 Bore Hole Grouting (65 mm and 100 mm diameter). The quantity to be paid for will be the number of linear meters of drill hole grouted in accordance with these specifications.

648-5 BASIS OF PAYMENT

648-5.01 Furnishing Equipment for Making Borings (on land or water). The unit price bid for each drill rig shall include the cost of all labor, materials and equipment including barges, platforms and
support vessels necessary to furnish, transport and maintain the drill rig, and dismantling and removing
the equipment.

648-5.02 Split Barrel Sample. The unit price bid per sample shall include the cost of all labor,
material and equipment necessary to obtain, mark, package and deliver the sample. The jars, cartons and
samples shall become the property of the State.

648-5.03 Thin-Walled Tube Sample. The unit price bid per sample shall include the cost of all
labor, materials and equipment necessary to obtain, mark, package and deliver the sample. The tubes and
samples shall become the property of the State.

648-5.04 Rock Core Drilling. The unit price bid per meter shall include the cost of all labor, material
and equipment necessary to obtain, mark, package and deliver the samples. The core boxes shall become
the property of the State.

648-5.05 Drill Hole (65 mm and 100 mm diameter). The unit price bid per meter shall include the cost of all labor, clearing of all drill holes in accordance to New York State Department of Public Service Rule 753, and material and equipment used to progress the hole from which an acceptable sample or samples were obtained and acceptably recorded on a driller's log. The unit price bid shall be based on 15 meter incremental depths as follows:

<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 15 meters</td>
<td>Meter</td>
</tr>
<tr>
<td>15 - 30 meters</td>
<td>Meter</td>
</tr>
<tr>
<td>30 - 45 meters</td>
<td>Meter</td>
</tr>
<tr>
<td>45 - 60 meters</td>
<td>Meter</td>
</tr>
<tr>
<td>over 60 meters</td>
<td>Meter</td>
</tr>
</tbody>
</table>

648-5.06 Open Well Piezometer. The unit price bid for this item shall include the cost of all labor,
materials and equipment necessary to satisfactorily install and protect the open well piezometer. The
Contractor will receive full payment after the open well piezometer has been approved by the Engineer.

648-5.07 Bore Hole Grouting (65 mm and 100 mm diameter). The unit price bid for grouting
borings shall include the cost of furnishing all labor, materials and equipment necessary to complete the
work as required by these specifications. The cost for progressing the boring will be paid under its
appropriate item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>648.01</td>
<td>Drill Hole, 65 mm diameter 0 to 15 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.02</td>
<td>Drill Hole, 65 mm diameter 15 to 30 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.03</td>
<td>Drill Hole, 65 mm diameter 30 to 45 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.04</td>
<td>Drill Hole, 65 mm diameter 45 to 60 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.05</td>
<td>Drill Hole, 65 mm diameter greater than 60 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.06</td>
<td>Drill Hole, 100 mm diameter 0 to 15 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.07</td>
<td>Drill Hole, 100 mm diameter 15 to 30 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.08</td>
<td>Drill Hole, 100 mm diameter 30 to 45 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.09</td>
<td>Drill Hole, 100 mm diameter 45 to 60 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.10</td>
<td>Drill Hole, 100 mm diameter greater than 60 m Depth Range</td>
<td>Meter</td>
</tr>
<tr>
<td>648.11</td>
<td>Split Barrel Sample</td>
<td>Each</td>
</tr>
<tr>
<td>648.12</td>
<td>Thin-Walled Tube Sample</td>
<td>Each</td>
</tr>
<tr>
<td>648.13</td>
<td>Rock Core Drilling AX</td>
<td>Meter</td>
</tr>
<tr>
<td>648.14</td>
<td>Rock Core Drilling BX</td>
<td>Meter</td>
</tr>
<tr>
<td>648.15</td>
<td>Rock Core Drilling NX</td>
<td>Meter</td>
</tr>
<tr>
<td>648.16</td>
<td>Rock Core Drilling HX</td>
<td>Meter</td>
</tr>
<tr>
<td>648.17</td>
<td>Furnishing Equipment for making Borings</td>
<td>Each</td>
</tr>
<tr>
<td>648.18</td>
<td>Furnishing Equipment for making Borings on water</td>
<td>Each</td>
</tr>
<tr>
<td>648.19</td>
<td>Furn. Equip. for making Borings on water using stationary platform</td>
<td>Each</td>
</tr>
<tr>
<td>648.20</td>
<td>Open Well Piezometer</td>
<td>Meter</td>
</tr>
<tr>
<td>648.21</td>
<td>Grouting 65 mm Bore Hole</td>
<td>Meter</td>
</tr>
<tr>
<td>648.22</td>
<td>Grouting 100mm Bore Hole</td>
<td>Meter</td>
</tr>
</tbody>
</table>
SECTION 650 - JACKING REINFORCED CONCRETE PIPE

650-1 DESCRIPTION. Under this work the Contractor shall install by jacking, an extra strength, reinforced concrete, tongue and groove, culvert pipe of the size and at the location shown on the plans or as specified by the Engineer.

650-2 MATERIALS. Pipe shall meet all the requirements of §706-02, Reinforced Concrete Pipe for Class V, except that the exterior barrel shall be smooth.

650-3 CONSTRUCTION DETAILS

650-3.01 Approval

A. General. Construction drawings, showing the proposed method and procedure of jacking the pipe and construction of jacking and receiving pits shall be submitted to the Engineer for approval before work on the jacking operation is started. Approval of construction drawings shall not relieve the Contractor of his responsibility to perform the work without damage to existing construction. Field conditions may require changes in the approved drawings and such changes shall be subject to the approval of the Engineer.

B. Jacking Under Railroad. Construction drawings, methods, work and necessary precautions related to jacking pipe under a railroad shall be submitted to, meet the requirements of, and have the approval of the Chief Engineer of the railroad company. No work shall be commenced until such approval has been received from the railroad company.

650-3.02 Jacking Procedures

A. General. The pipe shall be jacked with jacks of sufficient capacity to shove the pipe through the embankment into position true to required line and grade and with tongue downstream. When jacking the pipe, a minimum 13 mm thick steel cutting shield at least 600 mm long with an arc length equal to 1/3 of the pipe circumference shall be required to abut the upper 1/3 circumference and extend beyond the forward end of the pipe being jacked. The outside radius of this shield shall not exceed the outside radius of the pipe. Excavation ahead of the pipe shall not be permitted to progress beyond the end of the shield being used.

B. Jacking Under Railroad. Rail hangers shall be installed by railroad company forces prior to the jacking operations, unless the Engineer is advised otherwise by the railroad company. The rail hangers will not be removed by railroad forces until all voids in the embankment as a result of the jacking operation, have been filled by the Contractor to the satisfaction of the railroad company.

650-3.03 Contractor Responsibility. The Contractor shall be held responsible for surface subsidence and damage or disturbance to adjacent property and facilities that may result from his construction methods. In case loose material is encountered and cave-ins occur or are anticipated, all jacking will be discontinued, approved shoring shall be provided and all voids filled either by pressure grouting or other approved methods before jacking is continued.

Field conditions may require that the actual jacking operations be continued without interruption in order to prevent undermining the roadway or the railroad roadbed and tracks. Should the Engineer permit interruption of jacking operations, the Contractor shall provide bulkheads and dewatering measures as approved by the Engineer.

650-3.04 Railroad Responsibility. Any settlement or upheaval of the railroad tracks resulting from the pipe installation and occurring within one year from the date the work is completed, will be corrected by the railroad company.
§650

650-4 METHOD OF MEASUREMENT. The quantity to be paid for under this work will be the number of linear meters of extra strength reinforced concrete culvert pipe jacked into place and measured in its final position.

650-5 BASIS OF PAYMENT

650-5.01 General. The unit price bid per linear meter shall include the cost of jacking the pipe; sheeting, bracing and flooring the jacking and receiving pits; excavation and backfill; pressure grouting; construction drawings; and all labor, materials and equipment (including dewatering if required) necessary to complete the work in accordance with the plans and specifications or directions of the Engineer; except the pipe which will be paid for separately under the contract item for Reinforced Concrete Pipe Class V. Rail hangers (if required) shall be installed and removed by railroad company forces at no cost to the Contractor.

No extra payment of any sort will be made for premium time which may be required under this work, but the cost thereof shall be included in the unit price bid.

No partial or final payment for jacking pipe under a railroad will be made until the work has been approved by the respective railroad company.

Costs incurred by the railroad company to correct settlement or upheaval of the railroad tracks resulting from the pipe installation and occurring within one year from the date of work is completed, will be reimbursed to the railroad company directly by the State at no cost to the Contractor.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>650.01nn</td>
<td>Jacking Reinforced Concrete Pipe Under Railroad</td>
<td>Meter</td>
</tr>
<tr>
<td>650.02nn</td>
<td>Jacking Reinforced Concrete Pipe Under Highway</td>
<td>Meter</td>
</tr>
</tbody>
</table>

Refer to the Contract Proposal for full item number and full description.

SECTION 651 - COMMUNICATION FACILITIES

651-1 DESCRIPTION. The work in this section shall include special construction of communication facilities which are required for outside agencies such as police and fire departments.

The construction details for this work will be covered by special provisions in the contract documents.

SECTION 652 - FURNISHING AND APPLYING SALTS

652-1 DESCRIPTION. Under this work the Contractor shall furnish and apply salt for soil stabilization, as a dust palliative or for other purposes as specified.

652-2 MATERIALS. Materials for this work shall conform to the requirements of the following subsections of Section 700 - Materials:

- Calcium Chloride  712-02
- Sodium Chloride  712-03

652-3 CONSTRUCTION DETAILS

652-3.01 Stabilized Gravel Surface Course. The Contractor shall apply salt for stabilization in accordance with the construction details specified in §411-3.

652-3.02 Dust Control. The Contractor shall apply salt on the highway to control dust at the locations and during periods as the Engineer may direct. The salt shall be applied on the dampened road surface by means of approved line spreader or equal equipment. An approved sprinkler or other approved method
may be used to dampen the road surface. The recommended application rates for calcium chloride are as follows:

0.8 kg/m² per application
2.2 kg/m² per year

652-4 METHOD OF MEASUREMENT. Salt shall be measured by the number of the metric tons furnished and applied.

652-5 BASIS OF PAYMENT. The unit price bid per metric ton shall include all labor, material and equipment necessary to complete the work including necessary water to dampen the road surface.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>652.01</td>
<td>Furnishing and Applying Calcium Chloride</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>652.02</td>
<td>Furnishing and Applying Sodium Chloride</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

SECTION 653 (VACANT)

SECTION 654 - IMPACT ATTENUATORS

654-1 DESCRIPTION. The Contractor shall furnish and install, remove and dispose, remove and store, relocate, or refurbish impact attenuators of the indicated types and sizes at or from the locations indicated in the Contract Documents or those directed in accordance with these specifications, the Contract Documents, materials details, manufacturer’s directions and drawings, and the directions of the Engineer.

654-2 MATERIALS. Materials shall conform to the following subsections of these specifications:

- Class A Concrete
- White Pavement Marking Paints
- Concrete Grouting Material
- Anchoring Material- Chemically Curing
- Epoxy Coated Bar Reinforcement, Grade 420
- Sodium Chloride
- Inertial Barrier Modules
- Impact Attenuator, Reusable, HDPE Cylinders and Cables
- Impact Attenuator, Quad Beam Type with Expendable Modules
- Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips
- Impact Attenuator, Thrie Beam Type with Expendable Modules
- Impact Attenuator, HDPE Cylinders with Monorail and Diaphragms
- Galvanized Coating and Repair Methods
- Aluminum Sign Panels
- Reflective Sheeting

654-3 CONSTRUCTION DETAILS.

654-3.01 General. The following shall apply to all impact attenuators to be installed under this section.

A Drawings. Prior to installing any materials required under this section, the Contractor shall submit three (3) copies of the manufacturer’s drawings, modified as necessary to reflect site conditions, to the Engineer. The submission shall include certification that modifications made to reflect site conditions will not impair the satisfactory performance of the impact attenuator. Manufacturer’s drawings, modified as necessary to reflect site conditions, will be referred to in this section as “working drawings.” Working drawings will take precedence over manufacturer’s drawings.
Working drawings shall show supports, transition pieces, connections, miscellaneous parts, concrete or steel back-up structure, and anchorages not detailed in the plans, but which are necessary to develop the full performance of the impact attenuator. The Contractor shall not commence installation of the impact attenuator earlier than five (5) days following submission of the above mentioned working or manufacturer’s drawings unless authorized by the Engineer to do so.

**B Manuals.** In addition to the drawings mentioned above, the Contractor shall deliver to the Engineer three (3) copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type impact attenuator being installed. The Contractor shall not commence installation of the impact attenuator earlier than five (5) days following submission of the above mentioned manuals, unless authorized by the Engineer to do so.

**C Coordination with Other Work.** The work under this section shall be coordinated with the removal or installation of shielded objects, guide rail and median barriers, impact attenuators or end terminals so as to minimize the time that motorists are exposed to unnecessary hazard. Also, the Contractor shall minimize exposure of vehicular traffic to the possibility of impact on the back-up structure. Unless modified in the contract documents, minimize shall mean seven (7) or fewer calendar days.

**D Traffic Protection.** Traffic control devices, such as cones, drums, lights, signs, barricades, or other articles directed by the Engineer shall be provided and maintained under their respective pay items. These devices shall not be removed until the impact attenuator, including required transition pieces, is fully operational. If the impact attenuator is to be installed in lighted areas, or in areas to be lighted, the mentioned traffic control devices shall not be removed unless the lighting system is operational.

**654-3.02 Impact Attenuators Requiring Foundations.** If the work of furnishing and installing impact attenuators requires the provision of a foundation slab, the following shall apply:

**A Excavation.** Necessary excavation shall be performed in accordance with Section 203 of the Standard Specifications. If the foundation slab is to be installed in a pavement that is to remain in place in the completed project, the limits of excavation in such pavement shall be saw cut full depth prior to removal of the pavement and performance of the excavation work. Unless indicated otherwise, the limits of pavement excavation shall be 600 mm outside the perimeter of the foundation slab.

**B Foundation Slab.** The Contractor shall construct the reinforced concrete foundation slab and back-up structure to the dimensions indicated in the working or manufacturer’s drawings. The foundation slab shall be not less than the thickness indicated on the working drawings, manufacturer’s drawings, or 200 mm, whichever is greatest.

The concrete shall be Class A concrete batched in accordance with §501-3 Portland Cement Concrete, Construction Details. If accelerators are needed, the Contractor shall submit the concrete mix design to the Materials Bureau for prior approval. The concrete shall be formed, placed, finished, and cured in accordance with §502-3 Portland Cement Concrete Pavement, Construction Details.

The reinforcing bars shall be in conformance to §709-04 Epoxy Coated Bar Reinforcement, Grade 420. The size, length, and bending details of reinforcement shall be as shown in the foundation slab details in the manufacturer’s drawings or in the working drawings. The minimum allowable reinforcing shall be #16 longitudinal bars, spacing 400 mm on centers, and #16 cross bars, spacing 2 meters on centers. Longitudinal bars shall be placed such that they will not be cut during anchorage installation.

**C Pavement Restoration.** The excavated section of pavement between the new foundation slab and the limits of excavation shall be restored to the full height of the surrounding sound pavement in accordance with §402-3.05 Conditioning of Existing Surface, or in the manner directed by the Engineer.
§654-3.03 Anchorages. The impact attenuator shall be anchored to the new foundation slab or existing concrete foundation as shown on the manufacturer’s drawings or the working drawings. Anchor bolts and studs not cast integrally into the new foundation slab shall be anchored with approved concrete expansion anchors, concrete grouting material conforming to §701-05, or approved chemically curing anchoring material conforming to §701-07. Such anchor bolts or studs shall be set into holes drilled with rotary impact drills of the size recommended by the manufacturer of the anchor. Core drills will not be acceptable. Care shall be taken that anchor studs projecting from the surface and exposed to foot or wheeled traffic be well marked by barricades, plastic drums, or protected by other means as approved by the Engineer.

§654-3.04 Inertial Barrier Modules. The Contractor shall furnish and install Inertial Barrier Modules of the size and number required at the locations and to the configurations indicated on the contract plans, or at the locations and to the configurations directed by the Engineer. In addition to the requirements indicated in §654-3.01 General, the Contractor shall also paint and label the layout pattern and weights on paved surfaces using traffic or other durable paint. Glass beads will not be required. Either the metric weight or the U.S. customary weight, as directed by the Engineer, shall be marked.

The 90 kg units shall be restrained from movement by mechanical means, or by other means as approved by the Engineer.

§654-3.05 Impact Attenuator, Thrie Beam Type or Quadbeam Type with Expendable Modules. In addition to the requirements indicated in §654-3.01 General, §654-3.02 Impact Attenuators Requiring Foundation (if applicable,) and §654-3.03 Anchorages, the Contractor shall furnish and install Impact Attenuators, Thrie Beam Type or Quadbeam Type with Expendable Modules on existing or new foundations, as indicated, of the indicated width and length and at the locations indicated on the contract plans, in accordance with these specifications, the manufacturer’s directions and drawings, the working drawings, and the directions of the Engineer.

The manufacturer’s steel backup assemblies shall be used, except when protecting concrete piers, concrete parapets, concrete walls, or other rigid objects. In these excepted cases, either the manufacturer’s steel backup assembly or the manufacturer’s recommended concrete backup assembly may be used at the option of the Contractor, unless directed otherwise on the plans or by the Engineer. The Contractor shall furnish and install the appropriate standard transition piece. If there is no appropriate standard transition piece available, a manufacturer’s approved special transition piece shall be furnished and installed.

§654-3.06 Impact Attenuator, HDPE Cylinder Types.

A. General. In addition to the requirements indicated in §654-3.01 General, §654-3.02 Impact Attenuators Requiring Foundation , and 654-3.03 Anchorages, the Contractor shall furnish and install Impact Attenuator, HDPE Cylinders and Cable Type or Impact Attenuator, HDPE Cylinders with Monorail and Diaphragm Type on existing or new foundations, as indicated, of the indicated number of cylinders of the required thicknesses and dimensions in accordance with these specifications, the manufacturer’s directions, and the working drawings.

B. Impact Attenuator, HDPE Cylinders and Cable Type. In addition to the above in A. General, the following shall also apply. The base of concrete barriers and other similar solid objects shall be cut back at a 45° angle, and transition pieces shall be provided on both sides between the backup structure and the concrete barrier or other similar object.

C. Impact Attenuator, HDPE Cylinders with Monorail and Diaphragm. In addition to the above in A. General, the following shall also apply. Unless indicated otherwise, the Contractor shall select, furnish, and install either a metal backup structure or concrete backup structure. In bidirectional situations, a transition piece shall be installed to shield the back of the backup structure from impact by traffic.
654-3.07 Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips. The Contractor shall furnish and install Impact Attenuators, Corrugated Beam Type with Metal Tearing Strips on new or existing foundations, as indicated, of the indicated number of bays at the locations indicated in the contract documents in accordance with these specifications, the manufacturer’s instructions and drawings, the working drawings, and the directions of the Engineer.

654-3.08 Impact Attenuators, All Types, Remove and Dispose. The Contractor shall remove impact attenuators of the indicated type and associated foundation slabs, if required, from their existing locations. Upon removal, the impact attenuators and foundation slabs shall become the property of the Contractor, and the Contractor shall dispose of them in a manner and at a location approved by the Engineer. Holes in and other damage to the surfaces underlying the impact attenuator shall be repaired to the satisfaction of the engineer. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface. Voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as directed.

654-3.09 Impact Attenuators, All Types, Remove and Store. The Contractor shall remove impact attenuators of the indicated type from their existing locations with reasonable skill and care in a manner that preserves their condition. The impact attenuators shall remain the property of the State, and the Contractor shall store and protect them in a manner and at locations satisfactory to the Engineer. Damaged parts shall be replaced with like parts in satisfactory condition or repaired in a manner approved by the Engineer. If required, pavement slabs shall be removed and disposed of in a manner and at locations satisfactory to the Engineer. Voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as directed. Holes and other damage to the surfaces underlying the impact attenuator shall be repaired to the satisfaction of the engineer. Anchor bolts or studs that are no longer required or usable shall be removed, or cut off flush with the surface.

654-3.10 Impact Attenuators, All Types, Relocate. The Contractor shall remove impact attenuators of the indicated type from their existing locations with reasonable skill and care in a manner that preserves their condition, and reinstall them at the same location or install them at another designated location. If required, the Contractor shall construct a new foundation slab. The impact attenuators shall remain the property of the State during the course of the work. If intermediate storage is required during the relocation, the Contractor shall store and protect impact attenuators in a manner and at locations approved by the Engineer. Damaged parts shall be replaced with like parts in satisfactory condition or be repaired in a manner approved by the Engineer. If required, pavement slabs shall be removed and disposed of in a manner and at locations satisfactory to the Engineer. Voids resulting from the removal of foundation slabs shall be filled with compacted suitable material, compacted granular material, or other designated material, as directed. Holes and other damage to the surfaces underlying the impact attenuator shall be repaired to the satisfaction of the Engineer. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

§654-3.01C Coordination with Other Work, §654-3.01D Traffic Protection, and §654-3.09 Impact Attenuators, All Types, Remove and Store shall apply. If required, a new foundation slab shall be constructed in accordance with the requirements of §654-3.02, Impact Attenuators Requiring Foundations.

654-3.11 Impact Attenuators, All Types, Refurbish. The contractor shall refurbish bays of designated impact attenuators of the indicated type in accordance with these specifications, the directions of the manufacturer, and as approved by the Engineer. Damaged parts shall be replaced with like parts in satisfactory condition or repaired to the satisfaction of the Engineer. §654-3.01C Coordination with Other Work, and §654-3.01D Traffic Protection shall apply. In addition, the Contractor shall repair the anchorages in accordance with §654-3.03 Anchorages, if they are damaged.

654-4 METHOD OF MEASUREMENT.
654-4.01 General. Measurement will be taken as the number of impact attenuators of the indicated type and size satisfactorily furnished and installed on existing foundations; as the number of impact attenuators of the indicated type and size satisfactorily furnished and installed on new foundation slabs; as the number of impact attenuators of the indicated type satisfactorily removed and disposed; as the number of impact attenuators of the indicated type satisfactorily removed and stored; as the number of impact attenuators of the indicated type and size satisfactorily relocated to existing foundation; as the number of impact attenuators of the indicated type and size satisfactorily relocated to a new foundation slab, including construction of the new foundation slab; or as the number of individual bays of impact attenuators of the indicated type satisfactorily refurbished, all in accordance with these specifications, the directions of the Engineer, and the manufacturer’s or working drawings and manufacturer’s directions.

654-4.02 Number of Bays. Under the contract items for furnishing and installing Impact Attenuators, Quad Beam Type with Expendable Modules and the contract items for furnishing and installing Impact Attenuators, Corrugated Beam Type with Metal Tearing Strip, the nose will not be counted as a bay. Under the contract items for refurbishing Impact Attenuators, Quad Beam Type with Expendable Modules the nose will be counted as a bay.

654-5 BASIS OF PAYMENT.

654-5.01 General. Except as modified below, the following shall apply to contract items under this section. The unit prices bid for furnishing and installing, removing and disposing, removing and storing, relocating, or refurbishing Inertial Barrier Modules and Impact Attenuators of the various types shall include the cost of all labor, materials, and equipment necessary to satisfactorily perform the work.

A. Site preparation. Site preparation, if any, shall be paid for separately under appropriate contract items.

B. Pavement sawing. Pavement sawing in pavement to remain as finished surface, or that directed by the Engineer shall be separately paid. That conducted for the convenience of the contractor shall be at no additional expense to the State.

C. Excavation, and removal of existing foundation slabs. Excavation for new foundation slabs and for the removal of existing foundation slabs will be separately paid for under the contract item for unclassified excavation and disposal.

D. Pavement restoration. Pavement restoration shall be separately paid under the contract items for Truing and Leveling. If there are no contract pay items for Truing and Leveling, then pavement restoration shall be paid under the contract item for the top course of hot mix asphalt. If no contract items exist in the contract for paving items, then no separate payment for pavement restoration will be made.

E. Parts. The cost of replacing or repairing parts damaged during the course of the work shall be at no additional expense to the State. The cost of replacing or repairing parts having pre-existing damage shall be separately paid for under the provisions of Extra Work.

F. Maintenance and protection of Traffic. Maintenance and protection of traffic will be measured and paid for under appropriate items.

654-5.02 Progress Payments. The contract items under this section are eligible for progress payments as indicated below. The balance of payment will be made upon satisfactory completion of the work.

A. Working Drawings. Contract items requiring working drawings will be eligible for progress payment of ten (10) percent upon submission of the working drawings and certification that the modifications thereon will not impair the satisfactory performance of the impact attenuator.
Submission of manufacturer’s drawings that are not working drawings, as determined by the Engineer, will not entitle the Contractor to a progress payment.

**B Impact Attenuators with New Foundation Slabs.** Contract items requiring the construction of new foundation slabs will be eligible for progress payments of ten (10) percent upon satisfactory finishing and initiation of curing of the foundation slab.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>654.01xx</td>
<td>Inertial Barrier Module, ___ Kilograms</td>
<td>Each</td>
</tr>
<tr>
<td>654.02xx</td>
<td>Inertial Barrier Module, ___ Kilograms, Remove and Dispose</td>
<td>Each</td>
</tr>
<tr>
<td>654.03xx</td>
<td>Inertial Barrier Module, ___ Kilograms, Remove and Store</td>
<td>Each</td>
</tr>
<tr>
<td>654.04xx</td>
<td>Inertial Barrier Module, ___ Kilograms, Relocate</td>
<td>Each</td>
</tr>
</tbody>
</table>

*xx =01 for 90 kg units; 02 for 180 kg units; 03 for 320 kg units; 04 for 640 kg units; 05 for 960 kg units.*

| 654.10xxyy | Impact Attenuator, Quad Beam Type with Expendable Modules Including new Foundation Slab, xx Width Class, yy Bays | Each     |
| 654.11xxyy | Impact Attenuator, Quad Beam Type with Expendable Modules Existing Foundation, xx Width Class, yy Bays | Each     |

*xx = width class: 24, 30, 36, 69, 90 (inches)*

*yy = number of bays: 03, 04, 05, 06, 07, 08, 09*

| 654.12 | Impact Attenuator, Quad Beam Type with Expendable Modules Remove and Dispose | Each     |
| 654.13 | Impact Attenuator, Quad Beam Type with Expendable Modules Remove and Store  | Each     |
| 654.14 | Impact Attenuator, Quad Beam Type with Expendable Modules Refurbish Bay    | Each     |
| 654.15xxyy | Impact Attenuator, Quad Beam Type with Expendable Modules, Relocate to and Construct New Foundation Slab, xx Width Class, yy Bays | Each     |

*xx = width class: 24, 30, 36, 69, 90 (inches)*

*yy = number of bays: 03, 04, 05, 06, 07, 08, 09*

<p>| 654.16 | Impact Attenuator, Quad Beam Type with Expendable Modules, Relocate to Existing Foundation | Each     |
| 654.20xx | Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Including New Foundation Slab, xx Cylinders | Each     |
| 654.201527 | Impact Attenuator, HDPE Cylinders, Diaphragms, New Foundation Slab, 1.5 m Wide, 27 Cylinders | Each     |
| 654.202429 | Impact Attenuator, HDPE Cylinders, Diaphragms, New Foundation Slab, 2.4 m Wide, 29 Cylinders | Each     |
| 654.203029 | Impact Attenuator, HDPE Cylinders, Diaphragms, New Foundation Slab, 3.0 m Wide, 29 Cylinders | Each     |
| 654.211527 | Impact Attenuator, HDPE Cylinders, Diaphragms, on Existing Foundation, 1.5 m Wide, 27 Cylinders | Each     |
| 654.212429 | Impact Attenuator, HDPE Cylinders, Diaphragms, Existing Foundation, 2.4 m Wide, 29 Cylinders | Each     |
| 654.213029 | Impact Attenuator, HDPE Cylinders, Diaphragms, Existing Foundation, 3.0 m Wide, 29 Cylinders | Each     |
| 654.2215 | Impact Attenuator, HDPE Cylinders, Diaphragms, 1.5 m Wide, 27 Cylinders Remove and Dispose | Each     |
| 654.2224 | Impact Attenuator, HDPE Cylinders, Diaphragms, 2.4 m Wide, 29 Cylinders Remove and Dispose | Each     |
| 654.2230 | Impact Attenuator, HDPE Cylinders, Diaphragms, 3.0 m Wide, 29 Cylinders Remove and Dispose | Each     |
| 654.2315 | Impact Attenuator, HDPE Cylinders, Diaphragms, | Each     |</p>
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<tr>
<th>Specification</th>
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<th>Quantity</th>
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<td>654.241527</td>
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<tr>
<td>654.242429</td>
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<td>Each</td>
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<tr>
<td>654.243029</td>
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<tr>
<td>654.2515</td>
<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 1.5 m Wide, 27 Cylinders, Relocate to Existing Foundation</td>
<td>Each</td>
</tr>
<tr>
<td>654.2524</td>
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<td>Each</td>
</tr>
<tr>
<td>654.2530</td>
<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 3.0 m Wide, 29 Cylinders, Relocate to Existing Foundation</td>
<td>Each</td>
</tr>
<tr>
<td>654.2615</td>
<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 1.5 m Wide, 27 Cylinders Refurbish Diaphragm</td>
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<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 3.0 m Wide, 29 Cylinders, Refurbish Diaphragm</td>
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</tr>
<tr>
<td>654.2715</td>
<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 1.5 m Wide, 27 Cylinders, Refurbish Monorail</td>
<td>Meter</td>
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<td>654.2724</td>
<td>Impact Attenuator, HDPE Cylinders, Diaphragms, 2.4 m Wide, 29 Cylinders, Refurbish Monorail</td>
<td>Meter</td>
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<td>Meter</td>
</tr>
<tr>
<td>654.21xx</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, on Existing Foundation, xx Cylinders</td>
<td>Each</td>
</tr>
<tr>
<td></td>
<td>xx = number of cylinders ; 04, 06, 09</td>
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<tr>
<td>654.22</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Remove and Dispose</td>
<td>Each</td>
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<tr>
<td>654.23</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Remove and Store</td>
<td>Each</td>
</tr>
<tr>
<td>654.24xx</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Relocate to and Construct New Foundation Slab, xx Cylinders</td>
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<td>xx = number of cylinders ; 04, 06, 09</td>
<td></td>
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<tr>
<td>654.25</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Relocate to Existing Foundation</td>
<td>Each</td>
</tr>
<tr>
<td>654.26</td>
<td>Impact Attenuator, Reusable, HDPE Cylinders and Cable Type, Refurbish Cylinder</td>
<td>Each</td>
</tr>
<tr>
<td>654.30XXYR</td>
<td>Impact Attenuator, Beam Type, Metal Tearing Strips, New Foundation, XX Bays, Y Sides Widening</td>
<td>Each</td>
</tr>
<tr>
<td>654.31XXYR</td>
<td>Impact Attenuator, Beam Type, Metal Tearing Strips, Existing Foundation, XX Bays, Y Sides Widening</td>
<td>Each</td>
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<tr>
<td>654.32</td>
<td>Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips, Remove and Dispose</td>
<td>Each</td>
</tr>
<tr>
<td>654.33</td>
<td>Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips, Remove and Store</td>
<td>Each</td>
</tr>
<tr>
<td>654.34XXYR</td>
<td>Impact Attenuator, Beam Type, Metal Tearing Strips, Relocate to and Construct New Foundation,XX Bays,Y Sides Widening</td>
<td>Each</td>
</tr>
<tr>
<td>654.35</td>
<td>Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips,</td>
<td></td>
</tr>
</tbody>
</table>
§654

654.36XXYR Impact Attenuator, Beam Type, Metal Tearing Strips, Relocate to Existing Foundation, XX Bays, Y Sides Widening Each

Where XX = 06, or 09-19 bays

Y = 0, no flaring. Available only when XX = 06 or 09.

= 1, flared on only one side

= 2, flared on two sides

R = major revision number

654.40xxyy Impact Attenuator, Thrie Beam Type w\Expendable Modules, New Foundation Slab Each

654.41xxyy Impact Attenuator, Thrie Beam Type w\Expendable Modules, Existing Foundation Each

654.42 Impact Attenuator, Thrie Beam Type w\Expendable Modules, Remove and Dispose Each

654.43 Impact Attenuator, Thrie Beam Type w\Expendable Modules, Remove and Store Each

654.44xxyy Impact Attenuator, Thrie Beam Type w\Expendable Modules, Relocate to & Construct New Foundation Slab Each

654.45xxyy Impact Attenuator, Thrie Beam Type w\Expendable Modules, Relocate to Existing Foundation Each

654.46xxyy Impact Attenuator, Thrie Beam Type w\Expendable Modules, Refurbish Each

xx = width class; 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96

yy = number of bays; 03-12

SECTION 655 - FRAMES, GRATES AND COVERS

655-1 DESCRIPTION. This work shall consist of furnishing and placing frames, grates, covers and curb boxes for drainage structures as shown on the plans or as directed by the Engineer.

655-2 MATERIALS

655-2.01 Castings. All cast gratings, covers, frames and curb boxes manufactured in conformance to the Standard Sheets “Cast Manhole Frames, Grates and Covers”, or “Cast Frames and Curb Boxes and Welded Frames”, or “Telescoping Manhole Casting & Ring” shall meet the requirements of §715-05 Iron Castings, Class No. 30B or Class No. 35B. All other gratings, covers, frames and curb boxes shall meet the requirements of §715-02, Steel Castings, Grade N-1; or §715-07, Proof Loaded Iron Castings, Class No. 30B or Class No. 35B; or §715-09, Malleable Iron Castings, Grade 22010, at the Contractor’s option. No substitutions will be allowed.

655-2.02 Fabricated Articles. All frames, gratings and appurtenant parts shall be fabricated from steel conforming to ASTM A36M, AISI Grade 1020 Steel, AISI Grade 1025 Steel, or ASTM A529M Gr. 345, except that the longitudinal bars for grates G1, G2, G3, 10 PCB, 11 PCB and 12 PCB shall meet the requirements of ASTM A529M, Gr. 345. The Contractor shall submit mill certifications, to the Engineer, for ASTM A529M, Gr.345. Welding or splicing by welding of any member of the frame or grate, other than the welds shown on the standard sheets, plans, approved shop drawings, approved Materials Details, or in the proposal will not be permitted. Galvanizing shall be in accordance with §719-01 Type I, unless indicated otherwise.

Welding shall comply with the requirements specified in the New York State Steel Construction Manual, except that radiographic inspection will not be required.

655-3 CONSTRUCTION DETAILS

655-3.01 Frames and Grates. Frames, covers and grates shall be placed true to line and grade. Covers, grates and frames shall make firm, full and even bearing on their respective underlying surfaces and shall be non-rocking under the influence of traffic or other loads. On all frames, the Contractor shall
have the option of drilling and tapping holes or drilling holes in and welding nuts to the bottom of the frame to facilitate the stud bolts used to hold down the grate.

Unless otherwise specified, the hole shall be drilled and tapped or the nut welded to the frame before galvanizing. The threads shall be tapped sufficiently oversize to conform to ANSI B1.13M Class 6h after galvanizing.

655-3.02 Field Repairs for Improperly Fitting Systems. The Contractor may propose to the Engineer reasonable field repair procedures for improperly fitting castings. No field repairs of improperly fitting fabricated frames and grates shall be allowed. Field repairs may include grinding and/or proper welding techniques for the materials involved. Repairs that involve welding shall be allowed only on steel castings, and not on iron, and only with prior approval of the DCES. Implemented repairs must result in systems whose constituent parts have full, uniform and even bearing contact on their respective underlying surfaces and that do not rock or move under the influence of traffic and other loads. All such repairs must be completely satisfactory to the Engineer or the work shall be rejected and replaced with satisfactory systems. All repairs shall be done at no cost to the State.

655-4 METHOD OF MEASUREMENT

655-4.01 Frames and Grates. The quantity to be measured under this work will be the number of square meters measured inside the frame containing the grate and computed to the nearest 1/100 square meter. The payment areas shown on the standard sheets need not be computed.

655-5 BASIS OF PAYMENT

655-5.01 Frames and Grates. The unit price bid per square meter for cast or prefabricated frames and grates shall included the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including the cost of any field repair work for improperly fitting castings or to render the frame and grate non-rocking.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>655.0101</td>
<td>Frames and Grates (Castings)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>655.0201</td>
<td>Frames and Grates (Fabricated)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>655.0301</td>
<td>Frames and Grates (Parallel Bar Type)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>655.0401</td>
<td>Frames and Grates (Parallel Bar Type with Cast Frames)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>655.0501</td>
<td>Steel Fabricated Grates In Cast Frames</td>
<td>Square Meter</td>
</tr>
<tr>
<td>655.0601</td>
<td>Telescoping Manhole Frames and Covers</td>
<td>Square Meter</td>
</tr>
</tbody>
</table>

SECTION 656 - MISCELLANEOUS METALS

656-1 DESCRIPTION. This work shall consist of furnishing and placing all metal component parts in accordance with the specifications which are not included in other items of work and which are specifically identified on the plans to be reimbursed at the unit bid price for Miscellaneous Metals.

656-2 MATERIALS. Metals required for this work shall meet the requirements of the following Subsections of Section 700 - Materials:

| Castings, Forgings, and Metals (As Specified) | 715 |
| Miscellaneous Metals and Plastics (As Specified) | 725 |

656-3 CONSTRUCTION DETAILS

656-3.01 Drawings. Shop drawings shall be prepared, approved and distributed in accordance with the provisions of the SCM. When applicable, the manufacturer's specification date sheet (catalog clip) may be furnished in lieu of shop drawings. The Engineer may waive the shop drawing requirement for any non-welded component part that can be fabricated directly from the details shown on the plans.
656-3.02 Welding. Welding shall comply with the requirements specified in the New York State Steel Construction Manual.

656-3.03 Galvanizing. When materials for this work are to be galvanized, the process and spelter coating shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods.

656-3.04 Painting. All unembedded metal except castings shall be painted in accordance with Section 574, Localized Painting of Structural Steel. Galvanized material shall be painted in accordance with Section 657.

656-4 METHOD OF MEASUREMENT. Payment for this work shall be measured by the number of kilograms of metal furnished and placed in accordance with the plans and specifications.

656-5 BASIS OF PAYMENT. The unit price bid per kilogram shall include all labor, materials and equipment necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>656.01</td>
<td>Miscellaneous Metals</td>
<td>Kilogram</td>
</tr>
</tbody>
</table>

SECTION 657 - PAINTING GALVANIZED AND ALUMINUM SURFACES

657-1 DESCRIPTION. This work shall consist of painting galvanized and aluminum surfaces. The surfaces will not have been painted previously. See special note entitled “Galvanized and Aluminum Surface to be Painted” for the description of serialized items.

657-2 MATERIALS

657-2.01 Paint For Use On Galvanized Surfaces. Material for this work shall meet the requirements of:

708-06 Paint for Galvanized Surfaces

657-2.02 Paint for Use On Aluminum Surfaces. The portions of aluminum or aluminum alloys that will be in contact with cast or projected concrete shall meet the requirements of:

708-04 Zinc Chromate Primer

Substitutions for this material will be considered, provided the material is specifically formulated for use over aluminum and to reduce alkali attack.

Aluminum surfaces not in contact with concrete shall be painted as described in the contract documents with;

708-07 Paint for Aluminum Surfaces

657-2.03 Paints.

A. Data Sheets. At least five work days prior to the start of work, the Contractor shall supply the Engineer with one copy of the paint manufacturer's current technical data and materials safety data sheets for each coat to be applied. If manufacturer’s recommendations are more restrictive or require additional effort not defined in this specification, then the manufacturer’s recommendations shall be followed.
§657

**B. Storage.** Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

**C. Color.** The color of the primer will be the Contractor's option; however, it shall contrast with the underlying substrate. The color of the topcoat shall be in accordance with the contract documents or defined by §708-05. A ‘Rustic’ color shall be Weathered Brown.

**D. Labeling.** Paint arriving at the work site in new, unopened containers and labeled with the manufacturer's name, product name, component part, batch number, color, and shelf life date shall be used. Paint in containers having expired shelf life dates shall not be used. They shall be immediately removed from the work site.

657-2.04 Water for Pressure Washing. Water shall be clean, fresh potable water.

657-2.05 Abrasive for Sweep Blasting Galvanizing Surfaces. Abrasive size shall range between 200 and 500 microns, and shall have a Mohr’s hardness of 5 or less. Use of steel grit or shot is prohibited.

657-2.05 Paint Inspection Equipment. Prior to the start of and throughout the duration of the work, the Contractor shall ensure that the Engineer or Inspector is supplied with the following equipment in good working order:

- One bound copy of the Steel Structures Painting Council surface preparation specification, SSPC - SP COM “Surface Preparation Commentary for Steel and Concrete Substrates”.
- One bound copy of the Steel Structures Painting Council surface preparation specification, SSPC SP-1 - “Solvent Cleaning”.
- One bound copy of the Steel Structures Painting Council surface preparation specification , SSPC-SP 7, “Brush-Off Blast Cleaning”.
- One bound copy of the Steel Structures Painting Council method SSPC-PA2, Paint Application Specification No. 2 – “Measurement of Dry Film Thickness With Magnetic Gages”.
- ASTM D 4417 Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel.
- ASTM D 4285 Test Method for Indicating Oil or Water in Compressed Air.
- One Air Thermometer, pocket type, -10°C to +40°C.
- One Magnetic Dry-Film Thickness Gage, Type 2 (fixed probe).
- Two Wet-Film Thickness Gages, Prong-Type, capable of measuring 25 µm to 250 µm in 25 µm increments.
- Sling Psychrometer and US Weather Bureau Psychrometric Tables.

657-3 CONSTRUCTION DETAILS

657-3.01 Classification and Surface Preparation of Surfaces. For the purposes of this specification, a surface will be considered weathered if the galvanizing has been uncoated and exposed to a well-ventilated environment for a minimum of two years. A surface will be considered new if it was galvanized less than two years ago.

**A. Weathered Galvanized Surfaces.** All surfaces to be painted shall be pressure washed using equipment operating at a minimum pressure of 12.5 MPa, a water temperature of 85°C to 93°C, and a minimum flow of 15 L/minute. The nozzle shall be held at a distance of 150 mm to 300 mm from the surface.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil and grease, animal waste, salts, and other debris. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1. The areas shall be pressure washed again following this cleaning.
B. Newly Galvanized Surfaces. All surfaces to be painted shall be pressure washed, using equipment operating at a minimum pressure of 21 MPa, and a minimum flow of 15 L/minute. The nozzle shall be held at a distance of 150 mm to 300 mm from the surface.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil and grease, animal waste, salts, and other debris. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1. The areas shall be pressure washed again following this cleaning.

Once cleaned, all galvanized surfaces shall receive a light sweep blast using abrasive blasting equipment. All compressed air used to satisfy the requirements of this specification shall be clean. The cleanliness shall be verified with a white blotter test according to ASTM D 4285 at least once per shift.

The light blast shall remove zinc oxides from the galvanizing as well as etch the surface. The light sweep blast shall not remove excessive amounts of zinc from the galvanized surface. The sweep blast shall impart to the galvanized surface an anchor profile of 25 to 40 microns as measured using profile tape and a spring-loaded micrometer according to ASTM D 4417.

The initial thickness of the galvanizing prior to sweep blasting shall be established using a magnetic thickness gage in a manner as described under ASTM A123. If the sweep blast results in a 15% or greater loss of galvanized coating, the article shall be rejected. The sweep blast shall be performed in a manner that does not result in disbondment and flaking of the galvanizing.

After sweep blasting, the galvanized surfaces shall be thoroughly blown down with clean compressed air to remove all blast residue. Any sharp, protruding defects in the galvanized surface such as that commonly found on edges and holes shall be removed by hand tools.

Application of the primer shall be performed within 12 hours of sweep blasting the galvanized surface. If more than 12 hours elapse prior to priming, the galvanized surfaces shall be reblasted according to this specification at no additional cost to the State. If re-blasted, the item shall not have lost 15% or more of its original galvanized coating thickness.

C. Aluminum Surfaces. Aluminum surfaces shall be prepared using methods and technologies as described in the latest version of SSPC-SP COM, Surface Preparation Commentary for Steel and Concrete Substrates. Chemical stripping and water jetting methods for surface preparation are prohibited. The effectiveness of the method chosen shall be verified prior to production work for its ability to remove aluminum oxides and provide a surface profile as required by the paint manufacturer.

657-3.02 Painting.

A. Atmospheric Conditions. No paint shall be applied when the receiving surface and ambient temperatures are less than 5°C or greater than 38°C. If the manufacturer’s recommendations for temperature are more restrictive than those listed in this specification, the manufacturer’s temperature limits shall be used for application requirements. No paint shall be applied unless the receiving surface is absolutely dry.

Paint shall not be applied when the relative humidity is more than 85% unless the coating manufacturer’s requirements are more stringent. No paint shall be applied during rain.

Manufacturer’s recommended humidity and dew point restrictions shall be observed.

B. Mixing Paint. All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use.

C. Solvents and Thinners. Paint may be thinned if recommended by the manufacturer and approved by the Engineer. Under no circumstance should the paint be thinned where the resulting VOC level exceeds 340 g/L. The manufacturer shall be able to advise the Contractor and Engineer as to the maximum amount of thinner allowed.

Use of unauthorized solvents and thinners or using excess amounts of solvents and thinners is prohibited. Paint thinned excessively or incorrectly shall be removed at no additional cost.
§657

**D. Paint Application.** Painting shall not begin until cleaned surfaces have been inspected. The Contractor shall also provide sufficient time for the work to be inspected at various stages of completion. The item(s) shall cure in an environment that is free of airborne dust and dirt until the paint is dry to the touch. Paint may be applied using brush or roller, unless otherwise indicated by the contract documents. All paint shall be applied to produce a uniform, even coating free of runs, sags, drips, ridges or other defects. Areas exhibiting these defects shall be re-cleaned at no additional cost to the State.

Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating and not leave fibers in the coating. The roller nap length shall be limited in accordance with the paint manufacturer’s recommendation.

If the surface becomes contaminated before paint is applied, the surface shall be cleaned as described in this specification at no additional cost.

**E. Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness as directed by the paint manufacturer’s data sheets.

The actual dry-film thickness over galvanizing shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - Measurement of Dry-Film Thickness with Magnetic Gages, using a Type 2 fixed-probe magnetic gages. The gage(s) shall be properly calibrated over the galvanized surface according to their manufacturer’s recommendation prior to paint application.

The actual dry-film thickness over aluminum surfaces will be estimated using a wet-film thickness gauge.

Areas failing to meet the specified minimum dry film thickness shall be overcoated with the same type of paint to produce the total dry film thickness required. The overcoating must be performed within the paint manufacturer’s specified recoat window.

657-4 **METHOD OF MEASUREMENT.** The unit measurement for this work is lump sum.

657-5 **BASIS OF PAYMENT.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to complete the work.

657-5.01 **Progress Payments.** Progress payments will be made based on the ratio of area cleaned and painted to the total area to be painted as described in the contract documents.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>657.01nmnn</td>
<td>Painting Weathered Galvanized Surfaces</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>657.02nmnn</td>
<td>Painting Newly Galvanized Surfaces</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>657.03nmnn</td>
<td>Painting Aluminum Surfaces</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

*nmnn Serialized number identified structure detailed in contract documents.

**SECTION 658 (VACANT)**

**SECTION 659 - TELECOMMUNICATION UTILITIES**

659-1 **DESCRIPTION.** The work in this section shall include special construction required for telecommunications service utilities, including telephone, cellular telephone and cable television that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

659-2 **MATERIALS.** Materials shall meet the requirements specified by the respective utility company.

659-3 **CONSTRUCTION DETAILS**

659-3.01 **General.** The installation and testing procedures shall conform to the requirements specified by the utility company.
659-3.02 Schedule of Work. Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

659-3.03 Excavation. The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

659-3.04 Backfill. The requirements specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes and Conduits and Direct Burial Cables, shall apply.

659-4 METHOD OF MEASUREMENT. As specified in the special specifications.

659-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 660 - UTILITIES

660-1 DESCRIPTION. The work in this section shall include special construction required for service utilities that are publicly, privately or cooperatively owned. The extent of work, and construction specifications will be covered by special provisions in the contract documents.

660-2 MATERIALS. Materials shall meet the requirements specified by the respective utility company.

660-3 CONSTRUCTION DETAILS

660-3.01 General. The installation and testing procedures shall conform to the requirements specified by the utility company.

660-3.02 Schedule of Work. Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified, advance notice, period must be given to the utility company and Engineer prior to interruption of services for construction.

660-3.03 Excavation. The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

660-3.04 Backfilling. The requirements specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes and Conduits and Direct Burial Cables, shall apply.

660-4 METHOD OF MEASUREMENT. As specified in the special specifications.

660-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 661 - ELECTRIC UTILITIES

661-1 DESCRIPTION. The work in this section shall include special construction required for electric service utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

661-2 MATERIALS. Materials shall meet the requirements specified by the respective electric utility company.

661-3 CONSTRUCTION DETAILS

661-3.01 General. The installation and testing procedures shall conform to the requirements specified by the electric utility company.
§661

661-3.02 Schedule of Work. Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

661-3.03 Excavation. The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

661-3.04 Backfill. The requirements specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes and Conduits and Direct Burial Cables, shall apply.

661-4 METHOD OF MEASUREMENT. As specified in the special specifications.

661-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 662 - GAS, OIL & STEAM UTILITIES

662-1 DESCRIPTION. The work in this section shall include special construction required for gas, oil and steam service utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

662-2 MATERIALS. Materials shall meet the requirements specified by the respective utility company.

662-3 CONSTRUCTION DETAILS

662-3.01 General. The installation and testing procedures shall conform to the requirements specified by the utility company.

662-3.02 Schedule of Work. Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified, advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

662-3.03 Excavation. The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

662-3.04 Backfill. The requirements specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes and Conduits and Direct Burial Cables, shall apply.

662-4 METHOD OF MEASUREMENT. As specified in the special specifications.

662-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 663 - WATER SUPPLY UTILITIES

663-1 DESCRIPTION. This work shall consist of the construction or reconstruction of water supply utilities in accordance with these specifications, the contract documents and the standard sheets.

663-2 MATERIALS

663-2.01 General. Materials requirements are specified in the following subsections:

<table>
<thead>
<tr>
<th>Material</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement Concrete</td>
<td>501</td>
</tr>
<tr>
<td>Reinforced Concrete Pipe Classes II, III, IV, V</td>
<td>706-02</td>
</tr>
<tr>
<td>Prefabricated Adjustment Rings, Frames and Utility</td>
<td>715-13</td>
</tr>
<tr>
<td>Valve Risers for Drainage Units, Manholes and Utilities</td>
<td>715-13</td>
</tr>
<tr>
<td>High Strength Bolts, Nuts and Washers</td>
<td>715-14</td>
</tr>
<tr>
<td>Pins and Rollers</td>
<td>715-15</td>
</tr>
</tbody>
</table>
Materials for water systems shall meet the appropriate American Water Works Association (AWWA) standards and American National Standards Institute (ANSI) specifications, except as modified by these specifications. Asbestos cement pipe or lead tipped gaskets shall not be used. The materials provided shall meet the requirements specified in the “Owner Requirements for Water Mains and Appurtenances”.

663-2.02 Concrete. All concrete for thrust blocks and cradles for water mains shall meet the requirements of Class A Concrete in Section 501, Portland Cement Concrete General, except that the requirements for inspection facilities, automated batching controls and recordation will not apply. Class A concrete for thrust blocks and cradles, or other concrete that comes into contact with ductile iron or cast iron materials for water mains, including pipe, fittings, hydrants, valves and valve boxes shall not contain fly ash. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department, or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

663-3 CONSTRUCTION DETAILS

663-3.01 General. All work shall be done in accordance with applicable AWWA standards, the plans and specifications, and shall be completed to the satisfaction of the Engineer. Owner requirements will be specified in the contract documents under the special notes “Owner Requirements for Water Mains and Appurtenances”. The Contractor shall make all necessary arrangements, obtain all local permits, and pay all charges as required to satisfy the requirements and regulations of the system Owner. Any required health agency permits will be obtained by the system Owner. The local fire department shall be notified by the Contractor a minimum of forty-eight (48) hours prior to interruption of service to any existing hydrant and within twenty-four (24) hours after a hydrant is placed into service. The Contractor shall notify the Owner, in writing, of any hydrant installed with the drain hole plugged.

The locations of the existing mains as shown on the contract plans are often approximate, as indicated by the underground utility quality level designation. Where new water main connections, not including service connections of 2 NPS and smaller, to existing facilities are proposed, existing utility type, size and/or condition shall be determined by excavating test pits prior to the start of installation. The Contractor shall submit details for connecting existing pipe(s) to the proposed main(s) and drawings or catalog cuts of water pipes and appurtenances comprising the work to the Engineer, with sufficient time to allow for local approval, prior to ordering materials. At any time pipe laying is not in progress, the open ends of the working pipe shall be kept plugged and watertight with plugs, stoppers or other means acceptable to the Engineer.

The Engineer shall be notified immediately of the discovery of any suspected asbestos-containing water supply utilities not identified in the contract documents. Any asbestos-containing water supply utility not identified in the contract documents and encountered during the work shall not be disturbed. No cutting, grinding or any disturbance of asbestos-containing utility shall be performed under the items in this section.

663-3.02 Removals. Removal of existing water main shall include the removal of all appurtenances and fittings within the trench excavation width for that size pipe as shown on the standard sheets, except that an existing concrete thrust block need not be removed unless its presence will interfere with proposed work. Existing items requiring removal and disposal shall become the property of the Contractor and
shall be removed from the work site to the satisfaction of the Engineer. Existing items requiring removal and storage shall be removed and stored by the Contractor for pick up by the Owner. The Contractor shall exercise care in removing items to be stored to prevent damage. Unusable or unwanted material shall be disposed of by the Contractor. Removal of an existing water service connection shall include the removal of the service pipe from the main to the highway boundary or other location(s) shown in the contract documents and the removal of the curb stop and curb box. Unless otherwise noted in the Owner requirements, corporation stops shall be removed and the hole plugged with a solid brass or iron plug.

Disturbance of asbestos-containing water supply utility requires use of a New York State Department of Labor (NYSDOL) licensed contractor using NYSDOL certified asbestos handlers. Removal of asbestos-containing water supply utility encountered during excavation or exploration shall not be performed under the removal items contained in this section.

663-3.03 Shutdowns. A shutdown of any portion of a water system to make connections to existing mains shall be made with the consent of the system Owner. Approvals for shutting off a water service shall be obtained from the Engineer. The Contractor shall give a minimum of forty-eight (48) hours notice to each customer prior to interruption of service, unless the system Owner requires a longer notification period. Such notice may be provided by posting a written notice at the entrance to the building from the street. When a residential service is to be interrupted for more than 60 minutes during the establishment’s normal business hours, the Contractor shall, when directed by the Engineer, provide a temporary water service. When a commercial service is to be interrupted for more than 60 minutes during the establishment’s normal business hours, the Contractor shall, when directed by the Engineer, provide a temporary water service. A temporary water service shall be required only when specified in the plans, or when directed by the Engineer, and will then be paid for under the Temporary Water Service item.

663-3.04 Excavation and Backfill. The Contractor shall meet the requirements specified in Section 206, Trench, Culvert and Structure Excavation, except as modified by the contract documents. The payment width of trench excavation shall be as shown on the standard sheet for this section. Bell holes shall be excavated no larger than required to allow joint assembly and to allow the pipe to lay flat in the trench. Trenches for pipe sizes from 3 NPS to 24 NPS shall provide a minimum of 150mm clearance to rocks or boulders and trenches for pipe sizes from 30 NPS to 64 NPS shall provide a minimum of 225mm clearance to rocks or boulders. Longitudinal excavation and backfill limits shall be 1.0 m beyond the connection or termination point with an existing main, and 0.6 m beyond the barrel of a hydrant.

The Contractor shall meet the requirements of §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits, and Direct Burial Cables. Materials containing fly ash or slag, including Controlled Low Strength Material that contains flyash, shall not be used as backfill or allowed to come into contact with ductile iron or cast iron materials for water mains, including pipe, fittings, hydrants, valves and valve boxes. Bedding and embedment material used for backfill around plastic pipe shall have a maximum particle size of 19mm.

663-3.05 Thrust Restraint. Thrust forces produced in water mains at changes in direction or size shall be restrained in order to keep the main intact. Thrust restraint may be provided by restrained joints, retainer glands, thrust blocks or tie rods, as required by the Owner. The minimum required thrust block areas and volumes shown on the standard sheet are for a standard water system test pressure, soil bearing capacity and soil unit weight. These values shall be adjusted for higher water system test pressure requirements or different soil conditions in the field. The Contractor shall be responsible for providing the proper size and type of thrust restraint, based on the standard sheets, the Owner requirements and the contract plans. Thrust restraint for sizes larger than 24 NPS will be designed on a case by case basis, and will be shown in the contract documents.

663-3.06 Pipe.

A. General. Pipe shall be laid in close conformity to line and grade having a full, firm and even bearing at each joint and along the entire length of pipe. Pressurized pipe need not be laid with the bells upstream. Only gaskets certified by the Manufacturer for use with the type of pipe or fitting installed shall be used. Existing gray iron pipe shall be cut with an abrasive pipe saw, rotary wheel
cutter, guillotine pipe saw, milling wheel saw or a hydraulic squeeze cutter. The Contractor shall repair, realign or replace pipe that is damaged or disturbed through any cause occurring prior to acceptance of the contract. Pipe which is defective from any cause, including damage caused by handling and determined by the Engineer to not be repairable, will be unacceptable for installation and shall be replaced as directed by the Engineer at no cost to the State.

**B. Ductile Iron Cement Lined Water Pipe.** Ductile iron water mains shall be installed in accordance with AWWA Standard C600. Unless otherwise noted in the Owners requirements, ductile iron pipe up to 12 NPS shall be pressure class 350 or thicker, and the cement lining shall be 1.6 mm thick. Unless otherwise noted in the Owners requirements, ductile iron pipe from 14 NPS to 24 NPS shall be pressure class 250 or thicker, and the cement lining shall be 2.4 mm thick. Unless otherwise noted in the Owners requirements, ductile iron pipe from 30 NPS to 64 NPS shall be pressure class 250 or thicker and the cement lining shall be 3.2 mm thick. Ductile iron pipe joints shall be installed with deflections not exceeding that listed in the table on the standard sheet. Ductile iron pipe selected for cutting shall be field gauged in order to ensure that after smoothing and beveling (if required), the cut end will provide a sound joint. Ductile iron pipe shall be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw. Ductile iron pipe shall be cut with an oxyacetylene torch only when recommended by the Manufacturer and approved by the Engineer. Cut ends and rough edges shall be ground smooth. Cut ends shall be beveled if using push-on joints. The Contractor shall ensure that the cement mortar lining of ductile iron pipe is not damaged during cutting operations.

**C. Steel Water Pipe.** Steel water pipe shall be installed in accordance with the contract documents and the Owner requirements. Steel pipe may be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw. Steel pipe shall be welded in accordance with AWWA Standards and with the provisions of the “NYS Steel Construction Manual”. Fittings for steel pipe shall be shop fabricated in accordance with AWWA Standard C208. Linings and coatings shall be installed in accordance with the appropriate AWWA Standard for the specified material.

**D. Concrete Water Pipe.** Concrete water pipe shall be installed in accordance with the contract documents and the Owner requirements.

**E. Plastic Water Pipe.** Plastic water mains shall be installed in accordance with AWWA Standard C605. Unless otherwise noted in the Owners requirements, plastic water pipe shall be pressure class 150. Plastic water pipe may be cut with a hand saw, circular saw or similar equipment. After cutting plastic water pipe, ends shall be smoothed or beveled similar to factory ends to provide sound joint connections. Plastic water pipe shall be re-marked with an insertion line to allow proper joint make-up. Unless otherwise noted in the Owners requirements, plastic water pipe shall be installed with a coated tracing wire above the pipe to facilitate location. A portion of the wire shall be stripped and firmly connected to valves, hydrants, corporation stop and curb stops to provide electrical connectivity.

**F. Bridge Mounted Water Pipe.** Water pipe shall be installed on a bridge in accordance with the contract plans. This shall include, but is not limited to, expansion devices, rollers, chairs, connectors, insulation, insulation covering and sleeves.

**G. Handling and Assembly of Pipe.** Pipe and fittings shall be inspected prior to placement. The inside of pipe, fittings and existing water mains shall be kept free of dirt and foreign material. If dirt or potentially contaminated water has entered the inside of a water main, the main shall be cleaned and disinfected prior to placement to facilitate the disinfection process on the completed installation. Pipe and fittings shall be lowered into place, and shall not be rolled, dropped or allowed to fall into a trench or pit.
§663-3.07 Polyethylene Encasement and Insulation.

A. Polyethylene Encasement. When called for in the contract documents, ductile-iron pipe shall be polyethylene encased in accordance with the methods outlined in AWWA Standard C105.

B. Insulation for Buried Water Pipe. When called for in the contract documents, insulation shall be installed in accordance with the contract plans and the Manufacturer’s recommendations. Insulation for underground installation shall use appropriate material or be covered with an appropriate waterproof jacket or insulator, as specified in the Owner requirements.

§663-3.08 Valves & Valve Boxes.

A. General. Valves shall have an asphaltic or epoxy coating as required under AWWA Standard C509 or C515. Valves shall open in the direction specified in the Owner requirements. Valves shall be lowered into place, and shall not be rolled, dropped or allowed to fall into a trench or pit. Valves shall not be lifted or moved by the valve stem.

B. Valve Installation. Valves shall be installed where shown on the contract plan during the progress of the pipe laying. Valves shall be laid with full, firm and even bearing. Bearing shall be provided by concrete blocks, or a minimum of 150mm of well-compacted granular fill or crushed stone, as required in the Owner requirements or as shown on the plans.

C. Handling of Removed or Relocated Valves. All valves shown on the plans to be removed or relocated shall be carefully detached, cleaned and stored in locations acceptable to the Engineer within the job site. The Contractor shall take special precautions to prevent damage to the valve during disconnection, movement and reinstallation.

D. Valve Relocation. Valves shall be removed from the existing location, checked, all foreign material removed from the interior and placed in operating condition before reinstallation. Exterior rust and corrosion shall be removed and the valve exterior recoated with an asphaltic coating prior to installation.

E. Valve Boxes. Unless otherwise noted in the Owner requirements, valve boxes shall be slide type adjustable, set plumb over the center of the valve and to the proper grade. Any valve box which has moved sufficiently from the original position so as to prevent the application of the valve key shall be reset by the Contractor at no additional cost to the State. New valve box covers shall be cast with the word “WATER” on the top as a means of identification.

§663-3.09 Hydrants.

A. General. Each hydrant shall include bonnet, upper barrel, lower barrel and shoe with all internal operating parts. Hydrants shall be dry-barrel, traffic type, incorporating a frangible connection on the hydrant barrel or at the groundline joint and on the operating rod. The outside of the hydrant upper barrel shall be painted with a minimum of one coat of primer and one finish coat of industrial enamel in the color noted in the Owner requirements or to match existing hydrants if not noted. Unless otherwise noted in the Owner requirements, all hydrants shall have a 5 NPS main valve and be equipped with a 4½ NST steamer nozzle and two 2½ NST hose nozzles. Non-operational hydrants shall be bagged or covered, in a manner acceptable to the Engineer, until they are tested and placed in service.

B. Hydrant Installation. Hydrants shall be installed during the laying of pipe. Hydrants shall be restrained, typically from the main to the hydrant shoe, using one of the methods outlined under §663-3.05 “Thrust Restraint”. Hydrants shall be set plumb at the proposed locations. The groundline marked on the hydrant, or identified by the manufacturer using an offset from a point on the hydrant, shall be within 25 mm above or below finished grade. The hydrant shall be installed so that no portion of the lower barrel, (that portion remaining if the hydrant top is broken off) extends more than
§663

100 mm above grade. The measurement will be taken over a 1.5 m horizontal span when a change in grade occurs within 1.5 m of the hydrant. Hydrant drainage material meeting the specifications of §703-02, Table 703-4, Size Designation 1 or 2, shall be placed around the hydrant at the drip location (0.2 m’ minimum) to drain the barrel, except as noted on the standard sheets or the contract plans. Hydrant barrels shall be rotated so that the steamer nozzle is facing the roadway, unless otherwise noted in the contract documents.

C. Handling of Removed or Relocated Hydrants. All hydrants shown on the plans to be removed or relocated shall be carefully detached, cleaned and stored in locations designated by the Engineer within the job site. The Contractor shall take special precautions to prevent damage to the hydrant assembly during disconnection, movement and reinstallation.

D. Hydrant Relocation. Hydrants shall be removed from the existing location, checked, all foreign material removed from the interior of the barrel and placed in operating condition before reinstallation. Exterior rust and corrosion shall be removed and the hydrant repainted the color specified by the Owner prior to reinstallation. When the hydrant is ready for service, the hydrant shall be opened and closed to verify that all parts are in working condition. The barrel interior shall be inspected for proper drainage after reinstallation is completed.

663-3.10 Hydrant Fenders. Fenders shall be installed where shown on the contract plans, in accordance with the standard sheets.

663-3.11 Dry Hydrants. Dry hydrants shall be furnished and installed in accordance with the contract documents.

663-3.12 Tapping Sleeve, Valve & Valve Boxes and Line Stop & Tapping Fittings. Fittings shall be installed in accordance with the Manufacturers recommendations. All valves shall be installed in accordance with the requirements of §663-3.08.

663-3.13 Bolted, Sleeve Type Couplings. All couplings shall meet the requirements of AWWA Standard C219.

663-3.14 Iron Water Main Fittings. All fittings shall be compact ductile iron (AWWA C153) unless specifically required otherwise in the Owner requirements. When approved by the Owner, the Contractor may provide a comparable full body fitting (AWWA C110) when not specifically required.

663-3.15 Wedge Type Mechanical Restraint Glands. Glands shall be installed in accordance with the Manufacturer’s recommendations, using break away wedge bolts. If a gland needs to be moved or adjusted, the Contractor shall reinstall the wedges using a torque indicating wrench to within the torque range recommended by the Manufacturer.

663-3.16 High Deflection Restrained Joint Fittings. All fittings shall be compact ductile iron (AWWA C153) unless specifically required otherwise in the Owner requirements.

663-3.17 Water Service Connections. A water service connection shall include the installation of everything, except water service pipe, required to provide a connection from a main to a customer at the highway boundary, including corporation stop, curb stop, curb box, tapping sleeve or saddle, if required, and all necessary fittings.

Taps should be a minimum of 600mm from a pipe end. Multiple taps should be a minimum of 450mm apart, measured along the axis of the main. If taps are made at the 2 or 10 o’clock positions, the Contractor shall ensure that the high point in the water service pipe meets the minimum cover requirement. Taps greater than 2 NPS shall be made using a tapping sleeve and valve.

For ductile iron pipe, unless otherwise noted in the Owner requirements, maximum allowable direct tap sizes shall be as shown in Table 663-1. For plastic pipe, unless otherwise noted in the Owner requirements, taps up to NPS 1 may be direct tapped into a main, and taps from 1-1/4 NPS to 2 NPS shall be tapped using a tapping saddle.
Table 663-1 Maximum Allowable Direct Tap Size for Ductile Iron Pipe (NPS)

<table>
<thead>
<tr>
<th>Pipe Size (NPS)</th>
<th>Pressure Class 250</th>
<th>300</th>
<th>350</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>--</td>
<td>--</td>
<td>3/4</td>
</tr>
<tr>
<td>6</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>--</td>
<td>--</td>
<td>1-1/4</td>
</tr>
<tr>
<td>14</td>
<td>1-1/4</td>
<td>1-1/2</td>
<td>1-1/2</td>
</tr>
<tr>
<td>16</td>
<td>1-1/2</td>
<td>2</td>
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<td>18</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE: All thickness class sizes of ductile iron pipe may be direct tapped.

Unless otherwise noted in the Owner requirements, water service pipe shall be Type K copper. Unless otherwise noted in the Owner requirements, polyethylene water service pipe shall be installed with a coated tracing wire to facilitate location. A portion of the wire shall be stripped and firmly connected to the corporation stop and the curb stop to provide electrical connectivity.

The Contractor will have the option to install water service pipe using boring, drilling or other trenchless method. Trenchless installation shall be performed in a manner acceptable to the Engineer. Water service pipe installed using a trenchless method shall be installed in a single length free of couplings or other fittings over that length.

663-3.18 Water Meter Pits, Type A. All pits shall be furnished in accordance with details in the contract documents and the Owner requirements. Type A pits are concrete or masonry structures capable of holding water meters and valves, and allow personnel entry for service and repair. Unless otherwise noted in the Owner requirements, meters to be installed in water meter pits will be supplied by the Owner at no cost to the Contractor or to the State.

663-3.19 Water Meter Pits, Type B. All pits shall be furnished and installed in accordance with the standard sheets and the Owner requirements. Unless otherwise noted in the Owner requirements, meters to be installed in water meter pits will be supplied by the Owner at no cost to the Contractor or to the State.

663-3.20 Temporary Water Service for Water Main Installation. The Contractor shall, when called for in the contract documents or directed by the Engineer, provide temporary water service to customers during interruptions caused by water main work. The service may be provided by temporary piping or other method approved by the Engineer.

663-3.21 Adjust Valve Box Elevation. Prior to the placement of the top course and after the placement of the binder course, when required, the Contractor shall install adjustment rings or frames for valve boxes. The Contractor shall be responsible for ensuring that the adjustment rings or frames are compatible with the existing valve boxes. The adjustment ring or frame shall be placed so the valve box cover will not protrude above the finished surface of the pavement, and is no more than 5 mm below finished grade. The Contractor shall have the option of resetting the existing valve box to the required grade.

To ensure a firm and secure fit with the adjustment ring or frame, the seat of the existing valve box shall be free of all foreign material at the time of installation. The entire assembly shall be set on the seat of the existing valve box and secured. The valve box cover shall then be set upon the seat of the
adjustment ring or frame. All rings or frames shall be protected from displacement caused by traffic maintained on the roadway or equipment used in the paving operation.

663-3.22 Disconnect and Cap Existing Water Main. Existing water main shall be disconnected and capped in accordance with the contract documents.

663-3.23 Hydrostatic Testing. Hydrostatic pressure and leakage tests shall be performed in accordance with AWWA C600. Prior to formal testing, the mains shall be thoroughly flushed. Hydrostatic pressure and leakage tests shall be made on installations (water mains, valves, fittings, etc.) having diameters larger than 2 NPS. The testing shall include any filling points, sampling points or other appurtenances required to conduct the tests. The total leakage per day shall not exceed the amounts allowable under AWWA C600. Unless otherwise noted in the Owner requirements, the system shall be subjected to the pressure/leakage test with water under a hydrostatic pressure of 1035 kPa for two (2) hours.

663-3.24 Disinfection. Upon completion of all water supply related construction, all mains, valves, hydrants and other appurtenances built under this contract shall be flushed, disinfected and tested for bacteriological quality in accordance with AWWA C651. Tablets shall not be used for chlorination of solvent welded plastic or screwed-joint steel pipe due to danger of fire or explosion from the reaction of joint compounds with calcium hypochlorite.

663-4 METHOD OF MEASUREMENT

663-4.01 Water Pipe. The quantity to be measured for payment will be in meters of laying length to the nearest 0.1 m. The measurement for pipe will not include the length of fittings.

663-4.02 Water Service Pipe. The quantity to be measured for payment will be in meters of laying length to the nearest whole meter. The measurement for pipe will not include the length of fittings.

663-4.03 Steel Pipe Bends and Fittings. Steel pipe bends and fittings will be measured in meters of equivalent lengths of steel pipe, to the nearest 0.1 m. The length of bends will be the length of the circular arc using the angle of the bend and the radius of bend used to make the desired connection. The length of special fittings for steel pipe will be the length along the centerline from an intersecting centerline, as in a tee or wye. The lengths may be measured for different diameters on a tee or wye having legs of unequal diameter. Refer to AWWA Standard C208, Figure 1 and Table 1 for lengths.

663-4.04 Bridge Mounted Water Pipe. The quantity to be measured for payment will be in meters to the nearest 0.1 m from a point 1.5 m behind the back surface of each structure abutment or backwall, or to points indicated in the contract documents for installations that do not pass through an abutment or backwall.

663-4.05 Valve & Valve Boxes. The quantity to be measured for payment will be the number of units of each size furnished and incorporated into the work in accordance with the contract documents.

663-4.06 Hydrants. The quantity to be measured for payment will be the number of units furnished and incorporated into the work in accordance with the contract documents.

663-4.07 Hydrant Fenders. The quantity to be measured for payment will be the number of fenders furnished and incorporated into the work in accordance with the contract documents.

663-4.08 Dry Hydrants. The quantity to be measured for payment will be the number of dry hydrants, including all necessary pipe and fittings furnished and incorporated into the work in accordance with the contract documents.
663-4.09 Tapping Sleeve, Valve & Valve Boxes; Line Stop and Tapping Fittings; and Bolted, Sleeve Type Couplings. The quantity to be measured for payment will be the number of units of each size furnished and incorporated into the work in accordance with the contract documents.

663-4.10 Iron Water Main Fittings. The quantity to be measured for payment will be the bare weight of fittings installed, as listed in AWWA Standard C110 or C153, as applicable. Total contract quantity will be measured to the nearest whole kilogram. No measurement will be made for the weight of gaskets, other appurtenant hardware, retainer glands provided solely for thrust restraint or thrust restraints rods. The quantity measured for payment for fittings not listed in the AWWA Standards will be based upon Manufacturer certifications.

663-4.11 Wedge Type Mechanical Restrainsal Glands and High Deflection Restrained Joint Fittings. The quantity to be measured for payment will be the number of units furnished and incorporated into the work in accordance with the contract documents.

663-4.12 Polyethylene Encasement for Water Mains and Insulation for Water Mains. The quantity to be measured for payment will be the number of meters along the pipe axis measured to the nearest whole meter furnished and incorporated into the work in accordance with the contract documents.

663-4.13 Water Service Connections and Curb Stop & Curb Box. The quantity to be measured for payment will be the number of complete units furnished and incorporated into the work in accordance with the contract documents.

663-4.14 Water Meter Pits, Type A and Water Meter Pits, Type B. The quantity to be measured for payment will be the number of complete units furnished and incorporated into the work in accordance with the contract documents.

663-4.15 Temporary Water Service for Water Main Installation. Payment for Temporary Water Service for Water Main Installation will be made on a lump sum basis.

663-4.16 Relocate Existing Water Valve & Valve Box, Relocate Existing Hydrant Assembly and Relocate Existing Curb Stop & Curb Box. The quantity to be measured for payment will be the number of units of each relocated in accordance with the contract documents.

663-4.17 Adjust Existing Valve Box Elevation, Adjust Existing Hydrant Elevation and Adjust Existing Curb Box Elevation. The quantity to be measured for payment will be the number of units of each adjusted in accordance with the contract documents.

663-4.18 Disconnect and Cap Existing Water Main. The quantity to be measured for payment will be the number of mains disconnected and capped in accordance with the contract documents.

663-4.19 Remove and Dispose of Existing Water Main. The quantity to be measured for payment will be in meters along the pipe axis measured to the nearest whole meter in accordance with the contract documents.

663-4.20 Remove and Dispose of Existing Water Valve & Valve Box and Remove and Dispose of Existing Hydrant. The quantity to be measured for payment will be the number of units removed and disposed of in accordance with the contract documents.

663-4.21 Remove and Dispose of Existing Water Service Connection. The quantity to be measured for payment will be the number of units removed and disposed of in accordance with the contract documents.

663-4.22 Remove and Store Existing Water Valve & Valve Box and Remove and Store Existing Hydrant. The quantity to be measured for payment will be the number of units removed and stored in accordance with the contract documents.
663-5 BASIS OF PAYMENT

663-5.01 General. The unit price bid shall include the cost of all materials, labor and equipment necessary to complete the work, except that test pits, excavation and backfill will be paid for separately. Unless otherwise noted in the contract documents, payment for thrust restraint shall be included in the price bid for pipe and appurtenances. No additional payment will be made for permits, cutting existing mains, thrust restraint, disinfection or testing. Progress payments for installed or relocated items will be made at the unit bid price for 80 percent of the quantity installed, when the installation is completed and backfilled to a minimum of 600mm over the top of the pipe plus additional cover required to protect the installation from vehicular and construction traffic. The remaining 20 percent will be paid for when required testing and disinfection of the system has been satisfactorily completed.

663-5.02 Steel Pipe Bends and Fittings. The payment for steel pipe bends and fittings will be made under the steel water pipe item for equivalent lengths of steel pipe. The payment item for a reducer will be based on the larger diameter.

663-5.03 Bridge Mounted Water Pipe. The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work, including, but not limited to, expansion devices, rollers, chairs, connectors, insulation, insulation covering and sleeves, except that structural utility support members will be paid for under a structural steel item.

663-5.04 Water Service Pipe. The unit price bid for plastic pipe and polyethylene water service pipe will include the installation of tracing wire, if required. If the Contractor opts to install water service pipe using a trenchless method, excavation and backfill will be paid for as if the standard installation method had been used. No additional payment will be made for surface restoration not required due to use of trenchless installation.

663-5.05 Hydrants. The unit price bid for each hydrant shall include a length or lengths of anchor pipe, installed at any point between the main and the hydrant up to 2.0 m long at no additional cost to the State. Hydrant drainage material will be included in the payment for each hydrant at no additional cost to the State.

663-5.06 Hydrant Fenders. The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work. The work shall include excavation for the fenders, installation and backfill. The excavation for the concrete collars and slabs and the concrete required will be paid for separately.

663-5.07 Bolted, Sleeve Type Couplings. If a bolted coupling is used to join two different diameters of pipe, the payment item will be based on the larger size.

663-5.08 Iron Water Main Fittings. Payment for a full body (AWWA C110) fitting provided but not required will be the weight of a similar compact (AWWA C153) fitting. The payment item for a fitting with different size connections will be based on the largest NPS size on that fitting (i.e. a 12 NPS x 4 NPS Tee will be in the 10 NPS - 16 NPS range).

663-5.09 Water Service Connections. Payment for a water service connection will include the cost of all labor, materials and equipment necessary to complete the installation of everything required to provide a connection from a main to a customer at the highway boundary, including corporation stop, curb stop, curb box, tapping sleeve or saddle, if required, and all necessary fittings, except the service pipe, which will be paid for separately.

663-5.10 Water Meter Pits. The unit price bid shall include the cost of all labor, materials, including meter pit lids, covers and steps, and equipment necessary to complete the work.
§663

663-5.11 Relocate Existing Hydrant. The unit price bid for each hydrant relocation shall include a length of lateral pipe up to 2.0 m long, installed at any point between the main and the hydrant and hydrant drainage material at no additional cost to the State.

663-5.12 Adjust Existing Valve Box Elevation and Adjust Existing Curb Box Elevation. If the Contractor elects to reset the existing valve box, the costs of the work involved in the removal and replacement of existing disturbed pavement shall be included in the bid price for adjustment of the valve box.

663-5.13 Adjust Existing Hydrant Elevation. The unit price bid for each hydrant elevation adjustment shall include the cost of any barrel extensions required to complete the work at no additional cost to the State.

663-5.14 Disconnect and Cap Existing Water Main. Any fittings required to complete the work will be paid for separately.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>663.01xx</td>
<td>Ductile Iron Cement Lined Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.02xx</td>
<td>Steel Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.03xx</td>
<td>Concrete Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.04xx</td>
<td>Plastic Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.05xx</td>
<td>Bridge Mounted Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.06zz</td>
<td>Copper Water Service Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.07zz</td>
<td>Polyethylene Water Service Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.08zz</td>
<td>Steel Water Service Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.10xx</td>
<td>Resilient Wedge Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.11xx</td>
<td>Butterfly Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.12xx</td>
<td>Double Disk Gate Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.13nn</td>
<td>Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.14</td>
<td>Hydrant Fender</td>
<td>Each</td>
</tr>
<tr>
<td>663.15nn</td>
<td>Dry Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.16xxx</td>
<td>Tapping Sleeve, Valve &amp; Valve Box Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>663.17xx</td>
<td>Line Stop Fitting</td>
<td>Each</td>
</tr>
<tr>
<td>663.18xx</td>
<td>Bolted, Sleeve Type Coupling</td>
<td>Each</td>
</tr>
<tr>
<td>663.2001</td>
<td>Iron Water Main Fittings (3 NPS - 8 NPS)</td>
<td>Kilogram</td>
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<tr>
<td>663.2002</td>
<td>Iron Water Main Fittings (10 NPS - 16 NPS)</td>
<td>Kilogram</td>
</tr>
<tr>
<td>663.2003</td>
<td>Iron Water Main Fittings (18 NPS and larger)</td>
<td>Kilogram</td>
</tr>
<tr>
<td>663.21xx</td>
<td>Wedge Type Mechanical Restraint Glands (xx NPS)</td>
<td>Each</td>
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<tr>
<td>663.22xx</td>
<td>High Deflection Restrained Joint Fitting (xx NPS)</td>
<td>Each</td>
</tr>
<tr>
<td>663.23xx</td>
<td>Polyethylene Encasement for Water Pipe</td>
<td>Meter</td>
</tr>
<tr>
<td>663.24xxx</td>
<td>Insulation for Buried Water Pipe (xx NPS with gg Thick Insulation)</td>
<td>Meter</td>
</tr>
<tr>
<td>663.25zz</td>
<td>Water Service Connection</td>
<td>Each</td>
</tr>
<tr>
<td>663.26zz</td>
<td>Curb Stop &amp; Curb Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.27nn</td>
<td>Water Meter Pit, Type A</td>
<td>Each</td>
</tr>
<tr>
<td>663.28nn</td>
<td>Water Meter Pit, Type B</td>
<td>Each</td>
</tr>
<tr>
<td>663.29nn</td>
<td>Temporary Water Service for Water Main Installation</td>
<td>Lump Sum</td>
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<tr>
<td>663.30</td>
<td>Relocate Existing Water Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.31</td>
<td>Relocate Existing Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.32</td>
<td>Relocate Existing Curb Stop &amp; Curb Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.33</td>
<td>Adjust Existing Valve Box Elevation</td>
<td>Each</td>
</tr>
<tr>
<td>663.34</td>
<td>Adjust Existing Hydrant Elevation</td>
<td>Each</td>
</tr>
<tr>
<td>663.35</td>
<td>Adjust Existing Curb Box Elevation</td>
<td>Each</td>
</tr>
<tr>
<td>663.40</td>
<td>Disconnect and Cap Existing Water Main</td>
<td>Each</td>
</tr>
<tr>
<td>663.41xx</td>
<td>Remove and Dispose of Existing Water Main</td>
<td>Meter</td>
</tr>
<tr>
<td>663.42xx</td>
<td>Remove and Dispose of Existing Water Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
</tbody>
</table>
663.43    Remove and Dispose of Existing Hydrant        Each
663.44    Remove and Dispose of Existing Water Service Connection    Each
663.45    Remove and Store Existing Water Valve & Valve Box     Each
663.46    Remove and Store Existing Hydrant          Each
663.47    Remove and Store Existing Curb Stop & Curb Box     Each

 gg = Insulation Thickness Code
       (gg x 25 = mm of thickness)
 nn = Serialized item
 xx = NPS
 yy = NPS
 zz = Water Service Size, 01 = ½, 02 = 5/8 (not available in steel), 03= 3/4,
       04 = 1, 05 = 1-1/4, 06 = 1-1/2, 07 = 2

SECTION 664 - SANITARY SEWER UTILITIES

664-1 DESCRIPTION. The work in this section shall include special construction required for sanitary sewer utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

664-2 MATERIALS. Materials shall meet the requirements specified by the respective utility company.

664-3 CONSTRUCTION DETAILS

664-3.01 General. The installation and testing procedures shall conform to the requirements specified by the utility company.

664-3.02 Schedule of Work. Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

664-3.03 Excavation. The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

664-3.04 Backfill. The requirements specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes and Conduits and Direct Burial Cables, shall apply.

664-4 METHOD OF MEASUREMENT. As specified in the special specifications.

664-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 665 - WATERWAYS

665-1 DESCRIPTION. The work in this section shall include special construction required for the New York State Canal Corporation.

The extent of work, material required, construction details, method of measurement and basis of payment will be covered by special provisions in the contract documents.

SECTION 666 (VACANT)

SECTION 667 - LOCAL ROAD GRAVEL SURFACE, BASE, AND SUBBASE COURSES

667-1 DESCRIPTION.
§667

667-1.01  General.  The work consists of furnishing, placing and compacting gravel surface, base and subbase courses in conformity with the lines, grades, thicknesses and typical sections shown on the plans, or as determined by field conditions and ordered in writing by the municipality.

667-1.02  Material Types. Provide materials as specified by the following options.

Type A. Surface quality material with a maximum particle size of 25 mm.

Type B. Base quality material with a maximum particle size of 50 mm.

Type C. Subbase quality material with a maximum particle size of 75 mm.

667-2  MATERIALS.

667-2.01  Test and Control Methods. All tests shall be performed by laboratories accredited under the AASHTO accreditation program. Materials tests and quality control methods pertaining to the work of this section will be performed in conformance with the procedures contained in the appropriate New York State Department of Transportation (NYSDOT) and/or American Association of State Highway and Transportation Officials (AASHTO) publications which are current on the date of advertisement of bids.

667-2.02  Materials Requirements. Provide materials for road gravel surface, base, and subbase courses that consist of Sand and Gravel, approved Blast Furnace Slag or Stone that meet the requirements contained herein. Provide materials well graded from coarse to fine, and free from organic or other deleterious materials. Any gravel material will be rejected if it is determined to contain any unsound or deleterious materials.

A. Gradation. Perform sieve analysis in accordance with the AASHTO procedures T 27, T 88 or T 311. Report the following sieves for all tests: 75µm, 425µm, 6.3 mm, 12.5 mm, 19 mm, 25 mm, 37.5 mm, 50 mm, 75 mm.

Provide material meeting the gradation limits from Table 667-1.

B. Soundness. Material for local road gravel surface, base, and subbase courses will be accepted on the basis of Magnesium sulfate Soundness Loss after four (4) cycles performed according to NYSDOT procedures and Table 667-2.

C. Plasticity. Determine plasticity using either of the following methods:

1. Plasticity Index. The Plasticity Index of the material passing the #40 mesh sieve shall meet the values in Table 667-2. Determine plasticity using AASHTO tests T 89 and T 90.

2. Sand Equivalent. The sand equivalence of the granular material shall meet the values in Table 667-2. Determine sand equivalence using AASHTO test T 176.

<table>
<thead>
<tr>
<th>TABLE 667-1 PERCENT PASSING BY WEIGHT OF GRAVEL MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve (U.S. sieve)</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>75 mm (3&quot;)</td>
</tr>
<tr>
<td>50 mm (2&quot;)</td>
</tr>
<tr>
<td>37.5 mm (1.5&quot;)</td>
</tr>
<tr>
<td>25 mm (1&quot;)</td>
</tr>
<tr>
<td>19 mm (3/4&quot;)</td>
</tr>
<tr>
<td>6.3 mm (1/4&quot;)</td>
</tr>
<tr>
<td>425 µm (#40)</td>
</tr>
<tr>
<td>75 µm (#200)</td>
</tr>
</tbody>
</table>
### TABLE 667-2 TEST AND CONTROL LIMITS OF GRAVEL MATERIALS

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Material Type</th>
<th>A (Surface)</th>
<th>B (Base)</th>
<th>C (Subbase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Soundness loss (%)</td>
<td>20</td>
<td>20</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>2-9</td>
<td>0-5</td>
<td>0-8</td>
<td></td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>&gt;25</td>
<td>&gt;40</td>
<td>&gt;35</td>
<td></td>
</tr>
</tbody>
</table>

**D. Elongated Particles.** Not more than 30 percent, by weight, of the particles retained on a 12.5 mm sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be based on a visual inspection. When the municipality elects to test for this requirement, material with a percentage greater than 30 will be rejected.

**E. Fractured Faces.** When the municipality elects to test for this requirement, Type A material shall have at least two fractured faces on 50 percent of the stone particles larger than 12.5 mm or at least one fractured face on 75 percent of the particles larger than 12.5 mm. Type B material shall have at least one fractured face on 50 percent of the stone particles larger than 12.5 mm.

**667-2.03 Stockpiling.** Stockpile all material, except that material furnished under Type C will not be required to be stockpiled if the total project quantity is more than 500 tons, unless otherwise stated in the contract documents. Follow stockpile construction requirements, sampling, testing and acceptance/rejection procedures as stipulated by applicable NYSDOT procedures.

**667-3 CONSTRUCTION DETAILS.**

**667-3.01 General.** Use uniform gravel types and materials between the roadbed limits.

**667-3.02 Placement.**

A. Place the upper course material on the grade in a manner to minimize segregation, using equipment and procedures approved by the Municipality. Do not perform uncontrolled spreading from piles dumped on the grade.

B. The maximum compacted layer thickness is 380 mm, or as shown on the plans. In confined areas as defined by the Municipality the maximum compacted layer thickness is 150 mm. The minimum loose lift thickness is 1.5 times the maximum particle size.

**667-3.03 Compaction.** When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements of §203-3.12, Compaction. Density tests are not required for the acceptance of these courses. If a subbase course has been disturbed by frost action prior to paving, recompact the layer.

**667-3.04 Traffic and Contamination.** The movement of highway traffic over the final surface of the base or subbase may be permitted at locations designated by, and under such restrictions as directed by the Municipality, provided such movements take place prior to the final finishing of this course to the specified tolerance. The movement of construction equipment on this course may be permitted at locations designated by and under such restrictions as directed by the Municipality.

No payment will be made for furnishing, placing, maintaining, removing and disposing any protective layer. Include the cost thereof in the price bid.

If a layer is damaged or mixed with the subgrade or any other material due to the Contractor’s operation, remove such material and replace it with the appropriate material at no additional cost to the Municipality.
§667

667-3.05 Tolerance.

A. **Surface and Base Course.** Place material so that after compaction the top surface of the course does not extend more than six (6) mm above nor more than six (6) mm below true grade for the course at any location.

B. **Subbase Course.** Place material so that after compaction the top surface of the course does not extend more than twelve (12) mm above nor more than twelve (12) mm below true grade for the course at any location.

667-4 **METHOD OF MEASUREMENT.** The quantity is the number of cubic meters of material, computed from payment lines shown on the plans or, where changes has been ordered, from payment lines established by the Municipality.

667-5 **BASIS OF PAYMENT.** The unit price bid for this work includes the cost of furnishing all labor, material and equipment necessary to complete the work. Include the cost of adding water in the price bid unless the items for furnishing and applying water are included in the contract. No direct payment will be made for losses of material resulting from compaction, foundation settlement, erosion, or any other cause. Include the cost of such losses in the price bid for this item. No deductions will be made for the volumes occupied by manholes, catch basins and other such objects.

Progress payments will be made after each Type course has been properly placed and compacted. Payment will be made at the unit price bid for seventy-five (75) percent of the quantity. The balance of the quantity will be paid for after the final finishing to the required tolerance and just prior to the placing of the next course or Type.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>667.01</td>
<td>Local Road Gravel Surface Course, Type A</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>667.02</td>
<td>Local Road Gravel Base Course, Type B</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>667.03</td>
<td>Local Road Gravel Subbase Course, Type C</td>
<td>Cubic Meter</td>
</tr>
</tbody>
</table>

SECTION 668 AND 669 (VACANT)

SECTION 670 - HIGHWAY LIGHTING SYSTEM

670-1 **DESCRIPTION.** This work shall consist of furnishing and installing an operating highway lighting system in accordance with the plans, standard sheets, and specifications or as directed by the Engineer.

Where not specifically covered on the plans, specifications, or special provisions, all equipment shall be installed according to the manufacturer’s published recommendations.

Included in this work is the furnishing and installing of metal light standards, breakaway transformer bases, arms, luminaires, lamps, electrical conductors, fittings, minor miscellaneous components (pole line hardware, insulators, etc.), concrete foundations, pull boxes and all other materials necessary for operating and controlling the highway lighting system. Also included is the removal, relocation, storage, and/or disposal of the above materials.

670-2 **MATERIALS.** All electrical equipment shall conform to the EEI, NEMA, ANSI and ASTM Standards. All material shall conform to the latest requirements of the “National Electrical Code”, herein referred to as the “Code”; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply. Differences in standards or code requirements shall be resolved as determined by the Engineer.

The materials used in the construction of lighting systems shall meet the requirements of the following subsections of Section 700-Materials:

Aluminum Light Standards and Arms
High Mast Pole, Head Frame Assembly
### §670

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>with Luminaire Ring and Lowering Device</td>
<td>723-02</td>
</tr>
<tr>
<td>Portable Power Drive for High Mast Luminaire</td>
<td>723-03</td>
</tr>
<tr>
<td>Lowering System</td>
<td>723-03</td>
</tr>
<tr>
<td>Anchor Base (Aluminum)</td>
<td>723-10</td>
</tr>
<tr>
<td>Breakaway Transformer Base (Aluminum)</td>
<td>723-15</td>
</tr>
<tr>
<td>Rigid Plastic Conduit</td>
<td>723-19</td>
</tr>
<tr>
<td>Metal Steel Conduit, Zinc Coated</td>
<td>723-20</td>
</tr>
<tr>
<td>P.V.C. Coated Galvanized Steel Conduit</td>
<td>723-23</td>
</tr>
<tr>
<td>Flexible Liquid-Tight Steel Conduit</td>
<td>723-24</td>
</tr>
<tr>
<td>High Pressure Sodium Vapor Luminaires (Standard Mount)</td>
<td>723-27</td>
</tr>
<tr>
<td>Low Pressure Sodium Vapor Luminaires (Underbridge Mount)</td>
<td>723-28</td>
</tr>
<tr>
<td>High Pressure Sodium Vapor Luminaires (Underbridge Mount)</td>
<td>723-29</td>
</tr>
<tr>
<td>Mercury Vapor Luminaires (Standard Mount)</td>
<td>723-30</td>
</tr>
<tr>
<td>Mercury Vapor Luminaires (Underbridge Mount)</td>
<td>723-31</td>
</tr>
<tr>
<td>Cast Iron Junction Box</td>
<td>723-40</td>
</tr>
<tr>
<td>Precast Reinforced Concrete Foundations and Pullboxes</td>
<td>723-45</td>
</tr>
<tr>
<td>Photoelectric Control</td>
<td>723-50</td>
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<tr>
<td>Anchor Bolts</td>
<td>723-60</td>
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<tr>
<td>Single Conductor Cable</td>
<td>723-70</td>
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<tr>
<td>Single Conductor Direct Burial Cable</td>
<td>723-71</td>
</tr>
<tr>
<td>Ground Wire</td>
<td>723-75</td>
</tr>
<tr>
<td>Rubber Impregnated Woven Cotton-Polyester Fabric</td>
<td>728-01</td>
</tr>
<tr>
<td>Rubber Impregnated Random Fiber Pad</td>
<td>728-02</td>
</tr>
</tbody>
</table>

All cast-in-place concrete base, foundations and pullboxes shall conform to the requirements of Section 501, Portland Cement Concrete - General, except that the requirements for inspection facilities, automated batching control and recordation do not apply. The concrete shall be Class A concrete for structures unless otherwise specified. The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

All precast concrete bases and foundations shall meet the requirements of §723-45 Precast Reinforced Concrete Foundations and Pullboxes. Anchor bolts encased in concrete foundations shall meet the requirements of §723-60, and shall be set by template.

All concrete bases, foundations and pullboxes shall conform to the dimensions and details shown on the plans, standard sheets and specifications.

Materials will be subject to inspection at any time during the contract. Failure of the Engineer to note faulty material or faulty installation during construction will not relieve the Contractor of responsibility for removing or replacing such materials or redoing work which may fail to pass any of the Engineer’s inspections of this work.

### 670-2.01 Conduit.
Couplings, condulets, adaptors and bends shall be made from the same material as the conduit, unless otherwise indicated on the plans or directed by the Engineer.

### 670-2.02 Pullboxes.
Pullboxes shall be cast-in-place or precast concrete units. Precast concrete units shown on the contract drawings for rectangular or circular pullboxes will be acceptable if they are of sufficient interior volume required under the pay item. If no drawings are given, the details shown on the Standard Sheet “Pullbox, Conduit and Ground Rod Installation Details” shall apply.

### 670-2.03 Luminaires.
Luminaires shall be suitable for severe vibrations up to 3 G's, and lamp supports shall be provided if the lamp is horizontally mounted.

### 670-3 CONSTRUCTION DETAILS

### 670-3.01 Plans.
The Contractor shall study the plans and details and use them as a guide in determining the location of the highway lighting equipment. Any discrepancies in the contract documents shall be resolved with the Engineer before any materials are ordered. Additionally, the manufacturer or
supplier of the lighting equipment shall also use the plans to clearly label what each component part is or where it is to be installed.

All installation shall conform to the latest EEI, NEMA, ANSI and ASTM standards. In addition, workmanship shall conform to the latest requirements of the Code; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply.

Any work performed within the boundaries of New York City shall also be in accordance with the “General Specifications for Street Lighting Facilities” contained in the latest publication of “City of New York SPECIFICATIONS For Use With State of New York Department of Transportation Construction Contracts.” Differences in standards or code requirements shall be resolved as determined by the Engineer.

§670-3.02 Shop Drawings. The Contractor shall submit six copies of the Manufacturer's Shop Drawings to the Engineer for approval. These drawings shall cover the following items and be submitted at least ten working days prior to the date the Contractor orders the light standards, breakaway transformer base, arms, precast concrete foundations and high mast poles, head assemblies and lowering devices. These items shall not be shipped to the job site until the shop drawings are approved. The shop drawings shall be neatly drawn and clearly legible.

For luminaires and photoelectric controls catalog cuts may be submitted instead of shop drawings.

§670-3.03 Excavation and Miscellaneous Work. All excavation shall be performed in accordance with Section 206 Trench, Culvert and Structure Excavation, including the protection of workers and the public. Cuts in roadways, sidewalk surfaces and driveways shall be done in a neat manner, so as to cause the least possible damage. Sawcutting will be required unless otherwise shown on the plans or directed by the Engineer.

Excavation shall not be performed until immediately before installation of the conduit, direct burial cable or any other appurtenances.

The excavated material will be placed in a location or locations approved by the Engineer. These locations shall be selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to cause the minimum interference with the surface drainage.

All surplus excavated material shall be removed and disposed of by the Contractor as specified in §203-3.08, Disposal of Surplus Excavated Materials. Excavations shall be backfilled as specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables. After backfilling, the location shall be maintained to the satisfaction of the Engineer until permanent repairs are made.

Pavement or structure courses shall be replaced as specified in §206-3.02, Replacement of Pavement Structure Courses, except that in concrete sidewalks, the complete sidewalk panel shall be removed and replaced.

§670-3.04 Foundations. Locations of concrete foundations for light standards shown on the plans are approximate only and the exact location will be determined in the field. The Contractor has the option to use precast foundations in place of cast-in-place foundations for light standards. However, precast foundations shall not be allowed for high mast systems.

All excavation necessary for constructing or installing a lamppost foundation shall be performed in conformance to §670-3.03.

When cast-in-place concrete foundations can be constructed in undisturbed soil, as determined by the Engineer, the concrete shall be poured in direct contact with the earth. Forms shall not be used unless the excavation is oversize or where neat limits must be maintained. The top 0.3 to 0.5 meters shall be formed as specified on the plans or as directed by the Engineer. Care shall be taken to construct the tops of all foundations so they are level and true to line and grade. Anchor bolts shall be set by template, as ordered by the Engineer.

When cast-in-place concrete foundations are to be constructed in soil that will not support a vertical cut, the foundations shall be formed. When forms are used, the foundations shall be backfilled and compacted allowing sufficient room for the compaction equipment selected.

Where unstable soil is encountered, permanent support shall be used. This can include driving sheeting, augering in a pipe section, or any other method acceptable to the engineer.
When precast foundations are used, the size of the precast foundation shall not be less than that shown on the plans or standard sheet for cast-in-place foundations. They are only to be used in conjunction with one of the following special excavation and backfill methods to insure foundation stability:

**Method A.** The excavation shall allow a minimum clearance of 0.15 meters around the precast foundation to be backfilled with concrete meeting the requirements of §501-2.02, Class A. For backfill purposes, small construction mixers will be permitted.

**Method B.** The excavation shall allow a minimum clearance around the precast unit compatible with the compaction equipment used. The clear area shall be backfilled with Select Granular Fill in accordance with §203-2.02 of the Standard Specifications, and compacted in accordance with §203-3.15.

Method A or Method B can be used in undisturbed areas. Only Method B is to be used in disturbed areas.

**670-3.05 Grounding.** A 3 meter by 16 millimeter diameter, copperclad ground rod shall be driven near each foundation, maintaining at least 600 mm of cover, or through selected pullboxes where metal conduit is used. The ground rod shall be electrically connected to the base of the pole with a No. 6 soft drawn bare stranded copper ground wire. A copperclad groundwire clamp shall be used to attach the ground wire to the ground rod.

Where a 3 meter ground rod cannot be driven, or is insufficient to provide adequate grounding (see §670-3.16), alternate methods shall be used as shown on the plans or ordered by the Engineer. Such alternate methods can include changing the ground rod length or location, or connecting the ground wire to some other grounded object.

**670-3.06 Light Standards, Breakaway Transformer Bases and Arms.** Each metal light standard shall be set vertically (within 1° of plumb) on a foundation or anchorage, employing approved shims when necessary, either with or without a transformer base as shown on the plans or in the proposal. The transformer base, or the anchor base when a transformer base is not used, shall be securely bolted to the anchorage by the anchor bolts previously set.

The individual light standards shall be identified as required by the responsible maintenance agency and as shown on the plans.

Each arm shall be mounted on the shaft so the luminaire will be at the proper mounting height as shown on the plans. The mounting height shall be measured from the center of the light source to the pavement. The arms shall be in a plane perpendicular to the roadway. The Contractor, in conjunction with the Engineer, shall determine the necessary elevation data for fabricating the light standard with the correct mounting height.

A Number 8 Gauge galvanized steel or 6 millimeter nylon rope drag line shall be furnished and installed running from the terminal strip area in the luminaire to the anchor base or box where the power distribution cable is or will be installed. This drag line shall be securely anchored at each end, and removed only after the cables are installed.

The protective wrapping shall not be removed from any of the shafts or arms until the Engineer instructs the Contractor to do so.

**670-3.07 Conduit.** Underground conduit shall be either zinc coated metal steel conduit, PVC coated galvanized steel, rigid plastic, or flexible liquid-tight steel conduit, as indicated on the plans, and shall be carefully laid in trenches prepared to receive them. Unless indicated otherwise, conduits in exposed areas, when attached to the outside of structures, such as underdeck installations, shall be PVC coated galvanized steel conduit installed as shown on the plans or in a manner approved by the Engineer. Hot dipped, galvanized or non-rusting alloy steel clamps shall be provided to support the conduit at intervals not exceeding 1 m or as directed by the Engineer.

Underground conduit installations shall have a minimum cover of 0.45 meters except under roadways, where the minimum cover shall be 0.6 meters. The conduit shall be laid on a uniform grade to allow any condensation to drain to pull boxes or “T” drains, as detailed on the Standard Sheet “Pullbox,
Conduit and Ground Rod Installation Details. Where uniform grades cannot be maintained, “T” drains shall be installed where directed by the Engineer. Conduit shall be backfilled in accordance with §203-3.15 Fill and Backfill at Structures, Culverts, Pipes, Conduits, and Direct Burial Cables. However, in rock excavations, a bedding of selected backfill must be placed and tamped before laying the conduit.

All bends in the conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed, unless a template is used, for all bends in steel conduit. No bends will be accepted for exposed conduit which shows any evidence of destruction of the protective coating.

Where conduits terminate at pullboxes, the Contractor shall break into the pullbox and seal, usually with mortar, the remainder of the hole(s) in a manner acceptable to the Engineer. Sealed bonding bushings shall be provided at each conduit outlet in boxes. Bushing caps, to prevent entry of dirt and refuse prior to pulling cables, shall be placed on all conduit ends. Outlet boxes with conduits properly connected shall be accurately located according to the plans and securely fastened.

All conduits installed shall be tested for clear bore and correct installation by the Contractor using a ball mandrel, brush and snake before the installation will be accepted. Two short wire brushes shall be included in the mandrel assembly. Snaking of conduits shall be done by the Contractor in the presence of the Engineer. Any conduit which rejects the mandrel shall be cleared and the Contractor shall bear all costs to replace defective conduit and restore surface to original condition.

Numbers or letters shall be assigned to the various conduit runs, and as they test clear, they shall be identified by a brass tag, no less than 31 mm in diameter, attached by means of No. 20 AWG brass wire. All conduit terminations in pole bases or pull boxes shall be tagged.

As the conduit runs test clear, a record shall be kept under the heading of “Empty Conduits Tested, Left Clear, Tagged and Capped,” showing conduit designation, diameter, location, date tested and by whom. When completed, this record shall be signed by the Electrical Inspector and submitted in triplicate for approval. This record shall be entered on the Record Drawings.

All empty conduit and duct openings after test, shall be capped or plugged by the Contractor as directed. After a conduit is properly installed and cleaned, the Contractor shall furnish and install in each pull box a No. 10 AWG galvanized steel drag line or nylon or polypropylene rope, with a tensile strength of at least 2222 newtons, leaving at least 1 meter of extra line in each pull box, transformer base, or other terminus. If cable is not pulled through the conduit within thirty days, the steel drag shall be grounded to a suitable grounding device at each end of the circuit.

All metallic connections shall be tight to assure continuity of ground bondings.

Conduit shall be placed under existing pavement by approved jacking or boring methods and as directed by the Engineer. The jacking or boring pit shall be located beyond the outside shoulder keeping at least 0.6 meters clear of the edge of shoulder. Jacking pits will not be permitted in the median, but receiving pits may be dug in grass medians after the jacking is completed if permitted on the plans or by the Engineer.

670-3.08 Pullboxes. Cast-in-place or precast concrete pullboxes shall be constructed at the locations and to the dimensions shown in the plans, standard sheets, specifications, or proposal.

Excavations for pullboxes shall be performed in accordance with the requirements of §206-3, Construction Details for Trench, Culvert and Structure Excavation, and included in this item.

Frames and covers shall be furnished and placed on each pullbox. They shall be placed true to line and grade and make full and even bearing on the pullbox.

The frames and covers shall be of the design and detail shown in the plans, standard sheets, specifications or proposal. Frames and covers which do not fit together properly, are warped or rock, will be rejected by the Engineer. Any material rejected by the Engineer, will be removed from the site by the Contractor.

No pullbox shall be backfilled until all cement concrete has sufficiently hardened and forms, if any, have been removed.

The requirements of §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables, shall apply.

670-3.09 Junction Boxes. Cast iron junction boxes shall be installed at the locations shown on the plans. For surface mounting, the boxes shall be securely bolted to brackets as detailed on the plans. For
installation where boxes are embedded in cement concrete, the boxes shall be set with the covers flush with the surface.

All hardware used in conjunction with mounting of these boxes shall be rust and corrosion resistant.

670-3.10 Luminaires. Luminaires of the type and wattage specified, complete with all components shall be installed where shown on the plans standard sheets, or proposal or where directed by the Engineer. All necessary field adjustments required to achieve the specified light distribution shall be performed as directed by the Engineer.

A. Standard Mounting. Luminaires shall be installed on light standard mast arms with the vertical axis perpendicular to the roadway and the longitudinal axis parallel to the roadway centerline. The luminaires shall be installed, though not necessarily powered, immediately after the mast arms are connected to the shaft. Otherwise, vibration dampeners shall be used until the luminaires are installed.

B. Underbridge Mounting. Luminaires of the type and wattage specified shall be installed on wall mounts or outlet box studs.

Self-contained underbridge luminaires complete with all specified ballasts, and any other appurtenances necessary shall be installed according to manufacturers written instructions, as shown on the plans, as specified in the proposal or as directed by the Engineer.

670-3.11 Photoelectric Control. Photoelectric controls shall be installed at the locations shown on the plans, preferably facing north, and properly adjusted to energize the luminaires at the specified illumination levels.

670-3.12 Single Conductor Cable and Single Conductor Direct Burial Cable. Wire installation shall not start until raceways and boxes have been cleared of all foreign matter and all other operations of the work which are likely to damage the conductors have been completed. The National Electric Code Rules shall be observed regarding installation of wire and cable.

Unless otherwise specified, splices will be permitted only in pullboxes, junction boxes, utility manholes, luminaires, transformer bases, and lamppost hand holes. All conductor runs between units of equipment shall be without splices. Conductors in control cabinets shall not be spliced.

All splices shall be capable of satisfactory operation under continuous submersion in water. Multiple conductors shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the conductors.

Moisture shall be excluded from the joint during the splicing operation and the work shall be done in dry weather or under shelter. Perspiration from the splicer's hand should be wiped off with dry material. All materials and tools involved in the splicing process shall be kept dry.

One of the following methods shall be used for making a watertight and electrically insulated splice:

Method No. 1. The outer covering and insulation shall be removed from each conductor for a minimum length necessary for the use of a pressure release crimping tool. The conductor ends shall be bared and jointed with a seamless, solderless type sleeve connector of the same AWG size as the conductor being spliced, using a pressure release crimping tool designed for the size connector being used. After crimping the sleeve connector shall maintain proper contact with both conductors around the circumferences of the splice and along the length of the sleeve.

The portion of each conductor where insulation has been removed, and the sleeve connector, shall be reinsulated using a coat of fast drying sealing agent of electrical grade, wrapped tightly with overlapping layers of rubber tape, a second coat of the sealing agent applied, and then wrapped tightly with overlapping layers of polyvinylchloride tape.

The sealing agent and tape shall extend at least 25 mm onto the undisturbed insulation of each conductor. Sufficient layers of tape shall be applied to equal 1.5 times the thickness of the original insulation.

Rejacketing the cable shall be accomplished in a similar manner as described above except that the sealing agent and tape shall extend at least 0.1 meters onto the undisturbed outer covering of each cable.
§670 Individual splices in each conductor shall be staggered to minimize the outside diameter of the splice.

**Method No. 2.** All of the requirements for splicing, specified in Method No. 1, shall apply, except that the completed splice including sleeve connector and the portion of each conductor where the insulation has been removed, shall be reinsulated and the conductor rejacketed by using an acceptable mold poured full with a two component dielectric epoxy resin. The resin shall not require external heating to produce satisfactory pouring consistency.

670-3.13 **Ground Cable.** Ground cable shall be installed where and as detailed on the plans or as directed by the Engineer.

670-3.14 **Regulations.** All work shall be done in accordance with latest edition of the national electrical safety codes, rules and regulations of the State authorities having jurisdiction over such work, and regulations of the utility companies where the work is being installed. Where differences or discrepancies occur, the most stringent requirements shall apply.

670-3.15 **Prosecution of Work.** All work shall be done by qualified and experienced mechanics of each labor class, as determined by the Engineer. All work shall be inspected and approved by the Engineer before concealment.

670-3.16 **Tests.** The Contractor shall conduct all tests, in the presence of the Engineer. The equipment required for each test shall be supplied by the Contractor, along with the equipment manufacturer's written instructions describing how to perform the test. The following tests shall be performed by the Contractor, at the time directed by the Engineer, prior to acceptance of the work:

**A. Insulation Test.** Each circuit with associated ballasts and protective devices shall be insulation tested using an insulation tester connected according to manufacturers instructions. A polarization index shall be computed by dividing a ten minute reading by a one minute reading. The polarization index shall be greater than four (4) for acceptance of new circuits, and greater than two (2) for acceptance of existing circuits. The lighting system shall be properly grounded and disconnected while this test is taking place.

**B. Ground Test.** A ground test shall be performed by the Contractor using an earth tester with resolution to at least a tenth of an ohm. The test shall be performed, and the results interpreted, according to manufacturer's instructions. Readings of five ohms or less will be required for acceptance. Additional grounding methods satisfactory to the Engineer may be necessary until the installation can pass the ground test.

**C. Functional Test.** After satisfactory completion of all other tests, a functional test shall be performed consisting of not less than ten consecutive days of satisfactory operation. If unsatisfactory performance of any component of the lighting system is discovered during this time, the condition shall be corrected and the Engineer may require the test repeated until ten days of continuous satisfactory operation is obtained.

Temporary shut downs caused by power interruption or vehicle impact shall not constitute discontinuity of the functional test.

670-3.17 **Coordination with Utility Company.** The Contractor shall be responsible for all coordination with and between the utility company.

The Contractor shall make all necessary arrangements with the utility company for the required electrical services necessary for the energizing of a temporary lighting installation and barricade lighting.

The Contractor shall comply with the utility company regulations. The utility company will connect and disconnect the power as required. When an entry into a service manhole or attachment to any utility company pole is required, the Contractor shall notify the utility company sufficiently in advance, and under no condition shall the Contractor enter any utility company owned manhole or place an attachment to a utility company owned pole without an agreement with the utility company.
The service points shown on the plans are approximate only and the Contractor shall determine the exact location from the serving utility company.

When called for in the contract documents the Contractor shall make arrangements with the local utility company to complete the service connections.

**670-3.18 Removal and Disposal, or Storage, of Lighting Equipment.** Existing lighting equipment designated for storage shall be carefully removed from their present locations by disconnecting the conductors, unbolting the mast arm(s) and luminaire(s) and detaching the shaft (and transformer base) from the anchor bolts. The work shall be performed in a manner acceptable to the Engineer. Component parts designated for storage shall be neatly stored and protected during storage at locations and in a manner as approved by the Engineer. Standards designated for removal and disposal shall be disposed of by the contractor in a manner approved by the Engineer within the directed time period after removal from their original location. The concrete lamppost foundations shall be cut free of the attached trenched conduits and shall be removed by the Contractor from the job site. The hole resulting from removing the foundation shall be filled with an approved material and compacted as directed by the Engineer.

**670-3.19 Relocation of Lighting Equipment.** Lighting equipment designated for relocation shall be detached and stored as per §670-3.18, reinstalled and successfully retested at the new location. The complete relocation shall take place in one work shift unless otherwise shown on the plans or ordered by the Engineer.

Where bracket arms and luminaires are to be relocated onto other utility poles, the down leads shall also be relocated, or replaced in kind if necessary, AOB. (Down leads include small sections of conduit or wood molding, wires and fuses connecting the secondary power supply line to the luminaire.) The bracket arm shall be attached to the pole with hardware similar to existing. The Contractor shall also relocate the epoxied strap used where the bracket arm is located above telephone lines.

Any part of the bracket arm, luminaire, or down lead damaged during removal or reinstallation shall be replaced or repaired to the satisfaction of the Engineer.

**670-3.20 High Mast Pole, Head Frame Assembly and Lowering System.** The high mast steel pole, head frame assembly and lowering system shall be installed in accordance with the manufacturer's recommendations, or as directed by the Engineer. With each installation a Manufacturer's instructional manual shall be furnished in each pole base. This manual shall include, but not be limited to the following details:

1. Raise and lower assembly instructions
2. Operating instructions
3. Maintenance instructions
4. Attachments

Additionally, the luminaire ring with all luminaires installed shall be lowered and raised five (5) times, at least twice in the coldest part of the winter and twice in the hottest part of the summer, if possible, to test functionality. These test dates shall be determined by the Engineer. Failure to lower or rise properly will be means for rejection of the assembly.

**670-3.21 Portable Power Drive for High Mast Luminaire Lowering System.** The portable power drive shall be used to raise and lower the luminaire ring as described above, and be delivered in good condition to the location shown on the plans upon acceptance of the high mast system.

**670-4 METHOD OF MEASUREMENT**

**670-4.01 Foundations.** Lighting standard foundations will be measured as the number of complete units installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.02 Light Standards.** Light standards will be measured as each standard of the type specified, complete, in place, in accordance with plans, specifications or as directed by the Engineer.
§670

670-4.03 Arms. Arms of the type and length specified will be measured by the number of units furnished and installed on the respective light standards (or wood poles) according to the plans, specifications or as directed by the Engineer.

670-4.04 Breakaway Transformer Base. Breakaway transformer bases will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.05 Conduit. Conduit will be measured by the linear meters along the axis of the conduit, of the type and size specified, installed according to the plans, proposal, or as directed by the Engineer. Measurement shall include all couplings, condulets, adaptors and bends.

670-4.06 Pullboxes. Pullboxes, including frames and covers, will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.07 Junction Box. Cast iron junction boxes will be measured as the number of each size furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.08 Luminaires. Luminaires of the type and wattage specified will be measured by the number of units furnished and installed according to the plans, specifications or as directed by the Engineer.

670-4.09 Photoelectric Controls. Photoelectric controls will be measured as each control furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.10 Single Conductor Cable and Direct Burial Cable. Single Conductor Cable wire will be measured for payment by the number of linear meters of single conductor of each size actually installed in accordance with the plans and specifications or as directed by the Engineer.

670-4.11 Ground Wire. Ground wire will be measured for payment by the number of linear meters of ground wire installed in accordance with the plans and specifications or as directed by the Engineer.

670-4.12 Removal of Lighting Equipment. The removal of lighting equipment will be measured by the number of light standards (including bracket arms and luminaires), or foundations, removed from the site and stored or disposed of as ordered by the Engineer.

670-4.13 Relocation of Lighting Equipment. The relocation of lighting equipment will be measured by the number of specified units removed and reinstalled at the new location.

670-4.14 High Mast Pole, Head Frame and Lowering Assembly. High mast steel pole, head frame assembly and lowering system will be measured by the number of complete units furnished and installed in accordance with the contact documents.

670-4.15 Portable Power Drive for High Mast Luminaire Lowering System. The portable power drive for high mast luminaire lowering system will be measured by the number of complete units delivered.

670-5 BASIS OF PAYMENT

670-5.01 General. The Contractor shall pay all fees and expenses for testing, service connections, licenses, electrical energy and any other cost he may incur in constructing the highway illumination system, except that the cost of electrical energy used for public benefit prior to the completion of the contract will be borne by the State, when such operation is directed by the Engineer in writing. The cost of all minor miscellaneous components shall be included in the price bid for the various lighting items.

670-5.02 Foundations. The unit price for each lighting standard foundation shall include the cost of all labor and materials necessary to complete the work, including conduit elbows, grounding system,
anchor bolts, all appurtenances, excavation, special fill, and any protective system(s) required to ensure the safety of the workers and the public.

670-5.03 Light Standards. The unit bid for each light standard shall include the cost of all labor and other materials necessary to complete the work.

670-5.04 Arms. The unit price bid for each arm of the type and length specified shall include the cost of the arm, appropriate down leads and all labor and other materials necessary to install it on the designated light standard or wood pole shown on the plans.

670-5.05 Breakaway Transformer Bases. The unit price bid for each breakaway transformer base shall include the cost of the breakaway transformer base and all labor and other materials necessary to install it where shown on the plans.

670-5.06 Conduit. The unit price bid per linear meter shall include the conduit and all labor and other materials necessary to complete the work, including couplings, condulets, adaptors or bends. Excavation and backfill for conduit shall be paid for separately under the item for Conduit Excavation and Backfill or as indicated.

670-5.07 Pullbox. The unit price bid for each pullbox shall include the cost of all excavation, backfill, frames, covers, labor, equipment, and other materials necessary to complete the work.

670-5.08 Junction Box. The unit price bid per each junction box shall include the cost of furnishing and installing cast iron junction boxes, and all labor, equipment and any other material necessary to complete the work.

670-5.09 Luminaires

A. Standard Mount. The unit price bid for each standard mount luminaire shall include the cost of the luminaire of the type specified, labor and other material necessary to complete the work.

B. Underbridge Mount. The unit price bid for each underbridge luminaire shall include the cost of the underbridge luminaire of the type specified, complete with mounting hardware, and all labor and other materials necessary to complete the work.

670-5.10 Photoelectric Controls. The unit price bid for each control shall include the cost of all labor, equipment and any materials necessary to complete the work.

670-5.11 Single Conductor Cable and Direct Burial Cable. The unit price bid per linear meter shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work. Cable from the pole base to the luminaire, or from the overhead power source to the luminaire, will be included in the light standard item or bracket arm item.

670-5.12 Ground Wire. The unit price bid per linear meter shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work.

670-5.13 Remove and Store Lighting Equipment. The unit price bid for removing and storing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

670-5.14 Remove and Dispose of Lighting Equipment. The unit price bid for removing and disposing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

670-5.15 Relocate Lighting Equipment. The unit price bid for relocating the lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Installing
new concrete foundations will be paid for under their appropriate items. New conductors and conduit, where necessary, will also be paid for separately.

**670-5.16 High Mast Pole, Head Frame Assembly, and Lowering System.** The price bid shall include the furnishing of all labor, materials, and equipment necessary to complete the work. The luminaires will be paid for separately.

**670-5.17 Portable Power Drive for High Mast Luminaire Lowering System.** The price bid shall include the entire power drive assembly, and winch if necessary, delivered to the location indicated on the plans or directed by the Engineer.

### Payment will be made under:

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### SECTIONS 671 THRU 679 (VACANT)

### SECTION 680 - TRAFFIC SIGNALS

#### 680-1 DESCRIPTION

**680-1.01 Work.** This work shall consist of furnishing and installing new traffic signal equipment, in accordance with the plans, specifications, standard sheets, or directions of the Engineer.

**680-1.02 Definitions.** The following definitions shall apply to all work, equipment, and materials included under this section:

1. Actuation - The operation of any type of detector.
2. Controller - That part of a controller assembly which performs the basic timing and logic functions.
3. Controller Assembly - The complete assembly for controlling the operation of a traffic signal, consisting of a controller together with all auxiliary equipment, housed in a weatherproof cabinet or cabinets.

4. Cycle Length - The time in seconds required for one complete signal cycle.

5. Detector - A device for indicating the passage or presence of vehicles or pedestrians.

6. Inductance Loop Detector - A detector consisting of a wire loop embedded in the roadway surface connected to an electronic device that is capable of sensing the passage or presence of either moving or stationary vehicles by a change in the electrical inductance characteristics of the wire loop.

7. Interval - That part or parts of a signal cycle during which signal indications do not change.

8. Phase - That part of a signal cycle allocated to any traffic movement receiving the right of way or to any combination of traffic movement receiving the right of way simultaneously during one or more intervals. Each phase shall consist of at least one green interval and one yellow clearance interval.


10. Signal Face - That part of a signal head provided for controlling traffic in a single direction and consisting of one or more signal sections. Turning indications may be included in a signal face.

11. Signal Head - An assembly containing one or more signal faces which may be designated accordingly as one-way, two-way, etc.

12. Signal Indication - The illumination of a traffic signal lens or equivalent device, or a combination of several lenses or equivalent devices at the same time.

13. Signal Section - A complete unit for illuminating a lens consisting of a housing, lens, reflector, lamp receptacle, and lamp.

14. Type I Traffic Signal Section. A Type I Traffic Signal Section is a standard or polycarbonate traffic signal section without reflector, reflector ring, lens, and lamp receptacle.

15. Type I Pedestrian Signal Section. A Type I Pedestrian Signal Section is a standard or polycarbonate pedestrian signal section without reflector, lens, and lamp receptacle.

**680-2 MATERIALS**

**680-2.01 Traffic Signal Equipment.** The specific components used in the construction of new traffic signal systems shall meet the requirements of the following subsections included under section 700, MATERIALS DETAILS:

- Bar Reinforcement, Grade 420 709-01
- Iron Castings 715-05
- Breakaway Transformer Base 723-15
- Rigid Plastic Conduit 723-19
- Metal Steel Conduit, Zinc Coated 723-20
- P.V.C. Coated Galvanized Steel Conduit 723-23
- Flexible Liquid-Tight Steel Conduit 723-24
- Cast Iron Junction Boxes 723-40
- Precast Reinforced Concrete Pullboxes 723-45
- Signal Cable 724-01
- Span Wire 724-02
- Traffic Signal Poles 724-03
- Traffic Signal Heads 724-04
- Shielded Communication Cable 724-08
- Signal Cable with Integral Messenger 724-09
- Shielded Communication Cable with Integral Messenger 724-10
- Fire Pre-emption Tell Tale Light 724-15
- Inductance Loop Wire 724-20
- Shielded Lead-in Cable 724-21
- Roadway Loop Embedding Sealer 724-22
- Pedestrian Push Button and Sign 724-23
- Fiberoptic Pedestrian Signal Heads 724-04
- Fiberoptic Dual Indication Arrow 724-04
- Strobing Signal Indication 724-04
680-2.02 Concrete. All cast-in-place pullboxes, signal pole foundations and controller cabinet bases shall meet the requirements of Class A concrete in section 501, Portland Cement Concrete General, except that the requirements for inspection facilities, automated batching controls and recordation do not apply. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

All precast concrete pullboxes, signal pole foundations and controller cabinet bases shall meet the requirements of §723-45 Precast Reinforced Concrete Pullboxes.

680-2.03 Messenger Wire. Messenger wire shall meet the requirements of §724-02 Span Wire.

680-2.04 Guy Wire. Guy wire shall meet the requirements of §724-02 Span Wire.

680-2.05 Pullbox Frames and Covers. Frames and covers shall meet the requirements of §715-05 Iron Castings.

680-3 CONSTRUCTION DETAILS

680-3.01 Equipment List and Drawings. Unless otherwise waived, the Contractor shall submit to the Regional Director within 30 days following the award of contract, detailed specifications, catalog cuts, parts list, instruction sheets, and shop drawings of equipment and materials which he proposes to install.

680-3.02 (Vacant).

680-3.03 Negotiations with Utility Company. The Contractor shall be responsible for all negotiations involving utility companies.

The Contractor shall comply with utility company regulations.

When a entry into a service manhole or attachment to any utility company pole is required, the Contractor shall notify the utility company sufficiently in advance. Entry into a service manhole or attachment to any pole shall not be made without the presence of a utility company representative if the utility company so requires. The service points shown on the plans are approximate only and the Contractor shall determine the exact location from the serving utility company.

The Contractor shall make arrangements with the local utility company to complete the service connection.

680-3.04 Underground Facilities. The Contractor shall locate all existing underground facilities in accordance with the provisions of Industrial Code Rule 753. It shall be the Contractors responsibility to satisfy himself as to existing conditions and to protect and support in a suitable manner all underground facilities encountered during the trenching and excavating operations. The Contractor shall repair any damage to these lines caused by his operations, and if the nature of the damage is such as to endanger the operations of these services and utilities and the necessary repairs are not immediately made by the Contractor, the work may be performed by the State or other Contractor and the cost thereof charged against the Contractor.

680-3.05 Test Holes. Prior to excavating for pole placement and after locating all existing underground facilities, the Contractor shall dig a test hole or holes at the proposed location of each pole. If obstructions are encountered the Contractor shall properly backfill the test hole and move to a new location as directed by the Engineer.

680-3.06 Work Sites. The Contractor shall perform all work within the work site in a workmanlike manner and in accordance with U.S. Department of Labor's Occupational Safety and Health Standards.
The sites of the work and adjacent premises shall be kept as free from material, debris and rubbish as is practicable. All such material or debris that accumulates during the work shall be removed by the Contractor as the work progresses.

Neither the materials excavated, nor the materials used, shall be placed so as to prevent access to any fire hydrants, water valves, manholes, police call boxes or fire alarm boxes.

680-3.07 Schedule of Work. The Contractor shall notify the local power company at least 72 hours (or as required by the company) in advance of the time that the individual installation is complete and ready for operation in order that taps may be made by the power company to distribution lines.

Upon completion of a signal installation the signal may be placed in service prior to the completion of other installations or the signal head may be covered. The Contractor shall place the signal in operation or cover the head as directed by the Engineer.

When the traffic signal is placed in operation, it shall be operated in accordance with timing schedules to be supplied by the Department.

680-3.08 Contractor Responsibility with Utilities. All attachments to utility company poles shall be made in accordance with the specifications and subject to the inspection of the utility companies owning the poles. The height of all proposed attachments above the ground and their locations on the poles shall be in accordance with the plans, standard sheets or as directed by the Engineer and shall meet the approval of the utility companies owning the poles.

The Contractor shall protect all property and materials of the utility companies and shall be responsible for the repair or replacement of any damaged material or property. In the event that the point of attachment or location of the risers is such that the risers interfere with or do not provide proper clearance with existing utility company attachments, the Engineer, in consultation with the utility companies owning the poles, shall make the necessary adjustments in heights and location to eliminate such interference.

680-3.09 Excavation. All excavation shall be performed in accordance with Section 206 Trench, Culvert and Structure Excavation, including the protection of workers and the public.

Excavation shall not be performed until immediately before installation of the conduit, direct burial cable, footings, pullboxes or any other appurtenances. The excavated material shall be placed in a location or locations approved by the Engineer. These locations shall be selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to cause the minimum interference with the surface drainage. All surplus excavated material shall be removed and disposed of by the Contractor as specified in §203-3.08 Disposal of Surplus Excavated Materials.

Excavation shall be backfilled as specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables. After backfilling, the excavation shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

The outline of all areas to be removed in sidewalks, driveways, and pavement shall be saw cut to a depth of at least 75 mm prior to removing the sidewalk, driveway or pavement. Cuts shall be neat and true along score lines with no shatter outside the removal area. Damaged saw cut areas shall be recut.

Pavement, shoulder, sidewalks, curbs, driveways, lawns, plants and other such features shall be replaced in kind with material of equal quality or as shown on the plans, standard sheets or as directed by the Engineer.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter or driveway is broken or damaged, the entire square, section or slab shall be removed and replaced with the same kind and quality of material.

For transverse sidewalk, curb or gutter cuts in concrete the entire square or section shall be removed and replaced with the same kind and quality of material. For longitudinal cuts in concrete sidewalks only the area removed between sawcuts shall be replaced unless specified otherwise on the plans.

680-3.10 Pole Excavation and Concrete Foundation. Foundations shall be constructed as shown in the contract documents or as directed by the Engineer. However, the Contractor has the option to use either Cast-in-Place or Precast Concrete foundations for the signal poles.

If the Contractor elects to install a cast-in-place foundation, the signal pole may be installed on the foundation three (3) days after concrete placement. However, the span wire and signal heads may not be
installed until the concrete cylinder strength reaches at least 15 MPa. Therefore, the Contractor shall assist the Engineer in making a sufficient number of test cylinders of the foundation concrete, store these cylinders at the location directed by the Engineer, and transport these cylinders to the State testing facility in order to install the traffic signal as soon as possible.

If the Engineer requests the submittal of design computations for one or more signal poles, the Contractor shall not start construction of the foundations for those signal poles until the Engineer's review of the submittal is completed. The Engineer will have twenty (20) working days to review the design computation for one signal pole, and an additional two (2) working days for each additional signal pole. For those poles on which a traffic signal cabinet will be mounted, the Contractor shall orient the pole foundation to align the signal cabinet and cabinet wiring access hole as specified on the plans. If no orientation is specified on the plans, the Contractor shall orient the signal cabinet and cabinet wiring access hole 180° from the span wire or load attachment to the pole, unless otherwise directed by the Engineer. The Contractor shall notify the Engineer three (3) working days in advance of doing any pole foundation work and provide the intended pole orientation.

680-3.11 Poles. Poles shall be erected as specified on the plans, standard sheets and as directed by the Engineer.

Pole and signal locations shown on the contract plans shall be field checked for any condition that may affect their placement, where changes are necessary the exact location will be determined by the Engineer.

When field conditions require a change in pole position from that shown in the contract plans, the pole length requirements may vary. It shall be the Contractor’s responsibility to verify pole length before ordering poles.

Pole erection shall include installation of mast arms and lighting arms and attachment of fittings as specified on the plans and standard sheets as follows:

1. Anchor bolt covers if specified.
2. Weatherheads and couplings as required.
3. Service bracket.
4. Pole cap and mast arm end caps.
5. Cabinet mounting fittings, plates, brackets as needed for the cabinet being installed.
6. Reinforced couplings for wire entrances to cabinets.
7. Galvanized eyebolt, nuts and washers for attaching span wire assembly.
8. Galvanized pole clamps with eyes for attaching tether wires.

In addition, the Engineer may require the contractor to submit, at any time, design computations for any or all of the traffic signal poles in the contract. The design computations must be approved, stamped and signed by a professional engineer licensed in New York State. The Engineer shall have twenty (20) working days to review the design computations for one traffic signal pole, and an additional two (2) days for each additional signal pole.

If the Engineer's review of a pole's design indicates a problem(s) exists, the Contractor will be notified within the time allotted for the review. In these cases a meeting will be held between the Engineer and the Contractor to resolve the Engineer's concerns.

680-3.12 Grounding. A copper clad ground rod, ground wire and fittings shall be installed as shown on the plans, standard sheets or as directed by the Engineer. The ground system shall be electrically connected to the grounding terminal on the pole or controller cabinet.

The ground system when completed shall be tested in accordance with §680-3.32. If the requirements of this test are not met, additional ground rods, ground rod extensions, electrical bonding of metallic conduit or other grounding measures may be required as directed by the Engineer.

680-3.13 Conduit and Direct Burial Cable. Conduit and direct burial cable shall be installed as specified on the plans, standard sheets or as directed by the Engineer. Underground conduit and direct burial cable installations shall have a minimum cover of 0.45 m except under roadways, where the minimum cover shall be 0.6 m unless specified otherwise on the plans, or standard sheets. The conduit shall be laid on a uniform grade to allow any condensation to drain to pull boxes or “T” drains. Conduit
shall be backfilled in accordance with §203-3.15 Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables. In rock excavations a bedding of select backfill must be placed and tamped before laying the conduit.

Conduit may be placed under pavement by jacking or boring methods approved by the Engineer. Pavement may not be disturbed without permission of the Engineer. In the event obstructions are encountered, small test holes may be cut in the pavement upon approval of the Engineer. Jacking or boring pits shall be kept 0.6 m clear of the edge of pavement and shoulder whenever possible. Excavation for jacking or boring pits shall be in accordance with §680-3.09 Excavation.

Conduit or direct burial cable may be placed by machine methods approved by the Engineer. All bends in conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed for all bends in steel conduit. Any evidence of destruction of the protective coating will be cause for rejection. All connections in metallic conduit shall be tight. Ends of conduit shall be reamed to remove burrs and rough edges.

Conduit ends in pullboxes, junction boxes, cabinet, etc. shall be equipped with insulating bushings.

All conduits installed shall be tested for clear bore and correct installation by the Contractor in the presence of the Engineer.

All empty conduit after testing shall be immediately sealed by the Contractor.

After a conduit is properly installed, the Contractor shall furnish and install in each conduit run a No. 10AWG galvanized steel drag wire or nylon or polypropylene rope with a tensile strength of at least 2.2 kN. At least one meter of extra wire or rope shall be left at each end.

680-3.14 Pullboxes. Pullboxes shall be constructed and installed in accordance with the details specified on the standard sheets or as directed by the Engineer.

Cast iron frames and covers shall be furnished and placed on each pullbox. They shall be set in mortar and placed true to line and grade and make full and even bearing on the underlying construction surface. The frame and cover shall be as shown on the standard sheet. Frames and covers which do not fit together properly, will be rejected by the Engineer and shall be removed from the site.

680-3.15 Signal Control Cable and Shielded Communication Cable. Cable shall be installed to form a continuous circuit between the proper equipment terminals. All terminal connections shall be made with approved solderless lugs of the proper size using a crimping tool that is self-releasing when proper compression has been applied. Only connectors that provide continuity and physical contact around the circumference of the connector and conductor shall be used.

During installation of the cable, the Contractor shall take care not to damage conductors, insulation, or outer covering. The length of cable installed shall not cause excessive stress on the conductors or any part of the cable.

An insert lubricant approved by the Engineer shall be used in placing cable in conduit. Cable shall be pulled into conduit by hand and the use of winches or other power actuated pulling equipment will not be permitted.

At least one meter but not more than one and one half meter of slack shall be left for each cable at each pullbox or junction box. Short bends of cable shall be avoided inside pullboxes. Cable in pullboxes or junction boxes shall not cross over any other cables already in place nor block any conduit. All cable shall be identified as to function in each pullbox, junction box or cabinet by the use of aluminum or brass cable markers. If a wire numbering system is used for identification, the key to the system shall be placed along with the wiring diagram in the controller cabinet.

Conductors in controller cabinets shall be dressed neatly with tie wraps. Spare conductors shall be taped and coiled neatly in the bottom of the cabinet. Ends of spare conductors shall be taped. Field wiring entering controller cabinets shall be identified as to function.

Splices in shielded communication cable will not be allowed between equipment terminals. Where cable is installed on span wire, or messengers, it shall be supported at intervals not greater than 380 mm by messenger rings, stainless steel cable straps or other non-corrosive metal lashing approved by the Engineer. Taping and plastic cable ties will not be permitted.

Integral messenger cable shall be installed in accordance with the details specified on the standard sheets or as directed by the Engineer.

When integral messenger cable is installed on utility company poles, the Contractor shall make all arrangements with the utility company for the installation. The Contractor shall observe all utility
company requirements for attachments to poles and clearances with utility wires. The Contractor shall notify the utility company prior to start of the work and observe the utility company requirements for accomplishment of the work.

All necessary hardware used with integral messenger cable shall develop the full breaking strength of the integral messenger wire. Poles at each end and at each change of direction shall be guyed as specified on the plans or directed by the Engineer. When installed on utility company poles, guys shall be installed as directed by the utility company.

680-3.16 Cable Splices. Unless otherwise specified, cable splices will be permitted only in pullboxes, junction boxes, utility manholes, and at traffic signal heads. All cable runs between units of equipment shall be without splices unless shown on the plans or authorized by the Engineer. Conductors in controller cabinets shall not be spliced. Splices in overhead cable, when necessary, shall be made with the approval of, and as specified by the Engineer.

All splices shall be capable of satisfactory operation under continuous submersion in water. Multi-conductor cables shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the cable.

Moisture shall be excluded from the joint during the splicing operation and the work shall be done in dry weather or under shelter. Perspiration from the splicer's hand should be wiped off with dry material. All materials and tools involved in the splicing process shall be kept dry.

One of the following methods shall be used for making a watertight and electrically insulated splice:

**Method No. 1.** The outer covering and insulation shall be removed from each conductor for a minimum length necessary for the use of a pressure release crimping tool. The conductor ends shall be bared and joined with a seamless, solderless type sleeve connector of the same AWG size as the conductor being spliced, using a pressure release crimping tool designed for the size connector being used. After crimping the sleeve connector shall maintain proper contact with both conductors around the circumference of the splice and along the length of the sleeve.

The portion of each conductor where insulation has been removed, and the sleeve connector, shall be reinsulated using a coat of fast drying sealing agent of electrical grade, wrapped tightly with overlapping layers of rubber tape, a second coat of the sealing agent applied, and then wrapped tightly with overlapping layers of polyvinylchloride tape.

The sealing agent and tape shall extend at least 25 mm onto the undisturbed insulation of each conductor. Sufficient layers of tape shall be applied to equal 1.5 times the thickness of the original insulation.

Rejacketing the cable shall be accomplished in a similar manner as described above except that the sealing agent and tape shall extend at least 100 mm onto the undisturbed outer covering of each cable.

Individual splices in each conductor shall be staggered to minimize the outside diameter of the spliced cable.

**Method No. 2.** All of the requirements for splicing specified in Method No. 1. shall apply. except that the completed splice including sleeve connector and the portion of each conductor where the insulation has been removed. shall be reinsulated and the cable rejacketed by using an acceptable mold poured full with a two component electrical insulating resin approved by the Engineer. The resin shall not require external heating to produce satisfactory pouring consistency.

680-3.17 Span Wire Assembly. Span wire assemblies including necessary hardware shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer.

Span wire assemblies shall be either single span wire, dual span wire with upper tether or dual span wire with lower tether as specified on the plans.

The Contractor shall determine the span and tether wire diameter based upon pole design load using the table on the standard sheets. All necessary hardware for attaching span and tether wires to the poles shall develop the full breaking strength of the span or tether wire with which it is used, except that breakaway links for lower tether wires shall develop the strength specified on the standard sheets.
Sag shall be adjusted so that it is a minimum of 5 percent of the span when the traffic signal system, including overhead signs, is complete.

The Contractor shall determine the length of suspension and tether wire required to span the distance between poles, allow sufficient length for fastening and sag and after adjustments, make the whole assembly consistent with the plans, standard sheets or as directed by the Engineer.

680-3.18 Messenger Assembly. The messenger shall be installed in accordance with the details on the standard sheets or as directed by the Engineer.

When a messenger is installed on utility company poles the Contractor shall make all arrangements with the utility company for the installation. The Contractor shall observe all utility company requirements for attachments to poles and clearance with utility wires. The Contractor shall notify the utility company prior to the start of the work and observe the utility company requirements for accomplishment of the work.

All necessary hardware used with the messenger assembly shall develop the full breaking strength of the messenger strand. Poles at each end and at each change of direction along the run of messenger shall be guyed as specified on the plans or directed by the Engineer. When installed on utility company poles, guys shall be installed where required by the utility company. The signal control cable shall be fastened to the messenger at intervals not greater than 0.4 m by messenger rings, stainless steel cable straps or other non-corrosive metal lashings approved by the Engineer. Taping and plastic cable bands will not be permitted.

680-3.19 Guy Assembly. Guys shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer. Guys on utility company poles shall meet the utility company requirements.

Excavation for the anchor shall be of the minimum width possible to accept the unexpanded anchor. All backfill shall be compacted.

680-3.20 Riser Assembly. Risers and weatherheads shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer. Risers on utility company poles shall meet the utility company requirements.

680-3.21 Signal Heads. Signal heads shall be installed as specified on the plans, standard sheets or as directed by the Engineer. Each signal head shall be assembled from signal sections and brackets in the configuration specified on the plans. Signal heads shall be properly aligned to the satisfaction of the Engineer. All mounting hardware shall be securely tightened to prevent loosening by the wind.

Until signal heads are placed in operation they shall be bagged with opaque or other material, as approved by the Engineer, that is adequately secured in a neat and orderly manner.

Optically programmed signal heads shall be installed, directed and veiled in accordance with the manufacturer's instructions, plans, standard sheets and the Engineer's visibility requirements. Each section of the signal shall be masked with prescribed materials in an acceptable and skillful manner.

LED Traffic or Pedestrian Signal Modules, which are supplied by the State, shall be installed in new or existing traffic or pedestrian signal heads as shown on the plans or as ordered by the Engineer. When the Contractor is required to furnish the LED module, unless otherwise waived, the Contractor shall submit to the Regional Director within 30 days following the award of contract, detailed specifications and catalog cuts of the equipment he/she proposes to install. In either case, the Contractor shall first remove any existing components necessary to install the LED modules, and the removed components shall remain the property of the State.

680-3.22 Wiring Color Code. The following wire color code system, unless otherwise shown on the plans, shall be used for wiring signal heads:

A. Through C. (Vacant)
D. 1 Through 8 Phases

1. Priority of assigning signal phases, overlaps and double clearances to Groupings of Color - Coded Wire for Signal Heads:

<table>
<thead>
<tr>
<th>PRIORITY FUNCTION</th>
<th>PRIORITY FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 5</td>
<td>Phase 4</td>
</tr>
<tr>
<td>Phase 1</td>
<td>Overlap No. 1</td>
</tr>
<tr>
<td>Phase 6</td>
<td>Overlap No. 2</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Overlap No. 3</td>
</tr>
<tr>
<td>Phase 7</td>
<td>Overlap No. 4</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Double Clearance No. 1</td>
</tr>
<tr>
<td>Phase 8</td>
<td>Double Clearance No. 2</td>
</tr>
</tbody>
</table>

2. Groupings of color coded wire for signal heads:

<table>
<thead>
<tr>
<th>GROUP NUMBER</th>
<th>INDICATION</th>
<th>WIRE COLOR CODE*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-1-R</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-1-O</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-1-G</td>
</tr>
<tr>
<td>1</td>
<td>Ground Wire</td>
<td>14/19C-1-W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-1-W/B</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-1-O/B</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-1-G/B</td>
</tr>
<tr>
<td></td>
<td>Ground Wire</td>
<td>14/19C-1-B/W</td>
</tr>
<tr>
<td>2</td>
<td>Red</td>
<td>14/19C-1-R/W</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-1-BL/W</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-1-G/W</td>
</tr>
<tr>
<td>3</td>
<td>Ground Wire</td>
<td>14/19C-1-B/W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-2-R/W</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-2-BL/W</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-2-G/W</td>
</tr>
<tr>
<td>7</td>
<td>Ground Wire</td>
<td>14/19C-2-B/W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-3-R</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-3-0</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-3-G</td>
</tr>
<tr>
<td>9</td>
<td>Ground Wire</td>
<td>14/19C-3-W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-3-R/B</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-3-O/B</td>
</tr>
<tr>
<td>10</td>
<td>Green</td>
<td>14/19C-3-G/B</td>
</tr>
<tr>
<td></td>
<td>Ground Wire</td>
<td>14/19C-3-W/B</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/19C-3-R</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-3-0</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-3-G</td>
</tr>
<tr>
<td>11</td>
<td>Ground Wire</td>
<td>14/19C-3-W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/10C-1-R</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/10C-1-O</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/10C-1-G</td>
</tr>
<tr>
<td>12</td>
<td>Ground Wire</td>
<td>14/10C-1-W</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>14/10C-1-R/B</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/10C-1-O/B</td>
</tr>
<tr>
<td>13</td>
<td>Green</td>
<td>14/10C-1-G/B</td>
</tr>
<tr>
<td></td>
<td>Ground Wire</td>
<td>14/10C-1-W/B</td>
</tr>
</tbody>
</table>
E. Groupings of Color Coded Wire for Preempts (Blue Light) and Pedestrian Signals:

1. Preempts (Blue Light).

<table>
<thead>
<tr>
<th>WIRE COLOR CODE</th>
<th>INDICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>14/2C-1-B</td>
<td>Blue Light</td>
</tr>
<tr>
<td>14/2C-1-W</td>
<td>Ground Wire</td>
</tr>
</tbody>
</table>

2. Pedestrians Signals.

<table>
<thead>
<tr>
<th>PED NUMBER</th>
<th>WIRE COLOR CODE*</th>
<th>INDICATION</th>
<th>PED NUMBER</th>
<th>WIRE COLOR CODE*</th>
<th>INDICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14/5C-1-P/R</td>
<td>DONT WALK</td>
<td>3</td>
<td>14/5C-3-P/R</td>
<td>DONT WALK</td>
</tr>
<tr>
<td>1</td>
<td>14/5C-1-P/G</td>
<td>WALK</td>
<td>4</td>
<td>14/5C-3-P/G</td>
<td>WALK</td>
</tr>
<tr>
<td>1</td>
<td>14/5C-1-P/B</td>
<td>Switch Wire</td>
<td></td>
<td>14/5C-3-P/B</td>
<td>Switch Wire</td>
</tr>
<tr>
<td>1</td>
<td>14/5C-1-P/O</td>
<td>Switch Wire</td>
<td></td>
<td>14/5C-3-P/O</td>
<td>Switch Wire</td>
</tr>
<tr>
<td>1</td>
<td>14/5C-1-P/W</td>
<td>Ground Wire</td>
<td></td>
<td>14/5C-3-P/W</td>
<td>Ground Wire</td>
</tr>
<tr>
<td>2</td>
<td>14/5C-2-P/R</td>
<td>DONT WALK</td>
<td>3</td>
<td>14/5C-4-P/R</td>
<td>DONT WALK</td>
</tr>
<tr>
<td>2</td>
<td>14/5C-2-P/G</td>
<td>WALK</td>
<td>4</td>
<td>14/5C-4-P/G</td>
<td>WALK</td>
</tr>
<tr>
<td>2</td>
<td>14/5C-2-P/B</td>
<td>Switch Wire</td>
<td>5</td>
<td>14/5C-4-P/B</td>
<td>Switch Wire</td>
</tr>
<tr>
<td>2</td>
<td>14/5C-2-P/O</td>
<td>Switch Wire</td>
<td></td>
<td>14/5C-4-P/O</td>
<td>Switch Wire</td>
</tr>
<tr>
<td>2</td>
<td>14/5C-2-P/W</td>
<td>Ground Wire</td>
<td>5</td>
<td>14/5C-4-P/W</td>
<td>Ground Wire</td>
</tr>
</tbody>
</table>

* Key for Wire Color Code:

<table>
<thead>
<tr>
<th>XX</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>AWG</th>
<th>No. of Conductors</th>
<th>Cable No.</th>
<th>Color</th>
<th>Tracer</th>
</tr>
</thead>
</table>

Colors: R-Red, O-Orange, G-Green, BL-Blue, W-White, B-Black.

F. Notes:

The following steps should be used to determine the appropriate color coded wiring for a given signal installation:

1. Determine which functions are used in the signal operation.
2. Assign the color coded wire to the functions used in numerical order according to the priority given to the function.
3. Use the minimum number of conductors required to maintain the color code.

EXAMPLE: Signal X is a four phase signal

Step No.1: Phase 1, 5, 6, 4, and an overlap of Phase 6 + 4 is used in the Signal operation.

<table>
<thead>
<tr>
<th>Step No. 2--</th>
<th>Priority</th>
<th>Function</th>
<th>Color Coded Group No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Overlap No. 1</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Step No.3: Use one 19 conductor cable and one five conductor cable
680-3.23 Pedestrian Push Button and Sign. The push button and sign shall be installed and constructed in accordance with the details specified on the standard sheets. Push button and sign shall be installed on either an existing pole, a newly installed signal pole or on its own post and footing as specified on the plans.

The orientation shall be convenient to pedestrians intending to cross the street controlled by the push button at the marked or obvious crosswalk.

680-3.24 Fire Pre-Emption Tell Tale Light. The Tell Tale Light shall be installed in accordance with details on the standard sheets or as directed by the Engineer.

The light shall be wired in such a manner as to simultaneously display a blue light during the emergency pre-emption interval and at other times remain unlighted. It shall be oriented in the position which provides the best view to the emergency equipment approach roadway.

680-3.25 Flashing Beacon Sign Assembly. The flashing beacon sign assembly shall be constructed as shown on the plans, and standard sheets. It shall be installed on either an existing sign and post or a new pole as specified on the plans.

The sign panel shall be constructed in accordance with the appropriate subsections of Section 645, Guide Signs, Traffic Signs and Special Devices. The flashing beacon signal heads and solid state flasher and cabinet shall be installed as shown on the standard sheets.

When not mounted behind guiderail, the pole shall be equipped with an approved breakaway base or transformer base fabricated in accordance with §723-15.01--Breakaway Transformer Base (Aluminum).

680-3.26 Inductance Loop Installation. Loops shall be installed in accordance with the details specified on the plans, Standard Sheets or as directed by the Engineer. Loop dimensions shall be as specified on the plans.

Pullboxes, conduits and curb cuts shall be completed before beginning the loop installation.

The loop shall be outlined on the pavement to conform to the specified configuration. A power saw and wet cutting techniques shall be used to cut a slot in the pavement. Dry cutting techniques shall be used if directed by the Engineer and with appropriate measures to safeguard nearby vehicle and pedestrian traffic. The cut shall be 9.5 mm in width and the depth specified on the standard sheets. The corners shall be cored, drilled or chipped out as shown on the standard sheets. Sharp edges in the corners shall be smoothed. All saw cuts and corners shall be of the same depth.

Immediately after sawing by either wet or dry methods, the slot and pavement shall be flushed with pressurized clean water to remove the saw slurry, dust or other cutting debris. Filtered compressed air shall be used to remove all dust and moisture from the slot. If the slot is damp, do not proceed with the installation until it is dry. Hot air may be used to dry the saw slot.

At the edge of pavement or curb a 25 mm minimum diameter, Metal Steel Conduit, Zinc Coated, Flexible Liquid-Tight Steel Conduit or Rigid Plastic Conduit shall be installed between the pavement and pullbox in accordance with details specified on the standard sheets. The curb or pavement shall be cut or scored to leave a permanent mark to show where the conduit runs under the curb or pavement.

The loop wire shall be installed starting at the roadside pullbox, passed around the loop for the specified number of turns and brought back to the pullbox. Splices shall not be permitted outside the pullbox. The wire shall be depressed in the slot without the use of sharp objects which might damage the wire insulation.

The loop shall be held in place every 0.6 m with 25 mm (approximate) strips of rubber, neoprene, flexible tubing or foam backer rod as approved by the Engineer. These hold down strips shall be left in place when the slot is filled with Roadway Loop Embedding Sealer.

The pair of loop wires between the edge of pavement and the splice to the shielded lead-in cable in the pullbox shall be twisted together with at least five turns per 0.3 m.

The splice between the loop wires (twisted pair) and the shielded lead-in cable shall be moisture proof and shall have a dielectric strength at least equal to that of the original insulation.

The bared conductor ends shall be either twisted and soldered or joined using an uninsulated, size coded solderless type connector of the correct size using an appropriate crimping tool. The splice shall be reinsulated in accordance with §680-3.16 Cable Splices, Method No. I except that heat shrinkage polyolefin tubing may be used as an alternate to the rubber tape; also, the first layer of PVC tape and sealing agent shall be extended as needed to cover a minimum of 25 mm of the inductance loop wire tube.
§680

The polyolefin tubing shall be at least as thick as the original insulation. Upon completion of the reinsulating, a final waterproof coating shall be applied over the entire splice.

The loop wires (twisted pair) and the splice to the shielded lead-in cable with the pullbox shall be held by wire hangers as near as possible to the top of the box in order to prevent their immersion in water. The shielded lead-in cable shall be continuous (no splices) from the splice to the loop wires to the controller cabinet terminals. The drain or ground wire in the shielded cable shall be grounded at the controller cabinet terminals only.

The completed loop installation including the shielded lead-in to the controller cabinet shall have a minimum of 50 megohms leakage resistance to ground. This resistance shall be tested before the loop is sealed in the pavement and after the splice is made between the loop wires (twisted pair) and shielded lead-in. Resistance to ground shall be tested in accordance with the Insulation Resistance Test in §680-3.32.

When it is determined that the resistance to ground requirements are met, the slot shall be filled with Roadway Loop Embedding Sealer. The pavement temperature shall be at least 4.4°C and rising before the sealer is placed. All work involving the sealer shall be done in compliance with the manufacturer's specifications. When the loop embedding sealer has set sufficiently to open the loop to traffic, but the surface remains tacky, the loop may be dusted with cement dust to facilitate opening the loop to traffic.

680-3.27 Concrete Base for Controller Cabinet. Bases shall be installed and constructed in accordance with the details specified on the standard sheets. Bases shall be either pre-cast or cast-in-place. Anchor bolts shall be placed in the footing at the proper location. Conduits shall be installed in the footing as required by the plans.

Where the base is installed in unpaved areas a work pad shall be constructed in front of the cabinet door.

Excavation shall be in accordance with §680-3.09, Excavation.

680-3.28 Power Meter Base. At each power source, the Contractor shall provide two meters of slack in the traffic signal cable used for power supply and neatly coil this slack within the controller cabinet.

The Contractor shall install a meter base as shown on the standard sheets or as ordered by the Engineer. The meter base will be furnished by the utility company. The additional length of power cable in the controller cabinet shall be extended through the cabinet wall into the meter base and back to the controller circuit breaker. All meter base fittings shall be weather tight.

680-3.29 Overhead Traffic Signs. Sign and mounting brackets shall be installed as shown on the plans and standard sheets. Signs shall be aligned to the satisfaction of the Engineer.

Sign Panels shall be aluminum and constructed in accordance with the appropriate subsections of section 645-Guide Signs, Traffic Signs and Special Devices.

680-3.30 Field Galvanizing. All abrasions of galvanized steel due to handling equipment, erection, etc., and all points of attachment, shall be field repaired as specified in §719-01--Galvanized Coatings and Repair Methods.

680-3.31 Cast Iron Junction Boxes. Junction boxes shall be installed at the locations and according to the details on the plans or as directed by the Engineer. Dimensions shall be as shown on the plans.

680-3.32 Tests. The Contractor shall perform all tests described herein in the presence of the Engineer or his representative. Testing equipment shall be supplied by the Contractor.

Prior to placing a signal in operation, the Contractor shall perform the following tests:

A. **Continuity Test.** Each circuit shall be tested for continuity.

B. **Ground Test.** All traffic signal grounding systems when completed in place shall have a resistance to ground of not more than that shown in the table below as determined in the following manner:
1. Temporarily connect a 10 ampere load between the AC + side of the equipment cabinet fuse and the ground system. It should be assured that the power company applied voltage is 120 volts AC at the time of the test.

2. Disconnect the power company AC neutral from the ground system.

3. Connect a voltmeter between the power company AC neutral and the ground system.

<table>
<thead>
<tr>
<th>Controller Installed</th>
<th>Voltmeter Reading (Volts)</th>
<th>Equivalent Resistance (Ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Phase</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>Model 170 Microcomputer</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>All others</td>
<td>10</td>
<td>1.0</td>
</tr>
</tbody>
</table>

If the voltmeter reading is higher than the appropriate voltage shown in the above table under the 10 ampere load, the grounding system has an unacceptable resistance to ground. Additional grounding, including electrical bonding of underground metallic conduit, may be necessary in order to meet the requirements of this test.

**C. Insulation Resistance Test.** An insulation resistance test at 500 volts DC shall be made on each circuit between the circuit and ground. The insulation resistance shall not be less than 10 megohms on each circuit except that inductive loop detector circuits shall have an insulation resistance of not less than 50 megohms.

The insulation resistance test shall not be performed on magnetometer sensing elements. Splices in the pullbox adjacent to the magnetometer sensing elements shall not be made prior to performing an insulation resistance test on the lead-in conductors between the pullbox and the controller cabinet field terminals.

**D. Functional Test.** After satisfactory completion of all other tests, a functional test of the traffic signal control equipment shall be performed to demonstrate that every part of the signal system operates in accordance with the plans, specifications and to the satisfaction of the Engineer. The functional test for each signal system shall consist of not less than ten days of continuous satisfactory operation. If unsatisfactory performance of the system components is discovered during this time, the condition shall be corrected and the test repeated until ten days of continuous satisfactory operation is obtained.

Functional tests shall not begin on a Friday or on the day before a legal holiday. On the day the functional test begins, initial turn-on shall be made between the hours of 9:00 am and 2:00 pm unless otherwise ordered by the Engineer. Prior to turn-on all signal control equipment required for signal system shall be installed and ready for operation including pedestrian signal indications, pedestrian signs and push buttons, and vehicle detectors. All louvers, visors, and signal heads shall be directed to provide maximum visibility.

Temporary shut downs caused by power interruption or traffic accidents shall not constitute discontinuity of the functional test.

**680-3.33 Fiberoptic Pedestrian Signal Heads.** Fiberoptic pedestrian signal heads shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.34 Fiberoptic Dual Indication Arrow.** Fiberoptic dual indication arrows shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.35 Strobing Signal Section.** Strobing Signal Sections shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.36 LED Traffic Signal Module.** LED Traffic Signal Modules shall be installed in Type I Traffic Signal Sections according to the requirements of §680-3.21 Signal Heads.

**680-3.37 LED Pedestrian Signal Module.** LED Pedestrian Signal Modules shall be installed in Type I Pedestrian Signal Section according to the requirements of §680-3.21 Signal Heads.
680-4 METHOD OF MEASUREMENT

680-4.01 Each Unit. The following items will be measured for payment as the number of each unit furnished and installed in accordance with the contract documents or as directed by the Engineer:

Span Wire Assembly  Traffic Signal Section
Guy Assembly       Strobing Signal Indication
Pedestrian Signal Section  Traffic Signal Bracket Assembly
Pullbox             Traffic Signal Disconnect Hanger
Cast Iron Junction Box  Riser Assembly
Controller Assembly Component  Traffic Signal Pole
Fire Pre-Emption Tell Tale Light  Overhead Sign Assembly
Concrete Base for Controller Cabinet  Flashing Beacon Sign Assembly
Fiberoptic Dual Indication Arrow  Fiberoptic Pedestrian Signal Section
LED Pedestrian Signal Module  LED Traffic Signal Module
Type I Pedestrian Signal Section  Type I Traffic Signal Section
Pedestrian Push Button and Sign

680-4.02 Linear Meter Measurements. The following items will be measured for payment as the number of meters actually installed in accordance with the contract documents or as directed by the Engineer:

Inductance Loop Wire  Shielded Communication Cable
Shielded Lead-In Cable  Signal Cable with Integral Messenger
Inductance Loop Installation  Shielded Communication Cable w/ Integral Messenger
Messenger Assembly  Conduit
Signal Cable

Inductance loop wire shall be the actual number of meters of wire used and left in place. Measurement of inductance loop installation shall be the number of meters of pavement sawcut.

680-4.03 Pole Excavation and Concrete Foundation. The payment quantity of pole excavation and concrete foundation shall be the number of cubic meters of concrete shown in the table on the standard sheet for Traffic Signal Pole Foundations for the specified footing size. No adjustment will be made when the Contractor elects to install a square footing. When a square footing is specified on the plans, the payment quantity shown in the table will be multiplied by a factor of 1.3.

680-4.04 Conduit Jacking or Boring. The quantity of conduit jacking or boring shall be the number of linear meters as computed from the payment limits specified in the contract documents.

680-5 BASIS OF PAYMENT

680-5.01 General. The unit price bid for all items of work encompassed by this Section shall include the furnishing of all labor, materials, tools, equipment, safety requirements as determined by U.S. Department of Labor's Occupational Safety and Health Standards, and incidentals as necessary to complete the work of the item installed in place and performing all tests to the satisfaction of the Engineer. No direct payment will be made for the installation of the power service connection and meter base but the cost shall be covered in the various traffic signal items. Items with additional provisions are as follows:

680-5.02 Pedestrian Signal Section. The unit price bid for each section shall include one “WALK” and one “DON'T WALK” indication, and all necessary internal wiring, visor(s) and lamp(s).

680-5.03 Pedestrian Signal Bracket Assembly. The unit price bid for each bracket assembly shall include the bracket, fittings, wiring of the head assembly and installation.
§680

680-5.04 Pole Excavation and Concrete Foundation. The unit price bid per cubic meter shall include the excavation, any protective system(s) required to ensure the safety of the workers and the public, backfill (select granular backfill or concrete), form work, concrete, bar reinforcement for concrete, excavation and backfilling of test holes, conduit bends and fittings, restoration of surfaces in kind, and sawcutting.

Progress payments will be made at the unit price bid for 80 percent of the quantity for each foundation properly installed except for the mortar cap and restoration. The remaining 20 percent will be paid for upon satisfactory completion of each footing.

680-5.05 Pullbox. The unit price bid for each pullbox shall include all concrete, reinforcing steel, crushed stone or gravel, extensions, sawcutting, excavation, backfill, frames, covers, restoration of surfaces and incidentals as required.

680-5.06 Conduit. The unit price bid shall include all handling, cutting, bending, fitting, capping, painting, testing, furnishing and placing pull lines, condulets and concrete inserts, expansion and incidental fittings as required. Conduit bends and fittings in concrete footings will be paid for under the respective footing item. Conduit excavation and backfill and jacking or boring will be paid for under their respective items.

680-5.07 Inductance Loop Installation. The unit price bid per linear meter shall include the cost of all pavement sawing and drilling, loop embedding sealer, and pavement cut-outs. Inductance Loop Wire, pullboxes, Shielded lead-in Cable, Vehicle Detector Inductance Loop, Conduit, and Conduit Excavation and Backfill shall be paid under their respective items.

680-5.08 Controller Assembly. The unit price bid for each component of the Controller Assembly shall include all labor, material and equipment necessary to complete the work. The cost of the necessary grounding system shall be included in the unit price bid for the controller assembly components.

Progress payments will be made in the following manner:

Sixty-five percent of the bid price of each component will be paid after it is installed and ready for testing.

Twenty-five percent of the bid price will be paid after satisfactory completion of all tests required by these specifications, including the function test for ten days of continuous satisfactory operation of the traffic signal system at each signalized location.

The remaining ten percent will be paid when all the traffic signals in the contract are functioning to the satisfaction of the Engineer.

680-5.09 Fire Pre-Emption Tell Tale Light. The unit price bid shall include the light fixture, bulb, nipple, guard, and all attachments and fittings as required.

680-5.10 Concrete Base for Controller Cabinet. The unit price bid for each base shall include the cost of all sawcutting, excavation, backfill, form work, restoration of surfaces, concrete, test holes, conduit bends and fittings, and concrete work pad.

680-5.11 Pedestrian Push Button and Sign. The unit price bid shall include the push button, sign, mounting hardware, pole drilling, and necessary fittings as required. Where the push button and sign is installed on its own post the unit price shall also include the cost of the post, sawcutting, excavation, backfill, concrete, restoration of surfaces, and conduit bend and fittings.

680-5.12 Jacking or Boring. The unit price bid per meter shall include excavation, backfilling for jacking or boring pits; test holes; and restoration of surfaces in kind.

680-5.13 Signal Cable and Shielded Communication Cable. The unit price bid per meter shall include the connectors, lashing or messenger rings or plastic cable bands, splices when permitted, testing, cable markers, and incidental fittings for the cable connected in place.
680-5.14 Signal Cable with Integral Messenger and Shielded Communication Cable with Integral Messenger. The unit price bid per meter shall include connectors, splices when permitted, testing, cable markers, hardware and fittings to attach the cable to the pole and other incidentals for the cable connected in place.

680-5.15 Traffic Signal Sections. The unit price bid shall include housing, visors, lamps, lenses and incidentals to make an individual signal head section.

680-5.16 Traffic Signal Bracket Assembly. The unit price bid shall include all brackets, elbows, arms and fittings to attach the signal to span wire, pole and mast arm. It shall include all labor and materials to assemble the individual signal sections and brackets to form a complete signal head including internal wiring and installation on the span wire, pole and mast arm.

680-5.17 Traffic Signal Disconnect Hanger. The unit price bid shall include the disconnect hanger, wiring to the signal head and signal cable and installation on the signal head.

680-5.18 Traffic Signal Poles. The unit price bid for each pole shall include all the items specified in §680-3.11 and the necessary grounding system, anchor bolts, mast arms, lighting arms, pole assembly and erections, and field galvanizing as required. Breakaway transformer bases when specified shall be included in the price bid for each pole.

680-5.19 Overhead Sign Assembly. The unit price bid shall include the mounting brackets attaching the sign to signal head, span wire, pole, and mast arm, sign panel and incidental hardware and fittings.

680-5.20 Flashing Beacon Sign Assembly. The unit price bid shall include the flashing beacon signal head, two circuit flasher and cabinet, sign panel and mounting brackets and all other necessary hardware. The cost of the pole and pole excavation and concrete foundation will be paid for under their respective items. The cost of any necessary breakaway base shall be included in the cost of the pole.

680-5.21 LED Traffic Signal Module. The unit price bid shall include the LED module, the removal of existing components if necessary, and installation of the LED module on the signal head.

680-5.22 LED Pedestrian Signal Module. The unit price bid shall include the LED module, the removal of existing components if necessary, and installation of the LED module on the pedestrian signal head.

680-5.23 Type I Traffic Signal Section. The unit price bid shall include housing, door, visor and incidentals to make an individual Type I Signal Head Section.

680-5.24 Type I Pedestrian Signal Section. The unit price bid shall include housing, door, visor and incidentals to make an individual Type I Pedestrian Signal Section.

680-5.25 LED Traffic Signal Module Installation. The unit price bid shall include the cost of labor, materials, and equipment required to remove existing components if necessary, and install the State supplied Traffic Signal Modules as shown on the plans or as ordered by the Engineer.

680-5.26 LED Pedestrian Signal Module Installation. The unit price bid shall include the cost of labor, materials, and equipment required to remove existing components if necessary, and install the State supplied Pedestrian Signal Modules as shown on the plans or as ordered by the Engineer.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
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<tbody>
<tr>
<td>680.5001</td>
<td>Pole Excavation and Concrete Foundation</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>680.5002</td>
<td>Concrete Base for Controller Cabinet</td>
<td>Each</td>
</tr>
<tr>
<td>680.51XXYY</td>
<td>Pullbox</td>
<td>Each</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
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<tr>
<td><strong>XX</strong> = Size</td>
<td><strong>YY</strong> = Type</td>
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<tr>
<td>01 - 375 mm</td>
<td>01 - Reinforced Concrete</td>
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<tr>
<td>02 - 450 mm</td>
<td>02 - Optional Reinforced</td>
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<tr>
<td>03 - 600 mm</td>
<td>Concrete/Bituminous</td>
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<tr>
<td>04 - 750 mm</td>
<td>Fiber</td>
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<tr>
<td>05 - Rectangular 650 x 450</td>
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<tr>
<td>06 - Rectangular 650 x 450/600 mm Diameter</td>
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<tr>
<td>07 - Rectangular 650 x 450/750 mm Diameter</td>
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| 680.5120 | Cast Iron Junction Box | Each |
| 680.52XXYY | Conduit | Meter |
| **XX** = Type | **YY** = Diameter |

| 680.53 | Conduit Jacking or Boring | Meter |
| 680.54 | Inductance Loop Installation | Meter |
| 680.56 | Emergency Pre-emption System | Each |

| 680.60XXYY | Traffic Signal Pole--Span Wire | Each |
| 680.61XXYY | Traffic Signal Pole--Span Wire with Lighting Arm | Each |
| **XX** = Load in kilonewtons (10, 20, 30, 40, ...) |
| **YY** = Length in whole meters * |

| 680.62XXYY | Traffic Signal Pole--Mast Arm | Each |
| 680.63XXYY | Traffic Signal Pole--Dual Mast Arm** | Each |
| 680.64XXYY | Traffic Signal Pole--Mast Arm with Lighting Arm | Each |
| 680.65XXYY | Traffic Signal Pole--Dual Mast Arm** with Lighting Arm | Each |
| **XX** = Mast arm mounting height in meters and tenths of a meter* |
| **YY** = Mast arm length in whole meters |

| 680.67XX | Traffic Signal Pole--Post Top Mount | Each |
| 680.68XX | Traffic Signal Pole--Bracket Mount | Each |
| 680.69XX | Traffic Signal Pole Bracket Mount with Lighting Arm | Each |
| **XX** = Mounting height in meters and tenths of a meter* |

| 680.7001 | Single Span Wire Assembly | Each |
| 680.7002 | Dual Span Wire Assembly with Upper Tether Wire | Each |
| 680.7003 | Dual Span Wire Assembly with Lower Tether Wire | Each |
| 680.7004 | Messenger Assembly | Meter |
| 680.7005 | Guy Assembly | Each |
| 680.700602 | Riser Assembly, ½ NPS Diameter | Each |
| 680.700603 | Riser Assembly, 1 NPS Diameter | Each |
| 680.700604 | Riser Assembly, 1½ NPS Diameter | Each |
| 680.700606 | Riser Assembly, 2 NPS Diameter | Each |
| 680.700607 | Riser Assembly, 2½ NPS Diameter | Each |
| 680.700608 | Riser Assembly, 3 NPS Diameter | Each |
| 680.700609 | Riser Assembly, 3½ NPS Diameter | Each |
| 680.700610 | Riser Assembly, 4 NPS Diameter | Each |
| 680.700612 | Riser Assembly, 5 NPS Diameter | Each |
| 680.700613 | Riser Assembly, 6 NPS Diameter | Each |

| 680.71 | Shielded Lead-in Cable | Meter |
| 680.72 | Inductance Loop Wire | Meter |
| 680.73XXYY | Signal Cable | Meter |
| 680.74XXYY | Signal Cable with Integral Messenger | Meter |
| **XX** = Number of Conductors |
| **YY** = Wire Gauge |
680.75XXYY  Shielded Communication Cable  Meter
680.76XXYY  Shielded Communication Cable with Integral Messenger  Meter

$XX = Number of Pairs$

$YY = Wire Gauge$

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<th>Description</th>
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<td>Traffic Signal Section - 300 mm</td>
<td>Each</td>
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<tr>
<td>680.810101</td>
<td>Traffic Signal Module - 300 mm, Red Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810102</td>
<td>Traffic Signal Module - 300 mm, Red Arrow, LED</td>
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<tr>
<td>680.810103</td>
<td>Traffic Signal Module-300 mm Yellow Ball, LED</td>
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<td>Traffic Signal Module-300 mm Yellow Arrow, LED</td>
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<td>Traffic Signal Module-200 mm Yellow Ball, LED</td>
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<td>Traffic Signal Module-200 mm Yellow Arrow, LED</td>
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<td>Install Ball/Arrow LED Traffic Signal Module</td>
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<td>Traffic Signal Section -Fiberoptic Dual Indication Arrow</td>
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<td>Traffic Signal Section - Polycarbonate, Fiberoptic Dual Indication Arrow</td>
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<td>Traffic Signal Section-Strobing Signal Indication</td>
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<td>Traffic Signal Bracket Assembly 2 Way</td>
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<td>680.8113</td>
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<td>Traffic Signal Bracket Assembly 4 Way</td>
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<td>Traffic Signal Bracket Assembly 5 Way</td>
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<td>680.8120</td>
<td>Traffic Signal Disconnect Hanger</td>
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<td>Pedestrian Signal Section - 114 mm Letters</td>
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<td>680.813101</td>
<td>Pedestrian Signal Module - 300 mm, Hand Symbol, LED</td>
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<td>Pedestrian Signal Module - 300 mm by 300 mm MAN LED</td>
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<td>680.813104</td>
<td>Install LED Pedestrian Signal Module</td>
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<td>Pedestrian Signal Module - 300 mm, Bi-Modal Hand/Man Symbols, LED</td>
<td>Each</td>
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<td>Pedestrian Signal Section - Polycarbonate, Type I, 300 mm</td>
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<td>680.813107</td>
<td>Pedestrian Signal Module - 410 mm by 450 mm Bi-Modal HAND/MAN LED</td>
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<td>680.813108</td>
<td>Pedestrian Signal Section, Type I - for 410 mm by 450 mm LED module</td>
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<td>680.813109</td>
<td>Pedestrian Signal Section - Polycarbonate, Type I-for 410 mm by 450 mm LED module</td>
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</table>
§680

680.8132   Pedestrian Signal Section - 76 mm Letters       Each
680.8133   Pedestrian Signal Section - Fiberoptic        Each
680.8141   Pedestrian Signal Bracket Mount Assembly       Each
680.8142   Pedestrian Signal Post Top Mount Assembly       Each

680.82XX   Overhead Sign Assembly
            XX = Type
            Each

680.8220   Flashing Beacon Sign Assembly                Each
680.8225   Pedestrian Push Button and Sign - without Post   Each
680.8226   Pedestrian Push Button and Sign - with Post      Each
680.8230   Fire Pre-Emption Tell Tale Light            Each

NOTE:   SEE STANDARD CONTRACT PAY ITEM CATALOGUE FOR ITEM NUMBERS CONTAINING VARIABLES.

*  Mast arm mounting heights, and span wire pole length and load, are as defined on the `Standard Traffic Signal Poles' standard sheets and in §724-03, Traffic Signal Poles. The nominal luminaire mounting height and span shall be as indicated on the plans.

** The mast arm length and mounting height indicated by the item number is for only one of the mast arms. The other mast arm length and mounting height shall be as indicated on the plans.

SECTION 681 THRU SECTION 684 (VACANT)

SECTION 685 - EPOXY REFLECTORIZED PAVEMENT MARKINGS

685-1 DESCRIPTION.   Under this work, the Contractor shall furnish and apply epoxy reflectorized pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the NYSMUTCD and these specifications.

The epoxy marking material should be hot–applied by spray methods onto bituminous and portland cement concrete pavement surfaces at the thickness and width shown on the Contract Documents. Following an application of glass beads, the cured epoxy marking shall be an adherent reflectorized stripe.

685-2 MATERIALS.   Materials shall conform to the requirements of §727-03 White and Yellow Epoxy Reflectorized Pavement Markings.

685-3 CONSTRUCTION DETAILS

685-3.01 General.   All pavement markings and patterns shall be placed as shown on the Contract Documents and in accordance with the New York State, Manual of Uniform Traffic Control Devices (MUTCD).

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director and his/her authorized representative.

At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer's written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.

When pavement markings are applied under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

When necessary the Contractor shall establish marking line points at nine (9) meter intervals throughout the length of the pavement or as directed by the Engineer.

685-3.02 Atmospheric Conditions.   Epoxy pavement markings shall only be applied during conditions of dry weather and on substantially dry pavement surfaces. At the time of installation the
§685  
Pavement surface temperature shall be minimum of 10°C and the ambient temperature shall be a minimum of 10°C and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

**685-3.03 Surface Preparation.** The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer. Surface cleaning and preparation work shall be performed only in the area of the epoxy markings application. At the time of application, all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item. In addition, concrete curing compounds on new portland cement concrete surfaces and existing painted pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for in accordance with Section 635, Cleaning and Preparation of Pavement Surfaces for Pavement Markings.

**685-3.04 Epoxy Applicating Equipment.** Mobile applicating equipment for the placement of epoxy reflectorized pavement markings shall be approved by the Director (Materials Bureau) prior to the start of work. In general, a mobile applicator shall be a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and reflective glass spheres in continuous and skip-line patterns. The applicating equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of legends, symbols, crosswalks, and other special patterns. At any time throughout the duration of the project, the Contractor shall provide free access to his epoxy applicating equipment for inspection by the Engineer or his authorized representative. The Engineer may approve the use of a portable applicator in lieu of mobile truck mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these specifications. The applicating equipment shall be capable of installing a minimum of 30,000 m of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual tanks for the storage of Part A and Part B of the epoxy resin and for the storage of reflective glass spheres.
2. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.
3. Glass bead dispensing equipment and the capacity of applying the spheres a minimum rate of 2.4 kg/L of epoxy resin composition.
4. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.
5. All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of epoxy reflectorized pavement markings in a simultaneous sequence of operations as described in §685-3.05 Application of Epoxy Reflectorized Pavement Markings.

**685-3.05 Application of Epoxy Reflectorized Pavement Markings.** Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated by the Contract Documents. Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions and pavement surface temperature are acceptable to the Engineer. Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.
2. The epoxy resin, mixed and heated in accordance with the manufacturer's recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness.
3. Reflective glass spheres are injected into, or dropped onto, the liquid epoxy marking at a minimum rate of 2.4 kg/L of epoxy resin.

**685-3.06 Defective Epoxy Pavement Markings.** Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer as follows:

1. Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention.

   **Repair Method.** Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains. Immediately after surface preparation remove loose particles and foreign debris by brooming or blasting with compressed air. Repair shall be made by restriping over the cleaned surface in accordance with the requirements of this specification and at the full thickness indicated on the Contract Documents.

2. Uncured or discolored epoxy*; insufficient bond (to pavement surface or existing durable marking).

   **Repair Method.** The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense. The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending one meter in any direction. After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with requirements of §727–03 MATERIAL REQUIREMENTS, A., 2.0 paragraph d. Drying Time (Field); or applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Engineer.

Discoloration shall be defined as localized areas or patches of brown, graying or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer.

All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

**685-4 METHOD OF MEASUREMENT.** Pavement striping will be measured in linear meters along the centerline of the pavement stripe and will be based on a 100 mm wide stripe. Measurement for striping with a plan width greater or less than the basic 100 mm as shown on the plans or directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (millimeters) } \times \text{ Linear Meters}
\]

\[
100 \text{ mm}
\]

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: “SCHOOL” would be paid as six units. Double and triple headed arrows will be measured as a single unit, but the “X” in railroad grade crossing markings (M.U.T.C.D. figure 263-33) will be measured by linear meters of 100 mm stripe.

**685-5 BASIS OF PAYMENT.** The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

No payment will be made for the number of linear meters of skips in the dashed line.


**SECTION 685**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Meter</td>
</tr>
<tr>
<td>685.02</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes – 0.38 mm</td>
<td>Meter</td>
</tr>
<tr>
<td>685.03</td>
<td>White Epoxy Reflectorized Pavement Letters – 0.38 mm</td>
<td>Each</td>
</tr>
<tr>
<td>685.04</td>
<td>White Epoxy Reflectorized Pavement Symbols – 0.38 mm</td>
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<td>685.11</td>
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<td>Meter</td>
</tr>
<tr>
<td>685.12</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes – 0.51 mm</td>
<td>Meter</td>
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<td>685.14</td>
<td>White Epoxy Reflectorized Pavement Symbols – 0.51 mm</td>
<td>Each</td>
</tr>
</tbody>
</table>

**SECTION 686 (VACANT)**

**SECTION 687 - THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS**

**687-1 DESCRIPTION.** Under this work, the Contractor shall furnish and apply thermoplastic reflectORIZED pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the NYSMUTCD and these specifications.

The thermoplastic pavement marking compound shall be extruded in a molten state onto the pavement surface. Following surface application of glass beads and upon cooling to normal pavement temperatures, the resultant marking shall be an adherent reflectorized stripe of the specified thickness and width that is capable of resisting deformation by traffic.

**687-2 MATERIALS.** Materials shall conform to the requirements of §727-01 White and Yellow Thermoplastic ReflectORIZED Pavement Markings.

**687-3 CONSTRUCTION DETAILS**

**687-3.01 Equipment General.** Thermoplastic applying equipment shall be approved by the Engineer prior to the start of work.

Unless otherwise approved by the D.C.E.C., all projects specifying quantities greater than 20 000 m of longitudinal pavement marking lines will be striped using only mobile applying equipment for the longitudinal lines. Longitudinal pavement marking lines are Broken Lines (skipline), Edge Lines, Barrier Lines, and Solid Lines as defined by the M.U.T.C.D. Portable applying equipment will be acceptable for placing all other markings on these projects.

Thermoplastic material shall be applied to the pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for maintaining the temperature and controlling the flow of material (Note 1.)

**Note 1.** Alternate types of extrusion devices may be considered acceptable for use upon prior approval by the Materials Bureau. Requests for approval of alternate extrusion applying equipment shall be made to the Materials Bureau by the Contractor/Manufacturer at least 90 days prior to its date of intended use. Detailed requirements and procedures for the acceptance of alternate equipment are available from the Materials Bureau.

For heating the thermoplastic composition, the application equipment shall include a melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate “supply” vehicle or included as part of the mobile applying equipment. The kettle(s) shall be capable of heating the thermoplastic composition temperatures greater than 204.5°C. The heating mechanism shall be by means of a thermostatically controlled heat transfer medium. Heating of the composition by direct flame will not be allowed. Material temperature gauges shall be visible at both ends of the kettle(s).

Application equipment shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be so constructed so as to be easily accessible and exposable for
cleaning and maintenance. The equipment shall be constructed so that all mixing and conveying parts up to and including the extrusion shoe(s), maintain the material at the required plastic temperature.

The applicating equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying “skip” lines. The equipment shall be capable of applying varying widths of traffic markings.

The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow.

The bead dispenser shall be automatically operated in such a manner that it will only dispense beads while the composition is being applied.

Applicating equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

Applicators shall be equipped and constructed in such a manner as to satisfy the requirements of the National Board of Fire Underwriters and the appropriate agencies of the State of New York.

The equipment used for the placement of thermoplastic pavement markings shall be two general types: mobile applicator and portable applicator.

687-3.02 Mobile Applicating Equipment. The mobile applicator shall be defined as a truck mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by the extrusion method. The unit shall be equipped to apply the thermoplastic material at temperatures exceeding 204.5°C, and at the widths and thicknesses specified herein. The mobile unit shall be capable of operating continuously and of installing a minimum of 6000 m of longitudinal markings in an 8–hour day.

The mobile unit shall be equipped with a melting kettle(s) or materials storage reservoir(s) of such capacity as to allow for continuous marking operations. The kettle(s) or reservoirs shall be capable of heating or holding the thermoplastic composition at temperatures greater than 204.5°C.

The mobile unit shall be equipped with an extrusion shoe(s), and shall be capable of marking edgeline and centerline stripes. The extrusion shoe(s) shall be closed, heat jacketed or suitably insulated unit; shall hold the molten thermoplastic at a temperature greater than 204.5°C; and shall be capable of extruding a line between 75 to 200 mm in width; and at a thickness of not less than 3.2 mm nor more than 4.8 mm, and of generally uniform cross section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

The mobile unit shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

687-3.03 Portable Applicating Equipment. The portable applicator shall be defined as hand operated equipment, specifically designed for placing thermoplastic installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge, and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettle(s). The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at temperatures greater than 204.5°C, of extruding a line of from 75 to 200 mm in width, and in thickness of not less than 3.2 mm nor more than 4.8 mm and of generally uniform cross-section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

687-3.04 Application General. All pavement markings shall be placed as shown on the plans and in accordance with the New York State Manual of Uniform Traffic Control Devices.

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director or his authorized representative.
When pavement markings are applied under traffic the Contractor shall provide all necessary flags, markers, signs, etc. to maintain and protect traffic; and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, tracking marks, spilled thermoplastic or thermoplastic applied in unauthorized areas.

When necessary, the Contractor shall establish marking line points at nine (9) meter intervals throughout the length of pavement or as directed by the Engineer.

687-3.05 Atmospheric Conditions. Thermoplastic pavement markings shall be placed upon dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 12.5°C and the ambient temperatures shall be a minimum of 9.5°C and rising. The Engineer will determine when atmospheric conditions are such to produce satisfactory results (Note 2).

Note 2. To comply with the 12.5°C pavement surface temperature requirement, it will benefit the Contractor to schedule striping work for seasons of warm weather when possible. In cooler conditions, striping operations may be coordinated with bituminous paving work to take advantage of residual heat, providing that the ambient temperature requirements of §687-3.05 are still met.

687-3.06 Materials Application Requirements

A. Thermoplastic Primer. All pavement surfaces shall be primed except that on new bituminous pavements, when the thermoplastic pavement markings are applied within the same calendar year as the completion of paving operations, primer shall not be required.

The primer shall be either a one-component or a two-component, cold or hot applied material of the type recommended by the manufacturer of the thermoplastic pavement marking material. At least five working days prior to the start of thermoplastic application, the Contractor shall provide the Engineer with the manufacturer's written instructions for primer application. The application of the primer shall be performed in accordance with the manufacturer's written recommendations which shall include the method of application, the application rate, and the drying time.

B. Thermoplastic Composition.

1. Application Temperature - thermoplastic composition shall be applied at temperatures no lower than 204.5°C at the point of deposition. For purposes of these specifications, the point of deposition shall be defined as within the extrusion shoe.

2. Extruded Markings - all extruded markings shall be applied at the specified width, and at a thickness of not less than 3.2 mm nor more than 4.8 mm.

C. Reflective Glass Spheres (for Drop-On). Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 kg per 4 m² of composition.

687-3.07 Surface Cleaning and Preparation of Pavement. The Contractor shall be responsible for cleaning the pavement surface to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the thermoplastic markings application.

At the time of application all pavement surfaces shall be free of oil dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new Portland Cement concrete surfaces; and existing pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for under separate items.
687-3.08 Application of Thermoplastic Pavement Markings. All special markings, cross walks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator. Unless otherwise specified in the contract documents all center line, skip line, edge line and other longitudinal type markings may be applied with either a portable or a mobile applicator.

When the surface preparation work has been completed, if applicable, the bituminous and/or concrete pavement surface shall be primed according to the manufacturer's written instructions. Primer shall not be required on new bituminous pavement surfaces that are completed within the same calendar year as the thermoplastic marking application. The primer shall be spray applied onto the pavement surface and allowed to dry according to the manufacturer's written instructions. Pavement surfaces that are primed and not striped with thermoplastic within the required drying time or within the same work day shall be re-primed.

After the primer has dried, the thermoplastic shall be applied at composition temperatures no lower than 204°C at the point of deposition. Immediately after installation of the thermoplastic, drop-on reflective glass spheres shall be mechanically applied such that the spheres are held by and embedded in the surface of the molten composition.

687-4 METHOD OF MEASUREMENT. Pavement striping will be measured by linear meter along the centerline of the pavement stripe, and will be based on a 100 mm wide stripe. Measurement for striping with a plan width greater or less than the basic 100 mm as shown on the plans or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (millimeters)} \times \text{Linear Meters} \\
100 \text{ mm}
\]

No payment will be made for the number of linear meters of skips in the dashed line.

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or symbol. Example: “SCHOOL” would be measured as six units. Double and triple headed arrows will be measured as a single unit, but the “X” in railroad grade crossing markings (M.U.T.C.D. figure 263-33) will be measured by linear meters of 100 mm stripe.

687-5 BASIS OF PAYMENT. The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

\[
\begin{array}{l|l|l}
\text{Payment will be made under:} & \\
\text{Item No.} & \text{Item} & \text{Pay Unit} \\
687.0101 & \text{White Thermoplastic ReflectORIZED Pavement Stripes} & \text{Meter} \\
687.0201 & \text{Yellow Thermoplastic ReflectORIZED Pavement Stripes} & \text{Meter} \\
687.0301 & \text{White Thermoplastic ReflectORIZED Pavement Letters} & \text{Each} \\
687.0401 & \text{White Thermoplastic ReflectORIZED Pavement Symbols} & \text{Each} \\
\end{array}
\]

SECTION 688 - PREFORMED REFLECTORIZED PAVEMENT MARKINGS

688-1 DESCRIPTION. Under this work, the Contractor shall furnish and apply preformed reflectorized pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the NYSMUTCD and these specifications.

The preformed reflectorized pavement marking shall be applied on new and existing bituminous and portland cement concrete surfaces by hand and mechanical methods. The resultant marking shall be an adherent reflectorized stripe that is capable of molding itself to the contours of the pavement surface and of resisting deformation by traffic.

688-2 MATERIALS. Materials shall conform to the requirements of §727-04 White and Yellow Reflectorized Pavement Markings.
688-3 CONSTRUCTION DETAILS

688-3.01 General. All pavement markings and patterns shall be placed as shown on the plans and in accordance with the New York State Manual of Uniform Traffic Control Devices.

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director or his authorized representative.

At least five (5) days prior to the start of work, the Contractor shall provide the Engineer with the manufacturer's written instructions for the application of preformed marking and primer materials.

When pavement markings are applied under traffic, the Contractor shall supply all necessary flags, markers, signs, and other devices, to maintain traffic and to protect the markings until set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow will not be allowed without prior approval of the Engineer.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, preformed markings applied in unauthorized areas.

When required by the Engineer, the Contractor shall establish marking line points at nine (9) meter intervals throughout the length of the pavement or as directed by the Engineer.

688-3.02 Application Methods. Preformed pavement markings shall be applied by the following methods. The installation of markings on the project may be performed simultaneously by more than one method.

A. During Bituminous Paving Operations. Preformed markings shall be applied on newly paved bituminous surfaces after finish rolling is complete.

B. On Completed Pavements. Preformed markings shall be applied on new and existing bituminous and portland cement concrete pavement surfaces as prescribed in §688–3.03 Weather and Seasonal Limitations.

688-3.03 Weather and Seasonal Limitations. The Engineer shall determine as to when temperature and pavement surface conditions are such as to produce satisfactory results.

Preformed pavement markings shall be placed upon dry pavement surfaces; pavements exposed to rain or wet conditions shall be allowed to thoroughly dry before marking application.

Preformed markings applied in conjunction with §688–3.02A, During Bituminous Paving Operations, shall only be placed within the seasonal limitations of Standard Specification §402-3.01. The bituminous pavement surface temperature shall, at all times, be the controlling temperature at which preformed markings are placed, and shall be between 37.5°C and 76.5°C.

Preformed markings applied in conjunction with §688–3.02B, on completed pavements, shall be applied within the seasonal limitations of Table 688-1, Temperature and Seasonal Requirements. The pavement surface and ambient air temperatures in Table 688-1 shall, in all cases, be the controlling temperatures at which preformed markings are placed. Marking application work shall be discontinued when temperatures fall below the specified requirements.

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Pavement Surface Temperature</th>
<th>Ambient Air Temperature</th>
<th>Allowable Installation Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regions 1, 2, 3, 4, 5, 6, 7 &amp; 9 (All Counties)</td>
<td>21°C, Min.</td>
<td>15.5°C, Min.</td>
<td>May 15 to September 1</td>
</tr>
<tr>
<td>Region 8 (Ulster County only)</td>
<td>21°C, Min.</td>
<td>15.5°C, Min.</td>
<td>May 15 to September 15</td>
</tr>
<tr>
<td>Regions 8 &amp; 10 (except Ulster County)</td>
<td>21°C, Min.</td>
<td>15.5°C, Min.</td>
<td>May 1 to September 30</td>
</tr>
<tr>
<td>Region 11</td>
<td>21°C, Min.</td>
<td>15.5°C, Min.</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. Surface temperatures shall be measured on the pavement surface where the preformed markings are to be placed. The controlling temperature shall be the average of three temperature readings taken at locations 30± meter apart.
2. Ambient air temperatures shall be measured in the shade.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
688-3.04 Mechanical Applicating Equipment. Mechanical applicating equipment for the placement of preformed pavement marking stripes shall be of the type recommended by the manufacturer of the preformed material. All applicating equipment shall be approved by the Engineer prior to the start of work.

688-3.05 Rollers. Preformed markings applied in conjunction with §688-3.02a, during bituminous paving operations, shall be rolled into place with compaction equipment meeting the requirements of Standard Specification §402-3.04. Vibratory roller models shall operate in a ‘static’ mode.

Preformed markings applied in conjunction with §688-3.02B., On Completed Pavements, shall be rolled into place using steel shell or pneumatic rubber–tired roller equipment approved by the Engineer. Steel wheel rollers shall weigh a minimum of 90 kg on each axle. Pneumatic rubber–tired rollers shall exert a minimum tire compression on the pavement of 195 Kpa. Hand rollers or rubber tired vehicles (e.g. pick–up truck) meeting the above requirements may be suitable for use.

688-3.06 Primer Requirements. When required, primer or adhesive shall be used for marking applications in accordance with the written recommendations of the manufacturer of the preformed marking material.

Primer materials shall be placed at the application rate and by the application methods recommended by the manufacturer.

When primer is applied, the area of application shall be at least the width or dimension, of the new preformed marking, plus twenty-five (25) millimeter on each side.

688-3.07 Surface Cleaning and Preparation of Pavement Surfaces. The Contractor shall be responsible for cleaning the pavement surface to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the preformed markings application.

At the time of application, all pavement surfaces shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new portland cement concrete surfaces and existing pavement markings on both concrete and bituminous pavement surfaces shall be removed and paid for under separate items.

688-3.08 Application of Preformed Reflectorized Pavement Markings. Unless otherwise approved by the Engineer, all longitudinal lines shall be applied using mechanical applicating equipment. Transverse and special marking patterns may be applied by hand or mechanical methods.

Preformed marking operations shall not begin until after the pavement surface has been cleaned and prepared.

Preformed stripes shall not be applied over longitudinal paving joints or over the point of transition between the pavement surface and adjoining shoulder. The placement of stripes in the area of transition shall be either on the pavement or on the shoulder, as directed by the Engineer.

No roller shall operate in excess of 4.5 km/h. One roller pass shall be defined as one movement of the roller over any point of the preformed marking, in the direction of the marking application.

A. Application During Bituminous Paving Operations. The application of preformed markings shall not begin until finish rolling of the new bituminous pavement is complete.

At the time of marking application, the surface temperature of the new bituminous pavement shall be between 37.5°C and 76.5°C. The Contractor shall coordinate paving and preformed marking operations to conform with surface temperature requirements.

Immediately after finish rolling is complete, the preformed marking shall be applied on the new bituminous surface. Traces of water or other residue from finish rolling operations shall first be removed. Immediately after its placement, the preformed marking shall be adhered to the warm pavement surface by rolling. Rollers shall make a minimum one pass, and operate in the same direction that the marking was applied. Diagonal, reverse or crosswise rolling will not be allowed. The minimum one pass may be increased by the Engineer if, in his opinion, the desired adherence is not obtained.
B. Application on Completed Pavements. The application of preformed markings shall only be performed within the limitations of §688–3.03 Weather and Seasonal Limitations. If required by the manufacturer, primer and adhesive activators shall be applied and allowed to dry in accordance with the instructions of the manufacturer of the preformed material. The preformed marking shall be placed on the pavement surface and adhered by rolling. Rollers shall make a minimum of one pass, and operate in the same direction that the marking was applied. Diagonal, reverse or crosswise rolling will not be allowed. The minimum one pass may be increased by the Engineer if, in his opinion, the desired adherence is not obtained.

688-4 METHOD OF MEASUREMENT. Pavement striping will be measured by meters along the centerline of the pavement stripe and will be based on a 100 mm wide stripe. The preformed pavement markings will be inspected during and following installation to determine conformance with this specification. In addition, they will be inspected following a performance period that will extend for 180 calendar days following both their installation and opening of the roadway to traffic.

Within 15 consecutive calendar days after the end of the 180 day performance period, a final performance inspection will be made by the Engineer. If this inspection discloses any work, in whole or in part, as not being visibly intact and serviceable to the following extent, the Contractor shall completely repair or replace such work:

A. Broken Line. 90 percent measured longitudinally of the total length of all broken lines in any 150 meter long pavement section.

B. Dotted Line. 50 percent measured longitudinally of the total length of all dotted lines in any 30 meter long pavement section.

C. Solid Line and Edge Line. 90 percent measured longitudinally of the total length of solid line or edge line in any 150 meter long pavement section.

D. Channelizing Line, Stop Line, Crosswalk Lines, Clearance Line and Crossbars, Hatch Lines, Letters and Symbols. 90 percent by area of any individual line, letter or symbol.

When required all repair or replacement work shall be performed in accordance with this specification and completed within 60 calendar days of the earliest allowable installation date as specified in Table 1, for that location. The Engineer shall determine the limits or quantity of preformed to be repaired or replaced.

Upon completion of the final performance inspection, or after satisfactory completion of any necessary corrections, the Engineer will, within 10 calendar days, notify the Contractor in writing, of the date of such final performance inspection and release the Contractor from further performance responsibility.

Pavement striping on-going projects will be measured as the total of the striping applied, if after the final 180 day performance period, damage to the striping is not in excess of that specified (e.g. If 95% of the edgeline striping is intact in a 150 meter pavement section, the edgeline will be measured as the full 150 meters of applied marking. No deduction will be made for the damaged 5% (7.5 m) of striping).

Measurement for striping with a plan width greater or less than the basic 100 mm as shown on the plans or as directed by the Engineer, will be made by the following method:

Plan Width of Striping (millimeters) x Meters
100 (millimeters)

No payment will be made for the number of meters of gaps between broken or dotted line segments. Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: “SCHOOL” would be measured as six units.

Double and triple headed arrows will be measured as a single unit, but the “X” in railroad grade crossing markings (M.U.T.C.D. figure 263-33) will be measured by linear meter of 100 mm stripe.
**688-5 BASIS OF PAYMENT.** The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost of cleaning pavement surfaces of oil, dirt, dust, grease and similar foreign materials shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>688.01</td>
<td>White Preformed Reflectorized Pavement Stripes</td>
<td>Meter</td>
</tr>
<tr>
<td>688.02</td>
<td>Yellow Preformed Reflectorized Pavement Stripes</td>
<td>Meter</td>
</tr>
<tr>
<td>688.03</td>
<td>White Preformed Reflectorized Pavement Letters</td>
<td>Each</td>
</tr>
<tr>
<td>688.04</td>
<td>White Preformed Reflectorized Pavement Symbols</td>
<td>Each</td>
</tr>
</tbody>
</table>

**SECTIONS 689 THRU 696 (VACANT)**

**SECTION 697 - FIELD CHANGE ORDER**

**697-1 DESCRIPTION**

**697-1.01 General.** The Field Change Order (FCO) provides a contract contingency allowance for the timely payment of authorized additional work that is necessary to fulfill the intent of the plans and specifications.

**697-1.02 Eligible Work.** FCO payments shall be limited to work that is: (1) within the scope of the contract, (2) a quantity variation of existing contract pay items, or (3) a new contract pay item introduced as a result of minor field adjustments in the details of the project. All eligible items of work shall have a known unit price, either through use of a contract bid price or through an Agreed Price.

**697-2 MATERIALS.** None Specified.

**697-3 CONSTRUCTION DETAILS.** None Specified.

**697-4 METHOD OF MEASUREMENT.**

**697-4.01 Bid Price.** The unit price shown in the proposal for this item will be considered as the price bid, and shall not be altered in any manner. Should the amount shown be altered, the new figure will be disregarded and the original bid price will be used to determine the total amount bid for the contract.

**697-4.02 Payments.** Work for which FCO payments are processed will be measured in accordance with the specifications governing the work.

**697-5 BASIS OF PAYMENT.** All work to be paid under the FCO item must be authorized in advance of the work. Disputed work, force account work, work associated with Value Engineering Change Proposals, or payments for time related provisions are not eligible for FCO payment.

FCO payments will be determined from the quantities and unit prices of eligible work that has been completed in conformance with applicable Specifications. Work for which FCO payments are processed will be paid in accordance with the specifications governing the work.

Prior to processing the final agreement, the FCO payments will be reconciled through a final Order-on-Contract, such that the amount of FCO payments are converted to the corresponding quantities of the pertinent contract pay items. When payments are transferred to the appropriate items, the remaining amount of FCO funds will be deleted.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>697.0201</td>
<td>Field Change Order (FCO)</td>
<td>Dollars-Cents</td>
</tr>
</tbody>
</table>
SECTION 698 PRICE ADJUSTMENTS

698-1 DESCRIPTION. This section will provide for additional compensation to the Contractor for increases, or repayment by the Contractor for decreases, in the price of asphalt, fuel, or steel/iron products.

No adjustment will be provided for any new or additional work paid for by force account. Additional quantities of existing contract pay items at original bid prices will be considered eligible work. Additional work added by agreed price will be considered eligible work. Work performed by the Contractor at its own expense will not be eligible for price adjustment.

698-1.01 Asphalt Price Adjustment. This item will enable the Department to make price adjustments to account for changes in asphalt prices. Price adjustments will be made for eligible work listed in the proposal.

698-1.02 Fuel Price Adjustment. This item will enable the Department to make price adjustments to account for changes in fuel prices. Price adjustments will be made for eligible work listed in the proposal.

698-1.03 Steel/Iron Price Adjustment. This item will enable the Department to make price adjustments to account for changes in steel/iron product prices for materials which will be permanently incorporated into the work.

698-2 MATERIALS. None specified.

698-3 CONSTRUCTION DETAILS.

698-3.01 Asphalt Price Adjustment. The asphalt price adjustment will be based solely on the price changes for asphalt as determined by the formulas below. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price, nor will any adjustment be made if the monthly average posted price is within $10.00 of the Performance Graded Binder (PGB) index price.

A. Quantity. The quantity of asphalt (metric tons) considered for adjustment will be determined by multiplying the quantity of eligible work completed by the conversion factors which are listed in the proposal note entitled Asphalt Price Adjustment.

B. Prices. The PGB index price and the monthly average posted price are defined as follows:

1. Asphalt Index Price. A fixed price per metric ton of PGB used solely as a basis from which to compute asphalt price adjustments. The PGB index price will be the monthly average posted price for the month of the bid letting, as listed in the Engineering Bulletin entitled Fuel, Asphalt and Steel Price Adjustments. The PGB index price for additional work at the original contract bid price will be the monthly average posted price for the month of the bid letting. The PGB index price for additional work at agreed price will be the monthly average posted price for the month the agreed price was submitted to the Engineer.

2. Monthly Average Posted Price. The average FOB terminal price for unmodified PG 64-22 binder, without anti stripping agent, will be determined by the Department, based on prices of approved primary sources of PGB. Prices will be posted in a monthly Engineering Bulletin entitled Fuel, Asphalt and Steel Price Adjustments.

C. Adjustment. Asphalt price adjustment will be based on the following formulas:

1. When price increases:
   Price Adjustment = (Quantity of Asphalt) x (Average Posted Price - PGB Index Price - $10.00)
2. When price decreases:
Price Adjustment = (Quantity of Asphalt) x (Average Posted Price - PGB Index Price + $10.00)

§698-3.02 Fuel Price Adjustment. The fuel price adjustment will be based solely on the price changes for fuel as determined by the formulas below. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price, nor shall any adjustment be made if the monthly average posted price is within $0.03 of the fuel index price.

A. Quantity. The quantity of fuel (liters) considered for adjustment will be determined by multiplying the quantity of eligible work completed by the fuel usage factor which are listed on the proposal note entitled Fuel Price Adjustment.

B. Prices. The Fuel Index Price and the monthly average posted price are defined as follows:

1. Fuel Index Price. A fixed price per liter of fuel used solely as a basis from which to compute fuel price adjustments. The fuel index price will be the monthly average posted price for the month of the bid letting, as listed in the Engineering Bulletin entitled Fuel, Asphalt and Steel Price Adjustments. The fuel index price for additional work at the original contract bid price will be the monthly average posted price for the month of the bid letting. The fuel index price for additional work at agreed price will be the monthly average posted price for the month the agreed price was submitted to the Engineer.

2. Monthly Average Posted Price. An average FOB refinery or terminal price per liter determined by the Department based on prices for No. 2 fuel oil and unleaded gasoline in the cities of New York, Philadelphia, Detroit, and Boston. Prices will be posted in a monthly Engineering Bulletin entitled Fuel, Asphalt and Steel Price Adjustments.

C. Adjustment. Fuel price adjustment will be based on the following formulas:

1. When price increases:
Price Adjustment = (Quantity of Fuel) x (Average Posted Price - Fuel Index Price - $0.03)

2. When price decreases:
Price Adjustment = (Quantity of Fuel) x (Average Posted Price - Fuel Index Price + $0.03)

§698-3.03 Steel/Iron Price Adjustment. If the percentage change does not exceed 5%, no adjustments will be made for materials invoiced that month. For lump sum or each items, such as overhead sign structures, that are assembled from numerous components, the percentage change will be determined for the assembled contract pay item using the month that the largest value of materials were invoiced. To allow for multiple adjustments of various quantities at different times, for unit price items such as guardrail that are assembled from numerous components, the percentage change will be determined for a given quantity of the contract pay item using the month that the largest value of component materials for that quantity of the contract pay item were invoiced.

The weight of the steel and/or iron shall be determined from manufacturer’s/supplier’s data or shipping weights, and exclude minor appurtenances individually weighing less than 2 kg (i.e., nuts, bolts, washers, etc.). Eligible precast or prestressed concrete items shall have total reinforcing steel weight listed on the approved shop drawings. The following sources shall be used, in declining order of precedence, to determine the weight of steel/iron: approved shop drawings, contract documents, Department Standard Sheets, industry standards (i.e., AISC Manual of Steel Construction, AWWA Standards, etc.) and manufacturer’s data. Materials will be considered invoiced when invoiced from a Manufacturer or Material Supplier to the Contractor, to a Subcontractor or to a Fabricator.

A. Quantity. The quantity of steel and/or iron considered for adjustment for each core (3-digit) contract pay item number (e.g., 564 – Structural Steel) will be measured to the nearest 0.1 Metric Tons.
1. Percent Change Greater Than 5%. If the percentage change calculated by the Engineer is greater than 5%, Price Adjustments will be made for materials invoiced that month. The Contractor shall provide the Engineer a detailed list of the weight of eligible materials, including: the contract pay item, the weight of steel/iron, the month(s) of invoice, the source used to determine the weight, and if requested by the Engineer, copies of invoices to verify the month of invoice.

2. Percent Change -5% to +5%. If the percentage change calculated by the Engineer is 5% or less, no adjustments will be made for materials invoiced that month. The Contractor shall provide the Engineer with a list of the materials invoiced that month, including the contract pay item, the quantity invoiced, and if requested by the Engineer, copies of invoices to verify the month of invoice. The list shall be provided not later than the 15th of the following month.

3. Percent Change -5% and Lower. If the percentage change calculated by the Engineer is -5% or lower, a Price Rebate will be charged to the Contractor for materials invoiced that month. The Contractor shall provide the Engineer a detailed list of the weight of eligible materials, including: the contract pay item, the weight of steel/iron, the month(s) of invoice, the source used to determine the weight, and if requested by the Engineer, copies of invoices to verify the month of invoice. If the Contractor fails to provide the information required to determine the Price Rebate within 60 calendar days after the end of the month, the percentage change will be applied to the entire unit price, until such time as the Contractor provides the required information.

B. Prices. The Benchmark Steel Index and the Monthly Index are defined as follows:

1. Producer Price Index (PPI). Producer Price Index (PPI) values are published by the US Department of Labor (USDOL), Bureau of Labor Statistics (BLS). Recent PPI values are posted on the Construction Division website at www.dot.state.ny.us. A complete listing of PPI values can be found on the BLS website at http://data.bls.gov/PDQ/ outside.jsp?survey=wp.

2. Benchmark Steel Index (BI). Value of the PPI for Semifinished Steel Mill Products (WPU 101702) for the month of contract bid letting. The benchmark steel index for additional work at the original contract bid price will be the value of the PPI for the month of the bid letting. The benchmark steel index for additional work at agreed price will be the value of the PPI for the month the agreed price was submitted to the Engineer.

3. Monthly Steel Index (MI). Value of the PPI for Semifinished Steel Mill Products (WPU 101702) for the month the material is invoiced.

4. Cost Basis (CB). Cost Basis defined in dollars per metric ton listed in the monthly Engineering Bulletin Fuel, Asphalt and Steel Price Adjustments for the month of bid letting. The cost basis for additional work at the original contract bid price will be the cost basis listed for the month of the bid letting. The cost basis for additional work at agreed price will be the value of the cost basis for the month the agreed price was submitted to the Engineer.

C. Adjustment. Steel/Iron price adjustment will be based on the following formulas:

1. The percent change in any given month will be determined as follows:

\[
\text{Percentage Change} = \left( \frac{MI - BI}{BI} \right) \times 100
\]

2. When price increases:

\[
\text{Price Adjustment} = \left[ \left( \frac{MI - BI}{BI} \right) - 0.05 \right] (CB) \text{Qty}
\]
When price decreases:

\[
\text{Price Rebate} = \left[ \left( \frac{MI - BI}{BI} \right) + 0.05 \right] (CB) QTY
\]

698-4 METHOD OF MEASUREMENT. The unit price shown in the itemized proposal will be considered the unit price bid, although actual payment will be calculated based on changes in posted material prices. Should the amount shown be altered, the altered figures will be disregarded and the original price will be used to determine the total contract bid amount.

698-4.01 Asphalt Price Adjustment. Asphalt price adjustments will be measured on a Dollar Cents basis.

698-4.02 Fuel Price Adjustment. Fuel price adjustments will be measured on a Dollar Cents basis.

698-4.03 Steel/Iron Price Adjustment. Steel/Iron price adjustments will be measured on a Dollar Cents basis.

698-5 BASIS OF PAYMENT. Price adjustments will be based on the computations described above. Adjustments, either positive or negative, will be made when the accumulated amount for a price adjustment contract pay item exceeds $5,000, or at such additional times as the Engineer deems appropriate. Adjustments not meeting this criteria will be made in the final contract payment.

If price adjustments are based on estimated material quantities for that time, and a revision to the total material quantity is made in a subsequent or final estimate, an appropriate addition or deduction will be made to the price adjustment previously calculated. The addition or deduction will be based on the same adjustment factors used to calculate the price adjustment which is being revised. If the installation dates of the revised material quantity cannot be determined, the addition or deduction will be based on the adjustment factors in effect during the last month in which any portion of the material quantity was installed.

If eligible items are installed after the original contract completion date and during which time an extension of time without the assessment of engineering charges is approved, the monthly average posted price or monthly index value used to compute price adjustments will be the appropriate monthly average posted price or monthly index value.

If eligible items are installed after the scheduled contract completion date and during which time there are assessed engineering charges and/or liquidated damages, the monthly average posted price or monthly index value used to compute price adjustments will not exceed, but may be less than the monthly average posted price or monthly index value in effect on the last contract completion date without assessed engineering charges.

698-5.01 Asphalt Price Adjustment. The adjustment will be based on the monthly average posted price in effect at the time the work is completed. The monthly average posted price will be updated about the twentieth of each month and will apply to eligible work performed during the following month.

698-5.02 Fuel Price Adjustment. The adjustment will be based on the monthly average posted price in effect at the time the work is completed. The monthly average posted price will be updated about the twentieth of each month and will apply to eligible work performed during the following month.

698-5.03 Steel/Iron Price Adjustment. The minimum price adjustment for a contract is $5,000. The minimum price adjustment for any group of contract pay items sharing the same core (3-digit) contract pay item number (e.g., 564 – Structural Steel) is $1,000. The adjustment will be based on the index in effect at the time of purchase or invoice.

The monthly index is listed as preliminary for 4 months after initial publication. At contract final acceptance, the Engineer will make final revisions to the adjustment based on revised data. If all contract work is complete, preliminary index values as posted by the BLS may be used in place of final values. If a preliminary value is not posted for a given month or months, the preliminary value will be the average of the preceding and following months that are posted. If a final value is not posted for a given month or
months, the final value will be determined from the average annual value, if possible, or will be the average of the preceding and following months that are posted.

Payment will be made under:

<table>
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<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
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<td>Asphalt Price Adjustment</td>
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<tr>
<td>698.05</td>
<td>Fuel Price Adjustment</td>
<td>Dollars Cents</td>
</tr>
<tr>
<td>698.06</td>
<td>Steel/Iron Price Adjustment</td>
<td>Dollars Cents</td>
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SECTION 699 - MOBILIZATION

699-1 DESCRIPTION. Under this work the Contractor shall provide necessary bonds, insurance, and prefinancing and shall set up his necessary general plant, including shops, storage areas, office and such sanitary and other facilities as are required by local or state law or regulation.

699-2 MATERIALS. Such materials as required for mobilization and that are not to be part of the completed contract shall be as determined by the Contractor, except that they shall conform to any pertinent local or State Law, regulation or code.

699-3 CONSTRUCTION DETAILS. The work required to provide the above facilities and service for mobilization shall be done in a safe and workmanlike manner and shall conform with any pertinent local or State Law, regulation or code. Good housekeeping consistent with safety shall be maintained.

699-4 METHOD OF MEASUREMENT. Payment for mobilization will be made on a lump sum basis.

699-5 BASIS OF PAYMENT. The amount bid for mobilization shall not exceed four percent (4%) of the total contract bid price excluding the bid price for mobilization. Should the bidder exceed the foregoing four percent (4%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

The amount bid shall include the furnishing and maintaining of services and facilities noted under §699-1 DESCRIPTION, to the extent and at the time the Contractor deems them necessary for his operations, consistent with the requirements of this work and the respective contract.

The amount bid shall be payable to the Contractor with the first contract payment made for other contract work.

Payment will be made under:

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<td>Mobilization</td>
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