INTRODUCTION

This publication has been prepared to provide a compilation of standard requirements, called Specifications, used by the New York State Department of Transportation for construction contracts. These specifications are written to the Contractor. They define the Contractor’s responsibility in meeting each specification, enumerate the Department’s expectations and how they are going to measure and pay, and explain what the Contractor is expected to provide.

When this publication, entitled Standard Specifications (USC) and dated as shown on the Title Page, is incorporated by reference into the Department’s construction contracts, it is made a part of that contract. The requirements stated herein may be revised or amended from time to time by notes or special specifications or documents of any description that would be furnished as part of a construction contract.
Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.
# TABLE OF CONTENTS

Contents

Section 600 ......................................................................................................................... 4

INCIDENTAL CONSTRUCTION ............................................................................................ 4

SECTION 601 - ARCHITECTURAL PAVEMENTS AND TREATMENTS ..................... 4
SECTION 602 - REHABILITATION OF CULVERT AND STORM DRAIN PIPE ...... 5
SECTION 603 - CULVERTS AND STORM DRAINS ...................................................... 12
SECTION 604 - DRAINAGE STRUCTURES ................................................................. 19
SECTION 605 - UNDERDRAINS ....................................................................................... 25
SECTION 606 - GUIDE RAILING, MEDIAN BARRIER, AND CONCRETE BARRIER .... 27
SECTION 607 - FENCES ...................................................................................................... 50
SECTION 608 - SIDEWALKS, DRIVEWAYS, BICYCLE PATHS, AND VEGETATION CONTROL STRIPS .................................................................................................................. 55
SECTION 609 - CURB AND CURB & GUTTER .............................................................. 64
SECTION 610 - GROUND VEGETATION - PREPARATION, ESTABLISHMENT AND MANAGEMENT .............................................................................................................................. 71
SECTION 611 - PLANTING, TRANSPLANTING AND POST PLANTING CARE .......... 80
SECTION 612 (VACANT)....................................................................................................... 86
SECTION 613 - WILDLIFE AND ECOLOGY ................................................................... 86
SECTION 614 - PRUNING, IMPROVING AND REMOVING EXISTING VEGETATION ................................................................................................................................. 87
SECTION 615 - LANDSCAPE APPURTEINANCES ......................................................... 91
SECTION 616 - SOIL BIOENGINEERING ...................................................................... 91
SECTION 617 - INVASIVE SPECIES MANAGEMENT .................................................. 92
SECTION 618 (VACANT) .................................................................................................. 92
SECTION 619 - WORK ZONE TRAFFIC CONTROL ..................................................... 92
SECTION 620 - BANK AND CHANNEL PROTECTION ................................................. 144
SECTION 621 - CLEANING CULVERTS, DRAINAGE STRUCTURES AND EXISTING ROADSIDE SECTIONS ......................................................................................... 148
SECTION 622 - BUILDINGS AND MISCELLANEOUS STRUCTURES ................. 151
SECTION 623 - SCREENED GRAVEL, CRUSHED GRAVEL, CRUSHED STONE, CRUSHED SLAG ......................................................................................................................... 151
SECTION 624 - PAVED GUTTERS .................................................................................... 152
SECTION 625 - SURVEY OPERATIONS ....................................................................... 155
SECTION 626 THRU 628 (VACANT) ............................................................................ 154
SECTION 629 - PETROLEUM STORAGE TANK CLOSURE ...................................... 166
SECTION 630 - BARRICADES ......................................................................................... 171
SECTION 631 (VACANT) .................................................................................................. 172
SECTION 632 (VACANT) .................................................................................................. 172
SECTION 633 - CONDITIONING EXISTING PAVEMENT PRIOR TO HOT MIX ASPHALT (HMA) OVERLAY ............................................................ 172
SECTION 634 (VACANT) .................................................................................................. 175
SECTION 635 - CLEANING AND PREPARATION OF PAVEMENT SURFACES FOR PAVEMENT MARKINGS ............................................................ 175
SECTION 636 (VACANT) .................................................................................................. 177
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>637</td>
<td>Engineer's Field Office, Laboratory and Equipment</td>
<td>177</td>
</tr>
<tr>
<td>638</td>
<td>White Synthetic Resin Binder Concrete</td>
<td>190</td>
</tr>
<tr>
<td>639</td>
<td>Construction Contract Management Systems</td>
<td>193</td>
</tr>
<tr>
<td>640</td>
<td>Reflectorized Pavement Marking Paints</td>
<td>193</td>
</tr>
<tr>
<td>641</td>
<td>Bridge Washing</td>
<td>195</td>
</tr>
<tr>
<td>642</td>
<td>Roadside Maintenance</td>
<td>195</td>
</tr>
<tr>
<td>643</td>
<td>Noise Barriers</td>
<td>195</td>
</tr>
<tr>
<td>644</td>
<td>Overhead Sign Structures</td>
<td>196</td>
</tr>
<tr>
<td>645</td>
<td>Signs</td>
<td>206</td>
</tr>
<tr>
<td>646</td>
<td>Delineators, Reference Markers and Snowplowing Markers</td>
<td>215</td>
</tr>
<tr>
<td>647</td>
<td>Removing, Storing, and Relocating Signs, Sign Panel Assemblies, Sign Panel Supports, and Foundations</td>
<td>217</td>
</tr>
<tr>
<td>648</td>
<td>Subsurface Explorations</td>
<td>221</td>
</tr>
<tr>
<td>649</td>
<td>Audible Roadway Delineators</td>
<td>228</td>
</tr>
<tr>
<td>650</td>
<td>Trenchless Installation of Casing</td>
<td>231</td>
</tr>
<tr>
<td>651</td>
<td>Communication Facilities</td>
<td>241</td>
</tr>
<tr>
<td>652</td>
<td>Furnishing and Applying Salts</td>
<td>241</td>
</tr>
<tr>
<td>653</td>
<td>Pavement Ride Quality (Vacant)</td>
<td>242</td>
</tr>
<tr>
<td>654</td>
<td>Impact Attenuators - Permanent</td>
<td>244</td>
</tr>
<tr>
<td>655</td>
<td>Frames, Grates and Covers</td>
<td>249</td>
</tr>
<tr>
<td>656</td>
<td>Miscellaneous Metals</td>
<td>250</td>
</tr>
<tr>
<td>657</td>
<td>Painting Galvanized and Aluminum Surfaces</td>
<td>251</td>
</tr>
<tr>
<td>658</td>
<td>Water Wells</td>
<td>255</td>
</tr>
<tr>
<td>659</td>
<td>Telecommunication Utilities</td>
<td>256</td>
</tr>
<tr>
<td>660</td>
<td>Utilities</td>
<td>256</td>
</tr>
<tr>
<td>661</td>
<td>Electric Utilities</td>
<td>257</td>
</tr>
<tr>
<td>662</td>
<td>Gas, Oil &amp; Steam Utilities</td>
<td>257</td>
</tr>
<tr>
<td>663</td>
<td>Water Supply Utilities</td>
<td>258</td>
</tr>
<tr>
<td>664</td>
<td>Sanitary Sewer Utilities</td>
<td>269</td>
</tr>
<tr>
<td>665</td>
<td>Waterways</td>
<td>270</td>
</tr>
<tr>
<td>666</td>
<td>(Vacant)</td>
<td>270</td>
</tr>
<tr>
<td>667</td>
<td>Local Road Gravel Surface, Base, and Subbase Courses</td>
<td>270</td>
</tr>
<tr>
<td>668</td>
<td>Sections 668 and 669 (Vacant)</td>
<td>273</td>
</tr>
<tr>
<td>670</td>
<td>Highway Lighting System</td>
<td>273</td>
</tr>
<tr>
<td>671</td>
<td>Sections 671 thru 674 (Vacant)</td>
<td>285</td>
</tr>
<tr>
<td>675</td>
<td>Railroad Track and Appurtenances</td>
<td>285</td>
</tr>
<tr>
<td>676</td>
<td>Sections 676 thru 679 (Vacant)</td>
<td>285</td>
</tr>
<tr>
<td>680</td>
<td>Traffic Signals</td>
<td>285</td>
</tr>
<tr>
<td>681</td>
<td>Sections 681 and 682 (Vacant)</td>
<td>304</td>
</tr>
<tr>
<td>683</td>
<td>Intelligent Transportation Systems</td>
<td>304</td>
</tr>
<tr>
<td>684</td>
<td>(Vacant)</td>
<td>305</td>
</tr>
</tbody>
</table>
### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>685</td>
<td>EPOXY REFLECTORIZED PAVEMENT MARKINGS</td>
<td>305</td>
</tr>
<tr>
<td>686</td>
<td>(VACANT)</td>
<td>308</td>
</tr>
<tr>
<td>687</td>
<td>THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS</td>
<td>308</td>
</tr>
<tr>
<td>688</td>
<td>PREFORMED REFLECTORIZED PAVEMENT MARKINGS</td>
<td>312</td>
</tr>
<tr>
<td>689</td>
<td>(VACANT)</td>
<td>315</td>
</tr>
<tr>
<td>690</td>
<td>SPECIALTY WORK</td>
<td>316</td>
</tr>
<tr>
<td>691</td>
<td>THRU 695 (VACANT)</td>
<td>316</td>
</tr>
<tr>
<td>696</td>
<td>CONTRACTOR CHARGES</td>
<td>316</td>
</tr>
<tr>
<td>697</td>
<td>FIELD CHANGE PAYMENT</td>
<td>316</td>
</tr>
<tr>
<td>698</td>
<td>PRICE ADJUSTMENTS</td>
<td>317</td>
</tr>
<tr>
<td>699</td>
<td>MOBILIZATION</td>
<td>322</td>
</tr>
<tr>
<td>691</td>
<td>THRU 695</td>
<td>313</td>
</tr>
<tr>
<td>696</td>
<td>(VACANT)</td>
<td>313</td>
</tr>
<tr>
<td>697</td>
<td>FIELD CHANGE PAYMENT</td>
<td>314</td>
</tr>
<tr>
<td>698</td>
<td>PRICE ADJUSTMENTS</td>
<td>315</td>
</tr>
<tr>
<td>699</td>
<td>MOBILIZATION</td>
<td>319</td>
</tr>
</tbody>
</table>
Section 600
INCIDENTAL CONSTRUCTION

SECTION 601 - ARCHITECTURAL PAVEMENTS AND TREATMENTS
(Last Revised September 2016)

601-1 DESCRIPTION. This work shall consist of the construction, placing, or applying of architectural pavements and treatments in accordance with the Contract Documents or as directed by the Engineer.

601-2 MATERIALS. Materials shall conform to the following subsections.

- Bituminous Materials
- Bituminous Tack Coat (SS-1h or CSS-1h)
- Fine Aggregates
- Mineral Filler
- Precast Concrete Street Pavers
- Water

601-2.01 Precast Concrete Street Paving.

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 154º F minimum and a penetration of 80, and 10% asbestos-free fibers.

B. Polymeric Sand. Polymer modified graded sand designed specifically for filling joints between pavers. Polymeric sand shall be supplied in clearly labeled sealed packages.

601-3 CONSTRUCTION.

601-3.01 Precast Concrete Street Paving

A. The provisions under §401-3, Construction Details for Plant Mix Pavements - General, shall apply.

B. The Contractor shall construct the subbase according to the current 601 Standard Sheet(s).

Prior to placing the setting bed, the Contractor shall prepare the subbase surface according to §402-3.05a.

The bituminous setting bed shall consist of PG binder 64S-22 mixed with fine aggregate meeting the requirements of §703-01. Alternate PG binder grades may be allowed by the RME in lieu of PG 64S-22. The PG binder will meet the requirements outlined in Section 702 Bituminous Materials, Table 702-1 Performance-Graded Binders for Paving. The PG binder shall be 7.0% of the total batch weight. The mix shall be heated to approximately 325º F. The compacted thickness of the bituminous setting bed shall be ¾ inch.

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.

Precast concrete street pavers shall be laid in a 90º herringbone pattern according to the current 601 Standard Sheet(s) to provide a uniformly even surface, with no more than ¼” variation. Joints shall be ⅛ inch wide (± 1/16 inch). No precast concrete street pavers shall be laid when the air temperature is below 40º F. Joint lines shall not deviate more than ± ½” over 50 feet from string lines.
The Contractor shall fill gaps at the edges of the paved area with cut pavers or edge units. The Contractor shall adjust pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers subject to tire traffic shall be no less than one-third (1/3) of a whole unit. After pavers are placed on the adhesive, set them in it with at least one pass of a minimum 300 pound hand roller. Replace any cracked units with whole units and set them with the hand roller.

Polymeric sand shall be swept over the precast concrete street pavers until the joints are completely filled. The paver surface shall be swept clean and the joints lightly wetted with water. This joint filling operation shall not be performed if the air temperature is expected to fall below 40°F, or there is an expectation of rain within 4 hours of the completion.

601-4 METHOD OF MEASUREMENT. Architectural pavements and treatments will be measured by the number of square yards placed.

601-5 BASIS OF PAYMENT. The unit price bid per square yard shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material, except that any sawcutting of existing pavement, excavation, concrete base, curb, curb and gutter, and subbase course 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>601.01</td>
<td>Precast Concrete Street Paving (Bituminous Setting Bed)</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

SECTION 602 - REHABILITATION OF CULVERT AND STORM DRAIN PIPE
(Last Revised January 2019)

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:

- Portland Cement Concrete
- Shotcrete
- Concrete Repair Material
- Vertical and Overhead Patching Material
- Concrete Repair Material - High Early Strength
- Grout Sand
- Cured in Place Pipe (CIPP) Liner
- Polyvinyl Chloride Pipe (relining)
  - (Profile Wall)
  - (Corrugated)
- High Density Polyethylene Pipe (HDPE) (relining)
  - (Profile Wall)
  - (Smooth Wall)
- Corrugated Steel Pipe
  - (Polymer Coated)
- Tunnel Liner Plate (relining)
- Corrugated Structural Steel Plate for Pipe and Pipe Arches and Underpasses
- Anchor Bolts for Corrugated Culverts
- Zinc Chromate Primer
- Bar Reinforcement, Grade 60

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>Portland Cement Concrete</td>
<td></td>
</tr>
<tr>
<td>583</td>
<td>Shotcrete</td>
<td></td>
</tr>
<tr>
<td>701-04</td>
<td>Concrete Repair Material</td>
<td></td>
</tr>
<tr>
<td>701-08</td>
<td>Vertical and Overhead Patching Material</td>
<td></td>
</tr>
<tr>
<td>701-12</td>
<td>Concrete Repair Material - High Early Strength</td>
<td></td>
</tr>
<tr>
<td>703-04</td>
<td>Grout Sand</td>
<td></td>
</tr>
<tr>
<td>706-09</td>
<td>Cured in Place Pipe (CIPP) Liner</td>
<td></td>
</tr>
<tr>
<td>706-10</td>
<td>Polyvinyl Chloride Pipe (relining)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Profile Wall)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Corrugated)</td>
<td></td>
</tr>
<tr>
<td>706-11</td>
<td>High Density Polyethylene Pipe (HDPE) (relining)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Profile Wall)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Smooth Wall)</td>
<td></td>
</tr>
<tr>
<td>707-02</td>
<td>Corrugated Steel Pipe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Polymer Coated)</td>
<td></td>
</tr>
<tr>
<td>707-05</td>
<td>Tunnel Liner Plate (relining)</td>
<td></td>
</tr>
<tr>
<td>707-09</td>
<td>Corrugated Structural Steel Plate for Pipe and Pipe Arches and Underpasses</td>
<td></td>
</tr>
<tr>
<td>707-20</td>
<td>Anchor Bolts for Corrugated Culverts</td>
<td></td>
</tr>
<tr>
<td>708-04</td>
<td>Zinc Chromate Primer</td>
<td></td>
</tr>
<tr>
<td>709-01</td>
<td>Bar Reinforcement, Grade 60</td>
<td></td>
</tr>
</tbody>
</table>
602-2.02  Grout for Annular Space.  Design the grout for the annular space between the existing pipe and new liner pipe in accordance with the pipe Manufacturer’s recommendations. Calculate the required volume of grout based on the existing culvert/storm drain internal diameter (minus deformations) and the external diameter of liner pipe.  All grout components must appear on the Approved List unless approved by the Director, Materials Bureau.

602-3  CONSTRUCTION DETAILS.  Provide the Engineer, a minimum of 10 days prior to starting of the work, a written proposal of how the work will be progressed. The proposal shall include dewatering of the pipe; procedures for maintaining line and grade of the lining pipe, pipe manufacturer’s recommendations for the assembly of preapproved joints, or joint fusion methods; bracing methods; grout mix design; and void filing techniques.  Such proposals are also required, regardless of the rehabilitation method, for 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 lining material.  Inspect small inaccessible pipes, generally less than 48 inches in diameter, using a closed circuit television and camera to provide a visual inspection.  Provide strutting and bracing as required to ensure stability of the pipe.

602-3.02  Handling & Installing Lining Materials

   A.  General.  Install each run of lining 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.  Structural Paving of Inverts with Concrete.  Apply §603-3.07 Concrete Paving for Corrugated Structural Plate Pipe with the exception of the following:

   •  Pave the area along the invert’s periphery, providing concrete cover thickness over the crests of the corrugations and concrete reinforcement details as indicated on the plans.  If welding has been used to anchor the reinforcement or studs on a galvanized section of the pipe then upon completion of the anchoring, restore the coating in accordance with §702-02 Corrugated Steel Pipe, E. Coating Repair.  Coating restoration is not required where mechanical anchoring of the reinforcement has been utilized.
   •  Use Class D, Class H or Class J concrete for paving of the invert.

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

   •  Shotcrete may be used to line concrete pipe, stone arches, and corrugated metal pipes.
   •  All reinforcement design and details (e.g. spacing, anchoring, etc.) must be indicated on the plans.  If welding has been used to anchor the reinforcement or studs on a galvanized section of the pipe then upon completion of the anchoring, restore the coating in accordance with §702-02 Corrugated Steel Pipe, E. Coating restoration is not required where mechanical anchoring of the reinforcement has been utilized.
• Apply a minimum 2 inch thick shotcrete layer over the crests of the corrugations. The shotcrete layer limits along the periphery will be indicated on the plans.

D. Lining with Cured in Place Pipe (CIPP) Liner. The CIPP manufacturer’s / installer’s name shall appear on the Department’s Approved List of Materials and Equipment, Rehabilitation of Culverts and Storm Drains section.

The CIPP contractor shall provide the Engineer a report with design details and calculations for determining the minimum required thickness of the cured-in-place-pipe (CIPP) liner, the minimum internal pressure required to hold the wetted liner tight against the host pipe, and the maximum allowable internal pressure so as not to damage the wetted liner. All design calculations shall assume a fully deteriorated host pipe, unless Item 602.37xx, Lining Concrete pipe with Cured in Place Pipe (CIPP), is specified. All liner installations require the excavation of a resin containment pit to facilitate the installer’s collection and subsequent disposal of any waste (styrene or non-styrene) and / or curing water from the jobsite. When the liner curing is completed, the installer will remove all waste prior to the lined pipe being put back in service. The plans will indicate the size of the excavation for the resin containment pit. The excavation, temporary storage of the fill and restoration of the downstream channel will be performed under Section 206-1.02, measured under 206-4.04 and paid under 206.0201 Trench, Culvert and Structure Excavation – O.G.

Use a resin / liner system meeting the following criteria:

• System consists of one or more layers of flexible needled felt or an equivalent material as approved by the Materials Bureau.

• Liner is flexible enough to fit irregular pipe sections and able to negotiate pipe bends.

Liner’s surface must be coated with a plastic material compatible with the proposed resin. All liners containing styrene based resins require the use of a pre liner, to be inserted into the existing pipe before insertion of the CIPP liner. In addition to the pre liner, single or double sided liners may be specified in the contract plans, depending on the environmental setting of a particular application.

A thermoset resin and catalyst or an epoxy resin and hardener system, compatible with the proposed inversion system shall be used. If indicated in the contract documents, a resin containing less than five percent volatile organic compounds (VOCs) with less than 0.1 percent hazardous air pollutants (HAPs) and less than 0.1 percent of water quality pollutants as listed in 6 NYCRR Parts 700-705 shall be supplied. If the resin type (styrene or non-styrene) is not specified on the plans, the installer has the option to select the resin type. Proposed resin shall be compatible with the proposed inversion process.

Vacuum impregnate the liner with resin. Use a volume of resin capable of filling all voids in the liner material at nominal thickness and diameter. Adjust this resin volume by adding a minimum of 5% excess resin to allow for changes in resin volume due to polymerization and for any resin migration into the cracks and joints of the original pipe.

1. Installation. A cured-in-place-pipe (CIPP) liner may be installed into the host pipe by hydrostatic head, air pressure inversion, or a combination of the two. Do not exceed the manufacturer recommended maximum pressure to the liner felt fiber during the inversion process. Pulled in place installations may be allowed if it is indicated on the contract documents or if the installer is given prior approval by the Director, Materials Bureau.

a. Hydrostatic Head. The standpipe height must be sufficient to maintain at least the minimum required pressure between the CIPP liner and the existing (host) pipe. The lower end of the liner must extend beyond the outlet end whenever possible. Where changes in elevation may create excessive stresses on the liner felt, the use of bulkheads...
may be necessary. Alternative installation methods using a hydrostatic head will be subject to approval by the Director, Materials Bureau.

b. **Air Pressure.** The liner may be inverted using air pressure to extend it to the termination point. The air pressure needs to be adjusted and sustained to a level capable of holding the liner against the host pipe regardless of the curing method proposed to be used.

2. **Curing.** Cure the liner by circulating heated water throughout the section. Uniformly raise the temperature of the water above the level required to cure the resin. Monitor and record both the temperature of the curing water exiting the heating source and the temperature of the curing water returning to the heating source. Monitor and record the observed temperatures by the remote sensors on the liner-host pipe interfaces, located in the upstream and downstream area of the pipe. The remote temperature sensors readings will be used for monitoring the progress of curing and its duration. The minimum curing time is the sum of the minimum recommended initial and post-curing times as per the liner resin supplier’s recommendations. The onset of the initial curing approximately occurs when all remote temperature sensors register a temperature consistent with the “exotherm”, which shall be included in the Manufacturer’s recommendations. Post-cure the liner at least for the minimum post-curing time and at the minimum post-curing temperature level, as per the liner Manufacturer’s recommendations. Add post-curing time for any deviations from the recommended post-curing temperature levels. All resin Manufacturers’ curing proposals require approval by the Director of Materials Bureau prior to its initial use by the Department. Also, a new curing proposal submission for approval is required if an already approved liner Manufacturer introduces a new resin formulation and/or a new liner curing method to a Department contract.

3. **Water and Material Management.** After post-curing is completed, manage the curing water so that it does not cause or contribute to a violation of water quality standards to receiving waters or groundwater 6 NYCRR Part 700-704. In particular, the CIPP Contractor shall note the surface water quality and groundwater standards at 6 NYCRR Part 703 for pollutants such as styrene and thermal discharges. The CIPP Contractor shall enquire as to the classification of potential receiving surface waters in the project location if this information is not provided in the contract documents.

A. Handling of curing water used in a styrene based thermoset resin liner installation:

1. Collect and transport curing water from the site for reuse within another CIPP location; and/or
2. Collect the water and dispose or treat at off site facilities. Transport wastewaters within vehicles that have a waste transporter permit 6NYCRR 364. Off-site disposal shall be at a publicly owned treatment works or at a disposal facility permitted to accept the wastewater. The Contractor shall conduct off site treatment to reduce styrene concentrations to acceptable levels to meet water quality standards prior to discharge to the receiving waters; and/or
3. Treat wastewater on-site to acceptable styrene and thermal loading and discharge to receiving waters in accordance with agreements received from the Regional NYSDEC Office.

B. For curing water from non-styrene based processes, collect water for disposal off-site as described in A1 and A2 above or discharge on site if it does not contain pollutants that could cause or contribute to a violation of water quality standards. Reduce temperature to prevent a violation of the thermal standards to the receiving waters.
C. Collect any excess resin and any curing materials at the upstream and downstream ends of the installation for disposal.

D. Record and document quantities of curing water removed from the site. Provide record/documentation of the reuse and/or disposal facility and quantity disposed of curing water leaving the site.

After post-curing is completed, cool the liner to a temperature of 100º F prior to relieving the static head in the inversion standpipe. Cool-down may be accomplished by adding cool water into the inversion standpipe to replace warm curing water being removed from the liner. Contract documents may contain restrictions on the temperature of the released curing water or whether the curing water needs to be removed and treated. Any other proposed liner curing methods will be subject to the approval of the Director, Materials Bureau.

4. Workmanship / Damage / Defects. The finished pipe liner shall 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 3 feet from both ends of the distressed area, cut the distressed area out, and replace it at no cost to the Department. If the Cured-In Place-Pipe (CIPP) liner does not fit against its termination point, seal the space between the pipe and liner with a resin mixture compatible with the CIPP. The liner may be sampled and tested for tensile and flexural properties in accordance with ASTM F 1216 at the discretion of the Department. Failure to meet the designed properties will be a cause for liner rejection.

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

E. Lining with a new Liner Pipe-General. Before lining, pull or push a single piece of liner pipe through the existing pipe to verify liner clearance. The liner must be positioned and secured to facilitate its complete encapsulation by grout.

Follow the Manufacturer’s recommendations for handling and assembling the pipe and all provisions included in the approved written proposal.

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.

Grout the entire annular space. Provide a minimum annular space of 1 inch for grouting between the new and existing pipes. Provide details on how to hold the liner pipe to line and grade until the grout has set.

If the volume of the grout used is less than the anticipated (calculated) volume, 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 rehabilitate all identified voids. 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 from within the culvert. The voids must be filled to the satisfaction of the Engineer at no additional cost to the state. Grout that fills invert and connected voids is covered in the cost for these items.

1. Lining with High Density Polyethylene Pipe. Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

Reline with Smooth Wall Polyethylene Pipe or Profile Wall Polyethylene Pipe, as indicated in the contract documents.
Install all pipe, fittings, adapters and appurtenances according to the Manufacturer’s recommendations. Limit joint separations to less than ½ inch between adjoining sections. Field cuts will be permitted only at the terminal ends. No HDPE pipe sections less than 3 feet long will be allowed in any lining projects.

Perform all butt fusion, welding and extrusion welding of HDPE pipe in accordance with the Manufacturer’s recommendation. A Manufacturer’s representative – or an individual trained by the manufacturer – must be present at all times during any fusion or welding operations. Alternate joining methods will be subject to approval by the Director, Materials Bureau.

2. Lining with Polyvinyl Chloride Pipe. Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

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

   The installation proposal for this item to be submitted by the contractor for Departmental approval should in addition address the following PVC specific issues prior to any work approval is granted; Whether the PVC liner will be pulled or pushed through the culvert and the type of pushing or pulling ring/plate to be used; Whether a nose cone or a different device will be used in this process and how the jacking, pulling or pushing loads on the liner will be monitored in order to conform to the PVC liner’s Manufacturer’s specifications and guidelines. Include PVC liner’s Manufacturer’s specifications and guidelines in the submitted for approval proposal. Follow all Manufacturer’s recommendations during joint assembly operations.

3. Lining with Corrugated Metal Pipe. Reline with Polymer Coated Corrugated Steel Pipe.

   Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

   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 ½ inch between adjoining sections. To ensure that grout remains in the annular space, place internal expanding joint bands with annular corrugations and foam gaskets at each joint. Before grouting the annular space, brace and strut the bands. Do not obstruct with any bracing material the flow of grout into the annular space. Remove the bracing, struts and bands upon completion of this work.

4. Lining with Corrugated Steel Structural Plate Pipe and Pipe Arches with PCC Paved Invert.

   Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

   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 obstruct with any bracing material the flow of grout into the annular space. Once lining with this item has been completed, apply §603-3.07 Concrete Paving for Corrugated Structural Plate Pipe and as indicated in the contract documents.

5. Lining with Steel Tunnel Liner Plate. Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe - General.

   Line with tunnel liner plates (double flange). 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 18 inch 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 spacing.

602-3.03 Damaged Pipe and Repair. Repair all damage to the existing host pipe caused that is strictly
obstructing the progress of the relining operation. Repair any damage to the newly installed liner caused
during construction, consistent with recommendations of Section 603-3.04 Damaged Pipe and Repair.

602-4 METHOD OF MEASUREMENT

602-4.01 Lining with new pipe. This work will be measured as the number of feet along the bottom
centerline, measured to the nearest foot.

602-4.02 Paving inverts. This work shall be measured as the number of square feet determined by the
paved width measured along the pipes interior circumference at the top of the corrugations and the length
along the centerline of the pipe measured to the nearest square foot.

602-4.03 Shotcreting. This work shall be measured as the number of square feet determined by the
shotcreted width measured along the pipes interior circumference at the top of the corrugations and the
length along the centerline of the pipe measured to the nearest square foot.

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, dewatering and cleaning of existing pipe, and
the removal of any obstructions, intrusions or damaged pipe prior to lining.

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 such as
dewatering and cleaning to the existing pipe.

For Cured in Place Pipe, include the cost of furnishing all labor, materials and equipment necessary to
complete the work for the price unit bid and include all necessary preparations such as dewatering and
cleaning to the existing pipe, all activities involving water treatment as well as water and waste
transportation and disposal. The excavation for the resin containment pit, temporary storage of the fill and
restoration of the downstream channel will be paid for under 206.04 Trench and Culvert Excavation –
O.G.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>602.2002</td>
<td>Structural Paving of Inverts with Portland Cement Concrete</td>
<td>Square Feet</td>
</tr>
<tr>
<td>602.2101</td>
<td>Lining Culvert with Shotcrete</td>
<td>Square Feet</td>
</tr>
<tr>
<td>602.25xx</td>
<td>Lining with High Density Polyethylene Pipe</td>
<td>Feet</td>
</tr>
<tr>
<td>602.26xx</td>
<td>Lining with Smooth Wall High Density Polyethylene Pipe</td>
<td>Feet</td>
</tr>
<tr>
<td>602.27xx</td>
<td>Lining with Profile Wall High Density Polyethylene Pipe</td>
<td>Feet</td>
</tr>
<tr>
<td>602.30xx</td>
<td>Lining with Polyvinyl Chloride Pipe</td>
<td>Feet</td>
</tr>
<tr>
<td>602.36xx</td>
<td>Lining with Cured in Place Pipe (CIPP)</td>
<td>Feet</td>
</tr>
<tr>
<td>602.37xx</td>
<td>Lining Concrete pipe with Cured in Place Pipe (CIPP)</td>
<td>Feet</td>
</tr>
<tr>
<td>602.51xxx</td>
<td>Lining with Corrugated Steel Structural Plate Pipe</td>
<td>Feet</td>
</tr>
<tr>
<td></td>
<td>with PCC Paved invert</td>
<td></td>
</tr>
<tr>
<td>602.53xxxx</td>
<td>Lining with Corrugated Steel Structural Plate Pipe Arch</td>
<td></td>
</tr>
</tbody>
</table>
with PCC Paved invert

602.550101 Lining with Steel Tunnel Liner Plate 10 ga
Feet

602.550102 Lining with Steel Tunnel Liner Plate 8 ga
Square Feet

602.550103 Lining with Steel Tunnel Liner Plate 7 ga
Square Feet

602.550104 Lining with Steel Tunnel Liner Plate 5 ga
Square Feet

602.550105 Lining with Steel Tunnel Liner Plate 3 ga
Square Feet

602.75xx Lining with Polymer Coated CSP 12 ga, (2-2/3"x1/2")
Feet

602.80xx Lining with Polymer Coated CSP 12 ga, (3"x1") or (5"x1")
Feet

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:

<table>
<thead>
<tr>
<th>Material</th>
<th>Item Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotextile</td>
<td>207</td>
<td>Corrugated Structural Steel Plate for Pipe,</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>501</td>
<td>Pipe-Arch and Underpasses</td>
</tr>
<tr>
<td>Portland Cement</td>
<td>701-01</td>
<td>Galvanized Steel End Sections</td>
</tr>
<tr>
<td>Masonry Cement</td>
<td>701-02</td>
<td>Aluminum End Sections</td>
</tr>
<tr>
<td>Concrete Repair Material</td>
<td>701-04</td>
<td>Corrugated Aluminum Pipe</td>
</tr>
<tr>
<td>Concrete Repair Material – High Early Strength</td>
<td>701-12</td>
<td>Corrugated Aluminum Structural</td>
</tr>
<tr>
<td>Mortar Sand</td>
<td>703-03</td>
<td>Anchor Bolts for Corrugated Culverts</td>
</tr>
<tr>
<td>Non-Reinforced Concrete Pipe</td>
<td>706-01</td>
<td>Zinc Chromate Primer</td>
</tr>
<tr>
<td>Reinforced Concrete Pipe</td>
<td>706-02</td>
<td>Bar Reinforcement, Grade 60</td>
</tr>
<tr>
<td>Reinforced Concrete Elliptical Pipe</td>
<td>706-03</td>
<td>Wire Fabric for Concrete Reinforcement</td>
</tr>
<tr>
<td>Reinforced Concrete End Sections</td>
<td>706-07</td>
<td>Plastic Coated Fiber Blankets (For Curing)</td>
</tr>
<tr>
<td>Polypropylene Pipe</td>
<td>706-08</td>
<td>Membrane Curing Compound</td>
</tr>
<tr>
<td>Smooth Interior Corrugated Polyethylene Pipe</td>
<td>706-12</td>
<td>Water</td>
</tr>
<tr>
<td>Corrugated Steel Pipe</td>
<td>707-02</td>
<td>Galvanized Coatings and Repair Methods</td>
</tr>
<tr>
<td>Ductile Iron Pipe (Non-Pressure)</td>
<td>707-03</td>
<td></td>
</tr>
</tbody>
</table>

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 or §701-12). 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 12 inches beyond each side of the joint for its entire length. A minimum of 12 inches is required for any longitudinal lap.

**F. Polyethylene and Polypropylene 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 1/4 inch or joint separations greater than 1/2 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 40 inches.

**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 Section 203, *Select Granular Fill* 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 2 inch 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 2 square feet or less in each pipe section. Damage to bituminous paving in areas greater than 2 square feet in a pipe section will be cause for rejection of that section.

D. Polyethylene and Polypropylene 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 150 but not more than 300 ft-lbs 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 24 inches 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 250 gallons per inch of pipe diameter per mile 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 90 inches. Round pipe less than 24 inches in diameter, elliptical pipe, and larger diameter round pipe beginning with 66 inch diameter where the weight of the pipe section requires a shorter length shall have a minimum length of 72 inch.

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 90 or 72 inches 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 12 feet in length when using 90 inch minimum length pipe sections and at least 120 inches in length when used with 72 inch 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 18 inches from the end of the pipe sections and the flared end sections. Anchor each end of the device with a 1 inch 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 48 inches 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 2 1/4 inches , 1/4 inch minimum thickness with 1 1/4 inch maximum diameter holes centered 1 1/2 inch from each end. For pipe larger than 48 inches 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 and Polypropylene Pipe Connections. Manufactured ends shall be used for joint assemblies; no field cuts are permitted unless approved by the Engineer. No separations greater than 1/2 inch 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, except that the pipe shall protrude 2 inches 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 ASTM A36/A36M 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 in accordance with the drainage structure Standard Sheets. Large spaces may be chinked with 704-13 Precast Concrete Driveway and Sidewalk Pavers.

**H. Tolerance.** A 1/2 inch difference in diameter is allowed when joining round pipes or the spans or rises of pipe-arches. A 1 1/2 inch difference is allowed in the perimeters. These tolerances may be attained by proper production control or by match-marking pipe ends.

**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.

Pave the bottom 25 percent of the inside circumference for round pipe, the bottom 30 percent of the inside periphery for arch spans of 10 feet 3 inches and shorter and the bottom 35 percent of the inside periphery for arch spans longer than 10 feet 3 inches unless otherwise specified by the Engineer. A minimum cover of 4 inches is required over all corrugations. Schedule and conduct the diversion of water operations prior to and during the placement of pavement in a manner satisfactory to the Engineer. Prior to placing pavement clean and dry the surfaces to be in contact with concrete 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 4 inch minimum clearance from the edges of concrete and lap 6 inch minimum. Unless otherwise shown on the plans, the steel fabric reinforcement shall consist of No. 6 gauge wire at 6 inch 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 1 gallon per 150 square feet. 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 45°F, the requirements of 555-3.08C, Provisions for Concreting in Cold Weather, shall apply.

**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.
603-3.10 Culvert-End Safety Grates. Culvert-end safety grates shall be fabricated in accordance with the Standard Sheets.

The grate shall lay flat on the embankment slope, overlap the opening equally on each side, and at the top as indicated in the contract documents. The Contractor shall perform any necessary excavation, backfill, and final slope shaping and grading to ensure proper grate support and smooth uniform slopes in the area surrounding the grate. All disturbed areas will be reestablished to the satisfaction of the Engineer.

603-4 METHOD OF MEASUREMENT

603-4.01 Pipe. The Engineer will measure the pipe, in feet 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 relaid and any new pipe laid and furnished to replace existing pipe, in feet 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.

603-4.05 Culvert-End Safety Grates. Culvert-end safety grates will be measured in square feet to the nearest 0.1 square foot of safety-grate installed, using payment areas shown on the Standard Sheet. For sizes that are not shown on the Standard Sheet, the area will be computed as the product of the overall length and width.

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 24 inch 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.

603-5.04 Culvert-End Safety Grates. The unit price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including excavation, topsoil, seeding and mulching.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>603.0101</td>
<td>Culvert-End Safety Grate</td>
<td>Square Foot</td>
</tr>
<tr>
<td>603.0102</td>
<td>Culvert-End Safety Grate (Heavy-Duty)</td>
<td>Square Foot</td>
</tr>
<tr>
<td>603.02xx</td>
<td>Non-Reinforced Concrete Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>603.05xxxx</td>
<td>Corrugated Steel Pipe (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.06xxxx</td>
<td>Corrugated Steel Pipe Paved Invert (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.07xxxx</td>
<td>Corrugated Steel Pipe Fully Paved (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.08xxxx</td>
<td>Corrugated Steel Pipe Arch (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.09xxxx</td>
<td>Corrugated Steel Pipe Arch, Paved Invert (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.10xxxx</td>
<td>Corrugated Steel Pipe Arch, Fully Paved (2 2/3 x 1/2)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.11xxxx</td>
<td>Corrugated Steel Pipe (3 x 1) or (5 x 1)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.12xxxx</td>
<td>Corrugated Steel Pipe Paved Invert (3 x 1) or (5 x 1)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.13xxxx</td>
<td>Corrugated Steel Pipe Fully Paved (3 x 1) or (5 x 1)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.14xxxx</td>
<td>Corrugated Steel Pipe Arch (3 x 1) or (5 x 1)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.15xxxx</td>
<td>Corrugated Steel Pipe Arch Paved Invert (3 x 1) or (5 x 1)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.17xxxx</td>
<td>Galvanized Steel End Sections Pipe (2 2/3 x 1/2)</td>
<td>Each</td>
</tr>
<tr>
<td>603.18xxxx</td>
<td>Galvanized Steel End Sections Pipe Arch (2 2/3 x 1/2)</td>
<td>Each</td>
</tr>
<tr>
<td>603.20xxxx</td>
<td>Galvanized Steel End Sections Pipe Arch (3 x 1) or (5 x 1)</td>
<td>Each</td>
</tr>
<tr>
<td>603.23xx</td>
<td>Corrugated Structural Steel Plate Pipe (60 - 108 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.24xx</td>
<td>Corrugated Structural Steel Plate Pipe (114 - 162 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.25xx</td>
<td>Corrugated Structural Steel Plate Pipe (168 - 216 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.26xx</td>
<td>Corrugated Structural Steel Plate Pipe (222- 252 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.27xx</td>
<td>Corrugated Structural Steel Plate Pipe PCC Paved Invert (60 - 108 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.28xx</td>
<td>Corrugated Structural Steel Plate Pipe PCC Paved Invert (114 - 162 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.29xx</td>
<td>Corrugated Structural Steel Plate Pipe PCC Paved Invert (168 - 216 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.30xx</td>
<td>Corrugated Structural Steel Plate Pipe PCC Paved Invert (222 - 252 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.31xx</td>
<td>Corrugated Structural Steel Plate Pipe Arch (6 feet 1 inch - 20 feet 7 inch span, 9PI, Corner Plate)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.32xx</td>
<td>Corrugated Structural Steel Plate Pipe Arch, PCC Paved Invert (6 feet 1 inch - 19 feet 8 inch span, 9PI, Corner Plate)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.35xx</td>
<td>Corrugated Structural Steel Plate Underpass</td>
<td>Foot</td>
</tr>
<tr>
<td>603.40xxxx</td>
<td>Round Corrugated Aluminum Pipe (2 2/3 x 1/2) (12 - 30 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.41xxxx</td>
<td>Round Corrugated Aluminum Pipe (3 x 1) (36 - 96 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.44xxxx</td>
<td>Corrugated Aluminum Structural Plate Pipe (9 x 2 1/2)(60- 114 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.46xxxx</td>
<td>Corrugated Aluminum Structural Plate Pipe (9 x 2 1/2)(120- 180 Diam.)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.48xxxx</td>
<td>Corrugated Aluminum Pipe-Arch (2 2/3 x 1/2)(17 Span, 13 Rise) to (57 Span, 38 Rise), and (3 x 1) (60 span, 46 Rise to 95 Span, 67 Rise)</td>
<td>Foot</td>
</tr>
<tr>
<td>603.50xxxx</td>
<td>Corrugated Aluminum Structural Plate Pipe-Arch (9 x 2 1/2)</td>
<td>Foot</td>
</tr>
</tbody>
</table>
(6 ft 1 in Span, 5 ft Rise to 11 ft 5 in Span, 7 ft Rise)  Foot
603.52xxxx Corrugated Aluminum Structural Plate Pipe-Arch (9 x 2 1/2)
(12 feet 3 inch Span, 7 feet 3 inch Rise to 19 feet 5 inch Span, 11 feet 11 inch Rise)  Foot
603.53xxxx Corrugated Aluminum Pipe, Type IIR  Foot
603.54xxxx Corrugated Aluminum End Sections Pipe  Each
603.55xxxx Corrugated Aluminum End Sections, Pipe Arch  Each
603.56xxxx Corrugated Steel Pipe- Type IR  Foot
603.58xxxx Corrugated Aluminum Pipe- Type IR  Foot
603.59xxxx Corrugated Steel Pipe- Type IIR  Foot
603.60xx Reinforced Concrete Pipe Class III  Foot
603.61xx Reinforced Concrete Pipe Class IV  Foot
603.62xx Reinforced Concrete Pipe Class V  Foot
603.66xx Reinforced Concrete Horizontal Elliptical Pipe Class HE II  Foot
603.67xx Reinforced Concrete Horizontal Elliptical Pipe, Class HE III  Foot
603.68xx Reinforced Concrete Horizontal Elliptical Pipe, Class HE IV  Foot
603.69xx Reinforced Concrete Vertical Elliptical Pipe, Class VE IV  Foot
603.70xx Reinforced Concrete Vertical Elliptical Pipe, Class VE V  Foot
603.71xx Reinforced Concrete Vertical Elliptical Pipe, Class VE VI  Foot
603.72xx Reinforced Concrete Cattle Pass  Foot
603.73xx Reinforced Concrete Pipe End Sections  Each
603.74xx Reinforced Concrete Pipe Class II  Foot
603.77 Concrete Collars  Each
603.7802xx Polypropylene Pipe (Optional) -Type S, or Type D  Foot
xx= 12, 15, 18, 24, 30, 36, 42, 48, 60 (denoting pipe diameter in inches)
603.80xxxx Corrugated Steel Pipe-Polymer Coated (2 2/3 x 1/2)  Foot
603.81xxxx Corrugated Steel Pipe-Polymer Coated Paved Invert (2 2/3 x 1/2)  Foot
603.82xxxx Corrugated Steel Pipe-Arch Polymer Coated (2 2/3 x 1/2)  Foot
603.83xxxx Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (2 2/3 x 1/2)  Foot
603.84xxxx Corrugated Steel Pipe-Polymer Coated (3x1) or (5x1)  Foot
603.85xxxx Corrugated Steel Pipe-Polymer Coated Paved Invert (3x1) or (5x1)  Foot
603.86xxxx Corrugated Steel Pipe-Arch Polymer Coated (3x1) or (5x1)  Foot
603.87xxxx Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (3x1) or (5x1)  Foot
603.88xxxx Corrugated Steel Pipe-Aluminum Coated (Type II) (2 2/3 x 1/2)  Foot
603.89xxxx Corrugated Steel Pipe-Arch Aluminum Coated(Type II)(2 2/3 x 1/2)  Foot
603.90xxxx Corrugated Steel Pipe-Aluminum Coated (Type II)(3x1) or (5x1)  Foot
603.91xxxx Corrugated Steel Pipe-Arch Aluminum Coated(Type II)(3x1) or (5x1)  Foot
603.92xxxx Corrugated Steel Pipe-Aluminum Coated (Type 2) Type IR  Foot
603.93xxxx Corrugated Steel Pipe-Arch Aluminum Coated (Type 2) Type IIR  Foot
603.95xx Ductile Iron Pipe  Foot
603.96xxxx Smooth Lined Corrugated Aluminum Pipe (2 2/3 x 1/2)  Foot
603.97xxxx Smooth Lined Corrugated Aluminum Pipe (3 x 1)  Foot
603.98xx Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe  Foot
603.99xx Relaying Pipe  Foot

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 inches.

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
- Concrete Repair Material - High Early Strength 701-12
- 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 60 709-01
- 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 60.

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 1/2 inch wide. When specified, the outside of the masonry construction shall be plastered with 1/2 inch 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 16 inches. Steps shall be embedded into the walls of the riser or conical top section a minimum of 3 inches. The rung shall project a minimum clear distance of 4 inches 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 24 feet, 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) ¼ inch thick Premolded 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, §701-05 or §701-12. 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 Section 203, Select Granular Fill, 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 feet of height measured to the nearest tenth of a foot 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.

604-4.03 Altering Drainage Structures, Leaching Basins and Manholes. Altering drainage structures, leaching basins and manholes will be measured by the number of structures altered.

604-4.04 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

604-5.01 Drainage Structures, Leaching Basins and Manholes. The unit price bid per linear foot 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.

604-5.02 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. §604-5.01 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.

604-5.03 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.

604-5.04 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.

604-5.05 Transverse Drainage Interceptors. The price per linear foot 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>
</tr>
</thead>
<tbody>
<tr>
<td>604.01</td>
<td>Leaching Basin</td>
<td>Foot</td>
</tr>
<tr>
<td>604.06</td>
<td>Transverse Drainage Interceptors</td>
<td>Foot</td>
</tr>
<tr>
<td>604.07XXXYY</td>
<td>Altering Drainage Structures, Leaching Basins and Manholes</td>
<td>Each</td>
</tr>
<tr>
<td></td>
<td>XX = Region (01 through 11)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YY = Serialized 01 to 99 *</td>
<td></td>
</tr>
<tr>
<td>604.10</td>
<td>Prefabricated Adjustment Rings for Manholes</td>
<td>Each</td>
</tr>
<tr>
<td>604.11</td>
<td>Prefabricated Adjustment Frames for Drainage Structures</td>
<td>Each</td>
</tr>
<tr>
<td>604.30XXXYY</td>
<td>Rectangular Drainage Structure</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>XX = Structure Type **</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YY = Frame No. **</td>
<td></td>
</tr>
<tr>
<td>604.31XXXYY</td>
<td>Rectangular Drainage Structure with Round Option</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>XX = Structure Type **</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YY = Frame No. **</td>
<td></td>
</tr>
<tr>
<td>604.32XXXYY</td>
<td>Rectangular Drainage Structure with Concrete Cap</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>XX = Structure Type **</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YY = Frame No. **</td>
<td></td>
</tr>
<tr>
<td>604.40XX</td>
<td>Round Precast Manhole</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>XX = Type **</td>
<td></td>
</tr>
<tr>
<td>604.50XXXYY</td>
<td>Special Drainage Structure</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>XX = Region (01 through 11)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>YY = Serialized 01 to 99 *</td>
<td></td>
</tr>
</tbody>
</table>

* 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 in the contract documents.

605-2 MATERIALS

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

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrugated Steel Pipe - Type III, 16 gage</td>
<td>707-02</td>
</tr>
<tr>
<td>Porous Concrete Pipe Underdrain</td>
<td>706-05</td>
</tr>
<tr>
<td>Extra Strength Porous Concrete Pipe Underdrain</td>
<td>706-05</td>
</tr>
<tr>
<td>Perforated Corrugated Polyethylene Underdrain Tubing</td>
<td>706-13</td>
</tr>
<tr>
<td>Corrugated Aluminum Pipe - Type III, 16 gage</td>
<td>707-13</td>
</tr>
<tr>
<td>Perforated Polyvinyl Chloride Underdrain Pipe</td>
<td>706-18</td>
</tr>
</tbody>
</table>

Optional underdrain pipe shall meet the requirements of any of the above at the Contractors option except that porous concrete pipe shall not be used in an edge of pavement underdrain installation.

605-2.02 Underdrain Filter. The requirements for Underdrain Filter materials are described below. The procedure for acceptance or rejection of Underdrain Filter materials shall be in conformance with the procedures contained in the geotechnical control procedure “Procedure for the Control and Quality Assurance of Granular Materials”. Underdrain Filter material shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing for the type of underdrain filter material specified in the contract documents:

A. Underdrain Filter Type I. Provide material meeting the requirements of §733-20 Underdrain Filter, Type 1.

B. Underdrain Filter Type II. Provide material meeting the requirements of §733-20 Underdrain Filter, Type 2.

C. Underdrain Filter Type III. Provide material meeting the requirements of §703-07 Concrete Sand.

605-3 CONSTRUCTION DETAILS

605-3.01 Underdrain Pipe. The construction details of Section 603 Culverts and Storm Drains shall apply. The type of filter material to be used at any location will be as shown in the contract documents. A carefully leveled 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 in the contract documents, 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 (PVC) Underdrain Pipe. When these underdrains are daylighted through the side slope they shall be protected from sunlight by shielding with a minimum 3 ft. long section of corrugated steel or aluminum pipe at the outlet. The metal pipe for shielding the underdrain shall be of such internal
diameter to easily slip over the underdrain. For 4 in. and 6 in. diameter underdrains, the metal pipe shielding the underdrain shall extend a minimum of 6 in. into the ground and overlap the underdrain by 6 in. For underdrains from 8 in. through 12 in. in diameter, the metal shielding pipe shall extend at least 12 in. into the ground and overlap the underdrain by 12 in. In no case shall the outlet end of the underdrain be exposed or extend beyond the end of the metal pipe shielding it. To prevent intrusion of the filter material into the joint between the metal and underdrains, a reducer fitting shall be placed over the joint, roofing felt shall be wrapped around the joint, or another method shall be approved by the Engineer.

Perforated corrugated polyethylene underdrain tubing and perforated PVC 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. Corrugated Aluminum Pipe. Do not place grout in contact with aluminum pipe, such as at drainage inlet structures, including connections, fixtures, etc., unless the aluminum has been thoroughly coated with Zinc Chromate Primer, §708-04 Zinc Chromate Primer or an equivalent alternative as approved by the Materials Bureau.

C. 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 shall extend to a level 6 in. above the underdrain pipe or to the next course, whichever is less. Subsequent lifts of Underdrain Filter shall be no more than 6 in. thick prior to compaction and shall be compacted by two passes of a vibrating pad or drum type compactor. The remainder of the installation shall be in accordance with the applicable standard sheet or as indicated in the contract documents.

If the excavation for the underdrain extends outside the payment lines, it shall be backfilled with Underdrain Filter material installed at the Contractor's expense.

Any contaminated underdrain filter material shall be replaced by the Contractor at no additional cost to the State.

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 12 in. above the underdrain tubing or to the next course, whichever is less. After placement, 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 2 ft. 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 6 in. in thickness prior to compaction. Each lift shall be compacted by two passes of a vibrating pad or drum type compactor.

No compaction control tests will be required.

A. Underdrain Filter at Structures. Underdrain filter at structures denotes the installation of Underdrain Filter, Type I placed behind bridge abutments, walls, and other major structures requiring positive drainage to relieve large lateral pressures resulting from a saturated backfill. Underdrain Filter, Type I material shall be placed adjacent to structures in accordance with the contract documents. The lift thickness for the loose Type I material shall not exceed 6 in. 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 the footing heel projection plus 3 ft. shall be compacted simultaneously. Compactive effort for this material shall be provided by two passes of a vibratory or
drum type compactor. Placement and compaction operations shall be conducted in a manner so as to ensure 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. Underdrain pipe will be measured in feet, measured to the nearest whole foot, installed in accordance with the contract documents.

605-4.02 Underdrain Filter. Underdrain filter material will be measured in cubic yards, measured to the nearest whole cubic yard, installed between the payment lines shown in the contract documents. A deduction to the cross sectional area of the underdrain trench will be made for the pipes (based on nominal diameters) when the combined cross-sectional area exceeds 1.0 sq. ft. No deduction will be made for the cross-sectional area of an existing facility.

A. Underdrain Filter at Structures. Underdrain filter, Type I material at structures will be measured in cubic yards, measured to the nearest whole cubic yard, installed between the payment lines shown in the contract documents. 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 foot shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. The unit price bid per foot for perforated corrugated polyethylene underdrain tubing and perforated PVC underdrain pipe installations that are daylighted through the side slope shall include the shield pipe. Excavation, granular fill and backfill will be paid for separately.

605-5.02 Underdrain Filter. The unit price bid per cubic yard shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Excavation, granular fill and backfill 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>605.04xx</td>
<td>Porous Concrete Pipe Underdrain</td>
<td>Foot</td>
</tr>
<tr>
<td>605.05xx</td>
<td>Extra Strength Porous Concrete Pipe Underdrain</td>
<td>Foot</td>
</tr>
<tr>
<td>605.07xx</td>
<td>Corrugated Steel Pipe - Type III</td>
<td>Foot</td>
</tr>
<tr>
<td>605.08xx</td>
<td>Corrugated Aluminum Pipe - Type III</td>
<td>Foot</td>
</tr>
<tr>
<td>605.0901</td>
<td>Underdrain Filter, Type I</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>605.1001</td>
<td>Underdrain Filter, Type II</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>605.1101</td>
<td>Underdrain Filter, Type III</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>605.15xx</td>
<td>Perforated Corrugated Polyethylene Underdrain Tubing</td>
<td>Foot</td>
</tr>
<tr>
<td>605.16xx</td>
<td>Perforated Polyvinyl Chloride Underdrain Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>605.17xx</td>
<td>Optional Underdrain Pipe</td>
<td>Foot</td>
</tr>
</tbody>
</table>

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

SECTION 606 - GUIDE RAILING, MEDIAN BARRIER, AND CONCRETE BARRIER

(Last Revised May 1, 2019)
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 and Median Barrier.
Corrugated Beam Guide Railing and Median Barrier
Modified Heavy Post Blocked-Out (HPBO (Mod.)) Corrugated Beam Guide Railing and Median Barrier
Box Beam Guide Railing and Median Barrier
Concrete Barrier

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 (7 foot) posts in accordance with the contract documents, and as directed by the Engineer.

606-1.03 Retensioning Existing Cable Guide Railing And Median Barrier. Under this work the Contractor shall retension existing guide rail and median barrier cables in accordance with the Contract Documents.

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

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Grouting Material</td>
<td>701-05</td>
</tr>
<tr>
<td>Anchoring Materials-Chemically Curing</td>
<td>701-07</td>
</tr>
<tr>
<td>Precast Concrete Barrier</td>
<td>704-05</td>
</tr>
<tr>
<td>Premolded Resilient Joint Filler</td>
<td>705-07</td>
</tr>
<tr>
<td>Joint Filler</td>
<td>ASTM D1056</td>
</tr>
<tr>
<td>Wire Fabric For Concrete Reinforcement</td>
<td>709-02</td>
</tr>
<tr>
<td>Epoxy Coated Bar Reinforcement, Grade 60</td>
<td>709-04</td>
</tr>
<tr>
<td>Wood and Timber Posts and Timber Blockouts</td>
<td>710-13</td>
</tr>
<tr>
<td>Galvanized Steel Barrier Posts</td>
<td>710-14</td>
</tr>
<tr>
<td>Corrugated Beam Guide Railing End Terminal (Energy-Absorbing)</td>
<td>710-17</td>
</tr>
<tr>
<td>HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing)</td>
<td>710-18</td>
</tr>
<tr>
<td>HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing)</td>
<td>710-19</td>
</tr>
<tr>
<td>Corrugated Beam Guide Railing and Median Barrier</td>
<td>710-20</td>
</tr>
<tr>
<td>Box Beam Guide Railing and Median Barrier</td>
<td>710-21</td>
</tr>
<tr>
<td>Cable Guide Railing and Median Barrier.</td>
<td>710-22</td>
</tr>
<tr>
<td>Box Beam End Assembly Type III and Box Beam Median Barrier End Assembly, Type C</td>
<td>710-24</td>
</tr>
<tr>
<td>Plastic and Synthetic Block-Outs</td>
<td></td>
</tr>
</tbody>
</table>
for Heavy Post Guiderail Systems 710-26
Anchor Bolts for Guide Railing 710-28
Galvanized Coatings And Repair Methods 719-01
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.

606-2.02 Anchor Bolts. For the purpose of the guide railing specifications, the term anchor bolt will be used when referring to anchor rods, hooks, or studs.

Unless otherwise specified, anchor bolts embedded or grouted in concrete for securing post and railing base plates, or transitioning to concrete walls, parapets, and barriers shall meet the requirements of §710-28.

Anchor bolts 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 F1554 Grade 36.

Anchor bolts, 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 bolts shall conform to the requirements of §701-07 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.

<table>
<thead>
<tr>
<th>Bolts</th>
<th>Nuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A307 Grade A</td>
<td>ASTM A563 Grade A or Better</td>
</tr>
<tr>
<td>Washers</td>
<td>ASTM F436</td>
</tr>
</tbody>
</table>

Bolts, nuts and washers shall be galvanized in accordance with the provisions of §719-01 Galvanized Coatings and Repair Methods, Type II.

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. 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. 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 Anchorage Units. 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 575 lb/cu yd.
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. HPBO guide railing and median barrier (pre-2013 design) shall be reset as detailed in the current standard sheets, including 12 inch block-outs.

606-2.09 HPBO (Mod.) Corrugated Beam Guide Railing and Median Barrier. The material requirements of §710-20 Corrugated Beam Guide Railing and Median Barrier shall apply except that posts, block-outs, soil plates, anchor bolts, hardware, and fasteners shall be as detailed on the Standard Sheets. The Wood and Timber Posts and Timber Block-Outs shall conform to §710-13. The Plastic and Synthetic Block-Outs for Heavy Post Guiderrail 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 and as detailed on the Standard Sheets or Bridge Detail Sheets. Thrie beam shall conform to the material specifications of 710-20 and shall be as detailed on the Standard Sheets. All remaining material shall conform to the requirements of §710-23 except that:

A. Steel tubular block-outs and stiffening channels, where specified, shall conform to ASTM A36.
B. 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.
C. Shop drawings will not be required. Approval of the system will be made by the Engineer.

606-2.11 Vacant.

606-2.12 Vacant 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 (Vacant)

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 16 square inches, 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, and anchorage units shall be erected as specified in the contract plans or manufacturer’s drawings. Where drilling and grouting is required, Section 586 – Miscellaneous Structural Reconstruction shall apply, unless otherwise approved. Rail mounting height shall be within +/- 1/4 inch 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 there are conflicts between the proposed installation and other structures, the Contractor shall discuss with and recommend to the Engineer alternative locations or types of barrier, transitions, or end terminals that will not be in conflict with the 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 Section 203, Select Granular Fill.

On structures, concrete anchors, and paved medians, base plates for posts shall be anchored as shown in the Contract Documents. Alternate construction methods and equipment for drilling and grouting of holes shall be submitted to the Engineer for approval before operations begin. 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 1/4 inch for plumb and grade line.

Box beam to be installed on a curved alignment shall be shop bent or shop curved in accordance with Table 606-1.

| TABLE 606-1 SHOP BENDING AND SHOP MITERING OF BOX BEAM GUIDE RAILING AND MEDIAN BARRIER |
|-----------------------------------------------|-----------------|-----------------|
| Barrier Type                                 | Shop Bending Required | Shop Mitering Required |
| Box Beam Guide Railing                       | Radius over 20 ft and less than 720 ft | Radius of 20 ft or less |
| Box Beam Median Barrier                      | Radius over 30 ft and less than 1525 ft | Radius of 30 ft or less |

When shop bending or shop mitering of box beam guide railing or box beam median barrier is required, the rail element shall be shop-worked to the radius that the barrier will be installed on.

Corrugated beam guide railing and median barrier shall require shop curving if the radius is equal to or less than 150 feet. When shop curving of corrugated beam 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 Section 203, Select Granular Fill.

**F. End Terminals and Assemblies.** Installation of all proprietary products shall follow the manufacturer’s instructions. 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 shall be provided as specified in Section 619 Work Zone Traffic Control.

5. Reflective Sheeting. End terminals and assemblies which have a vertical face towards approaching traffic and are located on or closely adjacent to the shoulder shall be provided with reflective sheeting in accordance with Section 2C.65 of the MUTCD. The yellow and black stripe widths shall be 4 inches.

606-3.02 Cable Guide Railing and Median Barrier. Beginning 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 (96 foot spacing for reflectors) except those posts in the approach terminal and intermediate anchorage area, which curve away from the shoulder, or used in a median barrier. The reflector and method of attachment shall be as indicated on the standard sheet.

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

B. Cable Tensioning. The Contractor shall install and tension the cable of guide railing and median barrier 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 3 1/2 inches. 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 sheets.

C. Cable Splicing. The Contractor shall install cable splices in the following manner:
Place a splice end over the cable. Twist the cable to separate the three strands. Insert the wedge into the center of the strands, leaving at least one inch of excess cable, and pull the cable back until the wedge is snug to the splice. Pound the wedge into the splice. Crimp at least one wire of the cable over the wedge. Repeat the procedure for the other cable. Connect the two splice ends together.

606-3.03 Box Beam Guide Railing and Median Barrier. Rail sections for tangent runs shall be at least 18 feet long. Rail splices shall be a minimum of 18 inches from the centerline of any post.

606-3.04 Weak Post and HPBO (Mod.) 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. Rail splicing shall be as shown on the Standard Sheets.

A. Weak Post 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 5/16 inch mounting bolts are torqued. Before the final torquing, six of the 5/16 inch 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. HPBO (Mod.) Corrugated Beam Guide Railing and Median Barrier. HPBO (Mod.) guide railing shall be erected from the approach-end anchorage unit and downstream along the flow of traffic.

HPBO (Mod.) median barrier shall be erected from one of the anchorage sections and shall be completed as the work progresses.

HPBO (Mod.) guide railing and median barrier connections to walls or Concrete Barriers shall be as specified on the plans or the Standard Sheets.

During non-working hours, no uncompleted anchorage units or heavy posts without rail will be permitted to be exposed to traffic on either guide railing or median barrier.

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.

Unless otherwise specified, excavation shall be performed in accordance with §206-3. Granular backfill shall conform to Section 304 and shall match the subbase course type used on the adjacent roadway.

Half section concrete barrier shall be erected with the appropriate back-up posts and continuity plates 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 1/2 inch nominal joint openings. The joint opening, at any point in the plane of the joint, shall not vary by more than 1/4 inch. Premolded Resilient Joint Filler conforming to the requirements of §705-07 or Joint Filler conforming to the requirements of ASTM D1056 class 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 1/4 inch.
   b. The barrier shall not be out of plumb by more than 1/4 inch.
   c. Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
   d. When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

4. Placement Adjacent to Cement Concrete. The barrier shall be separated from cement concrete pavement or shoulders by a ½” thick (± ⅛”) premolded resilient joint filler meeting §705-07. The joint filler shall cover the entire pavement/shoulder face. A joint sealant reservoir ¼” - ½” deep shall be formed or routed in the joint filler. The Contractor shall abrasive blast the barrier and pavement/shoulder in the reservoir, and seal the joint using material meeting §705-02, Highway Joint Sealant, Type IV. Sealing shall be done in accordance with the manufacturer’s instructions, a copy of which shall be provided to the Engineer prior to commencement of work.
B. Cast-in-Place Concrete Barrier

1. Placing. Cast-in-place concrete barriers and footings shall not extend more than 200 feet without an expansion joint. The Contractor shall have the option of placing the cast-in-place concrete barrier with a monolithic cross-section or with a horizontal construction joint at the top of the footing. When the Contractor elects to cast a separate footing, the horizontal joint details must conform to those on the Standard Sheets or in the plans, or the Contractor must prepare joint details and submit them to the Regional Director for approval.

2. Joints

a. Contraction Joints. Cast-in-place concrete barrier shall have contraction joints every 20 feet in both the footing and the stem. When cast separately, the joints in the stem shall line up with the joints in the footing. Contraction joints shall be formed in or saw cut normal to the pavement. 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 2 hours after the forms are removed to avoid early formation of uncontrolled shrinkage cracks. Clear curing compound shall be promptly applied to the saw cut.

b. Expansion Joints. Expansion joints shall be formed normal to the pavement with Premolded Resilient Joint Filler meeting the requirements of §705-07 and shall provide for expansion of ½ inch. The filler material shall be cut to fully cover and conform to the cross section of the barrier, or to the footer and stem separately if they are cast separately.

In addition to the maximum separation of 200 feet, expansion joints shall be located at all immovable objects (bridge substructures, etc.), where shown on the plans, and/or as directed by the Engineer.

c. Construction Joints. When the Contractor’s operations require the use of a construction joint, one of the two following procedures may be used. However, if operations will not resume within 24 hours, only method A may be used.

Method A. Construct an expansion joint as detailed in the preceding section.

Method B. After initial set has taken place, remove the end form to expose the concrete. Roughen the surface to achieve a good interlock and increased bond area when the concrete operations are resumed. A one-inch strip around the periphery of the end surface should remain undisturbed to serve as a neat, linear contraction joint. The end surface shall be covered with several layers of wetted burlap to prevent drying. All reinforcing steel shall extend beyond the face to provide adequate lapping.

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 one foot 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. 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 surfaces at a rate of 1 gal/ 150 sf within one hour of form removal. 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 1/2 inch wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and contain Premolded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately one inch 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 1/4 inch.
   b. The barrier shall not be out of plumb by more than 1/4 inch.
   c. Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
   d. When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

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 1/2 inch 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 1000 feet.

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 1/4 inch, 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 gal/ 150 sf.

7. Placement Adjacent to Cement Concrete Pavement or Shoulders. The barrier shall be separated from the cement concrete pavement or shoulder by a 1/2 inch wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and
contain Premolded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately one inch 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 20 feet, 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.** Machine formed concrete barriers shall not extend more than 400 feet without an expansion joint. Expansion joints shall be formed normal to the pavement with Premolded Resilient Joint Filler meeting the requirements of §705-07 and shall provide for expansion of 1/2 inch. 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 + 1/2 inch.
    (2) Width (top) 0 to + 1/4 inch.
    (3) Width (base) 0 to + 1/2 inch.

    b. **Dimensional Tolerance**

    (1) Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
    (2) The barrier shall not be out of plumb by more than 1/4 inch.
    (3) Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
    (4) When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

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 6 inches or less, in diameter, and which do not expose the outermost surface of the steel reinforcement. Surface voids 5/8 inch, or less, in diameter and 1/4 inch, 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 or §701-12. 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 16 ounce 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.”

606-3.06 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier. The Contractor shall remove, store, clean and reset railing, posts, and precast concrete barrier as shown on the plans or as directed by the Engineer. The Contractor shall remove designated existing guide railing, median barrier and precast concrete barrier and neatly store them at locations approved by the Engineer. The work shall be done in a workmanlike manner so as to salvage all usable parts. The reset guide railing and/or median barrier shall be placed in accordance with the requirements of §606-3.01 General and the subsection for each specific system. Unless otherwise specified by the designer, all existing hardware, i.e., post bolts, J-bolts, splice bolts, etc., shall be replaced with new hardware. Cable systems shall be retensioned and all existing splice couplings and wedges shall be replaced. HPBO guide railing and median barrier (pre-2013 design) shall be reset as detailed in the current standard sheets, including 12 inch block-outs. The existing block-outs shall become the property of 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 and remove the old posts from the site.

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
Section 606-3.11 Retensioning Existing Cable Guide Railing and Median Barrier. Cable guide rail and median barrier shall be retensioned in accordance with the cable tensioning requirements of §606-3.02.

Section 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 6 inches 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.

Section 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. However, concrete anchor blocks shall be completely removed and the resulting holes backfilled. Anchor blocks become the property of the Contractor and shall be removed from the project.

If the center of the anchor block is inboard from a line six feet beyond the theoretical shoulder break, the Contractor shall backfill with material meeting the requirements of §733-04 compacted in 6 inch lifts.

If the center of the anchor block is more than six feet past the shoulder break, the backfill material and compaction shall be replaced in kind, character and condition, compacted in 6 inch lifts.

Other excavation and backfill shall conform to the requirements outlined in §606-3.01E. Roadway edge drains damaged due to the Contractor’s operations shall be repaired or replaced at no additional cost to the State.

Section 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 remove the Anchorage Unit Assemblies and End Assemblies from the site.

Section 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.

Section 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 Vacant.

606-3.18 Vacant 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 to be measured for payment will be in feet to the nearest foot of guide railing or median barrier installed, measured along the axis of the railing and between its pay limits as shown on the plans and/or standard sheets. The quantity to be measured for payment will be in feet to the nearest foot of shop bent or shop mitered guide railing or median barrier installed. If the guide railing does not terminate at an anchorage unit, end assembly, or transition to another type of barrier, but is anchored to a structure, the railing will be measured up to the structure.

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 50 feet extending along the end assembly from the front of the Nose Assembly to a point 50 feet 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.

The limits of payment for the Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) will extend a distance of 100 feet from the outer end of the terminal. At that point, payment will begin for corrugated beam guide railing.

The limits of payment for HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) will extend a distance of 50 feet from the outer end of the terminal. At that point, payment will begin for heavy post blocked-out corrugated beam guide railing.

The limits of payment for HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing) will extend a distance of 50 feet from the outer end of the terminal. At that point, payment will begin for heavy post blocked-out corrugated beam median barrier.
606-4.03 **Concrete Barrier and Terminal Sections.** The quantity of concrete barrier and terminal sections measured for payment will be the number of feet 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 feet 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 feet 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 feet 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, 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 feet 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 feet 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 feet 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 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 Cable Guide Railing and Median Barrier.** Quantity measured for payment will be the number of sections retensioned. A section shall consist of the length of cable guide rail or median barrier running between two concrete anchorage units.

606-4.12 **Vacant.**
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 Vacant Pier Protection. Pier protection shall be measured by the number of feet 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

<table>
<thead>
<tr>
<th>Rail Type</th>
<th>Payment Factor</th>
<th>1.0</th>
<th>1.1</th>
<th>1.3</th>
<th>1.4</th>
<th>1.6</th>
<th>1.8</th>
<th>1.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable*</td>
<td>Post Spacing Center to Center in Feet &amp; Inches</td>
<td>16’</td>
<td>12’</td>
<td>---</td>
<td>8’</td>
<td>---</td>
<td>---</td>
<td>4’</td>
</tr>
<tr>
<td>Box Beam</td>
<td></td>
<td>6’</td>
<td>---</td>
<td>3’</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Corrugated Beam</td>
<td></td>
<td>12’6”</td>
<td>---</td>
<td>6’3”</td>
<td>4’2”</td>
<td>---</td>
<td>3’ 1 1/2”</td>
<td></td>
</tr>
<tr>
<td>HPBO (Mod.) Corrugated Beam</td>
<td></td>
<td>6’3”</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>3’ 1 1/2”</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>

* 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 foot 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 corrugated guide rail and median barrier, or bent box beam guide rail, will be determined using the payment factors for the various typical post spacings listed in Table 606-2. Payment will be the sum of the products obtained by multiplying the unit price bid for a rail or median barrier by the payment factors listed in Table 606-2 for the relevant post spacings and multiplying each of those products by the length of rail having that given post spacing.

Payment for mitered box beam and median barrier with 6 foot post spacings will be made at the unit prices bid. If a reduced post spacing of 3 feet is used for mitered box beam guide rail, the payment will be determined by multiplying the unit price bid by a payment factor of 1.1 for the length installed.

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 foot for the above work items shall include the cost of furnishing all labor, equipment and materials necessary to complete the work and restore the system to full operating capacity.

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 606-2, 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.

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 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 Vacant 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 Vacant Pier Protection. The price bid per foot 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 and Median Barrier. The unit price bid for retensioning a section of cable guide railing or median barrier shall include the cost of all labor, materials 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.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>606.01</td>
<td>Cable Guide Railing</td>
<td>Foot</td>
</tr>
<tr>
<td>606.0101</td>
<td>Cable Guide Railing With Extra Long Posts</td>
<td>Foot</td>
</tr>
</tbody>
</table>
606.0201 Anchorage Units for Cable Guide Railing Each
606.03 Cable Median Barrier Foot
606.0310 Anchorage Units for Cable Median Barrier Each
606.10 Box Beam Guide Railing Foot
606.100002 Box Beam Guide Railing (Shop Bent or Shop Mitered) Foot
606.100003 Box Beam Guide Railing (Shop Mitered) Foot
606.1001 Box Beam Guide Railing With Extra Long Posts Foot
606.100102 Box Beam Guide Railing with Extra Long Posts (Shop Bent or Shop Mitered) Foot
606.100103 Box Beam Guide Railing with Extra Long Posts (Shop Mitered) Foot
606.11 Box Beam Median Barrier Foot
606.110002 Box Beam Median Barrier (Shop Bent or Shop Mitered) Foot
606.110003 Box Beam Median Barrier (Shop Mitered) Foot
606.120101 Box Beam End Piece Each
606.120102 Box Beam Guide Railing End Assembly Type I Each
606.120103 Box Beam Guide Railing End Assembly Type I with 18 ft Extension Each
606.120201 Box Beam Guide Railing End Assembly Type IIA Each
606.1203 Box Beam End Assembly Type III Each
606.1401 Box Beam Median Barrier End Assembly, Type A Each
606.1402 Box Beam Median Barrier End Assembly, Type B Each
606.1403 Box Beam Median Barrier End Assembly, Type C Each
606.16 Corrugated Beam Guide Railing Foot
606.160001 Corrugated Beam Guide Railing (Shop Curved) Foot
606.1601 Corrugated Beam Guide Railing With Extra Long Posts Foot
606.160101 Corrugated Beam Guide Railing With Extra Long Posts (Shop Curved) Foot
606.17 Corrugated Beam Median Barrier Foot
606.170001 Corrugated Beam Median Barrier (Shop Curved) Foot
606.18 Modified Weak-Post, Corrugated Beam Guide Rail Foot
606.180001 Modified Weak-Post, Corrugated Beam Guide Rail (Shop Curved) Foot
606.1801 Modified Weak-Post, Corrugated Beam Guide Rail With Extra Long Posts Foot
606.180101 Modified Weak-Post, Corrugated Beam Guide Rail With Extra Long Posts (Shop Curved) Foot
606.22 Anchorage Units for Corrugated Beam Guide Railing Each
606.2201 Anchorage Units for Corrugated Beam Guide Railing Buried In Back Slope Each
606.23 Anchorage Units for Corrugated Beam Guide Railing (Driveways, Walkways, and Other Openings) Each
606.24 Anchorage Units for Corrugated Beam Median Barrier Each
606.26 Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) Each
606.27 HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) Each
606.2701 HPBO (Mod.) Corrugated Beam Guide Railing Foot
606.270101 HPBO (Mod.) Corrugated Beam Guide Railing (Shop Curved) Foot
606.2702 HPBO (Mod.) Corrugated Beam Guide Railing with Extra Long Posts Foot
606.270201 HPBO (Mod.) Corrugated Beam Guide Railing with Extra Long Posts (Shop Curved) Foot
606.2703 Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing Each
606.2704 Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing Buried in Back Slope Each
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>606.28</td>
<td>HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing)</td>
<td>Each</td>
</tr>
<tr>
<td>606.2801</td>
<td>HPBO (Mod.) Corrugated Beam Median Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>606.2802</td>
<td>Anchorage Units for HPBO (Mod.) Corrugated Beam Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.3001</td>
<td>Concrete Barrier Type A (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3002</td>
<td>Concrete Barrier Type B (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3003</td>
<td>Concrete Barrier Type C (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3004</td>
<td>Half Section Concrete Barrier (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3011</td>
<td>Concrete Barrier Type A (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3012</td>
<td>Concrete Barrier Type B (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3013</td>
<td>Concrete Barrier Type C (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3014</td>
<td>Half Section Concrete Barrier (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3021</td>
<td>Concrete Barrier Type A (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3022</td>
<td>Concrete Barrier Type B (Cast-in Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3023</td>
<td>Concrete Barrier Type C (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3024</td>
<td>Half Section Concrete Barrier (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3031</td>
<td>Concrete Barrier Type A (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3032</td>
<td>Concrete Barrier Type B (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3033</td>
<td>Concrete Barrier Type C (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3034</td>
<td>Half Section Barrier (Machined Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3041</td>
<td>Single-Slope Concrete Median Barrier (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3042</td>
<td>Single-Slope Concrete Median Barrier (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3043</td>
<td>Single-Slope Concrete Median Barrier (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3044</td>
<td>Single-Slope Concrete Median Barrier (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3051</td>
<td>Single-Slope Concrete Median Barrier - Wide (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3052</td>
<td>Single-Slope Concrete Median Barrier - Wide (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3053</td>
<td>Single-Slope Concrete Median Barrier - Wide (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3054</td>
<td>Single-Slope Concrete Median Barrier - Wide (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3061</td>
<td>Single-Slope Concrete Half Section Barrier (Optional)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3062</td>
<td>Single-Slope Concrete Half Section Barrier (Precast)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3063</td>
<td>Single-Slope Concrete Half Section Barrier (Cast-in-Place)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.3064</td>
<td>Single-Slope Concrete Half Section Barrier (Machine Formed)</td>
<td>Foot</td>
</tr>
<tr>
<td>606.4701</td>
<td>I-Beam Posts for Existing Cable Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.4801</td>
<td>I-Beam Posts for Existing Cable Median Barrier Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4803</td>
<td>Extra Long I-Beam Posts for Existing Cable Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4805</td>
<td>I-Beam Posts for Existing Corrugated Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4807</td>
<td>Extra Long I-Beam Posts for Existing Corrugated Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4809</td>
<td>I-Beam Posts for Existing Box Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4811</td>
<td>Extra Long I-Beam Posts for Existing Box Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4813</td>
<td>I-Beam Posts for Existing Corrugated Beam Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.4815</td>
<td>I-Beam Posts for Existing Box Beam Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.4818</td>
<td>I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4820</td>
<td>Extra Long I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Guide Railing</td>
<td>Each</td>
</tr>
<tr>
<td>606.4822</td>
<td>I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.4824</td>
<td>Extra Long I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Median Barrier</td>
<td>Each</td>
</tr>
<tr>
<td>606.50</td>
<td>Resetting Cable Guide Railing</td>
<td>Foot</td>
</tr>
<tr>
<td>606.5010</td>
<td>Resetting Cable Median Barrier</td>
<td>Foot</td>
</tr>
</tbody>
</table>
606.5048  Resetting Cable Guide Railing (New Posts)  Foot
606.5049  Resetting Cable Median Barrier (New Posts)  Foot
606.51  Resetting Corrugated Beam Guide Railing  Foot
606.5148  Resetting Corrugated Beam Guide Railing (New Posts)  Foot
606.52  Resetting Corrugated Beam Median Barrier  Foot
606.5248  Resetting Corrugated Beam Median Barrier (New Posts)  Foot
606.53  Resetting Box Beam Guide Railing  Foot
606.5348  Resetting Box Beam Guide Railing (New Posts)  Foot
606.54  Resetting Box Beam Median Barrier  Foot
606.5448  Resetting Box Beam Median Barrier (New Posts)  Foot
606.5501  Resetting HPBO Corrugated Beam Guide Railing (New 12 in. Blockouts)  Foot
606.5601  Resetting HPBO Corrugated Beam Median Barrier (New 12 in. Blockouts)  Foot
606.57  Resetting Precast Concrete Barrier  Foot
606.5710  Resetting Precast Concrete Barrier- Half Section  Foot
606.58  Resetting HPBO (Mod.) Corrugated Beam Guide Railing  Foot
606.5801  Resetting HPBO (Mod.) Corrugated Beam Guide Railing (New Posts)  Foot
606.5810  Resetting HPBO (Mod.) Corrugated Beam Median Barrier  Foot
606.581001  Resetting HPBO (Mod.) Corrugated Beam Median Barrier (New Posts)  Foot
606.5901  Resetting Anchorage Units for Cable Guide railing or Median Barrier  Each
606.5910  Resetting Anchorage Units for Corrugated Beam Guide Rail or Median Barrier  Each
606.5920  Resetting Box Beam Guide Railing End Assembly  Each
606.5930  Resetting Box Beam Median Barrier End Assembly--Type A  Each
606.5931  Resetting Box Beam Median Barrier End Assembly--Type B  Each
606.5941  Resetting Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing  Each
606.5946  Resetting Anchorage Units for HPBO (Mod.) Corrugated Beam Median Barrier  Each
606.60  Removing and Storing Cable Guide Railing  Foot
606.6010  Removing and Storing Cable Median Barrier  Foot
606.61  Removing and Storing Corrugated Beam Guide Railing  Foot
606.62  Removing and Storing Corrugated Beam Median Barrier  Foot
606.63  Removing and Storing Box Beam Guide Railing  Foot
606.64  Removing and Storing Box Beam Median Barrier  Foot
606.65  Removing and Storing Precast Concrete Barrier  Foot
606.6510  Removing and Storing Precast Concrete Barrier-Half Section  Foot
606.66  Removing and Storing HPBO (Mod.) Corrugated Beam Guide Railing  Foot
606.67  Removing and Storing HPBO (Mod.) Corrugated Beam Median Barrier  Foot
606.6910  Removing and Storing Anchorage Units for Corrugated Beam Guide Railing and Median Barriers  Each
606.6911  Removing and Storing Weak- and Heavy-Post Corrugated Beam Terminals  Each
606.6920  Removing and Storing Box Beam Guide Railing End Assembly  Each
606.6932  Removing and Storing Box Beam Median Barrier End Assembly-Type C  Each
606.6941  Removing and Storing Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing  Each
606.6946  Removing and Storing Anchorage Units for HPBO(Mod) Corrugated Beam Median Barrier  Each
606.70  Removing and Disposing Cable Guide Railing  Foot
606.7010  Removing and Disposing Cable Median Barrier  Foot
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>606.71</td>
<td>Removing and Disposing Corrugated Beam Guide Railing Foot</td>
</tr>
<tr>
<td>606.7101</td>
<td>Removing and Disposing HPBO (Mod.) Corrugated Beam Guide Railing Foot</td>
</tr>
<tr>
<td>606.72</td>
<td>Removing and Disposing Corrugated Beam Median Barrier Foot</td>
</tr>
<tr>
<td>606.7201</td>
<td>Removing and Disposing HPBO (Mod.) Corrugated Beam Median Barrier Foot</td>
</tr>
<tr>
<td>606.73</td>
<td>Removing and Disposing Box Beam Guide Railing Foot</td>
</tr>
<tr>
<td>606.74</td>
<td>Removing and Disposing Box Beam Median Barrier Foot</td>
</tr>
<tr>
<td>606.75</td>
<td>Removing and Disposing Concrete Barrier Foot</td>
</tr>
<tr>
<td>606.7510</td>
<td>Removing and Disposing Concrete Barrier-Half Section Foot</td>
</tr>
<tr>
<td>606.76</td>
<td>Removing and Disposing of Guide Posts, Guide Rail Posts, and Median Barrier Posts Each</td>
</tr>
<tr>
<td>606.79</td>
<td>Removing and Disposing Anchorage Units for Cable Guide railing or Median Barrier Each</td>
</tr>
<tr>
<td>606.7910</td>
<td>Removing and Disposing Anchorage Units for Corrugated Beam Guide Railing and Median Barrier Each</td>
</tr>
<tr>
<td>606.7911</td>
<td>Removing and Disposing Weak- and Heavy-Post Corrugated Beam Terminals Each</td>
</tr>
<tr>
<td>606.7920</td>
<td>Removing and Disposing Box Beam Guide Railing End Assembly Each</td>
</tr>
<tr>
<td>606.7930</td>
<td>Removing and Disposing Box Beam Median Barrier End Assembly-Type A Each</td>
</tr>
<tr>
<td>606.7931</td>
<td>Removing and Disposing Box Beam Median Barrier End Assembly-Type B Each</td>
</tr>
<tr>
<td>606.7932</td>
<td>Removing and Disposing Box Beam Median Barrier End Assembly-Type C Each</td>
</tr>
<tr>
<td>606.7941</td>
<td>Removing and Disposing Anchorage Units for HPBO(Mod) Corrugated Beam Guide Railing Each</td>
</tr>
<tr>
<td>606.7946</td>
<td>Removing and Disposing Anchorage Units for HPBO(Mod) Corrugated Beam Median Barrier Each</td>
</tr>
<tr>
<td>606.8101</td>
<td>Guide Rail Transition Weak-Post Corrugated Beam to Box Beam Guide Rail (One or Two Way Operation) Each</td>
</tr>
<tr>
<td>606.8201</td>
<td>Guide Rail Transition Box Beam to Weak-Post Corrugated Beam Guide Rail (One Way Only) Each</td>
</tr>
<tr>
<td>606.83</td>
<td>Guide Rail Transition Cable to Box Beam (One or Two Way Operation) Each</td>
</tr>
<tr>
<td>606.84</td>
<td>Guide Rail Transition Box Beam to Cable (One Way Only) Each</td>
</tr>
<tr>
<td>606.8501</td>
<td>Median Barrier Transition Weak-Post Corrugated Beam to Box Beam Each</td>
</tr>
<tr>
<td>606.86</td>
<td>Guide Rail Transition Corrugated Beam to Thrie Beam Each</td>
</tr>
<tr>
<td>606.8701</td>
<td>Corrugated Beam Guide Railing Transition Assembly Two Rail Steel Bridge Railing Each</td>
</tr>
<tr>
<td>606.8702</td>
<td>Corrugated Beam Guide Railing Transition Assembly Four Rail Steel Bridge Railing Each</td>
</tr>
<tr>
<td>606.8703</td>
<td>Corrugated Beam Guide Railing Transition Assembly Discontinuous Steel Bridge Railing Each</td>
</tr>
<tr>
<td>606.8704</td>
<td>Corrugated Beam Guide Railing Transition Assembly Concrete Parapets, or Concrete Barrier Each</td>
</tr>
<tr>
<td>606.8801</td>
<td>Box Beam Guide Rail Transition to Concrete Barrier (One or Two Way Operation) Each</td>
</tr>
<tr>
<td>606.8802</td>
<td>Box Beam Guide Rail Transition to Concrete Barrier (One Way-Trailing End) Each</td>
</tr>
<tr>
<td>606.8803</td>
<td>Transition Between Box Beam Guide Rail and Single Slope Half Section Concrete Barrier (One or Two Way Operation) Each</td>
</tr>
<tr>
<td>606.8804</td>
<td>Transition Between Single Slope Half Section Concrete Barrier and Box Beam Guide Rail (One Way - Trailing End of Barrier) Each</td>
</tr>
<tr>
<td>606.8805</td>
<td>Transition Between Box Beam Median Barrier and</td>
</tr>
</tbody>
</table>
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**

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

**TYPE II**
### Fabric Options

- Coated Steel Fence Fabric
  - (95% Zinc 5% Aluminum- Mischmetal Alloy)
- Galvanized Steel
- Vinyl Coated Steel
- Aluminum
- Aluminum Coated Steel

### Frame Options

- Mischmetal Alloy Coating
  - (95% Zinc 5% Aluminum)
- Galvanized Steel
- Combined Coating on Steel
- Plastic on Steel
- Aluminum
- Aluminum Coated Steel

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 and Manufacturing:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Chromate Primer</td>
<td>708-04</td>
</tr>
<tr>
<td>Aluminum Fence Fabric</td>
<td>710-01</td>
</tr>
<tr>
<td>Galvanized Steel Fence Fabric</td>
<td>710-02</td>
</tr>
<tr>
<td>Vinyl Coated Steel Fence Fabric</td>
<td>710-03</td>
</tr>
<tr>
<td>Aluminum Coated Steel Fence Fabric</td>
<td>710-04</td>
</tr>
<tr>
<td>Coated Steel Fence Fabric (95% Zinc 5% Aluminum-Mischmetal Alloy)</td>
<td>710-05</td>
</tr>
<tr>
<td>Steel and Iron Posts, Rails, Braces and Fittings for Chain-Link Fence</td>
<td>710-10</td>
</tr>
<tr>
<td>Aluminum Posts, Rails, Braces and Fittings for Chain-Link Fence</td>
<td>710-11</td>
</tr>
<tr>
<td>Plastic Coated Posts, Rails, Braces and Fittings for Chain-Link Fence</td>
<td>710-12</td>
</tr>
<tr>
<td>Right-of-Way Fencing</td>
<td>710-30</td>
</tr>
</tbody>
</table>

**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 3/8 inch nominal diameter truss rods to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 8 feet apart. Gate leaves over 10 feet long shall have a horizontal brace or a 3/8 inch nominal diameter diagonal truss rod. Gate leaves over 16 feet shall have both a horizontal brace and a 3/8 inch 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 10 feet 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 1 inch nor more than 6 inch 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 10 foot 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 100 foot 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 2 inch 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 14 inches 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 8 foot 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 15 foot centers and metal line posts shall be placed on a maximum of 10 foot 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 5/32 inch diameter.

The woven wire fencing shall be fastened to all wood posts with either 1 1/2 inch 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 feet 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 10 feet 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 feet 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 20 feet 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 foot 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</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>with Top Rail</td>
<td></td>
</tr>
<tr>
<td>607.052X</td>
<td>Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>with Top Tension Wire</td>
<td></td>
</tr>
<tr>
<td>607.16xx</td>
<td>Fence Gate with Vinyl Coated Steel Chain-Link Fencing</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>on Plastic Coated Frame</td>
<td></td>
</tr>
<tr>
<td>607.19</td>
<td>Right-of-Way Fencing</td>
<td>Each</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>Foot</td>
</tr>
<tr>
<td>607.31xx</td>
<td>Optional Chain-Link Fence, Type I, with Top Tension Wire</td>
<td>Foot</td>
</tr>
<tr>
<td>607.32xx</td>
<td>Optional Chain-Link Fence, Type II, with Top Rail</td>
<td>Foot</td>
</tr>
</tbody>
</table>
SECTION 608 - SIDEWALKS, DRIVEWAYS, BICYCLE PATHS, AND VEGETATION CONTROL STRIPS  
(Last Revised January, 2017)

608-1 DESCRIPTION. This work shall consist of the construction of portland cement concrete or hot mix asphalt sidewalks and driveways; hot mix asphalt bicycle paths and vegetation control strips; precast concrete paving, brick paving, grouted stone block paving, and detectable warnings on pedestrian facilities in accordance the contract documents and as directed by the Engineer.

608-2 MATERIALS. Provide materials meeting the requirements specified in the following subsections of Section 700 - Materials and Manufacturing:

- Portland Cement: 701-01
- Bituminous Materials: 702-00
- 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 Sidewalk and Driveway Pavers: 704-08
- Stone Blocks: 704-09
- Precast Concrete Driveway and Sidewalk Pavers: 704-13
- Caulking Compound for Structures: 705-06
- Premolded Resilient Joint Filler: 705-07
- Masonry Mortar: 705-21
- Wire Fabric for Concrete Reinforcement: 709-02
- Fibers for Concrete Reinforcement: 711-01
- Membrane Curing Compound: 711-05
- Form Insulating Materials for Winter Concrete: 711-07
- Admixtures: 711-08
- Water: 712-01
- Surface-applied Detectable Warning Units: 726-01
- Embedded Detectable Warning Units: 726-02

608-2.01 Portland Cement Concrete Sidewalks and Driveways.

A. Conventionally Formed Sidewalks and Driveways. Provide concrete meeting the requirements for Class D in accordance with Section 501 Portland Cement Concrete-General. Provide concrete that contains an ASTM Type A water-reducing admixture meeting the requirements of §711-08 Admixtures and provides a minimum of 10% reduction of the design water content from the target mix design for Class D.
B. Machine Formed Sidewalks. Provide concrete meeting the requirements for Class J in accordance with Section 501 Portland Cement Concrete-General with the exception that the mix incorporates fibers for concrete reinforcement meeting the requirements of §711-01 Fibers for Concrete Reinforcement.

C. Accelerated Cure Sidewalks and Driveways. Submit a concrete mix design that achieves a compressive strength of 2,000 psi in less than 24 hours to the Materials Bureau for approval a minimum of 14 days prior to starting the work. Supply test data indicating that the concrete mix will have a scaling rating of one or less when tested in accordance with ASTM C672.

D. Reinforcement. Provide welded wire fabric reinforcement made of W2.9 or W3 wire at 6 inch centers transversely and longitudinally meeting the requirements of §709-02 Wire Fabric for Concrete Reinforcement. Provide fiber reinforcement meeting the requirements of §711-01 Fibers for Concrete Reinforcement. Add fiber reinforcement during batching at a rate of 1.5 pounds of fibers per cubic yard of concrete, using a method approved by the Regional Materials Engineer. Batch a volume of concrete such that whole standard size bags or packages of fibers are used. Indicate on each delivery ticket the amount of fibers added to the concrete.

608-2.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips. Provide a 9.5 mixture for surface course or 19.0 mixture for any course below the surface designed for < 0.3 million ESALs and produced in accordance with Section 401 using coarse aggregate Type F9. Use a PG 64S-22 binder to produce the hot mix asphalt. Alternate PG binder grades may be allowed with the approval of the Regional Materials Engineer.

Do not use polyphosphoric acid (PPA) downstate to modify the PG binder properties for mixtures containing limestone, limestone as an aggregate blend component, limestone as a constituent in crushed gravel aggregate, or recycled asphalt pavement (RAP) that includes any limestone. Do not use PPA downstate as a cross-linking agent for polymer modification of mixtures containing limestone, limestone as an aggregate blend component, limestone as a constituent in crushed gravel aggregate, or recycled asphalt pavement (RAP) that includes any limestone. Downstate, as it relates to PG binder is defined as Orange, Putnam, Rockland, Westchester, Nassau, Suffolk Counties and the City of New York.

Do not use polyphosphoric acid (PPA) upstate to modify the PG binder properties or as a cross-linking agent for polymer modification, regardless of the type of aggregate. Upstate is defined as all counties not designated as downstate.

608-2.03 Brick Paved Sidewalks and Driveways. Provide brick pavers meeting the requirements of §704-08 Brick Pavers, of the size, shape and color specified in the contract documents.

A. Sand Setting Bed. Provide sand for setting bed meet the requirements of §703-06 Cushion Sand.

B. Mortar Setting Bed. Provide mortar for setting bed meeting the requirements of §705-21 Masonry Mortar.

C. Bituminous Setting Bed. Provide hot mix asphalt for bituminous setting bed consisting of PG 64S-22 binder mixed with fine aggregate. Use PG binder meeting the requirements of Section 702 Bituminous Materials, Table 702-1 Performance-Graded Binders for Paving. Use a minimum of 7.0% PGB by batch weight. Alternate PG binder grades may be allowed with the approval of the Regional Materials Engineer. Heat the mix to approximately 325°F.

Provide neoprene-modified asphalt adhesive consisting of 2% neoprene, grade WM1, oxidized asphalt with an R & B softening point of 155°F minimum and a penetration of 80, and 10% asbestos-free fibers.
D. Sand-Cement Setting Bed. Provide sand-cement mixture for setting bed consisting of 1 part Portland Cement Type 2 and 6 parts Fine Aggregate, by volume.

608-2.04 Grouted Stone Block Paved Sidewalks and Driveways. Provide stone blocks meeting the requirements of §704-09 Stone Blocks of the size, shape and color specified in the contract documents.

A. Sand Setting Bed. Provide sand for setting bed meet the requirements of §703-06 Cushion Sand.

B. Mortar Setting Bed. Provide mortar for setting bed meeting the requirements of §705-21 Masonry Mortar.

C. Sand-Cement Setting Bed. Provide sand-cement mixture for setting bed consisting of 1 part Portland Cement Type 2 and 6 parts Fine Aggregate, by volume.

608-2.05 Precast Concrete Block Paved Sidewalks and Driveways. Provide precast concrete driveway and sidewalk pavers meeting the requirements of §704-13 Precast Concrete Driveway and Sidewalk Pavers of the size, shape and color specified in the contract documents. Provide granular setting bed material consisting of hard, durable; uncoated particles of soil or rock, free from lumps of clay and all deleterious substances in accordance with Table 608-1 Granular Material Setting Bed Gradation.

<table>
<thead>
<tr>
<th>TABLE 608-1 GRANULAR MATERIAL SETTING BED GRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>1/4 inch</td>
</tr>
<tr>
<td># 10</td>
</tr>
<tr>
<td># 40</td>
</tr>
<tr>
<td># 200</td>
</tr>
</tbody>
</table>

608-2.06 Surface-Applied Detectable Warning Units. Provide surface-applied detectable warning units meeting the requirements of §726-01 Surface-applied Detectable Warning Units of the color specified in the contract documents. Provide setting bed material and/or surface preparation materials in accordance with the manufacturer’s recommendations.

608-2.07 Embedded Detectable Warning Units. Provide embedded detectable warning units meeting the requirements of §726-02 Embedded Detectable Warning Units of the color specified in the contract documents. Provide setting bed material and/or surface preparation materials in accordance with the manufacturer’s recommendations.

608-3 CONSTRUCTION DETAILS. Construct all pedestrian facilities in accordance with the requirements of the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right Of Way (PROWAG). Not all facilities can be designed to meet the current PROWAG design standards. Features that do not meet PROWAG requirements must be approved by the Department and noted as non standard features in the contract documents. Chapter 2 of the NYS DOT Highway Design Manual provides direction. For facilities that cannot meet the current PROWAG design standards, construct facilities to meet the standards to the greatest extent practicable. Install all work in accordance with the Standard Sheets and the lines and grades shown in the contract documents. Dimensions shown on the Standard Sheets are the minimum values in order to be compliant with the PROWAG requirements and for acceptance of the work. Slopes shown on the Standard Sheets are maximum values for design and layout. Ensure constructed facilities do not have construction tolerances that result in work that does not meet the PROWAG requirements.
608-3.01 Portland Cement Concrete Sidewalks and Driveways. Install concrete sidewalks and driveways in accordance with Section 501 Portland Cement Concrete- General and the contract documents. Start concrete placement operations when the ambient air temperature is 40°F or higher, when measured in the shade, within an accuracy of ± 2°F. Discontinue placement if the ambient air temperature falls below 40°F. Ensure the surface temperature of the base material is 40°F or higher and that the surface does not have any snow, ice, frost, or standing water on it. Do not place concrete in the rain. Use insulating materials or heating equipment if necessary to prepare base material before placement begins. Form sidewalks and driveways conventionally or by machine. Install a premolded resilient joint filler at all joints between sidewalk and curb, pavement, buildings, or other vertical surfaces, and at all transverse construction joints. Fill any transverse gaps from ½ inch to 1 inch in width with Caulking Compound for Structures.

Ensure workers installing pedestrian facilities are familiar with the requirements for those facilities under the Americans with Disabilities Act. Provide an American Concrete Institute (ACI) Certified Concrete Flatwork Technician to perform all finishing. When the contract includes 10 cubic yards or more of sidewalk and driveway concrete, provide an ACI Certified Concrete Flatwork Finisher to directly supervise all finishing. Provide proof of ACI flatwork certification to the Engineer prior to concrete placement.

A. Conventionally Formed Sidewalks and Driveways. Use concrete forms free from warp and that extend to the full depth of the sidewalk or driveway. Ensure forms are secured so no displacement will occur during the placement of concrete.

Use welded wire fabric or fiber reinforcement. At commercial driveways, use welded wire fabric for both the sidewalk and the driveway, additional fiber reinforcement will be allowed at the Contractor’s option. When using wire fabric for concrete reinforcement, embed it at mid-depth in the slab.

Place the concrete in one course to the full depth shown in the contract documents. Immediately after placement of the concrete, thoroughly compact the concrete with internal mechanical vibrating equipment. Use internal mechanical vibrators that are adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. Insert the vibrating element vertically into the concrete mass at a depth sufficient to vibrate the entire depth, and then withdraw it completely from the concrete before advancing to the next point of application. Vibrate at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. Vibrate for a sufficient time duration to accomplish thorough consolidation and produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles. Work the concrete into all angles and corners of the forms, however, avoid over-vibration. Continue vibration in one place until the concrete has become uniformly plastic, but not to the extent that pools of laitance are formed. Supplement vibration by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Do not use vibrators to push or distribute the concrete laterally.

Use only hand screeding and finishing, do not use mechanical screeding or finishing equipment.

B. Machine Formed Sidewalks. Provide machine forming equipment consisting of a single self-propelled paver capable of placing, spreading, consolidating, screeding, and finishing the concrete such that hand finishing is kept to a minimum. Provide equipment guided by a reference system that ensures the pavement is placed to the specified line, grade, and cross section. Provide a paver equipped with rigid side forms that laterally support the concrete and minimize edge slumping, a full-width finishing pan, and attached internal vibrators capable of consolidating the entire concrete placement.

Apply the provisions of §569-3.05 E. Central and Transit Mixed Concrete to maintain desired slump during the concrete placement. Use fiber reinforcement only, do not use welded wire fabric reinforcement. Make water additions at the point of deposition in accordance with §569-3.05 E.
C. Accelerated Cure Sidewalks and Driveways. Use concrete forms free from warp and that extend to the full depth of the sidewalk or driveway. Ensure forms are secured so no displacement will occur during the placement of concrete. Use only conventional forming with welded wire fabric reinforcement embedded at mid-depth in the slab.

Place the concrete in one course to the full depth shown in the contract documents. Immediately after placement of the concrete, thoroughly compact the concrete with internal mechanical vibrating equipment. Use internal mechanical vibrators that are adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. Insert the vibrating element vertically into the concrete mass at a depth sufficient to vibrate the entire depth, and then withdraw it completely from the concrete before advancing to the next point of application. Vibrate at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. Vibrate for a sufficient time duration to accomplish thorough consolidation and produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles. Work the concrete into all angles and corners of the forms, however, avoid over-vibration. Continue vibration in one place until the concrete has become uniformly plastic, but not to the extent that pools of laitance are formed. Supplement vibration by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Do not use vibrators to push or distribute the concrete laterally.

Use only hand screeding and finishing, do not use mechanical screeding or finishing equipment.

To reduce the time needed to reach the required opening compressive strength, cover the concrete with form insulating materials such that the concrete curing temperature reaches a minimum of 25°F above ambient air temperature. Secure the insulation tight to the concrete surface to prevent air intrusion beneath the insulation. Extend these materials a minimum of 12 inches beyond the edge of the concrete to prevent air intrusion beneath the insulation. Apply external heat meeting the requirements of §555-3.08C.2. Provision of External Heat to the concrete at the Contractor's option.

Cast compressive strength cylinders for determining strength gain at the time of placement. Keep these cylinders insulated with the placement. Break cylinders at times requested by the Contractor until the minimum compressive strength of 2,000 psi is reached. Submit requests for alternate means to determine concrete maturity by coordinating cylinder compressive strengths to concrete curing temperature a minimum of 60 days prior to placement for approval by the Director, Materials Bureau.

D. Finishing. Use only magnesium floats and finishing tools, do not use aluminum or steel. Finish the concrete to produce a smooth surface and then broom the surface to a uniform slip-resistant texture. Tool the edges and scored joints of all sidewalk slabs with an edging tool having a 1/4 inch radius.

Score and tool the concrete surface at intervals of 5 feet, a minimum 1/8 inch to a maximum 1/4 inch in width, and to a minimum depth of one-third the total thickness.

E. Curing. Immediately after finishing, and not more than 30 minutes after concrete placement, apply a clear membrane curing compound that includes a fugitive dye at a rate of 1 gallon per 150 square feet. Do not apply curing compound in the rain. If rain damages the curing compound before it sets, reapply curing compound promptly after the concrete surface dries.

Submit requests for alternate means to determine concrete maturity by coordinating cylinder compressive strengths to concrete curing temperature a minimum of 60 days prior to placement for approval by the Director, Materials Bureau. If the ambient air temperature is expected to fall below 40°F anytime during the curing period, provide a supply of form insulating materials capable of maintaining a surface temperature of 55°F at the work site sufficient to cover all concrete placed.

Cure all driveways and sidewalks at driveways for a minimum of 3 days prior to opening to vehicle traffic. Place form insulating materials as necessary to prevent the newly placed concrete from being damaged by exposure to the elements.
exposed to ambient air temperatures at the concrete surface below 36°F during the curing period. Secure and overlap the form insulating materials tight to the concrete surface extending a minimum of 12 inches beyond the edge of the concrete to prevent air intrusion beneath the insulation. Maintain form insulating materials in place for the curing period. If the ambient air temperature falls below 40°F anytime during the curing period, cure conventionally formed sidewalks and driveways and machine formed sidewalks for a minimum of 6 days. If the concrete temperature falls below 32°F or the concrete is damaged by cold weather, remove and replace it at no additional cost to the State.

Place 4 equally spaced recording surface thermometers between the concrete surface and the insulating material and 12 inch from the outside edge of concrete for each day’s placement. Do not subject the concrete to a temperature drop in excess of 50°F during the first 24 hours after removing the insulation.

If saw cutting is necessary, use diamond blade saws equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control capable of making straight cuts to the dimensions required.

608-3.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips. Install hot mix asphalt sidewalks, driveways, bicycle paths and vegetation control strips in accordance with the provisions Section 402 Hot Mix Asphalt (HMA) Pavements, the Standard Sheets, and the contract documents. Place the number of courses and course thicknesses in accordance with Table 608-2 Hot Mix Asphalt Composition. Place vegetation control strips using a 9.5 mix with a minimum thickness of 3 inches in one course. Compact hot mix asphalt in accordance with the requirements of §402-3.07D. 80 Series Compaction Method.

<table>
<thead>
<tr>
<th>Total Placed Thickness</th>
<th>9.5 Mix</th>
<th>19.0 Mix</th>
<th>Number of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2 inch</td>
<td>1 1/2 inch</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2 inch</td>
<td>2 inch</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3 + inch</td>
<td>1 1/2 inch</td>
<td>1 1/2 + inch</td>
<td>2+</td>
</tr>
</tbody>
</table>

**NOTES:**
1. For the 19.0 mixture, place a maximum thickness of 3 inches in one pass.
2. A course consists of one or more separate lifts of a hot mix asphalt mixture to attain the indicated thickness.

608-3.03 Brick Paved Sidewalks and Driveways. Install brick pavers to the lines and grades and in the pattern shown in the contract documents to provide a uniform, even surface. Ensure joints between bricks are hand tight. Do not install or grout brick pavers in freezing weather. After installation, sweep a dry mixture of masonry mortar over the brick pavers until the joints are completely filled, and then lightly wet the joints with water. Clean brick pavers of excess mortar, and finish joints prior to the mortar setting up. Keep brick paving moist for 4 days after filling the joints with mortar. After the 4 day curing period, remove remaining mortar film using a light acid wash (10% solution of hydrochloric or muriatic acid) followed by flushing clean with water or as approved by the Engineer. Avoid the use of acid in areas where runoff could damage trees or other vegetation.

A. **Brick Paved Sidewalks and Driveways (Sand Setting Bed).** Lay brick pavers in a properly compacted 2 inch bed of cushion sand over the subbase or subgrade.

When used over tree pits, install bricks pavers in a 3 inch bed of cushion sand. After installation, sweep dry cushion sand over the brick pavers until the joints are completely filled. Do not use mortar to seal brick paver joints in tree pits.

B. **Brick Paved Sidewalks and Driveways (Mortar Setting Bed).** Lay brick pavers in a mortar setting bed, a minimum of 1 inch thick over the concrete or bituminous subbase.
C. Brick Paved Sidewalks and Driveways (Bituminous Setting Bed). Lay brick pavers in a 3/4 inch thick bituminous setting bed, over a concrete or bituminous subbase. Apply a coating of neoprene-modified asphalt adhesive by mopping, squeegeeing or troweling over the top surface of the bituminous setting bed to bond the bricks to the setting bed.

D. Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed). Lay brick pavers on a 2 inch thick setting bed of sand-cement over the subbase. Place the sand-cement setting bed not more than 4 hours prior to installing the brick pavers.

E. Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed). Install brick paver sidewalks and driveways using one of the following methods, at the Contractor's option:

1. Lay bricks on a setting bed of portland cement concrete while it is still fresh and firmly position bricks to provide a solid bedding under each brick.
2. Lay bricks in accordance with B. Brick Paved Sidewalks and Driveways (Mortar Setting Bed).

608-3.04 Grouted Stone Block Paved Sidewalks and Driveways. Install grouted stone blocks in the pattern shown in the contract documents to provide a uniform, even surface. Ensure joints between blocks are a maximum of 1-1/4 inch. Do not lay or grout blocks in freezing weather. After installation, sweep a dry mixture of masonry mortar over the stone blocks until the joints are completely filled and then lightly wet the joints with water. Clean stone blocks of excess mortar, and finish joints prior to the mortar setting up. Keep grouted stone block paving moist for 4 days after filling the joints with mortar. After the four day curing period, remove remaining mortar film using a light acid wash (10% ± solution of hydrochloric or muriatic acid) followed by flushing clean with water, or as approved by the Engineer. Avoid the use of acid in areas where runoff could damage trees or other vegetation.

A. Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed). Lay blocks in a bed of cushion sand, 3 inch thick over the subbase or subgrade.

When used over tree pits, install stone blocks in a 1 inch bed of cushion sand. After placement of blocks, sweep dry cushion sand over the stone blocks until the joints are completely filled. Do not use mortar to seal stone block joints in tree pits.

B. Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed). Lay stone blocks in a mortar setting bed, a minimum of 1 inch thick over the concrete or bituminous subbase.

C. Grouted Stone Block Paved Sidewalks and Driveways (Sand-Cement Setting Bed). Lay stone blocks on a 2 inch thick setting bed of sand-cement over the subbase. Place the sand-cement setting bed not more than 4 hours prior to installing the block paving.

D. Grouted Stone Block Paved Sidewalks and Driveways (Optional Concrete Setting Bed). Install grouted stone block paved sidewalks and driveways using one of the following methods, at the Contractor's option:

1. Lay stone blocks on a bed of portland cement concrete as specified in the contract documents while it is still fresh and firmly position blocks to provide a solid bedding under each block.
2. Lay stone blocks in accordance with B. Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed).

608-3.05 Precast Concrete Block Paved Sidewalks and Driveways. Install precast concrete driveway and sidewalk pavers, in the pattern shown in the contract documents to provide a uniform, even surface.
Lay blocks on a setting bed not to exceed 2 inches of uniformly compacted material placed over the specified subbase. Install the pavers in accordance with the manufacturer’s recommended procedures. Ensure joints are hand tight unless otherwise specified. Do not lay pavers in freezing weather. After the pavers are in place, sweep sand joint filler over the pavers until the joints are completely filled.

**608-3.06 Surface-Applied Detectable Warning Units.** Install surface-applied detectable warning units on existing curb ramps in accordance with the contract documents and the manufacturer’s recommendations for environmental conditions, surface preparation, installation procedures, curing procedures, and materials compatibility. If no color is specified in the contract documents, provide dark gray Federal Standard #36081 or darker. Ensure the detectable warning units provide the required contrast, light-on-dark or dark-on-light, with the adjacent sidewalk or ramp.

**608-3.07 Embedded Detectable Warning Units.** Install embedded detectable warning units in plastic concrete, directly on existing subbase prior to placing concrete, or inlaid on prepared concrete surfaces in accordance with the contract documents and as directed by the manufacturer. If no color is specified in the contract documents, provide dark gray Federal Standard #36081 or darker. Ensure the detectable warning units provide the required contrast, light-on-dark or dark-on-light, with the adjacent sidewalk or ramp.

Follow all applicable manufacturers' recommendations for environmental conditions, surface preparation, installation procedures, curing procedures, and materials compatibility.

**608-4 METHOD OF MEASUREMENT**

**608-4.01 Portland Cement Concrete Sidewalks and Driveways.** The quantity to be measured for payment will be in cubic yards to the nearest 0.1 cubic yard of concrete installed.

**608-4.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips.** The quantity to be measured for payment will be in tons to the nearest 0.01 tons of HMA installed. Plant Production Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for plant production, determined in accordance with §401-3.07 Documentation.

**608-4.03 Brick Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of brick paving installed.

**608-4.04 Grouted Stone Block Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of stone block paving installed.

**608-4.05 Precast Concrete Block Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of precast concrete paving installed.

**608-4.06 Surface-Applied Detectable Warning Units.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of surface-applied detectable warning units installed.

**608-4.07 Embedded Detectable Warning Units.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of embedded detectable warning units installed.

**608-5 BASIS OF PAYMENT**

**608-5.01 Portland Cement Concrete Sidewalks and Driveways.** The unit price bid for concrete sidewalks and driveways shall include the cost of furnishing all labor, materials, and equipment necessary
to satisfactorily complete the work, including preparing the subgrade, saw cutting and wire fabric reinforcement. Excavation and subbase course will be paid for separately.

608-5.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips. The unit price bid for HMA sidewalks, driveways and paths shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including preparing the subgrade, milling, cleaning surfaces, tack coat, saw cut, truing and leveling courses. Excavation and subbase course will be paid for separately.

Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed index price for Quality Adjustment to HMA Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

608-5.03 Brick Paved Sidewalks and Driveways. The price bid for brick paved sidewalks and driveways shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

608-5.04 Grouted Stone Block Paved Sidewalks and Driveways. The unit bid for grouted stone block paved sidewalks and driveways shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

608-5.05 Precast Concrete Block Paved Sidewalks and Driveways. The unit price bid for precast concrete block paved sidewalks and driveways shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

608-5.06 Surface-Applied Detectable Warning Units. The unit price bid for surface-applied detectable warning units shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including surface preparation.

608-5.07 Embedded Detectable Warning Units. The unit price bid for embedded detectable warning units shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including bedding material. No adjustment will be made for concrete removed to accommodate embedded units.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>608.0101</td>
<td>Concrete Sidewalks and Driveways</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>608.0102</td>
<td>Accelerated Cure Sidewalks and Driveways</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>608.020102</td>
<td>Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>608.000013</td>
<td>Plant Production Quality Adjustment to HMA Sidewalk Items</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>608.03</td>
<td>Brick Paved Sidewalks and Driveways (Sand Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.04</td>
<td>Brick Paved Sidewalks and Driveways (Mortar Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.05</td>
<td>Brick Paved Sidewalks and Driveways (Bituminous Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.06</td>
<td>Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.07</td>
<td>Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.08</td>
<td>Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>608.09</td>
<td>Grouted Stone Block Paved Sidewalks and Driveways</td>
<td>Square Yard</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 indicated 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 and Manufacturing.

Portland Cement, Type II 701-01
Concrete Repair Material 701-04
Concrete Grouting Material 701-05
Anchoring Material - Chemically Curing 701-07
Concrete Repair Material - High Early Strength 701-12
Coarse Aggregate 703-02
Concrete Sand 703-07
Premolded 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
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>TABLE 609-1 POUNDS OF AGGREGATE PER BAG OF CEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity of Aggregate</td>
</tr>
<tr>
<td>Concrete Sand</td>
</tr>
<tr>
<td>Coarse Aggregate, CA 2 Gradation</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, excluding granite traversable sloped curb, shall be set on a 3 inch thick continuous bed of dry concrete mix, or on a 3 inch thick dry concrete mix bed at the joints as shown on the Standard Sheets and wet concrete mix between the joints, or on a 3 inch minimum thick continuous bed of compacted granular material, at the Contractor's option.

Precast concrete curb, stone curb, and granite curb, excluding granite traversable sloped 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 12 inch 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 10 inches or to the top of the hot mix asphalt pavement, whichever is greater, measured from the bottom of the curb.

Precast curb, stone curb, and granite curb, excluding granite traversable sloped curb, with and without sawed ends, not on structure, shall be butted together with no mortar between the joints.

When the curb is set next to a concrete (rigid) pavement, grout conforming to §701-04 Concrete Repair Material, §701-12 Concrete Repair Material - High Early Strength, 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 on a structures approach, 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 1/4 inch 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, §701-04 Concrete Repair Material or §701-12 Concrete Repair Material - High Early Strength.

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. If no width is indicated in the Contract Documents, the width shall be the minimum shown on the Standard Sheet.

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 12 inches 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 curing compound.

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 10 feet. The joints between segments shall not exceed 1/4 inch 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 11/16 inches wide and contain Premolded 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 above the minimum on the Standard Sheets or above the width indicated in the Contract Documents without any other change in shape or dimension. If additional width is provided by the Contractor, there shall be no additional cost to the State for the additional width. If the Contract Documents or the Engineer do not require curb be placed across driveway entrances or there is no reference in the Contract Documents to placing curb across driveway entrances, the Contractor may continue placing curb across driveway entrances but the curb placed, 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 1/2 inch of the established line or 1/4 inch 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 1/8 inch minimum, 1/4 inch maximum and to a depth of 1 1/2 inch. The cut or formed joints shall extend slightly below the surface of the adjacent pavement and shall be spaced at 10 feet 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 11/16 inches wide and contain Premolded 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 Granite Traversable Sloped Curb. Granite traversable sloped curb shall be set on a continuous trapezoidal shaped wedge bed of dry concrete mix, with 12 inches of wet concrete mix at the front base and 6 inches at the back top as shown on the Standard Sheets. Granite traversable sloped curb shall be set such that the front bottom arris line is at the top of pavement and is on a 1 on 3 slope.

A. Portland Cement Concrete (Rigid) Pavement.
1. Existing Pavement. The Contractor shall place the granite traversable sloped curb on a wedge bed of dry concrete mix, as above, on the edge of the existing pavement. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. There shall be no wet concrete mix base.

2. New Pavement. The Contractor shall place the granite traversable sloped curb after paving. The granite traversable sloped curb shall be placed on a wedge bed of dry concrete mix, as above, on the edge of the new pavement. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. There shall be no wet concrete mix base.

B. Hot Mix Asphalt (Flexible) Pavement.

1. Existing Pavement. The Contractor shall sawcut 12 inches of the pavement and place the granite traversable sloped curb as above. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. The wet concrete mix base shall be placed on the subbase course and finished flush with the top of the binder allowing the top course to be placed over the concrete base. The wet concrete mix base shall be cured before placing of top course.

2. New Pavement. The Contractor shall place the granite traversable sloped curb after paving, decreasing the paving width, excluding the top course, by one foot where the granite traversable sloped curb is to be placed. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. The wet concrete mix base shall be placed on the subbase course and finished flush with the top of the binder course allowing the top course to be placed over the concrete base. The wet concrete mix base shall be cured before placing of top course.

Granite traversable sloped curb, with and without sawed ends, not on structure, shall be placed with joints of 1/4 inch to 3/4 inch but with a consistent joint width throughout. Grout conforming to §701-04 Concrete Repair Material or §705-21 Type M Masonry Mortar shall be placed in the joint formed between the curb lengths. The grout shall extend from the bottom to the top of the curb section completely filling the joint and struck flush with curb surface. Curb surfaces shall be cleaned of excess mortar to the satisfaction of the Engineer.

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.

609-3.06 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, in accordance to 714-06 Hot Mix Asphalt Curb, shall be mixed in a batch type bituminous concrete mixing plant. The dry mixing time shall be
a minimum of 15 seconds after the complete introduction of aggregates 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 surface shall be clean. When curb is to be laid on a cured or aged concrete base, hot mix asphalt pavement, or performance graded 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 meeting the requirements of Table 702-8. The tack coat shall be applied at a rate of 0.05 to 0.15 gallons per square yard. 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 MUTCD. 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 gallon per 200 linear feet 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 50°F 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 feet, rounded to the nearest foot. 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

609-5.01 Concrete Curb, Curb & Gutter, Stone Curb, Granite Curb, Optional Curb. The unit price bid per foot shall include the cost of all labor, materials, curb anchors, equipment, sawcutting and excavation to, in accordance with these specifications, place, backfill, concrete, 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 foot 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 foot 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 foot 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>609.01</td>
<td>Stone Curb (As Detailed)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.01XX</td>
<td>Stone Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.02XX</td>
<td>Granite Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.03</td>
<td>Granite Bridge Curb (As Detailed)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.03XX</td>
<td>Granite Bridge Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.035X</td>
<td>Stone Bridge Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.04</td>
<td>Cast-in-Place Concrete Curb (As Detailed)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.04XX</td>
<td>Cast-in-Place Concrete Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.05</td>
<td>Cast-in-Place Concrete Curb &amp; Gutter (As Detailed)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.05XX</td>
<td>Cast-in-Place Concrete Curb &amp; Gutter* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.08XX</td>
<td>Precast Concrete Curb* (Various Types as indicated)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.0901</td>
<td>Optional Curb (Pavement Concrete Type PVF150) or Cast-In-Place Concrete Type VF150 or Granite Type C)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.0902</td>
<td>Optional Curb (Pavement Concrete Type PM100 or Cast-In-Place Concrete Type M100 or Granite Type E100)</td>
<td>Foot</td>
</tr>
<tr>
<td>609.0903</td>
<td>Optional Curb (Pavement Concrete Type PT100 or Cast-In-Place Concrete Type T100)</td>
<td>Foot</td>
</tr>
</tbody>
</table>
SECTION 610 - GROUND VEGETATION - PREPARATION, ESTABLISHMENT AND MANAGEMENT

610-1 DESCRIPTION.

610-1.01 Topsoil. This work shall consist of furnishing, screening, storing, stockpiling and placing topsoil in accordance with the contract documents and as directed by the Engineer.

610-1.02 Preparation of Subsoil for Turf Establishment. This work shall consist of ground preparation when topsoil is not included in the work prior to establishment of turf in accordance with the contract documents and as directed by the Engineer.

610-1.03 Turf Establishment. The work shall consist of ground preparation and establishing turf in accordance with the contract documents and as directed by the Engineer.

610-1.04 Wildflower Seeding. The work shall consist of ground preparation, furnishing and placing wildflower seeding materials and caring for wildflower areas in accordance with the contract documents and as directed by the Engineer.

610-1.05 Sod. The work shall consist of ground preparation, furnishing, installing and caring for sod in accordance with the contract documents and as directed by the Engineer.

610-1.06 Soil Amendments. The work consists of furnishing and placing soil amendments in accordance with the contract documents and as directed by the Engineer.

610-1.07 Compost. The work consists of furnishing, placing and incorporating compost in accordance with the contract documents and as directed by the Engineer.

610-1.08 Mulch for Planting. The work consists of furnishing and placing mulch, in accordance with the contract documents and as directed by the Engineer.

610-1.09 Permeable Weed Control Landscape Fabric. The work consists of furnishing and placing permeable landscape fabric for weed control, in accordance with the contract documents and as directed by the Engineer.

610-1.10 Watering Vegetation. This work shall include watering turf, sod, wildflower seeding, trees, shrubs, ground covers, vines, other plants, and filling portable drip irrigation systems in accordance with the contract documents and as directed by the Engineer.

610-1.11 Weed Removal. This work shall consist of removal and disposal of all native and non-native weeds including roots from newly established turf and sod areas, wildflower seeded areas, tree and shrub pits and plant beds in accordance with the contract documents and as directed by the Engineer.
610-1.12 **Mowing.** This work shall consist of mowing newly established seeded or sodded areas including the removal and disposal of any debris and litter which has accumulated prior to or between mowings, in accordance with the contract documents and as directed by the Engineer.

610-1.13 **Mowing Limits Markers.** This work consists of furnishing and installing mowing limit markers in accordance with the contract documents and as directed by the Engineer.

610-2 **MATERIALS**

610-2.01 **Topsoil.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*. Excavated material from earthwork operations defined in Section 203 *Excavation and Embankment* that is unsuitable for embankments but conforms to §713-01 *Topsoil is acceptable*.

   Topsoil 713-01

610-2.02 **Preparation of Subsoil for Turf Establishment.** None specified.

610-2.03 **Turf Establishment.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

   Water 712-01
   Seeds 713-04
   Mulch For Turf Establishment and Erosion Control 713-11
   Mulch anchorage 713-12
   Straw 713-19

610-2.04 **Wildflower Seeding.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

   Water 712-01
   Seeds 713-04
   Mulch For Turf Establishment and Erosion Control 713-11
   Mulch anchorage 713-12
   Straw 713-19

610-2.05 **Sod.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

   Water 712-01
   Topsoil 713-01
   Sod 713-14

610-2.06 **Soil Amendment.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

   Water 712-01
   Limestone 713-02
   Fertilizer 713-03
   Mycorrhizal Fungi 713-09
   Moisture Retention Additive 713-10
   Sulfur 713-17

610-2.07 **Compost.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

   Compost 713-15
610-2.08 Mulch for Planting. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Mulch for Planting 713-05

610-2.09 Permeable Weed Control Landscape Fabric. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Weed Control Barriers 713-18

610-2.10 Watering Vegetation. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Water 712-01

610-2.11 Weed Removal. None specified.

610-2.12 Mowing. None specified.

610-2.13 Mowing Limits Markers. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Materials for the Protection of Plants 713-08

610-3 CONSTRUCTION DETAILS

610-3.01 Topsoil.

A. General. The subsoil within the areas to be covered by topsoil shall be graded so that the completed work after the topsoil is placed shall conform to the specified lines and grades. The Contractor shall scarify or till the surface of the subsoil to a depth of 6 inches before the topsoil is placed to permit bonding the topsoil with the subsoil. Tillage by disking, 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.

Topsoil in an unworkable condition due to excessive moisture, frost, or other conditions shall not be placed until its consistency is workable for spreading. Topsoil shall be placed on the designated area and spread to the depth specified in the contract documents or a minimum of 4 inches for turf areas and 3 inches for sod areas.

The finished surface shall be maintained for subsequent contract work such as seeding, sodding, mulching or planting.

The sites of all stockpiles shall be graded and maintained for subsequent contract work. Surplus topsoil will become the property of the Contractor.

Roots and top growth of non-native weeds or invasive species that emerge from topsoil stockpiles or after placement of the topsoil shall be eradicated and disposed of in accordance with §610-3.11 Weed Removal immediately upon emergence. Weed removal, treatment and disposal of invasive species will be paid for separately.

B. Topsoil – Reuse On-Site Materials. Topsoil stripping shall be completed prior to starting the general excavation in an area. The Contractor shall take reasonable care that the topsoil is not contaminated during the stripping and other handling operations.

Topsoil identified for reuse that has a known, established population of invasive species shall be treated to eliminate the presence of invasive species per §610-3.11 Weed Removal. The invasive species material shall be disposed appropriately and then the resulting topsoil may be used within the limits. Treatment and disposal of invasive species will be paid for separately.
C. Topsoil – Roadside, Lawn, Special Planting Mix and Acidic. The Contractor shall place topsoil only from approved stockpiles.

D. Topsoil – On-Site Wetland and Wetland Off-Site or Manufactured. The Contractor shall not use topsoil wetlands materials which exhibit the presence of invasive species. Care shall be taken not to impact wetland areas remaining.

On-site wetland topsoil stripping shall be completed prior to starting the general excavation in an area. After stripping, on-site wetland topsoil shall be placed within 24 hours or stored within the contract limits at a location approved by the Engineer.

610-3.02 Preparation of Subsoil for Turf Establishment. Prior to establishment of turf in areas that are not to receive topsoil or other permanent erosion control measures, the Contractor shall remove all loose stones and other objects over 2 inches in size to a 4 inch depth. The Contractor shall mix compost with subsoil in accordance with §610-3.07 B. Turf Establishment With No Topsoil/ On Subsoil within the areas to be seeded and grade the surface so that the completed work shall conform to the specified finished lines and grades. Compost will be paid for separately.

610-3.03 Turf Establishment. The Contractor shall coordinate establishment of turf with other site and construction activities.

The Contractor shall clean all equipment involved in turf establishment to remove plants, seeds and propagules prior to commencement of work. Any work to clean equipment shall be at no additional cost to the State.

The Contractor shall apply the seed mix at one and one half to two times the manufacturer’s recommended rate. Any method of sowing that does not injure the seeds and achieves even coverage in the process of spreading will be acceptable.

The Contractor shall perform the initial watering and shall spread straw uniformly in a continuous blanket to hide the soil from view or mulch Types I – V as specified in the contract documents. Rolled Erosion Control products shall be installed according to manufacturer’s recommendations and paid for separately. Mulch anchorage shall be applied.

The Contractor shall water, mow, and weed the turf establishment areas for the duration of the contract or until turf areas are accepted. Watering, mowing, and weeding to care for the turf will be paid for separately. Any work required to correct initial seeding (installation) shall be done at no additional cost to the State.

A. Turf Establishment – Roadside. Areas will be accepted when:

- free from thin or bare ground greater than one foot in diameter;
- at least 80 percent of the ground surface is covered with established specified permanent turf grass species;
- they have had one mowing cycle in accordance with §610-3.12 unless conditions prevent mowing, in which case turf grass shall be an average minimum height of 5 inches; and
- they exhibit healthy green color.

B. Turf Establishment- Lawns. Areas will be accepted when:

- free from thin or bare spots greater than six inches in diameter;
- at least 90 percent of the ground surface is covered with established specified permanent turf grass species;
• they have had one mowing cycle in accordance with §610-3.12 unless conditions prevent mowing, in which case turf grass shall be an average minimum height of 3 inches; and
• they exhibit healthy green color.

610-3.04 Wildflower Seeding. The Contractor shall clean all equipment involved in wildflower seeding to remove plants, seeds and propagules prior to commencement of work at no additional cost to the State. The Contractor shall install wildflower seeding materials in accordance with the contract documents. Any method of sowing that does not injure the seeds and provides soil contact in the process of spreading will be acceptable. The Contractor shall apply the seed mix at twice the seed supplier’s recommended rate.

The Contractor shall perform the initial watering and spread straw or mulch Types I – V as specified in the contract documents, uniformly at a rate consistent with seed supplier recommendations. Mulch anchorage is required unless otherwise specified in the contract documents. Wildflower seeding areas will be accepted after the seeding operation is complete. Any work required to correct initial seeding (installation) shall be done at no additional cost to the State.

The Contractor shall water the wildflower seeding areas for the duration of the contract. Watering to care for the wildflower seeding areas will be paid for separately.

610-3.05 Sod. The Contractor shall generally place sod during the seasons identified in Table 610-1 Sodding Seasons. The Contractor may request extension of seasons, provided the other conditions are met.

<table>
<thead>
<tr>
<th>TABLE 610-1 SODDING SEASONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic locations</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>R1-Essex, Warren (north of towns of Bolton &amp; Warrensburg), R2-Hamilton,  Herkimer (towns of Ohio and Webb) R7-Lewis, St. Lawrence, Franklin, Clinton, Jefferson (east of Rte 81)</td>
</tr>
<tr>
<td>R1– Greene, Rensselaer, Schenectady, Saratoga, Washington, Albany, Warren (towns of Bolton &amp; Warrensburg &amp; south) R2- Montgomery, Fulton, Oneida, Madison, Herkimer (south of town of Ohio) R3,6,9 – All counties R7- Jefferson (west of Route 81)</td>
</tr>
<tr>
<td>R4, 5 &amp; 8- All counties</td>
</tr>
<tr>
<td>R10, 11- All counties</td>
</tr>
</tbody>
</table>

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. No frozen sod shall be placed nor shall sod be placed on frozen ground surface. The Contractor shall exercise care to retain the soil existing on the roots of the sod during transporting, handling and transplanting operations. Sod shall be placed on a minimum of 3 inches of moist topsoil. The topsoil will be paid for separately.

The finished sod soil surface shall be flush with surface of the adjacent soil and adjacent structures. It shall meet the finished grades as shown in the contract documents. Sod will be accepted when:

• It has been in place a minimum of 60 days after installation,
• It is 95 percent covered with permanent grass species,
• It has had one mowing cycle in accordance with §610-3.12 Mowing,
• It exhibits healthy green color,
• It is free from thin, bare or brown spots greater than 6 inches in diameter, and
• It is firmly rooted in the soil.

Sod not meeting the standards for acceptance, shall be re-sodded until a satisfactory turf has been established, at no additional expense to the State. The Contractor shall water, mow and weed the sodded areas as necessary until contract final acceptance. These items will be paid for separately.

610-3.06 Soil Amendments. The Contractor shall place, apply or incorporate fertilizer, limestone, mycorrhizal fungi, sulfur and/or moisture retention additive where shown in the contract documents.

When mycorrhizal fungi are specified, application rates for turf shall ensure an even distribution of 100,000 propagules minimum per acre for drill seeding and 1,000,000 propagules minimum per acre for hydroseeding. Application rates for planting and Tree Root Zone Treatment, as well as any other aspects of distributing and/or incorporating mycorrhizal fungi, shall be in accordance with the manufacturer’s recommendations. All other amendments shall be mixed with topsoil prior to placing, spread evenly over the surface of turf, wildflower or sod areas, applied within shrub saucers or applied over the plant beds as appropriate, at the rates recommended by the manufacturer or as specified in the contract documents. The method of application shall ensure an even distribution. When hydraulic application is used, the minimum rate of water application shall be in accordance with manufacturer’s recommendation.

Trees shall be fertilized using Method No. 1, No. 2 or No. 3 in accordance with the contract documents.

A. Method No. 1. Holes shall be made in the earth about 18 inches deep and 18 inches 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; placing equal amounts of fertilizer in the lower 12 inches of each hole.

B. Method No. 2. Fertilizer shall be applied to soil’s surface hydraulically at the rate specified with sufficient water to saturate the soil for the area and depth of the tree roots without creating air pockets.

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

610-3.07 Compost.

A. Existing Soil: The Contractor shall spread 2 inches of Compost Type A or E within the limits shown in the contract documents and tilled into existing soil to a total depth of six inches.

B. Turf Establishment With No Topsoil/ On Subsoil. The Contractor shall spread 2 inches of Compost Type A, D or E within the limits shown in the contract documents and tilled into subsoil to a minimum depth of four inches.

C. Turf Establishment With Topsoil. The Contractor shall mix Compost Type A, D or E with topsoil as specified in the contract documents.

D. Plant Pits or Beds: Compost Type A, D or E shall be applied at a ratio of 1 part compost to 5 parts existing soil.
610-3.08 Mulch for Planting. The Contractor shall apply mulch consisting of wood chips, pine nuggets or shredded bark to the surface of the beds and tree pit areas in accordance with the contract documents. The Contractor shall apply mulch to a uniform depth of 3 inches over the shrub bed and tree pit areas and 2 inches over groundcover beds. The mulch shall be distributed so as to create a smooth, level cover over the exposed soil. Mulch shall not cover plants or be in contact with tree root flare, tree trunks, and plant stems.

610-3.09 Permeable Weed Control Landscape Fabric. Areas where landscape fabric is to be installed shall be smooth, firm, stable and free of rocks, clods, foliage, roots, trash, debris or other material that will prevent the matting from lying in direct contact with the soil surface.

The landscape fabric shall be placed where shown in the contract documents and as required by the manufacturer.

610-3.10 Watering Vegetation. The Contractor shall provide water without damage to plants, mulch, stakes, plant saucers, sod or other areas to be watered. Damage resulting from watering operations shall be repaired at no additional cost to the State.

Watering shall be applied in accordance with §610-3.03 Turf Establishment, §610-3.04 Wildflower Seeding, §610-3.05 Sod or §611-3.01 General. Watering for existing vegetation shall be as specified in the contract documents.

Watering shall be applied at the following rates:

A. Turf, Wildflowers, Sod, Planting Beds. In the absence of 1 inch of rainfall within 5 consecutive calendar days the Contractor shall water all turf, wildflowers, sod and planting beds once a week to a depth of 1 inch.

B. Trees and Planting Pits. Between April 1st and November 15th, in the absence of 1 inch of rainfall within 5 consecutive calendar days, the Contractor shall apply water to trees and planting pits once per week, except during July and August, when water shall be applied twice per week, with a minimum of 2 days between applications. Soil saucers or portable drip irrigation systems shall be filled once per watering.

610-3.11 Weed Removal. The Contractor shall perform weed removal in accordance with the contract documents. The Contractor shall remove and dispose of weeds including roots prior to flowering and seed formation by manual, chemical or mechanical means. Any method of weed removal that leaves live roots in the soil will not be permitted. An appropriately licensed applicator is required for chemical weed control methods. The Contractor shall ensure the preservation of desirable vegetation. Treatment and removal of invasive species will be paid for separately.

610-3.12 Mowing. The schedule may be modified to accommodate prevailing or forecast weather conditions. The Contractor shall be responsible, prior to each mowing, for the removal and disposal of any debris and litter which has accumulated since the last mowing. Care shall be taken to avoid damage to existing plant materials.

A. Roadside. The Contractor shall mow all turf establishment areas to a height of 5 inches whenever growth reaches 8 inches for the duration of the contract. Clippings shall be left in place.

B. Lawns. The Contractor shall mow all turf establishment areas to a height of 3 inches after initial growth reaches 5 inches, and then mowed to a height of 3 inches whenever a 5 inch height is reached thereafter for the duration of the contract. Clippings shall be mulched in place.
C. Sod. The Contractor shall mow all sodded areas to a height of 3 inches after initial growth reaches 5 inches, and then mowed to a height of 3 inches whenever a 5 inch height is reached thereafter for the duration of the contract. Clippings shall be mulched in place.

610-3.13 Mowing Limits Markers. The Contractor shall install mowing limit markers plumb to a depth in accordance with the manufacturer’s instruction.

610-4 METHOD OF MEASUREMENT

610-4.01 Topsoil. The quantity to be measured for payment will be in cubic yards of each type of topsoil measured to the nearest whole cubic yard of topsoil placed, from payment lines shown in the contract documents.

Cross sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown on the Plans and cannot be reasonably established by the Engineer.

610-4.02 Preparation of Subsoil for Turf Establishment. The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of subsoil area prepared for turf establishment.

610-4.03 Turf Establishment. The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of turf established.

610-4.04 Wildflower Seeding. The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of wildflower seeding.

610-4.05 Sod. The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of sod placed.

610-4.06 Soil Amendments. The quantity to be measured for payment will be in pounds to the nearest whole pound or in gallons to the nearest whole gallon of soil amendments (fertilizer, limestone, mycorrhizal fungi, sulfur and/or moisture retention additive) applied.

610-4.07 Compost. The quantity to be measured for payment will be in cubic yards to the nearest whole cubic yard of compost placed or incorporated.

610-4.08 Mulch for Planting. The quantity to be measured for payment will be in cubic yards to the nearest whole cubic yard of mulch placed.

610-4.09 Permeable Weed Control Landscape Fabric. The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard.

610-4.10 Watering Vegetation. The quantity to be measured for payment will be in 1000 gallons (MGal) to the nearest MGal of water applied, determined from approved measuring devices, or by measurement in tanks or containers of known capacity.

610-4.11 Weed Removal. The quantity to be measured for payment will be in square yards on slope weeded per occurrence to the nearest whole square yard.

610-4.12 Mowing. The quantity to be measured for payment will be the number of square yards on slope mowed per occurrence to the nearest whole square yard.
610-4.13 **Mowing Limits Markers.** The quantity to be measured for payment will be by the number of complete markers satisfactorily installed.

### 610-5 BASIS OF PAYMENT

610-5.01 **Topsoil.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including the handling, storing, stockpiling, and placement.

610-5.02 **Preparation of Subsoil for Turf Establishment.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

610-5.03 **Turf Establishment.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, mulch and mulch anchorage as necessary to satisfactorily complete the work.

610-5.04 **Wildflower Seeding.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, mulch and mulch anchorage necessary to satisfactorily complete the work.

610-5.05 **Sod.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, necessary to complete the work. Topsoil bed placed under the sod shall be paid for separately.

610-5.06 **Soil Amendments.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including water for hydraulic application.

610-5.07 **Compost.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

610-5.08 **Mulch for Planting.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

610-5.09 **Permeable Weed Control Landscape Fabric.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

610-5.10 **Watering Vegetation.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

610-5.11 **Weed Removal.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

610-5.12 **Mowing.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

610-5.13 **Mowing Limits Markers.** The unit price bid shall include the cost of all labor, materials, and equipment 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>610.0501</td>
<td>Fertilizer</td>
<td>Pound</td>
</tr>
</tbody>
</table>
SECTION 611 - PLANTING, TRANSPLANTING AND POST PLANTING CARE

611-1 DESCRIPTION.

611-1.01 General. Vacant

611-1.02 Planting. This work consists of furnishing, and planting trees, shrubs, vines, groundcovers and other plants in accordance with the contract documents and as directed by the Engineer.

611-1.03 Transplanting. This work consists of transplanting existing plants from existing locations to new locations in accordance with the contract documents and as directed by the Engineer.

611-1.04 Portable Drip Irrigation System. This work shall consist of furnishing, delivering, placing and removing Portable Drip Irrigation System (PDIS) for watering around newly planted trees and other vegetation in accordance with the contract documents and as directed by the Engineer.

611-1.05 Post-Planting Care. This work consists of the care of newly planted and transplanted trees, shrubs, vines, groundcovers and other plants in accordance with the contract documents and as directed by the Engineer.
611-1.06 Rodent Guards. This work shall consist of furnishing, delivering and placing rodent guards around newly planted trees and other vegetation in accordance with the contract documents and as directed by the Engineer.

611-2 MATERIALS

611-2.01 General. Materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Water 712-01
Topsoil 713-01
Mulch for Landscape Bedding 713-05
Materials for the Protection of Plants 713-08
Compost 713-15

611-2.02 Planting. Trees, shrubs, vines, groundcovers and other plants shall be as specified under '713-06 and as further specified in the contract documents.

611-2.03 Transplanting. Plants shall be existing plants in accordance with '713-06.

611-2.04 Portable Drip Irrigation System. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing. Materials may be new or previously used that meet the following material requirements.

Materials for the Protection of Plants 713-08

611-2.05 Post Planting Care. Materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Pesticides 713-13

611-2.06 Rodent Guards. Materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Materials for the Protection of Plants 713-08

611-3 CONSTRUCTION

611-3.01 General. Locations for plants shall be as specified in the contract documents. All plants for planting and transplanting shall be protected from damage and drying out, including during transportation, handling or while in temporary storage. No planting or transplanting shall be done when the soil is frozen, saturated (except in wetland conditions) or otherwise in an unsatisfactory condition for working. Planting seasons represent average times of suitable conditions between weather extremes. In general, planting or transplanting shall occur during these seasons. The Contractor may request an extension of the planting seasons.

<table>
<thead>
<tr>
<th>TABLE 611-1 PLANTING SEASONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting Seasons</td>
</tr>
<tr>
<td>Geographic locations</td>
</tr>
<tr>
<td>(NYSDOT Regions and Counties)</td>
</tr>
</tbody>
</table>
Locations for plants and outlines of areas to be planted shall be staked or marked out on the ground by the Contractor and approved by the Engineer before any plant pits or plant beds are dug. Where non-movable underground obstructions are encountered, the plant pits shall be relocated as approved by the Engineer.

Existing vegetation shall be removed from all new planting beds.

Where an impervious layer of soil (hardpan, fragipan and soils with greater than 20% clay content) is encountered during the excavation of plant pits or beds, all such soil shall be removed up to a depth of one foot beyond required plant pit depth in order to provide adequate drainage for the plant. The pits or beds shall be backfilled with topsoil. Any additional excavation required to properly plant or transplant in impervious soils will be considered extra work.

Planting soil shall be unamended existing soil excavated from the plant pit unless otherwise specified. Watering shall accompany backfilling of plant. The Contractor shall perform the initial watering for backfilling plant so that no voids occur in the plant pit.

No tree shall be staked, guyed or anchored unless otherwise specified in the contract documents.

Mulch shall Type A or B unless otherwise specified in the contract documents and shall be placed at the time of planting or transplanting.

The Contractor shall water, weed and maintain mulch at no cost to the state until the newly planted or transplanted material is accepted.

Plants will be accepted when all specified plants meet the following conditions:

- Species has been verified and plant is in its designated location
- Planted or transplanted in accordance with ANSI A 300, Part 1, 2, 3 and 6 Standard Practices
- Planted or transplanted in accordance with 611 Standard sheets
- living, healthy, unimpaired and in an undamaged condition
Watering, if specified, shall begin upon acceptance of the planting or transplanting and unless otherwise specified continue for one year or the duration of the contract, which ever is later. Watering after acceptance shall be performed as required in Section 610-3.09 Watering Vegetation and paid for separately. Installation of rodent guards if specified are paid for separately.

Plants that die after acceptance at any time during the contract duration shall be removed and unless otherwise specified, the surface area shall be restored to the condition of the adjacent surface at no additional cost to the state.

611-3.02 Planting. The Contractor shall notify the Engineer at least four calendar days before intended delivery of plants or planting materials to the site. The Contractor shall furnish the Engineer legible copies of the certificates of inspection of plant materials and documentation for each shipment showing point of origin, sizes, scientific names, quantities, and kinds of materials supplied.

Pruning at the time of planting shall be limited to the removal of dead, conflicting and broken branches; and to other pruning consistent with good horticultural practice in accordance with ANSI A300 Part 1 Standard Practices.

611-3.03 Transplanting. Transplanting shall be in accordance with ANSI A300 Part 1, 2, 3, 6 Standard Practices and accomplished by a digging method intended to preserve the root system intact to the extent practicable. Planting soil shall be unamended existing soil excavated from the plant pit unless otherwise specified. Transplanted stock shall be pruned prior to transplanting in accordance with ANSI A300 Part 1 Standard Practices.

The Contractor shall take appropriate measures to avoid damage to plant during the transplanting operation including:

1. Provide trunk and branch Protection.
2. Treat plant with an anti-desiccant prior to being dug up
3. Protect all roots from drying out.
4. Prune damaged plant roots greater than 1 inch in diameter

Plants shall be set in a vertical position.

Where the contract duration allows plants greater than 6 inch DBH shall be root pruned up to one year prior to transplanting.

611-3.04 Portable Drip Irrigation System (PDIS). After the requirements for planting under Section 611 Planting, Transplanting and Post Planting Care are completed; the Contractor shall supply and install the required number and size of PDIS as recommended by the manufacturer for the trees planted. Watering shall be performed as required in Section 610-3.09 Watering Vegetation and paid for separately. All PDIS that are damaged and or missing shall be replaced at no added cost to the State.

The Contractor shall remove PDIS in the fall prior to the first frost. The PDIS shall remain the property of the Contractor.

611-3.05 Post-Planting Care. If specified, the Contractor shall care for planting as needed for one year following the satisfactory completion of all of the planting and/or transplanting or for the duration of the contract, which ever is later. The contractor shall prepare and submit a post-planting care work schedule for approval.

Post-planting care shall consist of:

1. Mulching – with materials to match those used in initial planting, twice to maintain a depth of 3 inches.
2. Weeding - twice
3. Integrated vegetation and pest management- in the event of threat of serious damage from insects or diseases the plants shall be treated by preventative or remedial measures.
4. Pruning (ANSI A300 Part 1) - once to prune dead or damaged branches.
5. Maintenance/Replacement/of tree support system if present – once every six months
6. Removal of tree support system if present at the end of the post-planting care period.
7. Removal of rodent guards if present at the end of the post-planting care period

611-3.06 Rodent Guards. Vacant

611-4 METHOD OF MEASUREMENT.

611-4.01 Planting. The quantity to be measured for payment will be the number of plants placed.

611-4.02 Transplanting. The quantity to be measured for payment will be the number of plants placed.

611-4.03 Portable Drip Irrigation System (PDIS). The quantity of PDIS to be measured for payment will be the number of PDIS placed.

611-4.04 Post-Planting Care. The quantity to be measured for payment will be the number of plants cared for or nearest whole square yard on slope of plants cared for.

611-4.05 Rodent Guards. The quantity to be measured for payment will be the number of rodent guards placed.

611-5 BASIS OF PAYMENT.

611-5.01 Planting. The unit price bid for each plant shall include the cost of all labor, materials, and equipment, including initial watering and mulch, compost, plants and plant protection materials and topsoil necessary to satisfactorily complete the work.

611-5.02 Transplanting. The unit price bid for each plant shall include the cost of all labor, materials, and equipment, including initial watering, mulch, compost, plant and plant protection materials and topsoil necessary to satisfactorily complete the work.

611-5.03 Portable Drip Irrigation System. The unit price bid shall include the cost of all labor, materials, and equipment, necessary to satisfactorily complete the work.

611-5.04 Post-Planting Care. The unit price bid for each plant shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments for work satisfactorily performed may be paid at the mid point of the post-planting care in amounts not to exceed forty percent (40%) of the unit price bid for the respective work.

611-5.05 Rodent Guards. The unit price bid shall include the cost of all labor, materials, and equipment, necessary to satisfactorily complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>611.011x</td>
<td>Planting - Major Deciduous Trees – size as specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.012x</td>
<td>Planting - Major Deciduous Trees – 1 ¼ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Unit</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>611.013x</td>
<td>Planting - Major Deciduous Trees – 1 ½ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.014x</td>
<td>Planting - Major Deciduous Trees – 1 ¾ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.015x</td>
<td>Planting - Major Deciduous Trees – 2 inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.016x</td>
<td>Planting - Major Deciduous Trees – 2 ½ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.017x</td>
<td>Planting - Major Deciduous Trees – 3 inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.018x</td>
<td>Planting - Major Deciduous Trees – 3 ½ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.019x</td>
<td>Planting - Major Deciduous Trees – 4 inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.021x</td>
<td>Planting - Minor Deciduous Trees – size as specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.022x</td>
<td>Planting - Minor Deciduous Trees – 3 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.023x</td>
<td>Planting - Minor Deciduous Trees – 4 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.024x</td>
<td>Planting - Minor Deciduous Trees – 5 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.025x</td>
<td>Planting - Minor Deciduous Trees – ¾ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.026x</td>
<td>Planting - Minor Deciduous Trees – 1 inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.027x</td>
<td>Planting - Minor Deciduous Trees – 1 ¼ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.028x</td>
<td>Planting - Minor Deciduous Trees – 1 ½ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.029x</td>
<td>Planting - Minor Deciduous Trees – 1 ¾ inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.030x</td>
<td>Planting - Minor Deciduous Trees – 2 inch Caliper</td>
<td>Each</td>
</tr>
<tr>
<td>611.031x</td>
<td>Planting - Coniferous Trees – size as specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.032x</td>
<td>Planting - Coniferous Trees – 2 ½ foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.033x</td>
<td>Planting - Coniferous Trees – 3 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.034x</td>
<td>Planting - Coniferous Trees – 4 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.035x</td>
<td>Planting - Coniferous Trees – 5 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.036x</td>
<td>Planting - Coniferous Trees – 6 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.037x</td>
<td>Planting - Coniferous Trees – 7 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.038x</td>
<td>Planting - Coniferous Trees – 8 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.039x</td>
<td>Planting - Coniferous Trees – 9 foot height</td>
<td>Each</td>
</tr>
<tr>
<td>611.041x</td>
<td>Planting - Deciduous Shrubs – As Specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.042x</td>
<td>Planting - Deciduous Shrubs – 15 inch Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.043x</td>
<td>Planting - Deciduous Shrubs – 18 inch Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.044x</td>
<td>Planting - Deciduous Shrubs – 2 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.045x</td>
<td>Planting - Deciduous Shrubs – 3 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.046x</td>
<td>Planting - Deciduous Shrubs – 4 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.047x</td>
<td>Planting - Deciduous Shrubs – 5 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.048x</td>
<td>Planting - Deciduous Shrubs – 6 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.051x</td>
<td>Planting - Evergreen Shrubs – As Specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.052x</td>
<td>Planting - Evergreen Shrubs – 15 inch Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.053x</td>
<td>Planting - Evergreen Shrubs – 18 inch Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.054x</td>
<td>Planting - Evergreen Shrubs – 2 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.055x</td>
<td>Planting - Evergreen Shrubs – 2 ½ foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.056x</td>
<td>Planting - Evergreen Shrubs – 3 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.057x</td>
<td>Planting - Evergreen Shrubs – 3 ½ foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.058x</td>
<td>Planting - Evergreen Shrubs – 4 foot Height/Spread</td>
<td>Each</td>
</tr>
<tr>
<td>611.059x</td>
<td>Planting - Evergreen Shrubs – 5 foot Height/Spread</td>
<td>Each</td>
</tr>
</tbody>
</table>

x = Root Specification
1 = Ball & Burlap, Field Potted or Field Boxed,
2 = Container or Box Grown,
3 = Bare Root,
4 = In Ground Fabric Bag Grown

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>611.061y</td>
<td>Planting – Vines, Groundcovers – As Specified</td>
<td>Each</td>
</tr>
<tr>
<td>611.062y</td>
<td>Planting – Vines, Groundcovers – Number SP3 Container</td>
<td>Each</td>
</tr>
<tr>
<td>611.063y</td>
<td>Planting – Vines, Groundcovers – Number SP4 Container</td>
<td>Each</td>
</tr>
</tbody>
</table>

85
611.064y Planting – Vines, Groundcovers – Number SP5 Container Each
611.065y Planting – Vines, Groundcovers – Number 1 Container Each
611.066y Planting – Vines, Groundcovers – Number 2 Container Each
611.071y Planting - Herbaceous Plants – As Specified Each
611.072y Planting - Herbaceous Plants – Number SP4 Container Each
611.073y Planting - Herbaceous Plants – Number SP5 Container Each
611.074y Planting - Herbaceous Plants – Number 1 Container Each
611.075y Planting - Herbaceous Plants – Number 2 Container Each

y = Type Specification
1 = Container Grown, 2 = Bare Root
3 = Field Potted,

611.10 Transplanting 0 to 48 inch in height Each
611.11 Transplanting over 48 inch to 72 inches in height Each
611.12 Transplanting, over ¾ inch to 3 inches Diameter at Breast Height Each
611.13 Transplanting, over 3 inches to 6 inches Diameter at Breast Height Each
611.14 Transplanting over 6 inches to 12 inches Diameter at Breast Height Each
611.15 Transplanting Vines, Groundcovers, Each
611.16 Transplanting Herbaceous Plants Each
611.17 Portable Drip Irrigation System Each
611.18 Removal of Portable Drip Irrigation System Each
611.19 Post-Planting Care Each
611.20 Post-Planting Care Square yard
611.21 Rodent Guard Each

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

SECTION 612 (VACANT)

SECTION 613 - WILDLIFE AND ECOLOGY

613-1 DESCRIPTION.

613-1.01 Terrestrial Habitat. This work shall consist of the protection, preservation, restoration and management of terrestrial habitat.

613-1.02 Aquatic Habitat. This work shall consist of the protection, preservation, restoration and management of aquatic habitat.

613-1.04 Wetlands. This work shall consist of the protection, preservation, restoration and management of wetlands.

613-1.06 Streams and Riparian Zones. This work shall consist of the protection, preservation, restoration and management of rivers, streams and riparian zones.

613-2 MATERIALS. As specified in the special specifications.

613-3 CONSTRUCTION DETAILS. As specified in the special specifications.

613-4 METHOD OF MEASUREMENT. As specified in the special specifications.
613-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 614 - PRUNING, IMPROVING AND REMOVING EXISTING VEGETATION

614-1 DESCRIPTION.

614-1.01 Pruning Existing Trees. This work shall consist of pruning existing trees as shown in the contract documents and as directed by the Engineer.

614-1.02 Improvement of Vegetated Areas. This work shall consist of cutting, disposing of all wood and debris, stump removal, or mechanical or chemical treatment of specified trees and woody vegetation within the area shown in the contract documents and as directed by the Engineer.

614-1.03 Tree Removal. The work shall consist of felling trees over 4 inch in diameter at breast height, disposing of all wood and debris, and may require topping, stump removal and other work as shown in the contract documents and as directed by the Engineer.

614-1.04 Existing Stump Removal. The work shall consist of removing existing stumps, disposing of all wood and debris, as shown in the contract documents and as directed by the Engineer.

614-1.05 Tree Root Zone Treatment (Vertical Mulching/Aeration). This work shall consist of treating the root zone of trees through aeration and/or mulching of the roots as shown in the contract documents and as directed by the Engineer.

614-1.06 Tree Root Pruning. This work shall consist of cleanly pruning, existing tree roots severed during construction operations, typically related to linear excavation, as shown in the contract documents and as directed by the Engineer.

614-2 MATERIALS

614-2.01 Pruning Existing Trees. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Water 712-01

614-2.02 Improvement of Vegetated Areas. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Topsoil 713-01
Pesticides 713-13

614-2.03 Tree Removal. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Topsoil 713-01

614-2.04 Existing Stump Removal. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Topsoil 713-01
614-2.05 Tree Root Zone Treatment (Vertical Mulching/Aeration). The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

- Mortar Sand 703-03
- Mycorrhizal Fungi 713-09
- Compost 713-15

614-2.06 Tree Root Pruning. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

Water 712-01

614-3 CONSTRUCTION DETAILS

614-3.01 Pruning Existing Trees

A. Equipment. Workers shall employ accepted tree climbing methods, and shall not climb trees with climbing spurs. All tools used and methods employed in accordance ANSI A300 Part 1 Standard Practices, 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 disinfected with a 2% bleach solution and dried completely prior to the start of any work on a tree to prevent the spread of plant diseases.

B. Pruning. Pruning shall be in accordance ANSI A300 Part 1 Standard Practices. When specified the quantity of trees as shown in the contract documents shall be pruned so the resulting crown retains the growth habit of the tree species. Any and all branches interfering with or hindering the healthy growth of the tree shall be removed. All diseased branches and all dead branches 1 inch 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 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 branch bark ridge or callus collar. All existing nails, spikes, wire, plastic 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.

614-3.02 Improvement of Vegetated Areas. All trees and shrubs specified for removal will be designated by the Engineer either by separate marking, marking in sample areas, or otherwise. Unless otherwise specified, all stumps shall be cut to a height of about 6 inches above the ground. Unless otherwise specified, an approved herbicide shall be applied to all live stumps in accordance with the manufacturer's recommendations. An approved dye shall be added to the herbicide mixture to identify treated stumps and stubble. Where stump removal is specified, all stump holes shall be backfilled with topsoil, unless otherwise specified in the contract documents, and backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

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 in accordance with ANSI A300 Part 1 Standard Practices Pruning and ANSI Z133.1 Arboricultural Operations Safety.

Improvement of vegetated areas shall be completed in any area before any planting, seeding or other landscape 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 Section 201 Clearing and Grubbing.
614-3.03 Tree Removal. No tree shown in the contract documents or listed for removal shall be cut until it is approved by the Engineer. The contractor shall be responsible to coordinate all work involving utilities with the respective utility company. All trees shall be topped and limbed before felling unless otherwise approved. All injuries to the limbs, bark and roots of plants to remain shall be repaired in accordance with ANSI A300 Standard Practices Pruning and ANSI Z133.1 Arboricultural Operations Safety.

The Contractor shall field measure all trees at 4 ½ feet above the ground, commonly referred to as Diameter Breast Height (DBH) before they are cut.

Stumps of trees removed under this item for removal shall be grubbed, cut, ground to the depth of six inches below grade or as specified in the contract documents. All stump holes shall be backfilled with topsoil, unless otherwise specified in the contract documents and backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

614-3.04 Existing Stump Removal. Existing stumps listed for removal in the contract documents shall be ground to the depth of 6 inches below grade unless otherwise specified in the contract documents. Stumps shall include all visible wood and roots. Backfill to finished grade with topsoil, unless otherwise specified in the contract documents. The backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

614-3.05 Tree Root Zone Treatment (Vertical Mulching/Aeration). Locations of work shall include areas within the dripline or wider root zone of existing trees to be preserved as shown on the contract documents.

Appropriate drilling tools shall be used for drilling of holes for root zone restoration. Drilling equipment shall be hand held or light weight devices (no heavy machinery) so as to avoid further impact to tree roots through compaction.

Holes shall be drilled and existing soil removed within a zone beginning 3 feet from the trunk of the specified tree and extending to its dripline on an approximately 2 foot x 2 foot grid. Dimensions of holes or drill size shall be approximately 2 inches in diameter and a minimum of 12 inches deep. Efforts should be made to minimize drilling through large tree roots (especially near the trunk). When woody roots are encountered, the drill hole shall be moved to avoid root damage.

The hole shall be completely filled to original grade as follows:

Method 1: with mortar sand
Method 2: with mortar sand amended with Mycorrhizal Fungi.
Method 3: with compost.
Method 4: with compost amended with Mycorrhizal Fungi.

When mycorrhizal fungi are specified, they shall be a dry granular powder specifically designed for vertical mulching applications. Apply in accordance with the manufacturer’s recommendations at a rate of 3 ounces per hole or when pre-mixed in bulk 5 pounds per cubic yard of sand or compost.

614-3.06 Tree Root Pruning. Existing tree roots greater than 1 inch in diameter, measured at the edge of excavation, shall be pruned within 24 hours of the time they have been damaged by construction activity. The severed root shall be pruned at the edge of excavation, or 1 inch beyond the entire damaged portion of the tree root if damaged root extends beyond the edge of excavation into undisturbed soil. Pruning shall be in accordance with ANSI A300 Part 1 Standard Practices Pruning and ANSI Z133.1 Arboricultural Operations Safety. All cuts shall be cleanly made with sharp tools. The cutting surfaces of all tools, ladders, ropes, soles of workers shoes and other objects coming into contact with the tree roots shall be washed with a disinfectant at the start of any work on a tree to prevent the spread of plant diseases.
The excavated area around the existing tree roots shall be backfilled as soon as construction activities permit with the specified or approved materials. If the excavated area around the existing tree roots is not backfilled within 24 hours, all roots shall be kept moist, to prevent dessication.

614-4 METHOD OF MEASUREMENT

614-4.01 Pruning Existing Trees. The quantity to be measured for payment will be the number of trees pruned.

614-4.02 Improvement of Vegetated Areas. The quantity to be measured for payment will be in square yards measured to the nearest whole square yard of area improved.

614-4.03 Tree Removal. The quantity to be measured for payment will be the number of trees, including their stumps if specified.

614-4.04 Pre-Existing Stump Removal. The quantity to be measured for payment will be the number of pre-existing stumps removed.

614-4.05 Tree Root Zone Treatment (Vertical Mulching/Aeration). The quantity to be measured for payment will be in square yards treated within the zone, measured to the nearest square yard.

614-4.06 Tree Root Pruning. The quantity to be measured for payment will be in feet to the nearest whole foot, along excavation line.

614-5 BASIS OF PAYMENT

614-5.01 Pruning Existing Trees. The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

614-5.02 Improvement of Vegetated Areas. The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

614-5.03 Tree Removal. The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

When trees are specified in the contract documents for removal, payment for each tree removal will include removal of the stump.

614-5.04 Existing Stump Removal. The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

614-5.05 Tree Root Zone Treatment. The unit price bid shall include the cost of labor, materials, equipment and incidentals necessary to complete the work. Mycorrhizal Fungi and mulch will be paid for separately.

614-5.06 Tree Root Pruning. The unit price bid shall include the cost of labor, materials, equipment and incidentals 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>614.0411</td>
<td>Care of Trees up to 12” Diam. at Breast Height – Pruning</td>
<td>Each</td>
</tr>
<tr>
<td>614.0421</td>
<td>Care of Trees Over 12” to 24” Diam. at Breast Height - Pruning</td>
<td>Each</td>
</tr>
</tbody>
</table>
614.0431 Care of Trees Over 24” to 36” Diam. at Breast Height – Pruning Each
614.0441 Care of Trees Over 36” to 48” Diam. at Breast Height – Pruning Each
614.0451 Care of Trees Over 48” to 60” Diam. at Breast Height – Pruning Each
614.0461 Care of Trees Over 60” Diam. at Breast Height – Pruning Each
614.05 Improvement of Vegetated Areas Square Yard
614.0601nn Tree Removal Over 4” to 6” Diam. Breast Height Each
614.0602nn Tree Removal Over 6” to 12” at Breast Height Each
614.0603nn Tree Removal Over 12” to 18” at Breast Height Each
614.0604nn Tree Removal Over 18” to 24” at Breast Height Each
614.0605nn Tree Removal Over 24” to 36” at Breast Height Each
614.0606nn Tree Removal Over 36” to 48” at Breast Height Each
614.0607nn Tree Removal Over 48” to 60” at Breast Height Each
614.0608nn Tree Removal Over 60” to 72” at Breast Height Each

nn = Stump Treatment
01 = Stumps Cut to Above Grade, 02 = Stumps Cut Flush,
03 = Stumps Cut to Below Grade, 04 = Stumps Grubbed

614.0701 Pre-Existing Stump Removal up to 24” diameter at 6 inches above grade Each
614.0702 Pre-Existing Stump Removal over 24” to 48” diameter at 6 inches above grade Each
614.0703 Pre-Existing Stump Removal over 48” diameter at 6 inches above grade Each
614.08 Tree Root Zone Treatment (Vertical Mulching/Aeration) Square Yard
614.09 Tree Root Pruning Feet

SECTION 615 - LANDSCAPE APPURTEINANCES

615-1 DESCRIPTION. The work in this section shall include all work required for furnishing, placing, and/or special construction of landscape appurtenances.

615-2 MATERIALS. As specified in the special specifications.

615-3 CONSTRUCTION DETAILS. As specified in the special specifications.

615-4 METHOD OF MEASUREMENT. As specified in the special specifications.

615-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 616 - SOIL BIOENGINEERING

616-1 DESCRIPTION. This section shall include work required for soil bioengineering

616-2 MATERIALS. As specified in the special specifications.

616-3 CONSTRUCTION DETAILS. As specified in the special specifications.

616-4 METHOD OF MEASUREMENT. As specified in the special specifications.

616-5 BASIS OF PAYMENT. As specified in the special specifications.
SECTION 617 - INVASIVE SPECIES MANAGEMENT

617-1 DESCRIPTION. This work shall consist of the control, eradication and management of invasive species.

617-2 MATERIALS. As specified in the special specifications.

617-3 CONSTRUCTION DETAILS. As specified in the special specifications.

617-4 METHOD OF MEASUREMENT. As specified in the special specifications.

617-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 618 (VACANT)

SECTION 619 - WORK ZONE TRAFFIC CONTROL
(Last Revised September, 2017)

619-1 DESCRIPTION

619-1.01 General. Work zone traffic control shall consist of all work necessary to provide for the safe and efficient movement of traffic through or around work zones, and to protect workers and the public from damage to person and property which may result, directly or indirectly, from any construction operations. Work zone traffic control shall be completed under the direction of a trained, competent person, as shown in the contract documents, the MUTCD and as directed by the Engineer. The duration of this work shall be from the date any work is started on the contract site, including mobilization of equipment, signs, offices, and shops until the date of contract final acceptance. Temporary materials and components that are furnished by the Contractor shall remain the property of the Contractor.

See Figure 619-1 Component Parts of a Typical Highway Work Zone for definitions of terms.

619-1.02 Basic Work Zone Traffic Control. Work shall consist of controlling traffic over a reasonably smooth traveled way which shall be marked by signs, delineators, channelizing devices, pavement markings, and other devices as shown in the contract documents or as directed by the Engineer. Work after sunset and before sunrise shall include additional requirements for nighttime operations including, but not limited to, a written plan for nighttime operations, additional worker and equipment protection, additional channelizing devices and contract site patrol.

The Contractor shall conduct its operations to ensure the safety and convenience of travelers and abutting property owners as well as the safety of all workers on the contract. Travelers include, but may not be limited to motorists, motorcyclists, bicyclists and pedestrians.

Work shall be scheduled to keep the time and distance that existing pavement is removed or substantially disturbed to a minimum and consistent with the physical requirements of the contract. Unless otherwise indicated in the contract documents, the distance over which traffic is maintained on an unpaved surface shall not exceed 1/2 mile at any one time. During seasonal shutdown periods, no part of the highway shall be closed to traffic unless provided for in the contract documents, or the Contractor has submitted and the Engineer has approved a detailed schedule of operations reflecting a proposal to close the highway to traffic.

Basic work zone traffic control shall include the following:
A. Surface Condition, Debris, Drainage and Dust Control. Work shall consist of maintaining the surface condition of the traveled way, including detours, consistent with the preconstruction posted speed limit; including maintaining positive drainage, dust control and keeping the roadway free from debris and materials spilled from or tracked by vehicles or equipment. Debris and dust shall be controlled on all operations.

B. Seasonal Operations and Snow and Ice Control. Work shall consist of maintaining the traveled way to facilitate safe, efficient travel and permit snow and ice control by others during winter months and during any period that work is suspended.

C. Maintain Public Access. Work shall consist of maintaining public access to intersecting roads, residences, business establishments, adjacent property, bus stops and transportation facilities for vehicles, pedestrians, and bicyclists.

D. Maintain Existing Roadside Signs, Delineators and Markers. Work shall consist of maintaining, in their existing condition, existing highway signs, delineators, and markers within the contract limits.

E. Maintain Existing Guide Rail, Median Barrier and Bridge Rail. Work shall consist of maintaining existing traffic barriers and other safety devices, in their existing condition, within the contract limits.

F. Construction Vehicles and Equipment. Work shall consist of equipping construction vehicles and equipment with warning lights and reflective markings; and maintenance of vehicles and equipment in safe operating condition.

G. Barrier/Shadow Vehicles.

1. Barrier Vehicles. Work shall consist of furnishing barrier vehicles to guide traffic and protect workers in stationary lane and shoulder closures and other stationary temporary traffic control zones, as shown in the contract documents or as directed by the Engineer.

2. Shadow Vehicles. Work shall consist of furnishing shadow vehicles to guide traffic and to protect workers in mobile or short duration work zones not protected by stationary lane or shoulder closures, as shown in the contract documents or as directed by the Engineer.

H. Construction Signs. Work shall consist of furnishing, installing, moving, maintaining, deactivating, and removing construction signs, including warning lights, as shown in the contract documents or as directed by the Engineer.

I. Arrow Panels. Work shall consist of furnishing, installing, maintaining, and removing arrow panels as shown in the contract documents or as directed by the Engineer. Arrow panels are used to warn and guide traffic when travel lanes are temporarily closed by construction activities.

J. Channelizing Devices. Work shall consist of furnishing, placing, maintaining and removing channelizing devices, with warning lights where required, including drums, vertical panels, construction barricades, cones, and temporary tubular markers. Type III construction barricades and interim tubular markers may be specified under separate pay items.

K. Pavement Edge Drop-Off Protection. Work shall consist of furnishing and maintaining protection for edge drop-offs adjacent to the pavement or shoulder.
L. Flagging and Traffic Control. Work shall consist of furnishing the necessary traffic control equipment and flaggers for adequate traffic control. Portable traffic signal systems authorized by the Engineer may be utilized only on a highway designated as a Restricted Highway.

M. Maintain Existing Mailboxes. Work shall consist of maintaining postal route mailboxes serviced from vehicles, in a useable condition and location consistent with U.S. Postal Service requirements.

N. Contract Site Patrol. Work shall consist of furnishing personnel to patrol the contract area as necessary to ensure conditions on the site are adequate for public safety and convenience at all times.

619-1.03 Basic Work Zone Traffic Control (Daily Operations). Work shall consist of controlling and protecting traffic during a single work shift as shown in the contract documents, or as directed by the Engineer. The Contractor will not be required to repair or maintain the surface of the traveled way and other roadway features not part of the work, except to repair damage resulting from the Contractor’s operations.

619-1.04 Temporary Business Signs. Work shall consist of furnishing, installing, moving, covering, maintaining, and removing temporary business signs as shown in the contract documents or as directed by the Engineer.

619-1.05 Covering or Removal of Pavement Markings. Work shall consist of removing or covering existing permanent pavement markings, interim pavement markings, and temporary pavement markings including, but not limited to: edge lines, lane lines, center lines, crosswalks, stop bars, arrows, symbols, and diagonal markings in gores and medians as shown in the contract documents or as directed by the Engineer.

619-1.06 Temporary Pavement Markings. Work shall consist of furnishing and applying temporary pavement markings as shown in the contract documents or as directed by the Engineer. The work for removable pavement tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall include removal. Temporary pavement markings are intended for use on any new pavement or milled surface until the subsequent course is placed or interim pavement markings or final pavement markings are installed.

619-1.07 Interim Pavement Markings. Work shall consist of furnishing, applying, and maintaining, interim pavement markings as shown in the contract documents or as directed by the Engineer. Interim pavement markings are intended for use in diversions, temporary pavement realignments and crossovers, lane shifts and closures, and other traffic patterns associated with construction activities. Interim pavement markings are intended for use for a given phase or season, for a maximum of 1 year.

619-1.08 Temporary Rumble Strips. Work shall consist of installing, maintaining, and removing temporary rumble strips at the locations shown in the contract documents or as directed by the Engineer.

619-1.09 Interim Tubular Markers. Work shall consist of furnishing, installing, moving, and maintaining interim tubular markers attached to the pavement as shown in the contract documents or as directed by the Engineer. Interim tubular markers are typically used for 2-way, 2-lane freeway work zones and long-term closures where available width is limited.

619-1.10 Portable Variable Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS).
A. Portable Variable Message Signs (PVMS). Work shall consist of furnishing, installing, operating, maintaining, relocating, and removing PVMS as shown in the contract documents or as directed by the Engineer. PVMS with a pay unit of each shall be provided for the duration of the contract at the general locations specified in the contract documents and in accordance with the Special Note Requirements for Portable Variable Message Signs (PVMS). PVMS with a pay unit of weeks shall be provided at general locations and durations in accordance with the Special Note Requirements for Portable Variable Message Signs (PVMS) and the contract documents.

PVMS are intended to supplement other traffic control devices by displaying symbolic or word messages, but are not to be used alone to replace conventional traffic control devices.

B. Truck Mounted Variable Message Signs (TMVMS). Work shall consist of furnishing, installing, operating, maintaining and relocating TMVMS as shown in the contract documents or as directed by the Engineer. TMVMS with a pay unit of each shall be provided for the duration of the contract at the general locations specified in the contract documents. TMVMS with a pay unit of weeks shall be provided at general locations and durations in accordance with the Special Note Requirements for Truck Mounted Variable Message Signs and the contract documents. TMVMS are intended to supplement other traffic control devices by displaying symbolic or word messages. They may only be used alone to replace conventional traffic control devices in mobile and short duration work zones or situations of limited duration.

619-1.11 Type III Construction Barricades. Work shall consist of furnishing, installing, moving, maintaining, and removing Type III construction barricades, with warning lights where specified, as shown in the contract documents or as directed by the Engineer.

619-1.12 Temporary Concrete Barrier. Work shall consist of furnishing, installing, moving, maintaining, and removing temporary concrete barrier, including barrier warning lights and transitions to and from guide rail where specified, as shown in the contract documents or as directed by the Engineer.

619-1.13 Temporary Glare Screen. Work shall consist of furnishing, installing, moving, maintaining, and removing glare screen mounted on a concrete barrier as shown in the contract documents or as directed by the Engineer.

619-1.14 Temporary Impact Attenuator. Work shall consist of furnishing, installing, maintaining, repairing, moving and removing temporary impact attenuators as shown in the contract documents or as directed by the Engineer.

619-1.15 Temporary Sand Barrel Arrays. Work shall consist of furnishing, installing, maintaining, relocating and removing temporary sand barrel arrays as shown in the contract documents or as directed by the Engineer.

619-1.16 Vehicle Arresting Barrier. Work shall consist of providing vehicle arresting barriers (net-type) and their anchorages as shown on the Standard Sheets to prevent errant vehicles from entering a closed work area as shown in the contract documents or as directed by the Engineer.

619-1.17 Maintain or Modify Traffic Signal Equipment. Work shall consist of modifying or maintaining in proper operation, existing, relocated, modified, or newly installed traffic signals as shown in the contract documents or as directed by the Engineer.

619-1.18 Temporary Traffic Signals. Work shall consist of furnishing, installing, moving, maintaining, and removing temporary traffic signals and necessary components as shown in the contract documents or as directed by the Engineer. Temporary signals shall be installed only on a highway designated as a Restricted Highway.
619-1.19 **Nighttime Operations.** Work shall consist of developing a Nighttime Operations and Lighting Plan, and furnishing, installing, operating, maintaining, moving and removing lighting equipment for nighttime construction operations as shown in the contract documents or as directed by the Engineer.

619-1.20 **Traffic Control Supervisor.** Work shall consist of providing a full-time traffic control supervisor having adequate training, experience, and authority to implement and maintain all traffic control operations, as shown in the contract documents or as directed by the Engineer.

619-1.21 **Temporary Structures and Approaches.** Work shall consist of designing, constructing, moving, maintaining, and removing temporary structures, and necessary appurtenances, as shown in the contract documents or as directed by the Engineer. Temporary structures may also include temporary structural elements added to an existing structure to allow temporary use, or staged removal, of the structure.

619-1.22 **Pavement Patching.** Work shall consist of providing and installing pavement patching materials to maintain pavements open to traffic in acceptable condition as shown in the contract documents or as directed by the Engineer.

619-1.23 **Mailboxes.** Work shall consist of relocating or replacing postal route mailboxes and/or mailbox supports consistent with U.S. Postal Service requirements, as shown in the contract documents or as directed by the Engineer.
FIGURE 619-1 COMPONENT PARTS OF A TYPICAL HIGHWAY WORK ZONE
619-2 MATERIALS.

619-2.01 General. All materials used shall comply with the requirements of the following subsections of Section 700 Materials and Manufacturing, or as established by this section, the applicable Standard Sheets, and the contract documents.

Concrete Grouting Material 701-05
Precast Concrete Barrier 704-05
Epoxy Polysulfide Grout 721-03
Traffic Signal Heads 724-04
Removable Raised Pavement Markers 727-02
Epoxy Paint 727-03
Permanent Tape 727-04
Glass Beads for Pavement Markings 727-05
Removable Pavement Tape 727-06
Removable Wet-Night Reflective Tape 727-07
Permanent Wet-Night Reflective Tape 727-08
Traffic Paint 727-09
Drums 729-01
Cones 729-02
Temporary Tubular Markers 729-03
Vertical Panels 729-04
Stop/Slow Paddles 729-05
Type II Construction Barricades 729-07
Type III Construction Barricades 729-08
Temporary Sign Supports 729-09
Temporary Impact Attenuators - Redirective 729-10
Temporary Impact Attenuators - Gating 729-11
Truck-Mounted Impact Attenuators 729-12
Temporary Sand Barrels 729-13
Vehicle Arresting Systems 729-14
Arrow Panels 729-15
Portable Variable-Message Signs 729-16
Temporary Glare Screens 729-17
Warning Lights 729-18
Truck Mounted Variable Message Signs 729-22
Aluminum Sign Panels 730-01
Temporary Plywood Sign Panels 730-02
Temporary Rigid Lightweight Sign Panels 730-03
Reflective Sheeting 730-05
Reflectorized Sheeting Sign Characters (Type IV) 730-12
Reflectorized Sheeting Sign Characters (Type V) 730-13
Temporary Wooden Sign Posts 730-19
Stiffeners, Overhead Brackets and Miscellaneous Hardware 730-22
Fiberglass Reinforced Plastic Sign Panels 730-23
Type A Sign Supports 730-24
Type B Sign Supports 730-25
619-2.02 Basic Work Zone Traffic Control.

A. Surface Condition, Debris, Drainage and Dust Control. Materials used to repair pavement surfaces shall be compatible with the pavement. In general, plant-mixed hot mix asphalt is suitable for all pavement surfaces to be repaired. Material other than plant-mixed hot mix asphalt may be used if approved by the Engineer.

Environmentally compatible, approved dust palliatives may be used in conformance with any conditions placed on their use.

B. Seasonal Operations and Snow and Ice Control. (None Specified)

C. Maintain Public Access. (None Specified)

D. Maintain Existing Roadside Signs, Delineators and Markers. All materials used to maintain existing roadside appurtenances shall be consistent with the features to be maintained.

E. Maintain Existing Guide Rail, Median Barrier and Bridge Rail. All materials used to maintain existing roadside appurtenances shall be consistent with the features to be maintained.

F. Construction Vehicles and Equipment. All vehicles with a GVWR greater than 10,000 lbs and with restricted visibility to the rear shall be equipped with an operational audible backup alarm. Any vehicle with a non-operational backup alarm shall be taken out of service until the alarm is repaired.

All vehicles and equipment within the contract limits and on the roadway shall be equipped with a rotating amber or flashing Light Emitting Diode (LED) beacon visible from all directions for a minimum of 1,000 feet during daylight. Flashing LED beacons shall meet the requirements of SAE J845 Class 2. Strobe lights shall not be used.

All trucks with a GVWR greater than 10,000 lbs shall display a minimum 2 inch wide band of reflective sheeting on the front, rear and each side. The sheeting need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the body or trailer. The centerline of the sheeting shall be between 15 inches and 60 inches above the ground. All other construction equipment shall display a minimum 2 inch wide band of reflective sheeting on the front and rear (100 square inches per end minimum) as practicable. Reflective markings on construction vehicles and equipment shall conform to §730-05 Reflective Sheeting ASTM Type III, Type VII or Type IX.

G. Barrier/Shadow Vehicles. Barrier/Shadow vehicles shall weigh a minimum of 18,000 lb and shall be equipped with a Type B or Type C Arrow Panel. Ballast may be used to bring a lighter vehicle up to the indicated weight provided the ballast is securely contained within an enclosed body or otherwise securely fastened to the vehicle such that the ballast will not separate from the vehicle upon impact. Where the preconstruction posted speed limit is 55 mph or less, barrier/shadow vehicles shall be equipped with a Test Level-2 truck mounted or trailer mounted impact attenuator. Where the preconstruction posted speed limit is more than 55 mph, barrier/shadow vehicles shall be equipped with a Test Level-3 truck mounted or trailer mounted impact attenuator. Impact attenuators meeting the requirements of NCHRP 350 Test Level 3 are also acceptable as Test Level 2 devices.

Where a barrier vehicle remains stationary for extended periods of time, the Contractor may utilize a barrier trailer in lieu of a barrier vehicle. A barrier trailer is a trailer that may be detached from the tow vehicle and that meets barrier vehicle weight, arrow board, attenuator and placement distance requirements.

H. Construction Signs. 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, including face shape, color, dimensions, and characters shall be fabricated using colors,
character series, character sizes, symbols, route shields and borders as shown in the MUTCD or in the contract documents.

1. **Sign Panels.** Modification of sign legends by overlaying an existing legend with a revised legend, changing a single word or distance, such as changing LEFT to RIGHT or 1000 to 1500 will be permitted if the overlay is a match to the rest of the sign in terms of legend size and type, sheeting color and reflectivity. The overlay shall be firmly adhered to the underlying panel. Any such overlays shall provide a visual match to the rest of the sign when viewed from a distance of 100 feet or greater during all periods in which the sign will be used.

   a. **Rigid Sign Panels.** Rigid sign panels shall be aluminum, fiberglass, plywood, or lightweight plastic. Orange signs on rigid panels shall conform to §730-05 Reflective Sheeting fluorescent-orange ASTM Type IX (Class E) sheeting. All other colors of construction sign faces on rigid panels shall conform to §730-05 Reflective Sheeting ASTM Type III (Class B) sheeting. White characters and borders shall conform to §730-12 Reflectorized Sheeting Sign Characters (Type IV) or §730-13 Reflectorized Sheeting Sign Characters (Type V). Shields shall be either demountable or directly applied panels and shall conform to §730-13 Reflectorized Sheeting Sign Characters (Type V). Black sign characters and background shall be non-reflective and shall conform to §730-13 Reflectorized Sheeting Sign Characters (Type V).

   b. **Flexible Sign Panels.** Flexible sign panels shall be a solid, fluorescent-orange, durable elastomeric material. Flexible panels fabricated from mesh will not be allowed. 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.

2. **Mounting Temporary Signs.** Temporary sign supports, except those located beyond the deflection distances of guide rail or temporary barrier as given in Table 619-6 Guide Rail & Concrete Barrier Standard Deflection Distances or otherwise protected against impact by errant vehicles, shall meet the following requirements for portable or fixed supports. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. All wood supports shall be painted white.

   a. **Portable Temporary Sign Supports.** Ballast used to stabilize supports shall be bagged sand or other suitable material, and shall be located at ground level. Portable supports shall be a configuration which is NCHRP 350 approved, or be constructed in accordance with a Standard Sheet(s).

   b. **Fixed Temporary Sign Supports.** The Contractor shall provide NCHRP 350 approved Type A, Type B or wooden sign posts in accordance with §730-19 Temporary Wooden Sign Posts, §730-24 Type A Sign Supports, or §730-25 Type B Sign Supports as appropriate.

3. **Sign Covers.** Covers used to inactivate unneeded construction signs shall be a single dark color, opaque material containing no wording or images. Rigid covers shall match the size and shape of the sign panel(s). Fabric sign covers may require more than one layer of fabric to prevent legibility of the sign being covered. Rigid Lightweight panels used as covers shall meet the requirements §730-03 Temporary Rigid Lightweight Sign. Signs hinged on the back side of the sign face to fold at the center and completely cover the sign face may be used.

   1. **Arrow Panels.** Arrow panels shall be in accordance with §729-15 Arrow Panels.
J. **Channelizing Devices.** Drums shall be in accordance with §729-01 Drums. Standard cones, tall cones and extra tall cones shall be in accordance with §729-02 Cones. Temporary tubular markers shall be in accordance with §729-03 Temporary Tubular Markers. Standard and oversized vertical panels shall be in accordance with §729-04 Vertical Panels. Type II construction barricades shall be in accordance with §729-07 Type II Construction Barricades.

K. **Pavement Edge Drop-off Protection.** (None Specified)

L. **Flagging and Traffic Control.** Hand signaling devices used to control traffic shall meet the requirements of the MUTCD. The standard signaling device shall be STOP/SLOW signal paddles in accordance with §729-05 Stop/Slow Paddles. Red signal flags shall be a minimum of 24 inches x 24 inches. Automated Flagging Assistance Devices shall be in accordance with §729-19 Automated Flagging Assistance Devices. Portable traffic signals shall be in accordance with §729-20 Portable Traffic Signals.

M. **Maintain Existing Mailboxes.** (None Specified)

N. **Contract Site Patrol.** (None Specified)

619-2.03 **Basic Work Zone Traffic Control (Daily Operations).** (None Specified)

619-2.04 **Temporary Business Signs.** Temporary business signs shall conform to the MUTCD. Sign panels shall be in accordance with ‘619-2.02H.1. Sign Panels, except that the panels shall be white on a blue background. Supplemental arrows, as required, shall be white on a blue background (M5-1 to M6-2). Temporary business signs shall be mounted on temporary sign supports.

619-2.05 **Covering or Removal of Pavement Markings.** Tape used to cover existing pavement markings shall be non-reflective, pavement marking masking tape, substantially similar in color to the pavement surface, in accordance with §727-06 Removable Pavement Tape.

619-2.06 **Temporary Pavement Markings.** Temporary pavement markings shall consist of removable raised pavement markers in accordance with §727-02 Removable Raised Pavement Markers, or removable pavement tape in accordance with §727-06 Removable Pavement Tape, or removable wet-night reflective tape in accordance with §727-07 Removable Wet-Night Reflective Tape, or traffic paint in accordance with §727-09 Traffic Paint and §727-05 Glass Beads for Pavement Markings, or temporary overlay markers in accordance with §729-21 Temporary Overlay Markers.

619-2.07 **Interim Pavement Markings.** Interim pavement markings shall consist of traffic paint in accordance with §727-09 Traffic Paint and §727-05 Glass Beads for Pavement Markings, epoxy paint in accordance with §727-03 Epoxy Paint and §727-05 Glass Beads for Pavement Markings, removable pavement tape in accordance with §727-06 Removable Pavement Tape, removable wet-night reflective tape in accordance with §727-07 Removable Wet-Night Reflective Tape. Interim pavement markings shall be supplemented, where specified, with removable raised pavement markers in accordance with §727-02 Removable Raised Pavement Markers.

619-2.08 **Temporary Rumble Strips.**

A. **Raised Asphalt Rumble Strips.** Raised asphalt rumble strips shall be formed from 6.3 or 9.5 hot mix asphalt. Asphalt Emulsion Tack Coat shall be used to adhere the rumble strip to the existing pavement.
B. Raised, Removable-Tape Rumble Strips. Removable-tape rumble strips shall be formed from black, non-reflectorized, removable pavement-marking tape. Raised, removable-tape rumble strips shall have a minimum width of 6 inches, measured in the direction of traffic, with sufficient layers of tape such that each finished rumble strip has a thickness of 3/8 inches ± 1/8 inch.

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 of 4 inches, measured in the direction of traffic, with a thickness of between ¼ inch and ½ inch.

D. Saw-Cut Rumble Strips. Saw-cut rumble strips shall have a width of 4 inches ± ½ inch measured in the direction of traffic. The depressions shall have a rectangular cross section with a depth of 3/8 inches ± 1/8 inch.

E. Milled-in Rumble Strips. Milled-in rumble strips shall have a nominal width of 6 inches measured in the direction of traffic. The depressions shall have a semicircular, concave cross section with a depth of 3/8 inches ± 1/8 inch.

F. Removing Temporary Rumble Strips. Rumble strip depressions shall be filled in with a 6.3 or a 9.5 hot mix asphalt meeting the requirements of Section 402, Hot Mix Asphalt (HMA) Pavements.

619-2.09 Interim Tubular Markers. Interim tubular markers shall be in accordance with §729-03 Temporary Tubular Markers.

619-2.10 Portable Variable-Message Signs (PVMS) & Truck Mounted Variable Message Signs (TMVMS). Portable Variable-Message Signs shall be in accordance with §729-16 Portable Variable-Message Signs (PVMS). Truck Mounted Variable Message Signs (TMVMS) shall be in accordance with §729-22 Truck Mounted Variable Message Signs. When a TMVMS is used as an arrow board, it shall comply with 729-15 Arrow Panels.

619-2.11 Type III Construction Barricades. Type III construction barricades shall be fabricated in accordance with §729-08 Type III Construction Barricades. All barricades used at night shall be equipped with warning lights in accordance with §729-18 Warning Lights.

619-2.12 Temporary Concrete Barrier. Temporary concrete barrier segments shall be precast concrete units in accordance with the Standard Sheets or approved Materials Details. All temporary concrete barrier supplied after January 1, 2015 shall be produced in accordance with the requirements of §704-05 Precast Concrete Barrier, and shall have a legible permanent marking. Temporary concrete barrier supplied prior to January 1, 2015 which was not produced in accordance with the requirements of §704-05 Precast Concrete Barrier, shall be material certified in accordance with specific Standard Sheets or Materials Details used for fabrication.

Warning lights for temporary concrete barrier with warning lights shall be in accordance with §729-18 Warning Lights. Where warning lights are not required, temporary concrete barrier segments shall be delineated using reflective panels covered with ASTM Type IX sheeting, approximately 3 x 6 inch, having a minimum area of 18 square inches. Where warning lights are required, barrier need not be delineated with panels. Reflective pavement marking material applied to the face of the barrier shall not, by itself, be considered acceptable delineation. Where transitions between Temporary Concrete Barrier and box beam are required, the box beam shall be in accordance with the requirements of §710-21 Box Beam Guide Railing and Median Barrier. Where required, the Transition End Pieces shall be precast concrete units in accordance with the Standard Sheets and shall be produced in accordance with the requirements of §704-05 Precast Concrete Barrier with a legible permanent marking.
619-2.13 **Temporary Glare Screen.** Temporary glare screen shall be in accordance with §729-17 Temporary Glare Screens.

619-2.14 **Temporary Impact Attenuator.** Temporary impact attenuators shall be in accordance with §729-10 Temporary Impact Attenuators - Redirective or §729-11 Temporary Impact Attenuators - Gating.

619-2.15 **Temporary Sand Barrel Arrays.** Temporary sand barrels shall meet the requirements of §729-13 Temporary Sand Barrels. Sand fill shall meet the material requirements of §703-06 Cushion Sand or §203-2.02I. Sand Backfill. Deicing material shall meet the requirements of §712-03 Sodium Chloride.

619-2.16 **Vehicle Arresting Barrier (VAB).** Vehicle arresting barriers shall meet the requirements of §729-14 Vehicle Arrester Systems. Portland Cement Concrete used for bases shall be Class A or C, except that requirements for automated batching shall not apply.

619-2.17 **Maintain or Modify Traffic Signal Equipment.** All traffic signal hardware, including but not limited to wire, cable, conduit, pull boxes, switch packs, modules and relays, detectors, signal heads, poles, and pedestrian push buttons used to maintain proper operation, shall meet the applicable requirements of Section 680 Traffic Signals. Materials which will be permanently incorporated into the work shall be in accordance with Section 680 Traffic Signals.

619-2.18 **Temporary Traffic Signals.** Equipment for temporary traffic signals shall meet the requirements of Section 680 Traffic Signals, except that used equipment in good operating condition may be furnished, and for which material certifications are not required. 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. Portable traffic signals shall be in accordance with §729-20 Portable Traffic Signals.

All other equipment for temporary traffic signals shall meet the requirements of Section 680 Traffic Signals except for the following modifications:

- **A. Temporary Poles.** Temporary timber poles shall be ANSI O5.1, Class 2, treated with an appropriate waterborne wood preservative. Preservative retention shall be appropriate for the species when used in ground-contact application.

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

- **C. Traffic Signal Heads.** The materials and painting requirements of '724-04 Traffic Signal Heads shall not apply except that the signal head housing shall be dark green.

- **D. 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.

619-2.19 **Nighttime Operations.** (None Specified)

619-2.20 **Traffic Control Supervisor.** (None Specified)

619-2.21 **Temporary Structures and Approaches.** When specific details and materials are shown in the contract documents for temporary structures, substitutions or alterations may be permitted if approved by Deputy Chief Engineer (Structures) (DCES).

When specific details are not shown in the contract documents, the Contractor shall assume all liability and responsibility for determining that all materials required conform to the AASHTO Standard
Specifications for Highway Bridges or AASHTO LRFD Bridge Design Specifications, unless otherwise approved by the DCES. Used material shall not be furnished for fracture-critical members. Mill certifications shall be provided for all fracture critical material. Excluded from this provision are pedestrian and pre-engineered (fabricated) proprietary structures.

619-2.22 Pavement Patching. In general, hot mix asphalt (HMA) is suitable for all pavement surfaces. During winter months when HMA is not available, a bituminous cold-patch material shall be used.

619-2.23 Mailboxes. Materials used shall meet the requirements of the U.S. Postal Service.

619-3 CONSTRUCTION DETAILS

619-3.01 General. The Contractor shall designate a work zone traffic control competent person who has the primary responsibility and sufficient authority for implementing the work zone traffic control plan and other safety and mobility aspects as necessary. The Contractor’s work zone traffic control competent person shall be appropriately experienced and adequately trained in traffic control operations by recognized training programs, including the American Traffic Safety Services Association (ATSSA) “Traffic Control Supervisor”, the National Safety Council, unions, or construction industry associations, or by an individual instructor from such a program in accordance with the level of decisions that the individual will be required to make, reflecting current industry practices and Department requirements.

The Contractor shall generally maintain a traveled way suitable for moving traffic, in accordance with the contract documents and ensure construction equipment, vehicles, and materials are safely stored beyond the clear zone or behind protective barrier during non-working hours so as not to constitute a hazard to vehicles, bicycles and pedestrians. Construction operations shall be conducted to ensure a minimum of delay to traffic. Stopping traffic for more than 5 minutes shall not be permitted unless specifically authorized in the contract documents or in writing by the Engineer. All operations shall be carried out in a manner that provides workers with safe access to the worksite and protects workers from moving traffic. The work zone traffic control competent person shall routinely inspect all work zone traffic control equipment and devices to make sure they are in a safe operating condition in accordance with §619-3.02N Contract Site Patrol. Unless otherwise noted, temporary items supplied in accordance with this section shall remain the property of the Contractor.

Where pedestrians are not prohibited from the street or highway, pedestrian traffic shall be maintained to allow their safe passage as shown in the contract documents. Where sidewalks, walkways, or shoulders must be temporarily closed to facilitate construction operations, safe pedestrian passage shall be maintained on at least one side of the roadway at all times, unless other temporary pedestrian accommodations are provided in the contract documents or are approved by the Engineer. Where pedestrian access is prohibited, workers shall not cross or enter travel lanes open to traffic.

The requirements in this section refer to posted speed limits. If prevailing or operating speeds for a highway exceed the preconstruction posted limits, the contract documents may direct the Contractor to assume that the preconstruction posted speed limits are different than posted.

619-3.02 Basic Work Zone Traffic Control. The Contractor shall control traffic so 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.

The Contractor shall cease operations and restore the traveled way to safe operating condition during any specific periods listed in the contract documents, at such times as traffic renders conditions unsafe to continue work, and during periods of darkness (before sunrise or after sunset), fog, snow or rain, high winds, or other inclement weather that renders conditions unsafe to continue work, for either the traveling public or the workers. The Engineer will determine when traffic or weather conditions render work operations unsafe.
A. Surface Condition, Debris, Drainage and Dust Control. The traveled way, sidewalks and pedestrian walkways 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 water. Except when construction operations necessitate disturbance of the normal surface, the Contractor shall maintain the pavement surface in such a condition as to permit the safe, comfortable passage of vehicles at the posted speed limit. A satisfactory riding surface shall be maintained both when work is underway, and when work is inactive. Special attention shall be given to maintenance of the traveled surface during hours of inactivity, including nights, weekends, holidays, and the winter season.

Milling operations shall be conducted to prevent pavement runoff from collecting along milled joints. Bumps and transverse irregularities shall be eliminated to the extent practical. Pavement joints and milling rebates resulting in longitudinal or transverse vertical faces exceeding 1 inch in height that would be exposed to traffic during non-work hours shall be sloped or tapered with temporary patches or shims providing a taper rate in accordance with Table 619-1 Required Treatment for Transverse Bumps.

Where longitudinal tapered wedge paving joints are used, temporary pavement markings shall be provided prior to reopening lanes to traffic. The joints may be left open to traffic provided traffic is not expected to frequently change lanes, and UNEVEN LANES (W8-11) signs are posted in advance of the condition, posted at each ramp and roadway intersection and repeated every ½ mile, supplemented with NEXT [X] MILES (W7-3aP) auxiliary signs.

Transverse bumps or vertical faces, unpaved surfaces, milled or grooved pavement, rough pavement, and other surface irregularities 1 inch or more in height shall be adequately sloped or tapered, or BUMP (W8-1) or other appropriate warning signs shall be posted in advance of the condition. A Type 1 Object Marker (OM1-3) or a drum with a flashing warning light shall be installed on the right side of the roadway at the bump or other condition. On expressways and freeways, an object marker or a drum with a flashing warning light shall be installed on both sides of the roadway.

Where traffic will be riding on milled pavement, the Contractor shall install GROOVED PAVEMENT (W8-15) signs on the approaches. On multilane highways where only one lane in a direction is milled and multiple lanes are open to traffic, the Contractor shall supplement the GROOVED PAVEMENT sign with a black on orange LEFT LANE (M5-4), CENTER LANE (M5-5) or RIGHT LANE (M5-6) panel below the warning sign. Where only an entrance or exit ramp is milled, the Contractor shall sign the mainline with a GROOVED PAVEMENT sign and a supplemental ON RAMP (W13-4) panel.

Where both BUMP and GROOVED PAVEMENT signs are warranted, the GROOVED PAVEMENT sign shall be installed 500 feet upstream of the BUMP sign in non-urban areas, and 300 feet upstream in urban areas. Where the posted speed limit is 45 mph or higher, the Contractor shall place a portable variable message sign (PVMS) in advance of pavement that has been milled or grooved and is open to traffic, warning motorcycle riders to use caution. The PVMS will be paid for separately.

For expressways where the posted speed limit is 45 mph or higher, the Contractor shall not leave milled or grooved pavement for more than 7 calendar days before placement of the next pavement course.

The Contractor shall keep the traveled way, sidewalks, and walkways free of construction materials and foreign objects that fall from vehicles or equipment. Materials spilled by, dropped from, or tracked by traffic or by any vehicle used in the Contractor’s operations along or across any public traveled way shall be removed immediately.

The Contractor shall keep all surface drainage facilities operative at all times. Positive drainage 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. Maintaining positive drainage shall include cleaning of drainage grates on roadway pavements. Cleaning of
drainage structures and drainage pipes of material not deposited due to the Contractor’s operations will be paid for separately. Repair of drainage structures will be paid for separately.

Dust control measures shall be applied to control dust resulting from traffic on unpaved surfaces and from Contractor operations on or adjacent to the roadway. Dust control shall be adequate to prevent dust which hinders driver visibility or which creates a nuisance condition for property owners and residents adjacent to the contract. Dusty conditions resulting from the Contractor’s operations may be corrected by the use of calcium chloride and/or water. If used, water shall be distributed uniformly using a suitable spray head or spray bar.

<table>
<thead>
<tr>
<th>Height of Bump (in)</th>
<th>Anticipated Exposure Time (Calendar Days)</th>
<th>Posted Speed ≤ 45 mph</th>
<th>Posted Speed &gt; 45 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 6</td>
<td>≤ 7</td>
<td>6:1</td>
<td>10:1</td>
</tr>
<tr>
<td></td>
<td>&gt; 7</td>
<td>15:1</td>
<td>30:1</td>
</tr>
</tbody>
</table>

**B. Seasonal Operations and Snow and Ice Control.** The Contractor shall maintain the traveled way in such a condition and conduct operations in such a manner that snow and ice may readily be controlled by others as and when necessary, and in such a manner that proper drainage is provided for the melting of snow banks resulting from normal plowing. The Contractor will not be responsible for snow and ice control on the pavement, shoulder, or sidewalks which are not restricted by construction operations and open to the public.

During periods of seasonal shutdown, the traveled way shall be maintained in an acceptable manner for travel, and all traffic control devices and safety features maintained in a safe, operable condition. All construction signs and temporary traffic control devices that are not needed during shutdown periods shall be covered or removed.

**C. Maintain Public Access.** The Contractor shall provide and maintain at all times safe and adequate ingress and egress for intersecting roads, residences, business establishments, adjacent properties, bus stops and other transportation facilities for vehicles, pedestrians and bicycles; at existing or at new access points, consistent with the work, unless otherwise authorized by the Engineer. Whenever construction operations disrupt or interfere with normal traffic patterns, intersections, business establishment access points, and driveways shall be clearly marked using channelizing devices.

A ROAD CLOSED (R11-2) sign on a temporary sign support and Type III construction barricades with warning lights shall be used whenever an entire roadway or ramp is closed to traffic.

Where pedestrian facilities exist, or where pedestrian traffic is reasonably anticipated, the Contractor shall maintain pedestrian access on at least one side of the highway or street at all times, in accordance with the contract documents and the MUTCD. Where an existing pedestrian facility is disrupted, closed or relocated, the temporary facility shall include accessibility features consistent with the features in the existing pedestrian facility. Pedestrian access may be provided using existing pedestrian facilities, temporary sidewalks or walkways, or alternate paths. Where a sidewalk is closed, it shall be marked with a Type II or Type III construction barricade and a SIDEWALK CLOSED (R9-9) sign. Advance warning signs and directional guidance shall be provided to direct pedestrians to alternate paths and crosswalks and to alert motorists. Where bus service is maintained, the Contractor shall provide suitable areas or locations for the loading and unloading of passengers.

Potentially hazardous areas adjacent to sidewalks, walkways, or other areas used by pedestrians shall be protected to prevent pedestrian intrusion in accordance with '107-05F. Restricted Areas.

Open sidewalks and walkways shall be maintained and kept smooth and free from holes, obstructions, and tripping hazards. Surfaces shall consist of pavement, firmly compacted granular material, or other surfaces noted in the contract documents or approved by the Engineer. The width of the temporary facility shall match that of the existing facility where practicable. When it is not
possible to meet the minimum width of 5 ft. for the entire length of the facility, a 5 ft. by 5 ft. passing space should be provided every 200 ft. Construction materials, vehicles, equipment, debris, temporary sign supports or other materials shall not be placed or stored on open sidewalks or walkways unless expressly shown in the contract documents or approved by the Engineer.

Where bicycles are not prohibited from the highway, adequate accommodations for bicyclists shall be maintained in the travel lanes, on the shoulder, or on alternate paths or facilities.

D. Maintain Existing Roadside Signs, Delineators and Markers. Existing Department authorized signs, delineators, markers and their supports within the contract limits shall remain under the control and jurisdiction of the Engineer. Signs not authorized by the Department shall be removed from the right of way, as directed by the Engineer, in accordance with Section 647 Removing, Storing and Relocating Signs.

1. Maintenance. Existing signs, delineators, markers and their supports shall be maintained by the Contractor. Adequate visibility of route markers and directional signing shall be provided for drivers at all times. If relocation of route markers and directional signing is necessary to accommodate construction operations, the temporary or new locations shall be subject to approval by the Engineer. Existing roadside delineators shall be removed or relocated only to the minimum extent necessary to accommodate the work under the contract. Where contract operations require the temporary removal of existing delineators to facilitate work operations, temporary roadside delineation consisting of the existing delineators, temporary delineators, or channelizing devices shall be in place each night and at any time work operations at that location are suspended. Temporary devices shall be placed at the outer edge of the shoulder at a spacing similar to the existing delineator spacing.

2. Storage. Existing signs, delineators, markers, and their supports which directly interfere with the construction operations shall be removed, stored, protected, cleaned and replaced in accordance with the contract documents and the provisions of Section 647 Removing, Storing and Relocating Signs and will be paid for separately. Existing signs, delineators and markers removed for the Contractor’s convenience shall be stored, cleaned and replaced at no additional cost to the State. Existing signs, delineators and markers lost or damaged due to negligence of the Contractor shall be replaced at no additional cost to the State.

E. Maintain Existing Guide Rail, Median Barrier, and Bridge Rail. When construction operations require the temporary removal of existing bridge rail, guide rail or median barrier; or when existing rail will be removed and replaced with new rail, the Contractor shall schedule operations to minimize the time period that rail is not installed. Unless otherwise specified in the contract documents, guide rail or median barrier shall be replaced or the location otherwise protected within 14 calendar days.

Bridge rail systems shall be maintained in service at all times on any structure on which vehicle or pedestrian traffic is maintained, unless a temporary barrier is installed, or other means are used to ensure that vehicles, bicyclists and pedestrians are not exposed to the unprotected edge of a bridge.

During non-work hours when traffic is being maintained on the facility, all temporary ends (free ends) of guide rail, median barrier and bridge rail shall be temporarily terminated and marked with a channelizing drum or object marker equipped with a Type A flashing warning light. Corrugated beam guide rail and median barrier, and heavy-post, blocked-out, corrugated beam guide rail and median barrier shall be temporarily terminated by having the exposed ends (free ends) dropped to the ground and pinned. The approach ends of box beam guide rail, median barrier and bridge rail shall be temporarily terminated with box beam guide rail 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 are required to adapt box beam guide rail end assemblies to box beam median barriers.
During any overnight period when existing guide rail or median barrier is temporarily removed, the Contractor shall install channelizing devices in the location where the guide rail or median barrier was removed in accordance with §619-3.02J.6. *Removed Existing Guide Rail or Median Barrier.*

**F. Construction Vehicles and Equipment.** All construction vehicles and equipment operating within the contract limits, whether in the work space, in the traffic space, in spoil areas, in storage areas, or any other areas under the contract, shall be operated at all times with due consideration for the safety of the public and workers.

All vehicles and equipment within the contract limits and on the roadway shall operate a rotating or flashing amber beacon. If visibility of the beacon is blocked by a portion of the vehicle or equipment, additional beacons shall be provided. Beacons shall be mounted in a manner which does not cause glare for the driver or operator. Short-term delivery vehicles not equipped with rotating or flashing amber beacon shall display four-way emergency flashers when in the temporary traffic control zone.

Other than vehicles registered and meeting all applicable requirements of the NYS Vehicle and Traffic Law, no construction vehicle or equipment used in the performance of the work shall be permitted to operate in travel lanes or shoulders open to traffic unless proper traffic control devices and other safety measures are in place to warn drivers of the presence of the equipment.

On any highway where the posted speed limit is 45 mph or higher, no construction vehicle or equipment shall operate in a travel lane or shoulder open to traffic unless followed by a vehicle equipped with flashing warning lights and *SLOW MOVING VEHICLE* (W21-4) sign on the rear.

The Contractor shall ensure that all construction vehicles and equipment are safely stored beyond the clear zone during non-working hours so as not to constitute a hazard to vehicles and pedestrians, unless protected by traffic barrier.

**G. Barrier Vehicles/Barrier Trailers/Shadow Vehicles.**

1. **Barrier Vehicles.** The Contractor shall provide barrier vehicles to guide traffic and protect workers at the beginning of stationary shoulder closures, lane closures and other stationary work zones in accordance with the contract documents.

When located in the taper of a lane closure and another arrow panel is not present, arrow panels on barrier vehicles shall be operated in the appropriate flashing arrow mode. For all other applications, arrow panels shall either display the four-corner flashing caution mode, or shall be turned off. Barrier vehicles should normally be unoccupied, with transmission in gear, parking brakes set and wheels straight, except when being moved. Barrier trailers should have parking brakes set and arrow panels shall be operated in the appropriate flashing arrow mode.

Barrier vehicles and barrier trailers shall be moved if necessary as the work progresses. The placement distance (distance a barrier vehicle or barrier trailer is located in advance of the first workers or hazard) shall be based on Table 619-2 *Placement Distance for Barrier/Shadow Vehicles.*

<table>
<thead>
<tr>
<th>Posted Speed Limit (mph)</th>
<th>Placement Distance (ft)</th>
<th>Barrier Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>18,000 lb</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>&gt; 55</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>45-55</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>&lt; 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shadow Vehicles</td>
<td>Placement Distance for Barrier/Shadow Vehicles</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>&gt; 55</td>
<td>230</td>
<td>325</td>
</tr>
<tr>
<td>50 - 55</td>
<td>180</td>
<td>280</td>
</tr>
<tr>
<td>≤ 45</td>
<td>100</td>
<td>200</td>
</tr>
</tbody>
</table>

2. **Shadow Vehicles.** For posted speed limits of 30 mph or higher, the Contractor shall provide shadow vehicles to guide traffic and protect workers conducting mobile or short duration work operations except where the travel lane is closed to traffic by traffic barriers or by channelizing devices, including, but not limited to, pavement marking application, pavement marking removal and sweeping.

When located in an open travel lane of a multilane roadway, the shadow vehicle shall display the flashing arrow panel in the appropriate mode. When located in a travel lane closed by barrier or channelizing devices, on a shoulder, otherwise not in an open travel lane, or on a two-lane, two-way roadway, the arrow panel shall either display the four-corner flashing caution mode or be turned off.

The shadow vehicle shall be moved as necessary to keep pace with the work operations. The placement distance (distance the shadow vehicle is in advance of the first workers or hazard) shall be as shown in Table 619-2 Placement Distance for Barrier/Shadow Vehicles.

When mobile or short duration work operations occupy a long distance of a travel lane not closed to traffic by barrier or channelizing devices, such that traffic may reenter the lane between work operations, the Contractor shall provide additional shadow vehicles for any gaps in the operation of 500 ft or more.

**H. Construction Signs.** The Contractor shall install and maintain construction signs in good condition to adequately and safely inform and direct motorists, bicyclists and pedestrians. Existing and construction signs shall indicate actual roadway conditions, and shall be covered, uncovered, changed, relocated, or removed immediately to reflect current conditions. Construction signs shall be covered or removed when they no longer indicate actual conditions.

The Contractor shall provide measures to protect workers during placement and removal of construction signs adequate for the prevailing speed, volume of traffic and roadway geometry where the work is to occur. Such protection may include, but is not limited to, the use of flaggers, spotters, and shadow vehicles equipped with truck-mounted or trailer mounted attenuators. Where pedestrian access is prohibited, workers shall not cross or enter travel lanes open to traffic.

All signs shall be kept clean, mounted at the required height on acceptable supports, and installed in the proper position, alignment and orientation so as to give maximum visibility. Construction signs will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Work Zone Traffic Control Devices*. When auxiliary panels are mounted above or below a warning or regulatory sign, they shall not cover any part of the warning or regulatory sign. Signs shall be placed so that each sign is visible at night, at the desired distance, without being obscured by another sign, existing features on the highway, or foliage. The faces of stored signs shall not be visible to traffic in any direction, regardless of the orientation of the sign.

1. **Sign Panels.** Panels shall be flat and shall not be bowed or warped. Panel shapes shall not be altered, such as trimming corners of diamond shaped panels. If insufficient clearance exists, rectangular and/or smaller signs shall be used to obtain proper clearance. Panels with any wrinkling, delamination, or lack of adhesion of the reflective sheeting or legend will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Work Zone Traffic Control Devices*. Signs shall not bear any advertising message or any other message. A nonretroreflective logo or identifying information of the owner.
may be located on the back of the sign. The logo shall not exceed 1 square foot. The owner information shall not exceed 2 inches in height.

Flexible, or roll-up, sign panels shall only be used for short-term, daytime use. 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. Fluorescent-orange colored flexible sign panels shall be approved by the Engineer prior to and for the duration of their use.

2. Mounting Temporary Signs. Unless otherwise noted in the contract documents or in the MUTCD, construction signs shall be mounted on a separate support. In cases where construction signs on an existing support will replace or supplement existing sign(s), they shall be mounted in accordance with the Standard Sheet(s). The type of temporary sign supports used shall be selected by the Contractor. 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 temporary sign supports. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. Signs that are to remain at one location may be supported on fixed temporary sign supports.

Supports for construction signs shielded by barrier or guide rail, and located beyond the deflection distance described in Table 619-6 Guide Rail and Temporary Concrete Barrier Standard Deflection Distances are not required to be NCHRP 350 approved.

When not in service, temporary signs mounted on portable temporary sign supports shall be stored in such a manner and location that they do not interfere with or present a hazard to vehicular, bicycle or pedestrian traffic. No signs or supports shall be stored on the traveled way, shoulders or sidewalks during non-working hours. Portable temporary sign supports stored within the clear zone shall be laid flat such that no part of the support is more than 4 inches above the ground. No portable temporary sign supports shall be leaned against or overhang the traffic side of traffic barrier.

All mounting heights are measured from the bottom of the lower sign panel to the nearest edge of pavement or to the ground directly below the sign, whichever results in a higher mounting. Rigid sign panels shall have a minimum mounting height of 5 feet, or a minimum mounting height of 7 feet, where pedestrians or parked vehicles are present. For signs incorporating an auxiliary panel below the primary panel, the minimum mounting heights shall be 4 feet and 6 feet, respectively. For pedestrian regulatory and guide signs the minimum mounting height shall be 4 feet.

Flexible panel and lightweight rigid panel signs shall be mounted at the same height as rigid panel signs, except they may be mounted, when approved by the Engineer, as low as 1 foot when all the following conditions are met:

a. On two-lane, two-way roadways, or;
b. Where there will be no parked vehicles to obstruct the view.
c. Where the first warning sign(s) of a work zone warning sign sequence is mounted at a height of 5 feet or higher, and is located in advance of any flexible signs to alert motorists that they are entering a temporary traffic control zone.
d. When the lower mounting height does not adversely affect visibility of the sign by motorists.

3. Sign Covers. Covers for unneeded construction and/or permanent signs shall be attached in such a manner to cover the entire sign face including auxiliary panels above or below the main sign panel. The cover shall be firmly attached to the sign in a secure manner using straps, small hand clamps, small brackets or other means to prevent dislodging. Sign covers shall be
maintained in good condition to present a neat appearance and minimize distraction to motorists. Damaged covers which are no longer effective shall be promptly replaced.

Sign covers for permanent signs that are unrelated to work zone traffic control operations will be paid for separately.

4. State Law Signs. Signs advising motorists of increased fines or license suspension for speeding within the work zone shall be installed in accordance with the contract documents. The LICENSE SUSPENDED AFTER TWO WORK ZONE SPEEDING TICKETS (NYR9-11) or the FINES DOUBLED FOR SPEEDING IN WORK ZONES (NYR9-12) sign shall be posted in advance of work zones not having a reduced regulatory speed limit. The FINES DOUBLED FOR SPEEDING IN WORK ZONES (NYR9-12) sign shall be posted in advance of work zones having a reduced regulatory speed limit. The state law sign shall be installed approximately 1,000 feet upstream of the first construction warning sign on highways with preconstruction posted speed limits equal to or greater than 45 mph and 300-500 feet upstream of the first construction warning sign on highways with preconstruction posted speed limits of less than 45 mph. For contracts with multiple work zones, the state law sign shall be installed at the aforementioned distances upstream of the ROAD WORK NEXT XX MILES (G20-1) sign or at the contract limits and need not be installed prior to each activity area. If any of the individual activity areas have a reduced regulatory speed limit, the FINES DOUBLED FOR SPEEDING IN WORK ZONES shall be used.

5. Special Use Work Zone Signs. Special use work zone signs shall be installed in accordance with the contract documents.

Reduced regulatory speed limits in work zones shall be posted in accordance with contract documents with SPEED LIMIT signs (R2-1) supplemented with WORK ZONE plaques (G20-5aP) of the same width mounted above the speed limit signs. The work zone plaques shall be placed on the same post and as the speed limit signs. REDUCED SPEED LIMIT AHEAD sign(s) (W3-5) shall be posted in advance of the first speed limit sign reducing the speed limit in a work zone.

All reduced regulatory speed limit signs shall be installed on both sides of expressways and freeways. When traffic is reduced to a single lane, reduced regulatory speed limit signs should be installed only on the right side of the highway. Reduced regulatory speed limit signs shall be placed within the work zone activity area at a maximum spacing of ½ mile. Reduced regulatory speed limit signs shall be completely covered or removed, and preconstruction posted speed limit signs shall be uncovered or replaced, after a work zone activity area is restored. A work zone plaque shall not be mounted above preconstruction posted speed limit signs within a work zone.

The END WORK ZONE SPEED LIMIT signs (R2-12) or the preconstruction posted speed limit sign (R2-1) shall be posted 100 ft beyond the end of a work zone activity area having a reduced regulatory speed limit. An END HIGHER FINES sign (R2-11) shall be placed 200 feet beyond the END WORK ZONE SPEED LIMIT sign.

Where shown in the contract documents, the Contractor shall install BE PREPARED TO STOP (W3-4) signs to inform oncoming traffic of potential stopped, queued or very slow conditions upstream of advanced warning signs. Multiple signs may be installed and covered for later use. A PVMS may be used for the sign or as a supplement.

Each BE PREPARED TO STOP sign shall be mounted on a temporary sign support, and shall be equipped with a pair of orange warning flags. For approaches on expressways and freeways with three lanes or more, both sides of the approach shall be signed unless the median is too narrow to fit the sign and the support.

The BE PREPARED TO STOP signs shall be posted approximately ½ mile in advance of the anticipated end of the queue. If the end of the queue is beyond the sign, the sign location shall be adjusted for the subsequent work day until the desired advance warning reflects typical conditions.
for that location. If the resulting adjustment places the sign in advance of the first warning sign, the Contractor shall also furnish and place a ROAD WORK (W20-1) sign approximately 1,000 feet in advance of the BE PREPARED TO STOP signs.

I. Arrow Panels. The Contractor shall provide, operate and maintain arrow panels, also known as arrow boards, on highways having two or more travel lanes in the same direction, where the posted speed limit is 40 mph or higher, whenever a lane or lanes are closed to traffic and vehicles are required to merge with traffic in adjacent lanes. One arrow panel shall be provided for each lane closed to traffic regardless of the duration. Arrow panels shall be mounted so that the base of the panel is at least 7 feet above the pavement surface. Arrow panels shall be legible continuously from any point within the roadway (inclusive of shoulders) from 1,500 feet in advance of the lane closure taper to the beginning of the lane closure taper. Any arrow panel which cannot provide a sufficiently bright and clearly legible arrow display at any point within the roadway within the above distance shall be immediately repaired or replaced.

Arrow panels shall not be used where they would interfere with the operation of a traffic signal or flasher or where there is an operation controlled by a signal or flagger(s). Arrow panels will not be permitted for alignment changes or lane diversions where the number of through traffic lanes is not reduced, or for any application on two-lane, two-way roadways except in the caution mode.

J. Channelizing Devices. Where construction operations obliterate pavement markings, or otherwise change or disrupt the normal traffic pattern, the Contractor shall use channelizing devices to physically separate traffic from portions of the roadway not available for travel; to separate traffic from hazards adjacent to the roadway; to separate opposing or adjacent travel lanes; to mark the location of hazards within or adjacent to the roadway; and to clearly define the intended travel path for vehicles, bicycles, and pedestrians. Spacing of devices shall be sufficiently close at all times to provide clear and adequate guidance to ensure that vehicles, bicycles, and pedestrians follow the intended travel path. Channelizing device spacing requirements are stated in center-to-center distances.

Channelizing devices shall be maintained upright, at proper spacing, in proper alignment and orientation, and kept clean. Channelizing devices used at night shall be retroreflective. Channelizing devices shall not bear any advertising or other message. A non-retroreflective logo or identifying information of the owner may be located on the back, base or top of channelizing devices where it does not obstruct the face, color, or reflectivity. The logo shall not exceed 1 square foot. The owner information shall not exceed 2 inches in height. The Contractor shall make frequent checks commensurate with traffic conditions to identify and reset channelizing devices dislodged by traffic. Deformed or damaged devices and devices that do not maintain appearance, color, and reflectivity will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) Quality Guidelines for Work Zone Traffic Control Devices. Ballast and/or mailboxes shall not be placed on top of a device or at any point above ground level. Ballast rings may be added to traffic cones, or traffic cones may be doubled, with one cone on top of the other, to serve as ballast.

One Type A flashing warning light shall be installed on the first channelizing device in each series of a nightwork shoulder or travel lane closure. One Type A flashing warning light shall be installed on channelizing devices used to mark the location of hazards in or adjacent to the travel lane, including, but not limited to, pavement discontinuities, drainage structures, excavations, fixed objects, and other obstructions and potential hazards remaining at the end of the work shift. Where the placement of numerous Type A flashing warning lights may present a distraction to motorists, flashing warning lights may be eliminated at intermediate locations such as driveway entrances or intersections.
Cones may be used in work zones where workers are not exposed to traffic, where the cones are placed to protect the work, and the placement does not create a hazard for traffic. In this application, cones are not considered channelizing devices.

Channelizing device application is summarized in Table 619-3A *Channelizing Device Application for Short-Term Stationary Work Zones* and Table 619-3B *Channelizing Device Application for Intermediate-Term and Long-Term Stationary Work Zones*. Where permitted, the Contractor may opt to substitute interim tubular markers or Type III construction barricades for other channelizing devices at no additional cost to the State.

1. **Tapers.** Tapers are defined as a transition area where motorists are redirected out of their normal path to a new path, including the tapered portion of lane closures, lane shifts, transitions, crossovers, ramps, intersections, or interchanges. The Contractor shall use drums, oversized vertical panels, or Type II construction barricades to delineate tapers. The Contractor may also use standard cones, tall cones, extra tall cones, and vertical panels for short term work zones during daylight hours only. At stationary work zones where workers are exposed to traffic and the posted speed limit is 40 mph or more, the spacing between channelizing devices shall not exceed 40 feet. Where the posted speed limit is less than 40 mph, the spacing between channelizing devices shall not exceed 20 feet.

2. **Traveled Way (Including Lane and Shoulder Closures).** The Contractor shall use drums, tall cones, extra tall cones, vertical panels, oversized vertical panels, or Type II construction barricades to delineate the traveled way. The Contractor may also use standard cones and vertical panels for short term work zones during daylight hours only. At stationary work zones, where no workers are exposed to traffic or no workers are present, the spacing between channelizing devices shall not exceed 80 feet. At stationary work zones, where workers are exposed to traffic, the spacing between channelizing devices shall not exceed 40 feet. Where necessary to permit ingress or egress by construction vehicles, wider gaps may be provided between channelizing devices, not to exceed the deletion of every fifth device.

At expressway gores, the Contractor shall use drums, tall cones, extra tall cones, oversized vertical panels, or Type II construction barricades. The Contractor may also use standard cones and vertical panels for short term work zones (during daylight hours) only. The Contractor may opt to substitute Type III construction barricades except in locations where they restrict driver vision. The spacing between channelizing devices shall not exceed 20 feet.

At transverse bumps and other hazards on roadways where the posted speed limit is 40 mph or less, the Contractor shall use drums, extra tall cones or oversized vertical panels.

Along lane or shoulder closures, where traffic will be traveling adjacent to the closures, two channelizing devices consisting of tall cones, extra tall cones, drums, vertical panels, oversized vertical panels or Type II construction barricades shall be placed transversely across each closed lane and shoulder at maximum 800 feet intervals except in locations where it would interfere with milling, paving or other ongoing work, to discourage traffic from driving through the closed lane. The Contractor may also use standard cones for short term work zones (during daytime hours) only. The Contractor may opt to substitute one Type III construction barricade for two transverse devices. These transverse devices may be relocated or adjusted as necessary to permit passage of construction vehicles.

3. **Roadway or Pavement Edge.** The Contractor shall use drums, tall cones, extra tall cones, vertical panels, oversized vertical panels, or Type II construction barricades where the work introduces or exposes hazards within the roadway or at the outside edge of the roadway, and pavement edge markings or permanent delineators are not installed. The Contractor may opt to substitute Type III construction barricades. The spacing between channelizing devices shall not
4. **Roadway Intersections and Commercial Driveway Radii.** The Contractor shall use drums, or extra tall cones to delineate roadway intersections and commercial driveways. The Contractor may also use standard cones, tall cones, and temporary tubular markers for short term work zones during daylight hours only. The spacing between channelizing devices shall not exceed 6 feet. Reduced spacing near roadway intersections and commercial driveways may be necessary to provide clear guidance. Vertical panels, oversized vertical panels, Type II barricades and Type III barricades shall not be used.

A non-signalized intersecting roadway shall be delineated by a new series of channelizing devices, and the series will start with one drum equipped with a Type A flashing warning light, placed along the primary roadway after the intersection.

5. **Residential Driveway Radii.** The Contractor shall use drums, or extra tall cones to delineate residential driveways. The Contractor may also use standard cones, tall cones, and temporary tubular markers for short term work zones during daylight hours only. The spacing between channelizing devices shall not exceed 6 feet. Reduced spacing near residential driveways may be necessary to provide clear guidance. Vertical panels, oversized vertical panels, Type II barricades and Type III barricades shall not be used.

6. **Removed Existing Guide Rail or Median Barrier.** The Contractor shall use drums, tall cones, extra tall cones, temporary tubular markers, vertical panels, oversized vertical panels, Type II construction barricades, Type III construction barricades to delineate the edge of the shoulder or median in locations where guide rail or median barrier was removed. The spacing between channelizing devices shall not exceed 80 feet where the shoulder width is 4 feet or greater, and shall not exceed 40 feet where the shoulder width is less than 4 feet. A minimum of three devices shall be provided for each individual run of guide rail or median barrier that has been removed.

7. **Placing, Maintaining and Removing Channelizing Devices.** The Contractor shall take all necessary precautions to protect the public and workers during the placement, maintenance, and removal of channelizing devices. Warning signs shall be in place in advance of and prior to the start of channelizing device placement, and shall remain in place until after the channelizing devices have been removed.

Channelizing devices shall be set up and removed by properly trained worker(s). The Contractor shall protect workers during placement and removal of channelizing devices, using measures adequate for the prevailing speed, volume of traffic and roadway geometry where the work is to occur. Protection shall include the use of automatic devices or from protected areas of a vehicle where practicable. Such protection may include, but is not limited to, the use of cone-setting equipment, cone baskets mounted on work vehicles, flaggers, spotters, and shadow vehicles equipped with impact attenuators. Workers placing or removing traffic control channelizing devices onto/from the roadway from the back or side of a moving vehicle shall be protected by a fall restraint system consisting of side racks, harness and lanyard and/or cone basket so that a worker cannot fall off the vehicle and strike the pavement. Workers shall be seated in seats having seatbelts on moving work vehicles when not in the process of placing or removing channelizing devices.

A shadow vehicle shall protect the channelizing device placement or removal operation on multi-lane highways, or a vehicle with a side or front cone basket shall meet the requirements of a shadow vehicle. Vehicles with front mounted cone baskets shall be used only on expressways and freeways traveling in the same direction as traffic.
<table>
<thead>
<tr>
<th>Work Zone Provisions</th>
<th>Channelizing Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-Term Stationary Work Zones involve daytime work that occupies a location for</td>
<td></td>
</tr>
<tr>
<td>more than one hour and up to a single daylight period</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Device Spacing (center to center)</strong></td>
<td></td>
</tr>
<tr>
<td>Shoulder/Merging/Shifting Tapers</td>
<td>X X X X X</td>
</tr>
<tr>
<td>20 ft.</td>
<td></td>
</tr>
<tr>
<td>≥ 40 mph</td>
<td>X X X X X</td>
</tr>
<tr>
<td>One-Lane Taper for Alternating Two-Way Traffic</td>
<td>X X X X X</td>
</tr>
<tr>
<td>20 ft.</td>
<td></td>
</tr>
<tr>
<td>40 ft.</td>
<td>X X X X X</td>
</tr>
<tr>
<td>Longitudinal Lane or Shoulder Closure w/Workers</td>
<td>X X X X X</td>
</tr>
<tr>
<td>40 ft.</td>
<td></td>
</tr>
<tr>
<td>Longitudinal Lane or Shoulder Closure w/No Workers</td>
<td>X X X X X</td>
</tr>
<tr>
<td>80 ft.</td>
<td></td>
</tr>
<tr>
<td>Freeway / Expressway Gores</td>
<td>X X X X X</td>
</tr>
<tr>
<td>20 ft.</td>
<td></td>
</tr>
<tr>
<td>Marking for Transverse Bumps ¹</td>
<td>X2</td>
</tr>
<tr>
<td>Transverse Device within Closed Traffic Lane and/or</td>
<td>X2</td>
</tr>
<tr>
<td>800 ft.</td>
<td></td>
</tr>
<tr>
<td>Roadway edge exposed with no Edgeline or Permanent Delineators</td>
<td>X X X X O</td>
</tr>
<tr>
<td>200 ft.</td>
<td></td>
</tr>
<tr>
<td>Roadway Intersection or Commercial Driveway Radii</td>
<td>X X X X X</td>
</tr>
<tr>
<td>6 ft.</td>
<td></td>
</tr>
<tr>
<td>Residential Driveway Radii</td>
<td>X X X X X</td>
</tr>
<tr>
<td>6 ft.</td>
<td></td>
</tr>
<tr>
<td>Removal of existing guide rail</td>
<td>X X X X O</td>
</tr>
<tr>
<td>Shoulder width ≥ 4 ft.</td>
<td></td>
</tr>
<tr>
<td>80 ft.</td>
<td></td>
</tr>
<tr>
<td>Shoulder width &lt; 4 ft.</td>
<td></td>
</tr>
<tr>
<td>40 ft.</td>
<td></td>
</tr>
<tr>
<td>Pavement Drop offs &gt; 2 in. and &lt; 24 in.</td>
<td>X</td>
</tr>
<tr>
<td>Drop off ≥ 24 in. within 10 ft. of active travel way; Posted speed ≤ 45 mph; Drop</td>
<td></td>
</tr>
<tr>
<td>off Length ≤ 100 ft.; Not to last longer than 1 work shift</td>
<td>X</td>
</tr>
<tr>
<td>Closed Roads</td>
<td>N/A</td>
</tr>
<tr>
<td>Closed Sidewalks</td>
<td>X</td>
</tr>
</tbody>
</table>

NOTES: X = Allowed  Blank = Not Allowed  O = Optional at Contractor's expense

1 - A Type 1 Object Marker may be used in lieu of channelizing device
2 - Channelizing devices shall be equipped with a flashing warning light
## TABLE 619-3B  CHANNELIZING DEVICE APPLICATION FOR INTERMEDIATE-TERM AND LONG-TERM STATIONARY WORK ZONES

**Work Zone Provisions**

Intermediate-term and Long-Term Stationary Work Zones involve work that occupies a location for more than 1 daylight period or nighttime work that occupies a location for more than 1 hour.

<table>
<thead>
<tr>
<th>Work Zone Provisions</th>
<th>Channelizing Device</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Device Spacing</strong> (center to center)</td>
<td></td>
</tr>
<tr>
<td>Shoulder/Merging/Shifting Tapers</td>
<td></td>
</tr>
<tr>
<td>&lt;40 mph</td>
<td>20 ft. X</td>
</tr>
<tr>
<td>≥ 40 mph</td>
<td>40 ft. X</td>
</tr>
<tr>
<td>One-Lane Taper for Alternating Two-Way Traffic</td>
<td>20 ft. X</td>
</tr>
<tr>
<td>Longitudinal Lane or Shoulder Closure w/Workers</td>
<td>40 ft. X X X X X X</td>
</tr>
<tr>
<td>Longitudinal Lane or Shoulder Closure w/No Workers</td>
<td>80 ft. X X X X X X</td>
</tr>
<tr>
<td>Freeway / Expressway Gores</td>
<td>20 ft. X X X X X X O</td>
</tr>
<tr>
<td>Marking for Transverse Bumps</td>
<td></td>
</tr>
<tr>
<td>Transverse Device within Closed Traffic Lane and/or</td>
<td></td>
</tr>
<tr>
<td>Roadway edge exposed with no Edgeline or Permanent Delineators</td>
<td>200 ft. X X X X X X O</td>
</tr>
<tr>
<td>Roadway Intersection or Commercial Driveway Radii</td>
<td>6 ft. X X</td>
</tr>
<tr>
<td>Residential Driveway Radii</td>
<td>6 ft. X X</td>
</tr>
<tr>
<td>Removal of existing guide rail</td>
<td></td>
</tr>
<tr>
<td>shoulder width ≥ 4</td>
<td>80 ft. X X X X X X O</td>
</tr>
<tr>
<td>shoulder width &lt; 4</td>
<td>40 ft. X X X X X X O</td>
</tr>
<tr>
<td>Pavement Drop offs &gt; 2 in. and &lt; 24 in.</td>
<td>See Table 619-4</td>
</tr>
<tr>
<td>Drop off ≥ 24 in. within 10 ft. of active travel way; Postsed speed ≤45 mph; Drop off Length ≤ 100 ft.; Not to last longer than 1 work shift</td>
<td>20 ft. X X X X X X</td>
</tr>
<tr>
<td>Two-Lane Two-Way Operations on expressways and freeways at</td>
<td></td>
</tr>
<tr>
<td>along curves</td>
<td>20 ft. X X X X X X O</td>
</tr>
<tr>
<td>along tangents</td>
<td>40 ft. X X X X X X O</td>
</tr>
<tr>
<td>Two-Lane Two-Way Operations on expressways and freeways between Crossovers</td>
<td></td>
</tr>
<tr>
<td>Closed Roads</td>
<td></td>
</tr>
<tr>
<td>Closed Sidewalks</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**  
X = Allowed  
Blank = Not Allowed  
O = Optional at Contractor's expense  
1 - A Type 1 Object Marker may be used in lieu of channelizing device.  
2 - Channelizing devices shall be equipped with a flashing warning light.

### K. Pavement Edge Drop-Off Protection.

A drop-off is an abrupt difference in surface elevation of more than 2 inches at approximately 1V:3H or steeper. In the absence of adequate Traffic Control Plans in the contract documents, the Contractor shall submit alternate Traffic Control Plans to the...
Engineer for approval at least 30 calendar days prior to proposed work which will create a drop-off of over 24 inches within 10 feet from the edge of the traveled way for durations longer than one shift.

The Contractor shall provide pavement edge drop-off protection in accordance with Table 619-4 Pavement Edge Drop-Off Protection. Channelizing devices used to mark drop-offs shall be placed, as practicable, to not reduce the available travel lane width, at the elevation of the open travel lane in order to provide maximum target value and visibility for motorists.

A drop-off of greater than 24 inches within 10 feet from the edge of the traveled way to remain at the end of the work shift shall be separated from traffic with temporary or permanent barrier. For posted speed limit of 45 mph and less, a drop-off of greater than 24 inches within 10 feet from the edge of the traveled way that is 100 feet or less in length will be allowed with channelizing devices consisting of drums, extra tall cones or oversized vertical panels only at a maximum spacing of 20 feet for short durations not to exceed one work shift.

Unless otherwise noted in the contract documents, the Contractor shall begin work to eliminate unprotected drop-offs created by contract work within 7 calendar days of the completion of the work creating the drop-off. Work shall continue in a timely manner until such time as the unprotected drop-off condition is eliminated.

Where pavement edge lines are not provided, channelizing devices shall be preceded by a NO SHOULDER (W8-23) sign, repeated at all ramps and roadway intersections. Signs shall be repeated every ½ mile and supplemented with a NEXT [X] MILES (W7-3aP) plaque where applicable.

Where pavement edge lines are provided, channelizing devices shall be preceded by SHOULDER DROP-OFF (W8-17) signs, repeated at all ramps and roadway intersections. Signing shall be repeated every ½ mile and supplemented with NEXT [X] MILES (W7-3aP) plaque where applicable.

### TABLE 619-4 PAVEMENT EDGE DROP-OFF PROTECTION

<table>
<thead>
<tr>
<th>Drop-Off Height</th>
<th>Edge Line Pavement Markings</th>
<th>Drum Spacing (feet)</th>
<th>Vertical Panel Spacing (feet)</th>
<th>Tubular Marker Spacing (feet)</th>
<th>Tall Cone Spacing (feet)</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DROP-OFF AT OR WITHIN SHOULDER AREA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Within 4 ft. from Travel Lane</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – 6 in.</td>
<td>Yes</td>
<td>100</td>
<td>100</td>
<td>N/A</td>
<td>N/A</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td>6 - 24 in.</td>
<td>Yes</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>20</td>
<td>N/A</td>
<td>N/A</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td><strong>More than 4 ft. from Travel Lane</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – 6 in.</td>
<td>Yes</td>
<td>200</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>100</td>
<td>100</td>
<td>40</td>
<td>40</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td>6 - 24 in.</td>
<td>Yes</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td><strong>DROP-OFF OUTSIDE OF SHOULDER EDGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Shoulder width ≤ 4 ft.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – 6 in.</td>
<td>Yes</td>
<td>100</td>
<td>100</td>
<td>N/A</td>
<td>N/A</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>100</td>
<td>100</td>
<td>N/A</td>
<td>N/A</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td>6 - 24 in.</td>
<td>Yes</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>Shoulder Drop-off</td>
</tr>
<tr>
<td>No</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>No Shoulder</td>
<td></td>
</tr>
<tr>
<td><strong>Shoulder width &gt; 4 ft.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
L. Flagging and Traffic Control. The Contractor shall provide an adequate number of competent flaggers to control traffic when it is necessary to maintain alternating one-way traffic in one lane of a two-lane, two-way roadway, and at all other locations where construction operations, construction vehicles and equipment, and temporary traffic patterns related to the construction operations require positive temporary traffic control for safe, efficient traffic operations. These locations include, but are not limited to, locations where construction traffic enters, exits, or crosses open traffic lanes, locations of temporary stoppage of traffic for work operations, rail crossings, locations requiring slowing of traffic adjacent to work operations, on-ramps with restricted site distance, pedestrian crossings, intersections, and other locations where traffic needs to be alerted to unexpected conditions ahead.

Multiple lane approaches shall be reduced to a single lane prior to a flagger station. Automated flagger assistance devices (AFAD), portable traffic signals, and temporary traffic signals used to control traffic at the Contractor’s option in lieu of flaggers shall be at no additional expense to the State.

1. Flagger Training. All flaggers shall be adequately trained in flagging operations by recognized training programs, including the American Traffic Safety Services Association, the National Safety Council, unions, or construction industry associations, or by an individual who holds a current certification as a flagger training instructor from such a program. Prior to the start of flagging operations, the Contractor shall provide to the Engineer a list of certified flaggers to be used in the operation, identifying the source of flagger training for each individual. When requested by the Engineer, flaggers shall demonstrate their competency in flagging procedures. Flaggers not competent in flagging procedures shall be retrained or replaced at once.

2. Flagger Equipment. Flaggers shall wear orange protective helmets and traffic control apparel in accordance with *107-05A. High Visibility Apparel. Flaggers shall be appropriately dressed, including apparel that covers the legs, torso and arms with sleeves a minimum of 4 inches long and appropriate footwear. Immodest or sloppy dress will not be permitted. Flaggers shall be equipped with an emergency air horn to alert workers of errant vehicles or other dangerous situations. Where flaggers are not within sight of each other, each flagger shall be equipped with a communication device, such as portable phone or two-way radio. The communication device shall only be used to communicate with other flaggers, other workers, or supervisor(s) regarding the flagging operations. Where the distance between flaggers is more than ½ mile or where shown in the contract documents, the Contractor shall use pilot cars to lead lines of vehicles through the work zone.

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 in opposite directions, shall be STOP/SLOW signal paddles. Red signal flags may be used where display of the STOP and SLOW faces in opposite directions may be inappropriate or misleading.

3. Operational Control. Flaggers shall be located in a position clearly visible to, but not in the path of, approaching traffic, with an available escape path to avoid an oncoming errant vehicle. The number of flaggers to be furnished for each operation shall be sufficient to provide safe, efficient flow of vehicle and pedestrian traffic. A spotter is not a flagger, and shall only direct construction vehicles or equipment, and shall not direct traffic in any manner.
Work zones utilizing flaggers shall comply with the Standard Sheet for flagger operation and a Flagger symbol (W20-7) sign shall be provided in advance of each flagger.

For control of alternating one-way traffic, one flagger shall be provided at each end of the one-way section, with additional flaggers provided to control traffic entering the one-way section from intermediate intersections and major commercial driveways. Where the length of the one-way section is less than 150 feet, the posted speed limit is less than 40 mph, traffic volumes are such that queues do not develop, and sight distances are adequate, the Contractor may request approval from the Engineer to use a single flagger.

For intersection control, at least one flagger shall be provided for each intersection approach. Where traffic speeds and/or volumes are unusually low, and adequate sight distance is available, such that safe operations can be ensured with fewer flaggers, the Contractor may request approval from the Engineer to use fewer flaggers. When flagging at an intersection with a traffic signal, the signal shall be turned off unless directed otherwise by the Engineer.

The Contractor shall provide enhanced flagger stations consisting of a Flag Tree (6F.57) and additional cones at all approaches to flaggers, in accordance with the Standard Sheet, in order to provide effective advanced warning to motorists. Flag Trees shall display a minimum of 3 orange warning flags, with the flags mounted such that the lowest corners of the flags are at a minimum height of 8 feet. On roadways with posted speed limits less than 40 mph, in locations having obstructed traffic flow, such as those having controlled intersections along the approach or approaches, where conditions do not permit placing the devices in a manner that will provide effective advanced warning to motorists, enhanced flagger stations need not be provided.

Flaggers shall be alert at all times, and shall not stand with their backs to approaching traffic. Flaggers shall only direct traffic to stop, to slow or to proceed, using hand signals to supplement the signaling device in accordance with the flagging procedures shown in the MUTCD. Flaggers shall be provided periodic breaks (minimum 15 minutes every 4 hours) throughout the work day, with competent substitutes provided during breaks to maintain continuous coverage of the flagging operation.

A spotter shall be provided at all locations where construction vehicles or equipment must back across or into open travel lanes, sidewalks, or pedestrian walkways. A spotter shall only direct construction vehicles or equipment, and shall not direct traffic in any manner.

For ongoing flagging operations at a specific location, the Contractor may request approval from the Engineer to substitute portable traffic signals in lieu of flaggers.

4. Automated Flagging Assistance Devices (AFAD). AFADs are devices to control traffic through work zones remotely by a single flagger at a central location or at one end of the work zone.

A minimum of 7 calendar days prior to initial deployment of the AFAD system, the Contractor shall submit a traffic control plan to the Engineer, for review and approval, detailing AFAD operation including a list of competent flaggers trained to operate the AFAD. AFADs shall be used only on two-lane two-way or single lane one-way roadways. AFADs shall not be used where there are intersections and/or commercial driveways or where construction operations within the controlled highway segment frequently disrupt traffic flow. Appropriate flagger apparel and equipment shall be maintained near each AFAD to facilitate flagging in the event of a malfunction or operational need due to frequent disruptions of traffic flow. The Contractor shall immediately provide traffic control with flaggers if an AFAD malfunctions; fails to properly or adequately control traffic; creates congestion, queues or gridlock which cannot be remedied by timely on-site adjustments to the signal operation; or is otherwise inadequate.

A competent flagger, who has been trained on the operation of the AFAD, shall operate and not leave the AFAD(s) unattended at any time. The flagger shall have an unobstructed view of the AFAD(s) and approaching traffic in both directions at all times. The distance between AFADs shall not exceed ½ mile. Work zones utilizing AFADs shall comply with the Standard
Sheet for flagger operation on a 2-lane 2-way roadway, where the AFAD is used in lieu of a flagger and a BE PREPARED TO STOP sign (W3-4) is to be used in lieu of the Flagger symbol sign. Red/Yellow lens AFAD shall have a STOP HERE ON RED (R10-6) sign installed on the right-hand shoulder at least 8 ft in advance of the AFAD where vehicles are expected to stop.

A portable traffic signal may be used, at the Contractor’s option, as an AFAD. A Signal Ahead symbol (W3-3) sign shall replace the Flagger symbol sign. An 18 inch wide removable stop line with a STOP HERE ON RED (R10-6) sign shall be installed at intended stopping point. The Engineer may waive the requirement for a stop line if the roadway is unpaved or it is otherwise impractical to install a stop line and the STOP HERE ON RED sign is in place.

When the work no longer necessitates use of the AFAD or portable traffic signal, the units shall be removed or turned off and moved out of view from the traveled way.

**M. Maintain Existing Mailboxes.** The Contractor shall not move any mailbox which contains mail. The Contractor will advise the owner to remove mail before the box is moved. Mailboxes shall be mounted, either permanently or temporarily, on a post. Before acceptance of the work, any mailbox which has been disturbed or moved shall be restored by the Contractor at a location consistent with the requirements of the U.S. Postal Service and the contract documents.

**N. Contract Site Patrol.** The Contractor shall provide adequate personnel and supervision to conduct operations and patrol the contract site to ensure that conditions are adequate for public safety and convenience at all times. The Contractor shall patrol the site as often as necessary during working and non-working hours to adjust and maintain signs, channelizing devices, and other traffic control devices and safety features.

**619-3.03 Basic Work Zone Traffic Control (Daily Operations).** The Contractor shall control traffic in accordance with §619-3.02 Basic Work Zone Traffic Control paragraphs A. Surface Condition; C. Maintain Public Access; D. Maintain Existing Roadside Signs; F. Construction Vehicles; G. Barrier/Shadow Vehicles; H. Construction Signs; I. Arrow Panels; J. Channelizing Devices; L. Flagging; M. Maintaining Existing Mailboxes; and O. Portable Traffic Signals so that a person who has no knowledge of conditions may safely and with a minimum of discomfort and inconvenience drive, ride, or walk, during the day or at night, over all or any portion of the highway and/or structure under construction where traffic is to be maintained. The Contractor will not be required to repair or maintain the roadway except to repair any damages resulting from its operations.

The Contractor shall cease operations and clear the traveled way, shoulders, and clear zones of all obstructions including traffic control devices, construction equipment, and materials at the end of each work shift.

**619-3.04 Temporary Business Signs.** The Contractor shall provide temporary business signs (NYI8-4) mounted on temporary sign supports to identify business entrances in accordance with the contract documents. Entrances shall be identified by only a single sign. Temporary business signs shall be mounted at a minimum height of 7 feet, and at a location that will guide traffic seeking access to the business, but where they will not interfere with traffic flow or other traffic control devices.

**619-3.05 Covering or Removal of Pavement Markings.** The Contractor shall remove or cover existing permanent pavement markings, interim pavement markings and temporary pavement markings, as indicated in the contract documents or directed by the Engineer, to accommodate traffic pattern changes by covering the markings with preformed removable pavement marking masking tape, or by removing the markings. Masking tape shall be placed in blocks to prevent the underlying shape of pavement marking symbols or letters from being confused with existing markings.
A. **Removal of Pavement Markings.** The removal method will be at the Contractor’s option, subject to its ability to achieve satisfactory results. Removal shall be completed prior to the installation of temporary pavement markings or interim pavement markings. Grinding to remove pavement markings will typically remove 1/8 to 1/4 inch of pavement surface. Prior to installation, the existing marking and adjacent pavement shall be cleaned of debris by compressed air or sweeping.

B. **Masking Pavement Markings.** Removable pavement marking masking tape shall be installed in accordance with the manufacturer’s written instructions. Prior to installation, the existing pavement marking and adjacent pavement shall be cleaned by compressed air, sweeping, or other means adequate to remove debris, but that does not result in damage to the existing pavement marking. The width of the removable pavement marking masking tape shall be sufficient to completely cover the existing pavement marking.

The masking tape shall firmly adhere to the entire length and width of the existing pavement marking to be covered. The Contractor shall maintain the tape for the duration of its use. Any tape that is loosened, removed, or that fails to retain its original matte finish, or that for any other reason fails to obliterate the existing pavement marking shall be replaced immediately, at no additional expense to the State.

When the covered pavement markings are to be restored to service, masking tape shall be removed. Temporary adhesive residues will be allowed to remain, providing that the existing pavement marking visibility is not impaired.

Any damage to the existing pavement markings or to the pavement surface that results from the removal of the masking tape shall be repaired at no additional cost to the State. If the existing marking cannot be repaired satisfactorily, the Contractor shall remove damaged pavement markings completely and/or replace the pavement section at no additional cost to the State.

**619-3.06 Temporary Pavement Markings.** The Contractor shall install and maintain temporary pavement markings in accordance with the contract documents, using patterns and colors shown in the MUTCD to establish temporary traffic pattern(s) during construction on any pavement, including milled or grooved surface, resurfaced, new pavement, or other paved surface without pavement markings, for a maximum of 14 calendar days.

Within 14 calendar days after placement, the Contractor shall either (1) install the succeeding pavement course or (2) install the remaining temporary pavement markings including edge lines, stop bars, and simple crosswalks, with no hatching. Pavements which will be open to traffic shall be properly marked before being opened, before nightfall, or before the end of the work day, whichever is soonest, except areas that are open during the work shift and delineated with channelizing devices or flaggers.

Traffic paint need not be removed before placing a subsequent course. Removable pavement tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall be removed before placing a subsequent course at no additional cost to the State.

Temporary pavement marking stripes shall be a minimum of 4 inches in width. Temporary pavement markings shall be applied to a clean, dry pavement in accordance with the manufacturer’s recommendations. Hatch lines and symbols will not be required as temporary pavement markings unless required by the contract documents.

Traffic paint pavement markings shall be applied at a minimum wet film thickness of 20 mil, immediately followed by an application of glass beads, at a rate of 6 lb/gal of paint.

Where specified, removable raised pavement markers shall be used to supplement line pavement markings. The raised markers shall not be a substitute for line pavement markings, letters or symbols. Removable raised pavement markers spaced every 5 feet may be used to supplement line pavement markings. Two removable raised pavement markers spaced at each end of the 2 foot marking may be used to supplement a 2 foot broken line pavement marking.

If unanticipated weather or other conditions prevent the application of temporary pavement markings, the Contractor shall apply 2 foot removable pavement tape markings or temporary overlay markers at 40
foot spaces at no additional cost to the State, for a maximum of 3 days until such time as temporary pavement markings may be applied, or the next pavement course is installed.

A. **Divided Highways.** On freeways, expressways and parkways, the Contractor shall install broken lines a minimum of 2 feet long at 40 foot spacing to separate traffic lanes in the same direction. The Contractor shall install solid edge lines for a minimum of 100 feet on either side of the apex of a gore.

B. **Undivided Multilane Highways.** On three or more lane highways, and two or more lane highways with center two way left turn lanes, the Contractor shall install white broken lines a minimum of 2 feet long at 40 foot spacing to separate traffic flows in the same direction, and partial barrier or full barrier centerline to separate traffic flows in opposite directions.

C. **Two-Lane, Two-Way Highways.** For two-lane, two-way highways, the Contractor shall install a temporary pavement markings consisting of full barrier centerline markings in no passing zones and 2 foot broken line markings at 40 foot spacing in passing zones.

Two-lane, two-way highways may for a maximum of 3 days have the centerline marked with yellow 2 foot by 4 inch removable pavement tape or yellow temporary overlay markers at 40 foot spaces with NO CENTER STRIPE (W8-12) signs and DO NOT PASS (R4-1) signs at no additional cost to the State. A NO CENTER STRIPE sign shall be installed in advance of the area marked with yellow 2 foot removable pavement tape markings or temporary overlay markers, as well as after major intersections and after major traffic generators within the area marked with the removable pavement tape markings or temporary overlay markings. A DO NOT PASS sign shall be installed within 100 feet of the beginning of the area with the removable pavement tape markings or temporary overlay markers, and a second DO NOT PASS sign shall be installed within 1,100 feet of the first DO NOT PASS sign and subsequent DO NOT PASS sign(s) shall not exceed 3,000 feet spacing. On an approach without centerline pavement markings where passing will not be permitted, a black on orange NO PASSING ZONE (W14-3) pennant shaped sign shall be installed on that approach. Full barrier, partial barrier or broken line temporary centerline pavement markings shall be placed within three calendar days.

619-3.07 **Interim Pavement Markings.** Work shall consist of furnishing, applying, and maintaining interim pavement markings as shown in the contract documents or as directed by the Engineer. The work for removable tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall include removal. Interim pavement markings are intended for use in diversions, temporary pavement realignments and crossovers, lane shifts and closures, and other traffic patterns associated with construction activities. Interim pavement markings are intended for use for a given phase or season, for a maximum of 1 year.

A. **Installation.** Interim pavement markings shall be applied to a clean, dry pavement in accordance with the manufacturer’s recommendations. Interim pavement markings on roadways open to traffic shall be applied in the direction of traffic. Traffic paint and epoxy paint pavement markings shall be applied at a minimum wet film thickness of 20 mils, immediately followed by an application of glass beads at a rate of 6 lb/gal of paint.

Painted markings may be supplemented with removable raised pavement markers. Removable raised pavement markers shall be spaced at 5 feet to supplement a solid line, and 4 markers spaced shall be used to supplement a 10 foot segment of broken line. When used to supplement a solid or broken line, markers shall be spaced a maximum of 80 feet on tangents and a maximum of 40 feet for curves with a radius less than 2,800 feet. Removable raised pavement markers shall not be used alone to simulate interim pavement markings.
B. Maintenance/Replacement. Traffic paint or removable tape shall be replaced upon (1) abrasion of the line such that more than 10 percent of the underlying pavement is visible within any 300 feet segment of line or (2) loss of more than 2 consecutive skip lines or (3) loss of more than 50 feet of continuous line or (4) failure of any line to be clearly visible at night under low-beam headlamp illumination when viewed from a distance of 200 feet.

Missing removable raised pavement markers shall be replaced upon (1) loss of more than 10 percent of the markers within a 300 feet long segment of line or (2) loss of more than 3 consecutive markers or (3) failure of any line to be clearly visible at night under low-beam headlamp illumination when viewed from a distance of 200 feet.

The Contractor will not be responsible for damage or loss caused by snowplowing. In the event that such pavement markings are damaged or lost, the Engineer will determine whether to replace the lost pavement markings in kind or with other marking materials. Separate payment will be made for pavement markings replaced, or installed due to damage or loss caused by snowplowing.

619-3.08 Temporary Rumble Strips. The Contractor shall install temporary rumble strips in three sets of 6-strip patterns with 10 foot between individual strips. The type of strip installed will be at the Contractor’s option, except that sawcut or milled-in strips shall not be installed on new top course surfaces or existing surfaces that will not be paved over. Where there is no usable shoulder, or the shoulder is less than 3 feet wide, the rumble strips should be ended 3 feet short of the edge of usable pavement. On curbed roadways, rumble strips should end a minimum of 3 feet from the curb in order not to interfere with drainage. Rumble strips shall typically be placed in advance of each of the last three long-term advance warning signs such that drivers are alerted in time to see and read the signs. Rumble strips will typically be installed for a minimum of one week.

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 45°F 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. Raised asphalt rumble strips shall have a width of 6 to 9 inches, measured in the direction of traffic, and have a final compacted thickness of 3/8 inch ± 1/8 inch.

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 masking 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 strip.

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 travel lane with saw-cut rumble strips 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 24 inches. 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 3/32 inches 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 travel lane with milled-in rumble strips 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 resulting 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.

619-3.09 Interim Tubular Markers. The Contractor shall install interim tubular markers in accordance with the contract documents. The Contractor shall attach interim tubular markers to the pavement in a manner that prevents them from being moved or dislodged by traffic. Interim tubular markers shall be installed on pavement that has been cleaned to remove pavement markings, oil, dirt, or other debris or substances that may interfere with a proper bond. Attachment to the pavement shall be by mechanical fastener or by adhesive, in accordance with the manufacturer’s recommendations. Bonding agents shall be of sufficient amount or size to ensure proper bonding of the base to the pavement.

Interim tubular markers removed or damaged by the Contractor’s operations or by traffic shall be replaced immediately, so that positive separation is maintained between opposing lanes of traffic at all times. Damaged reflective sheeting on interim tubular markers shall be replaced before nightfall as necessary to maintain adequate visibility of the markers. In cases where only isolated individual markers are lost or damaged, and adequate visibility is maintained by the remaining markers, replacement will not be required until more than 3 consecutive markers, or 25 percent of all markers within ½ mile have been damaged or lost. The replacement of markers damaged or lost by traffic, where the Contractor has demonstrated reasonable effort to collect the costs from the person(s) responsible for damage will be considered extra work.

619-3.10 Portable Variable Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS). The Contractor shall provide, operate and maintain PVMS & TMVMS as indicated in the contract documents until the progress of work no longer requires their use. The Contractor shall relocate or reorient PVMS with a pay unit of each, if necessary, up to 4 times per year as conditions dictate, at no additional cost to the State. The Contractor shall provide, operate and maintain PVMS with a pay unit of weeks at the general locations and duration stated in the contract documents and in accordance with the Special Note Requirements for Portable Variable Message Signs (PVMS). There shall be no extra payment due for each relocation or reorientation of TMVMS. On the PVMS & TMVMS, the message to be displayed shall be as required by the contract documents and may change on a daily basis or more frequently as conditions dictate. NYSDOT’s Variable Message Sign Guidelines shall be reviewed to ensure compliance with Chapter 5 - Messages.
If the contract requires a NTCIP compliant PVMS, the Contractor shall provide the Engineer with the model, manufacture date and manufacturer of the NTCIP compliant PVMS the Contractor plans to use from the Approved List. After delivery to the work site, the Contractor shall allow the Regional Transportation Management Center (TMC) to conduct operations and communications tests on one or more samples supplied by the Contractor. The testing will determine if the proposed PVMS meets the TMC’s operational requirements by demonstrating remote communications to and from the TMC using NTCIP compliant operating software. TMVMS do not require NTCIP compliant communications. The message to be displayed shall be as required by the contract documents or as directed by the Engineer.

PVMS specified with cellular communications shall be equipped with control software compatible with the current computer operating system used in the Engineer’s Field Office. PVMS with Cellular Communications Option shall have cellular telephone service provided by the Contractor. The Contractor shall supply the Engineer with two copies of operating instructions for the PVMS and the control software. The Contractor shall supply the Engineer with a copy of control software a minimum of 14 calendar days prior to installation of the first unit. Electronic copies of software instructions are acceptable.

PVMS shall be placed so that the base of the message panel is at least 7 feet above the adjacent pavement surface and aligned to provide optimum viewing by approaching motorists. The Contractor shall supply the Engineer with an accurate log of the text of all messages and times messages were displayed monthly, not later than the 15th of the following month. The log of messages may be either a listing in a manual register or printouts from the control software. The Contractor shall inform the Engineer of PVMS and TMVMS locations and update as they are relocated and removed. The PVMS shall be protected from unauthorized use. All cabinet doors shall be secured and/or padlocked, and default manufacturer’s passwords shall be changed. Additional security measures shall be implemented as needed.

### 619-3.11 Type III Construction Barricades

Type III construction barricades shall be installed at all locations where a highway, bridge, ramp, or other segment of the roadway is closed to traffic. Type III construction barricades shall be maintained upright, in proper alignment and orientation. If ballast is used to maintain alignment and position of the barricade, it shall consist of dry sand contained in a closed waterproof bag, and shall be placed at ground level.

Barricade rails shall be oriented such that the stripes slope downward toward the side on which traffic is to pass. If traffic may pass to either side, adjacent barricades shall be arranged such that the stripes slope downward toward each side starting at the center. Where no passage is intended or permitted, the stripes shall slope downward toward the center of the barricade or barricades.

At night, each Type III construction barricade used to close a roadway, a segment of a roadway or a sidewalk shall be equipped with one flashing warning light.

### 619-3.12 Temporary Concrete Barrier

The Engineer will inspect temporary concrete barrier segments upon delivery to the contract. Any barrier segment having damage and/or defects in the concrete and/or joint connections will be rejected if the performance of the barrier may be affected.

Temporary concrete barrier segments shall be fastened together with connection keys to form a continuous string. When joined together, the barrier segments shall form a smooth and continuous barrier. Any segments damaged or misaligned shall be corrected or replaced.

Tapered end sections shall not be used in traversable medians, gores, and other areas where impacts on a tapered end section could allow vehicles to penetrate into opposing or adjacent lanes of traffic. Where the posted speed limit is 45 mph or higher, a temporary impact attenuator or temporary sand barrel array shall be provided on approach ends of temporary concrete barrier when the offset from the edge of the traveled way to end of the barrier is less than 12 feet, and will be paid for separately.

Temporary delineation shall be provided with each segment of temporary concrete barrier in accordance with the Standard Sheet. When temporary glare screen is attached to the barrier, temporary delineation shall be mounted such that its visibility is not blocked by the glare screen.
Where space is available, approach ends of the barrier string shall be flared away from the traveled way at the taper rate shown in Table 619-5 Flare Rates for Positive Barrier and terminated in a tapered end section, embedded in a slope, or otherwise protected against impact by errant vehicles.

The Contractor shall install unpinned temporary concrete barrier where indicated in the contract documents, with one segment at either end of the string pinned using a minimum of four pins on the construction, or non-traffic side, and with the segment immediately adjacent to the pinned segment, towards the center of the string, pinned using two pins on the construction side. Where pins extend above the top surface of the barrier anchor recess, they shall be capped.

The Contractor shall install pinned temporary concrete barrier where indicated in the contract documents, with each segment pinned with a minimum of 4 pins on the construction, or non-traffic side, side in order to reduce movement of temporary concrete barrier on structures and in other locations where limited deflection is desired. Where an unpinned portion of a barrier string is connected to a pinned string in the direction of approaching traffic, the barrier segment immediately prior to the pinned segment shall be pinned using two pins on the construction side.

TABLE 619-5 FLARE RATES FOR POSITIVE BARRIER

<table>
<thead>
<tr>
<th>POSTED PRECONSTRUCTION SPEED LIMIT (mph)</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>55</th>
<th>65</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPORARY CONCRETE BARRIER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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>15:1</td>
</tr>
</tbody>
</table>

TABLE 619-6 GUIDE RAIL AND TEMPORARY CONCRETE BARRIER STANDARD DEFLECTION DISTANCES

<table>
<thead>
<tr>
<th>BARRIER TYPE</th>
<th>POST SPACING (ft)</th>
<th>DEFLECTION DISTANCES (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABLE GUIDE RAIL</td>
<td>16</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>7.0</td>
</tr>
<tr>
<td>CORRUGATED W-BEAM (WEAK POST)GUIDE RAIL</td>
<td>12.5</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>6.25</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>4.16</td>
<td>5.0</td>
</tr>
<tr>
<td>CORRUGATED W-BEAM (HEAVY POST BLOCKED OUT)</td>
<td>6.25</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>3.12</td>
<td>2.0</td>
</tr>
<tr>
<td>BOX BEAM GUIDE RAIL</td>
<td>6.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>CORRUGATED W-BEAM (WEAK POST)MEDIAN BARRIER</td>
<td>12.5</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>6.25</td>
<td>5.0</td>
</tr>
<tr>
<td>CORRUGATED W-BEAM (HEAVY POST)MEDIAN BARRIER</td>
<td>6.25</td>
<td>2.0</td>
</tr>
<tr>
<td>BOX BEAM MEDIAN BARRIER</td>
<td>6.0</td>
<td>3.0</td>
</tr>
<tr>
<td>TEMPORARY CONCRETE BARRIER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNPINNED STIFFENED WITH BOX BEAM PINNED</td>
<td>Not Applicable</td>
<td>3.3**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.8**</td>
</tr>
</tbody>
</table>
* Note: Standard Deflection is caused by a 4400 lb test vehicle traveling 62mph impacting the barrier at a 25° angle.
** Note: MASH Standard Deflection caused by 5000 lb test vehicle traveling 62mph impacting the barrier at a 25° angle.

The Contractor shall install temporary concrete barrier stiffened with box beam where indicated in the contract documents, in accordance with the Standard Sheet, in order to reduce deflection of temporary concrete barrier on structures and in other locations where limited deflection is desired. Temporary concrete barrier stiffened with box beam shall be installed at least 50 feet prior to, be continuous through, and extend at least 50 feet beyond the area requiring limited deflection wherever practicable. Where space limits extending the string of barrier stiffened with box beam, one segment at either end of the string shall be pinned with 4 pins on the construction, or non-traffic, side and the segment immediately adjacent to the pinned segment, towards the center of the string, shall be pinned using a minimum of two pins on the construction side.

The Contractor shall install pinned temporary concrete barrier stiffened with box beam where indicated in the contract documents, with each segment pinned with a minimum of 4 pins, on the construction, or non-traffic side, side.

Pins shall have the following minimum pin embedment lengths:

- Bridge Decks and Cement Concrete Pavement 5 in.
- Flexible Pavement 18 in.
- Unpaved Areas 30 in.

After removal of the barrier, holes created in the surface to pin the barrier shall be filled, unless that area will be further disturbed. Holes in flexible pavement or unpaved areas shall be filled with material consistent with the subbase, base and surface material. Holes in portland cement concrete pavement or structural decks shall be filled with material meeting the requirements of §701-05 Concrete Grout Material or §721-03 Epoxy Polysulfide Grout.

A. Barrier Without Warning Lights. Where warning lights for temporary concrete barrier are not required, the Contractor shall provide and maintain delineation on the temporary concrete barrier. The delineation shall be maintained visible and free of dirt and snow, including during shutdown periods. The maximum spacing of delineation shall be 20 feet.

B. Barrier With Warning Lights. Type C warning lights shall be provided on temporary concrete barrier with warning lights. The maximum spacing of warning lights shall be 40 feet in tangents and 20 feet in curves with radii less than 2,800 feet. Warning lights shall be attached to the barrier so that the lights remain securely in place and so that the attachment minimizes damage to the barrier.

All warning lights shall be kept clean, properly aligned and in operating condition. Batteries shall be replaced as necessary to maintain adequate visibility of the warning lights at night.

Where channelizing devices with Type A flashing warning lights are not provided immediately preceding a run of barrier to be marked with warning lights, the first warning light on that run of barrier shall be a Type A warning light.

C. Box Beam Guide Rail to Temporary Concrete Barrier Transition. Where required, the Contractor shall install the Transition from Box Beam to Flared Temporary Concrete Barrier or the Transition from Box Beam to Unflared Temporary Concrete Barrier in accordance with the details shown on the Standard Sheets. With the approval of the Engineer, the Contractor may choose to switch options, at no additional cost to the State.

Where the Contractor elects or is required to bolt the box beam to the face of the Temporary Concrete Barrier, the pieces of box beam thus bolted shall be removed from the job and become the Contractor’s
property when the Temporary Concrete Barrier is removed. The Contractor shall replace any box beam having holes in its face with new pieces of box beam, as needed. After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts and new or acceptable reset box beam guide rail.

When an unflared box to Temporary Concrete Barrier transition is removed, the heavy posts, blockouts, rub rail, and Transition End Piece and associated hardware shall become the property of the Contractor and shall be removed from the project before its completion.

D. Temporary Concrete Barrier to Box Beam Guide Rail Transition. Where required, the Contractor shall install Temporary Concrete Barrier Face to Box Beam Transition or Back of Temporary Concrete Barrier Back to Box Beam Transition in accordance with the details shown on the Standard Sheets. When the box beam is mounted to the traffic-side face, a tapered box beam end piece shall be used. When the box beam is behind the Temporary Concrete Barrier, the Contractor shall bolt to the Temporary Concrete Barrier or shall provide an overlap of box beam extending upstream past four segments of the downstream end of the Temporary Concrete Barrier.

When box beam is required to be bolted to the Temporary Concrete Barrier, or the Contractor elects to do so, the necessary positions for the bolts shall be located on the Temporary Concrete Barrier and drilled in the field. The pieces of box beam thus bolted shall be removed from the job and become the Contractor’s property when the Temporary Concrete Barrier is removed. The Contractor shall replace any box beam having holes in its face with new pieces of box beam, as needed. After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts and new or acceptable reset box beam guide rail.

619-3.13 Temporary Glare Screen. Temporary glare screen shall be installed in accordance with the manufacturer’s instructions. All components of the glare screen shall be maintained in a safe and functional condition. Damaged components shall be repaired or replaced.

If blades are utilized, the blades shall be spaced and angled to provide approximately a 22° headlight cutoff angle. The screen shall not overhang the face of the barrier and shall not cover delineation or lights. The screen shall be kept plumb and properly positioned on the barrier, with reflectorization securely affixed to the screen. Cleaning of the reflectorization shall be by a method that does not damage the paddles, reflectorization or barrier, and is not hazardous to traffic.

The Contractor shall remove and dispose of the temporary glare screen upon completion of the contract or when it is no longer required. Upon removal of the temporary glare screen, there shall be no protrusions remaining on the top face of the barrier. Bolt holes or other damage to permanent barrier from glare screen installation shall be repaired by the Contractor at no additional cost to the State.

619-3.14 Temporary Impact Attenuator. The Contractor shall install temporary impact attenuators in accordance with the contract documents, the manufacturer’s instructions and materials details. The Contractor shall provide the Engineer a copy of the manufacturer’s materials details and installation instructions a minimum of 7 calendar days prior to use, to allow verification of the attenuator supplied and proper installation. The selection of the manufacturer and model of temporary impact attenuator shall be at the Contractor’s option, provided the attenuator supplied is of the type indicated, gating or redirective; shields the hazard; and fits in the location without encroachment into travel lanes or required offsets.

The Contractor shall maintain temporary impact attenuators for continuous operation. If an attenuator is out of operation, the Contractor shall immediately mark the hazard with drums, vertical panels and or extra tall cones until repairs are made or a new attenuator is installed. The Contractor shall promptly begin repairs to damaged attenuators, and shall complete repairs to a damaged attenuator or mitigate the hazard within 1 work day. Attenuators damaged beyond repair shall be replaced within 3 work days.
When temporary impact attenuators are removed or moved to another location, the Contractor shall restore the location to match the surrounding area.

619-3.15 Temporary Sand Barrel Arrays. The Contractor shall install sand barrel arrays in accordance with the patterns shown on the Standard Sheet or a NCHRP 350 approved pattern and fill the barrels with sand to provide the desired module weight, plus or minus 5 percent. Units that will be in use between November 1 and March 31 shall have sodium chloride, as dry rock salt, equal to 3% - 5% by weight of the sand, thoroughly mixed into the sand to prevent freezing. The sand shall be placed in the modules loose, not in bags or sacks. If the contract documents indicate that the site necessitates securing of the modules, the work shall be performed as recommended by the manufacturer.

The Contractor shall maintain sand barrel arrays for continuous 24 hour operation. If an array is out of operation, the Contractor shall immediately mark the hazard with drums, vertical panels and or extra tall cones until repairs are made or new module(s) are installed. The Contractor shall promptly begin repairs to damaged arrays, and shall complete repairs to a damaged array or mitigate the hazard within one work day.

619-3.16 Vehicle Arresting Barrier (VAB). Vehicle arresting barriers (VAB) shall be installed in accordance with the contract documents and the manufacturer's instructions and materials details. The Contractor shall provide the Engineer a copy of the manufacturer’s materials details and installation instructions a minimum of 5 work days prior to use, to allow verification of the barrier supplied and proper installation. The deceleration area behind the VAB shall be kept clear of workers, vehicles or stored materials. The Contractor shall provide for periodic surveillance of each VAB by workers or by electronic device.

The Contractor shall maintain vehicle arresting barrier for continuous operation. If a barrier is out of operation, the entire barrier shall be restored within 4 hours after the incident, or prior to the next shift the barrier will be used. No work may be progressed in an unprotected area, and the hazard shall be eliminated or minimized, until restorations have been completed.

The VAB, except anchorages, shall be dismantled and removed prior to reopening the road to traffic. After the last day of use, if directed by the Engineer, temporary anchorages shall be removed and disturbed areas shall be restored to match the surrounding area.

619-3.17 Maintain or Modify Traffic Signal Equipment. Traffic signals shall be maintained in proper operation, including the maintenance of all features of the traffic signal operation in effect and operating at the time any work begins on the contract. Traffic-actuated phases shall remain actuated, and signals operating within signal systems shall remain coordinated 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 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, 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, paid for separately.

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 2 hours of 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 2-hour time period. The Contractor shall continue the flagger services until the signal is in proper operation. A flagger warning (W20-7 or W20-7a) sign shall be used on all approaches to an intersection controlled by flaggers.
If the malfunction is in the equipment supplied by the State, due to an area wide power outage, or due to a localized power outage beyond the Contractor’s control, the Contractor shall notify the Engineer and, if directed by the Engineer, provide flaggers until the malfunction is corrected or State personnel take over. Such flagging operations in excess of 4 hours for the first call and for any subsequent call will be considered extra work.

The Contractor shall provide the Engineer, on a monthly basis, with a record of all maintenance calls received and responded to, as well as a record of all corrective action taken by the Contractor.

**A. Requirement A.** The Contractor shall maintain in proper operation the indicated existing, relocated, modified, and newly installed signals in accordance with the contract documents. If such signals are to be removed, the Contractor shall be responsible for operation and maintenance until the signals are removed. The Contractor shall be responsible for their continuous operation except for reasonable shutdown periods authorized by the Engineer during relocation and transfer operations.

**B. Requirement B.** 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 Section 680 Traffic Signals. The six month warranty/guarantee period shall be measured from the day the State assumes maintenance responsibility.

**C. Requirement C.** At relocated, modified or newly installed signals, the Department will assume responsibility for the following items after successful testing as required by Section 680 Traffic Signals has been completed. Assumption of the below listed responsibilities by the State will not relieve the Contractor of the responsibility for operation and maintenance of the signal. At existing microcomputer controlled traffic signals, the Department will be responsible for the following items:

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.

**D. Modify Traffic Signal Equipment.** Where the Contractor is required to temporarily modify or relocate existing traffic signals because of construction operations, all existing equipment, fittings, wire, cable, conduit, and related materials shall be reinstalled and extended where necessary. Temporary timber poles, and related material shall be furnished and installed where necessary.

**619-3.18 Temporary Traffic Signals.** The Contractor shall install temporary traffic signals in accordance with the contract documents and the MUTCD. The Contractor shall maintain traffic signal systems, including traffic detectors, in proper operation until approved removal, and be responsible for its continuous 24-hour operation except for reasonable shutdown during relocation and transfer operations. Substitution of temporary traffic signals for flaggers shall be at no additional cost to the State.

If for any reason a signal does not function as required, the Contractor shall commence repair work on this signal within 2 hours after notification of a malfunction. In the event flashing operation occurs, all signal faces shall show flashing red indications. Flashing operation of a signal is considered a malfunction. The Contractor shall provide an adequate number of flaggers to control traffic at each malfunctioning traffic signal, in accordance with '619-3.02L. Flagging and Traffic Control until the signal is restored to proper operation.

If the malfunction is due to an area wide power outage or due to a localized power outage beyond the Contractor’s control, the Contractor shall notify the Engineer and, if directed by the Engineer, provide flaggers until the malfunction is corrected or State personnel take over. Flagging operations in excess of 4 hours for the first maintenance call shall be paid for as extra work.
619-3.19 Nighttime Operations. Work occurring after sunset and before sunrise will be considered nighttime operations. All workers involved in nighttime operations shall wear protective helmets and nighttime apparel in accordance with §107-05A. High Visibility Apparel at all times.

Vehicles operating on the pavement of a closed roadway or travel lane shall display four-way flashers or rotating amber beacons at all times. Vehicles using headlights, except for rollers and vehicles retrieving channelizing devices, shall travel facing in the same direction as adjacent traffic in order to avoid glare and confusion to drivers.

The Contractor shall meet the following additional requirements for work zone traffic control during nighttime operations.

A. Nighttime Operations and Lighting Plan. Thirty days prior to the start of nighttime operations, the Contractor shall submit a written Nighttime Operations and Lighting Plan to the Engineer for approval. The plan shall detail all aspects of the traffic control setup, the functions, responsibilities and identities of the nighttime traffic control competent person 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 conditions on the contract.

The Contractor shall submit a Nighttime Operations and Lighting Plan to the Engineer, at a scale and printed size similar to the contract plans and appropriate to adequately describe the work, including the following:

- Layout showing location of light towers, including typical spacing, lateral placement and mounting height, and clearly show the location of all lights necessary for all work to be done at night.
- Description of light towers to be used and electrical power source.
- Specific technical details on all lighting equipment, including brand names, model numbers, power rating and photometric data.
- Details of any hoods, louvers, shields or other means to be used to control glare.
- Attachment and mounting details for lights to be attached to equipment.
- Lighting calculations confirming that the illumination requirements will be met by the layout.

The Contractor shall maintain a supply of emergency flares for use in the event of unanticipated situations such as traffic accidents, equipment breakdowns, failure of lighting equipment, etc.

B. Lighting for Nighttime Operations. Prior to the first night of nighttime operations, the Contractor shall set up and operate the lighting equipment at night as a trial run to demonstrate its ability to establish a safe, properly illuminated, nighttime operation. The Contractor shall furnish the Engineer with a photometer, capable of measuring the level of illumination, for use as necessary to check the adequacy of illumination throughout nighttime operations.

1. Equipment. The Contractor shall supply all lighting equipment required to provide a work zone safe for the workers and traffic. Material and/or equipment shall be in good operating condition and in compliance with applicable safety and design codes.

   a. Light Towers. Light towers shall be provided as a primary means of illumination, and shall provide Level I illumination throughout the work space. They may be supplemented to the extent necessary by lighting fixtures mounted on construction equipment to provide Level II or Level III illumination where required for paving, milling and similar moving operations. Light towers shall be sturdy and free-standing without the aid of guy wires or bracing, and
shall be capable of being moved as necessary to keep pace with construction operations. Light towers shall be positioned to minimize the risk of being impacted by traffic on the roadway or by construction traffic or equipment.

b. Light Towers on Paving, Milling, and Finishing Machines. If needed to supplement portable and/or trailer-mounted light towers, towers shall be affixed to paving, milling, and finishing machines to provide the required level of illumination for the specified distance in front of and behind the machine. Luminaires shall be aimed and adjusted to provide uniform illumination with a maximum uniformity ratio of 5:1. The hopper, auger, and screed areas of pavers and the operator’s controls on all machines shall be uniformly illuminated.

c. Construction Equipment Lights. All construction equipment, including rollers, backhoes, loaders, and other equipment operating in areas not illuminated to a minimum of Level I Illumination, shall be equipped with a minimum of two 500 watt flood lights facing in each direction to provide a minimum of 1 foot-candle of horizontal illumination measured 60 feet in front of and behind the equipment. In areas illuminated to a minimum of Level I, construction equipment may move unescorted. In non-illuminated areas, construction equipment shall be equipped with conventional vehicle headlights, shall be illuminated with flood lights on the vehicle, or shall be escorted to permit safe movement. Headlights shall not be permitted as the sole means of illumination while working.

d. Equipment Mounting. The Contractor shall provide suitable brackets and hardware to mount lighting fixtures and generators on machines and equipment. Mountings shall be designed so that light fixtures can be aimed and positioned as necessary to reduce glare and to provide the required illumination. Mounting brackets and fixtures shall not interfere with the equipment operator or any overhead structures, and shall provide for secure connection of the fixtures with minimum vibration.

e. Portable Generators. The Contractor shall provide portable generators to furnish adequate power to operate all required lighting equipment. Fuel tank capacity and availability of fuel on site shall be sufficient to permit uninterrupted operation throughout the planned shift. Adequate switches shall be provided to control the various lights. All wiring shall be weatherproof and installed in accordance with 29 CFR 1926 Subpart K. All power sources shall be equipped with a Ground-Fault Circuit Interrupter.

2. Illumination Requirements. Tower-mounted luminaires, whether fixed, portable, trailer-mounted, or equipment-mounted, shall be of sufficient wattage and/or quantity to provide the required level of illumination and uniformity over the area of operation while minimizing glare.

The uniformity of illumination, defined as the ratio of the average illumination to the minimum illumination over an area requiring an indicated illumination level, shall not exceed 5:1. Illumination levels on approach roadways should be increased sequentially to prevent motorists from becoming disoriented by rapid changes from full dark to very bright conditions.

Existing street and highway lighting shall not eliminate the need for the Contractor to provide lighting. Consideration will be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided. Such consideration shall be presented in the Contractor’s lighting plan. In the event of any failure of the lighting system, nighttime operation(s) shall be discontinued until the required level of illumination is restored.

a. Level I (5 foot-candles). Level I illumination shall be provided for all areas of general construction operations to include all work operations by Contractors personnel, including work zone traffic control set-up and operations, staging, excavation, cleaning and sweeping,
pavement marking, spoil disposal, landscaping, planting and seeding, layout and measurements ahead of the actual work, borrow areas, spoil areas, and truck cleanout areas. Level I illumination shall be provided near the beginning of lane closure tapers and at road closures for nighttime work zones, including the setup and removal of the closure tapers. Level I illumination shall be provided a minimum of 400 feet ahead and 800 feet behind a paving or milling machine, or for the entire area of concrete placement or pavement work if less than this distance. This area shall be extended as necessary to incorporate all vehicle and equipment operations associated with the paving operation.

The only exception to the requirement for Level I illumination throughout the area of construction operations is that finish rollers can work beyond the area of Level I illumination using floodlights mounted on the roller.

b. Level II (10 foot-candles). Level II illumination shall be provided for flagging stations, asphalt paving, milling, and concrete placement and/or removal operations, including bridge decks, 50 feet ahead of and 100 feet behind a paving or milling machine.

c. Level III (20 foot-candles). Level III illumination shall be provided for pavement or structural crack filling, joint repair, pavement patching and repairs, installation of signal equipment or other electrical/mechanical equipment, and other tasks involving fine details or intricate parts and equipment.

3. Glare Control. All lighting shall be designed, installed, and operated to avoid glare that affects traffic on the roadway or that causes annoyance or discomfort for residences adjoining the roadway. The Contractor shall locate and aim lighting fixtures to provide the required level of illumination and uniformity in the work zone without the creation of objectionable glare. The Engineer will determine when glare exceeds acceptable levels, either for traffic or for adjoining residences.

The Contractor shall provide shields, visors or louvers on luminaires as necessary to reduce objectionable levels of glare. As a minimum, the following requirements shall be met to avoid objectionable glare on roadways open to traffic in either direction:

- Tower-mounted luminaires shall be aimed either generally parallel or perpendicular to the roadway.
- Luminaires shall be aimed such that the angle between the center of the beam axis and the vertical mounting pole is no greater than 45°.
- No luminaires shall be permitted that provide a luminous intensity greater than 20,000 candelas at an angle of 72° above the vertical.
- Except where prevented by overhead utilities or structures, towers shall be extended to their full working height when in use to reduce glare and provide uniform illumination.

619-3.20 Traffic Control Supervisor. When indicated in the contract documents, the Contractor shall provide a dedicated traffic control supervisor having adequate training, experience, and authority to implement and maintain all traffic control operations. The traffic control supervisor shall not be assigned other duties that interfere with performance as a traffic control supervisor.

The traffic control supervisor shall be adequately trained in traffic control operations by recognized training programs, including the American Traffic Safety Services Association “Traffic Control Supervisor”, the National Safety Council, unions, or construction industry associations, or by an individual instructor from such a program. Traffic control supervisors not competent to the satisfaction of the Engineer shall be replaced immediately.

During setup and removal of lane closures and other traffic control setups, the traffic control supervisor shall be assisted by additional workers as necessary. The traffic control supervisor shall patrol...
the contract area to ensure that conditions on the site are adequate for public safety and convenience at all times, to monitor worker safety from intrusions into the work area, and to ensure that the work adheres to the provisions for work zone traffic control. The traffic control supervisor shall ensure signs, channelizing devices, barricades, barrier, impact attenuators and other traffic control devices are adjusted and maintained as necessary. The Contractor shall provide workers to install, maintain, adjust, and remove traffic control devices as required by the work operations.

When the work does not require closure of an active lane, roadway, or ramp; when no construction operations occur within 30 feet of active traffic lanes; and when there is no delivery of materials or equipment; the Engineer may waive the requirements for a traffic control supervisor.

619-3.21 Temporary Structures and Approaches. The Contractor shall design, construct, maintain and remove temporary structures and their approaches, or move and remove existing structures to provide temporary structures along with their temporary approaches. The Contractor shall install temporary approaches, including necessary earth support structures, 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 AASHTO Standard Specifications for Highway Bridges, Division II or AASHTO LRFD Bridge Construction Specifications, except as modified herein. Fabrication shall be performed by an AISC Category III-Certified Fabricator. Plans and design computations shall bear the stamp and signature of a Professional Engineer.

When specific details are not included in the contract documents, or when the Contractor receives approval to vary from the contract documents, the Contractor shall design all elements of the temporary structure and approaches including the railing system. Design shall be done in conformance with the NYSDOT Load and Resistance Factor Design (LRFD) Bridge Design Specifications, except that the only design live load shall be HL-93. Alternatively, the design shall be in conformance with the NYSDOT Standard Specifications for Highway Bridges, except that the minimum design live load shall be HS 20. The bridge rail shall be designed for a minimum of TL-2.

Any structure that is expected to be in service for more than 5 years, shall be designed as a permanent structure according to the NYSDOT Load and Resistance Factor Design (LRFD) Bridge Design Specifications, including the Permit Vehicle and seismic loading.

Load rating calculations for the temporary structure shall be submitted to the DCES. Load ratings shall be computed based on Load Factor Design (LFD) or Allowable Stress Design (ASD), and shall be based on an HS-20 loading. Additionally, if the structure is designed using the NYSDOT LRFD specifications, load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. LRFR ratings shall be shown at the Inventory and Operating levels as rating factors of the AASHTO HL-93 live load. All Load Ratings shall be calculated in accordance with the AASHTO Manual for Bridge Evaluation.

Prior to beginning construction of any temporary structure designed by the Contractor, the Contractor shall submit detailed plans and calculations to the DCES for review and approval in accordance with §585-3.02 Working Drawings. 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 Professional Engineer shall submit with the plans the method for documenting that all primary member material meets the physical properties required by the design. In the absence of record plans or other valid documentation for the used materials, 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 NYS Steel Construction Manual. Complete penetration groove welds in primary members 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 7 calendar days prior to commencement of fabrication.
Prior to opening a temporary structure to traffic, the structure shall be inspected by a Professional Engineer who shall certify in writing to the Engineer that the structure was constructed in accordance with the design. The Contractor shall have the temporary structure inspected, under the direction of a Professional Engineer, by a person familiar with bridge construction at least once a month. On or before each anniversary of the opening of a temporary structure that has been open to traffic for one year or more, the structure shall be inspected by a Professional Engineer, who shall certify in writing that:

1. The plans of the structure, including its foundations, have been reviewed.
2. A hands-on inspection of the structure has been performed in accordance with the latest edition of the NYSDOT Bridge Inspection Manual by an inspection team whose leader is a Professional Engineer and who was present for the inspection.
3. A detailed inspection of those areas of the structure critical to its integrity has been performed.
4. The structure is currently adequate for its design loads.

A signed and stamped copy of the inspection results shall be provided to the Engineer within one week of the inspection.

**619-3.22 Pavement Patching.** The Contractor shall place paving materials suitable to provide temporary pavement patches on paved surfaces where vehicular, bicycle or pedestrian traffic is to be maintained, including the traveled way, shoulders, sidewalks, and other paved surfaces damaged by traffic or environmental factors and not by Contractor operations. During periods of active work on the contract, the Contractor shall complete needed patches on a daily basis. During periods of winter shutdown, the Contractor shall inspect the contract on a regular basis, and pavement patches shall be installed as needed.

The Contractor shall place pavement patches to provide a relatively smooth, uniform driving surface suitable for safe travel at the posted speed limit. Pavement patches shall be placed to repair surface irregularities including, but not limited to, holes, depressions, cracks and uneven joints. Areas to be patched shall be adequately cleaned and tack-coated if necessary, and patching material shall be thoroughly compacted by hand or by roller.

**619-3.23 Mailboxes.** In the event the original mounting post has been lost, damaged, is unusable, or is not consistent with U.S. Postal Service requirements, the Contractor shall furnish and install a new mounting post and/or mailbox with mounting post at the designated location and at the proper height in accordance with the requirements of the U.S. Postal Service.

**619-4 METHOD OF MEASUREMENT**

**619-4.01 General.** (None Specified.)

**619-4.02 Basic Work Zone Traffic Control.** The work under basic work zone traffic control will be measured for payment on a lump sum basis.

**619-4.03 Basic Work Zone Traffic Control (Daily Operations).** The work under basic work zone traffic control (daily operations) will be measured for payment on a lump sum basis.

**619-4.04 Temporary Business Signs.** The quantity to be measured for payment will be in square feet to the nearest 0.1 square feet of business signs installed.

**619-4.05 Covering or Removal of Pavement Markings.** The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes covered or removed. No measurement will be made for the gaps between broken and dotted line segments. If preformed tape is used to cover an existing line, payment will be based on the width of the line covered. Measurement for covering or removal of striping with a width greater than 4 inches will be made by the following method:
Width of Striping (in) x Number of Feet
4 (in)

Letters and symbols will be measured by each unit covered or removed. A unit will consist of one letter or one symbol except that a double-headed arrow will be measured as two units and triple headed arrow will be measured as three units. Example: "SCHOOL" would be measured as six units. Each R in a railroad crossing marking will be measured as a single unit, but the "X" will be measured by the number of feet of 4 inch stripe.

619-4.06 Temporary Pavement Markings. The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes installed, and will be based on a 4 inch wide stripe. No measurement will be made for the length of skips in the dashed line. Measurement for installation of striping with a width greater than 4 inches will be made by the following method:

Width of Striping (in) x Number of Feet
4 (in)

619-4.07 Interim Pavement Markings. The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes installed, and will be based on a 4 inch wide stripe. No measurement will be made for the length of skips in the dashed line. Measurement for installation of striping with a width greater than 4 inches will be made by the following method:

Width of Striping (in) x Number of Feet
4 (in)

Letters and symbols will be measured by each unit installed. A unit will consist of one letter or one symbol except that a double-headed arrow will be measured as two units and triple headed arrow will be measured as three units. Example: “SCHOOL” would be measured as six units. Each R in a railroad crossing marking will be measured as a single unit, but the “X” will be measured by the number of feet of 4 inch stripe.

619-4.08 Temporary Rumble Strips. The quantity to be measured for payment will be in feet to the nearest whole foot of individual temporary rumble strip installed, measured transverse to the direction of traffic flow.

619-4.09 Interim Tubular Markers. The quantity to be measured for payment will be the number of interim tubular markers installed.

619-4.10 Portable Variable-Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS). The quantity of PVMS or TMVMS with a pay unit of each to be measured for payment will be the number of signs provided. The quantity of PVMS or TMVMS with a pay unit of weeks to be measured for payment will be in weeks to the nearest whole week.

619-4.11 Type III Construction Barricades. The quantity to be measured for payment will be the number of barricade units installed.

619-4.12 Temporary Concrete Barrier. The quantity to be measured for payment of temporary concrete barrier will be in feet to the nearest foot along the centerline of temporary concrete barrier installed.
The quantity to be measured for payment of pinned temporary concrete barrier will be in feet to the nearest foot along the centerline of pinned temporary concrete barrier installed.

The quantity to be measured for payment of temporary concrete barrier stiffened with box beam will be in feet to the nearest foot along the centerline of temporary concrete barrier stiffened with box beam installed.

The quantity to be measured for payment of temporary concrete barrier with barrier warning lights installed will be in feet to the nearest foot along the centerline of temporary concrete barrier installed.

The quantity to be measured for payment of Box Beam to Flared Temporary Concrete Barrier Transition will be the number of such transitions installed.

The quantity to be measured for payment of Box Beam to Unflared Temporary Concrete Barrier Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Face to Box Beam Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Back to Box Beam Transition will be the number of such transitions installed.

619-4.13 Temporary Glare Screen. The quantity to be measured for payment will be in feet to the nearest whole foot along the length of the temporary glare screen installed.

619-4.14 Temporary Impact Attenuator. The quantity to be measured for payment will be the number of temporary impact attenuators installed.

619-4.15 Temporary Sand Barrel Arrays. The quantity to be measured for payment will be the number of individual sand barrel modules installed.

619-4.16 Vehicle Arresting Barrier. The quantity to be measured for payment will be the number of barriers installed.

619-4.17 Maintain or Modify Traffic Signal Equipment. The quantity of signalized intersections maintained to be measured for payment will be in months to the nearest 1/4 month. The quantity of traffic signal equipment modified to be measured for payment will be on an each location basis.

619-4.18 Temporary Traffic Signals. The work under temporary traffic signals will be measured for payment on an each location basis.

619-4.19 Nighttime Operations. The work under nighttime operations will be measured for payment on a lump sum basis.

619-4.20 Traffic Control Supervisor. The work under traffic control supervisor will be measured for payment on a monthly basis to the nearest 1/4 month.

619-4.21 Temporary Structures and Approaches. The quantity to be measured for payment will be the number of temporary structures and approaches installed.

619-4.22 Pavement Patching. The quantity to be measured for payment will be in cubic yards to the nearest 0.1 cubic yard of pavement patching installed.

619-4.23 Mailboxes. The quantity to be measured for payment will be the number of mailboxes installed.

619-5 BASIS OF PAYMENT
619-5.01 General. The price bid shall include all labor, materials and equipment necessary to complete the work. No payment will be made for damage caused by vehicle accidents, vandalism, or any other similar causes.

A. Non-Payment. For each calendar day during which there are substantial deficiencies in compliance with the requirements of this section, no payment will be made under basic work zone traffic control. The amount of such calendar day nonpayment will be deducted from monies due the Contractor in accordance with Table 619-7 Basic Work Zone Traffic Control Nonpayment.

<table>
<thead>
<tr>
<th>Original Contract Amount</th>
<th>To and Including</th>
<th>Nonpayment Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0</td>
<td>$ 500,000</td>
<td>$ 200</td>
</tr>
<tr>
<td>$ 500,000</td>
<td>$ 2,000,000</td>
<td>$ 400</td>
</tr>
<tr>
<td>$ 2,000,000</td>
<td>$ 5,000,000</td>
<td>$ 500</td>
</tr>
<tr>
<td>$ 5,000,000</td>
<td>$ 10,000,000</td>
<td>$ 750</td>
</tr>
<tr>
<td>$ 10,000,000</td>
<td>$ 20,000,000</td>
<td>$ 1,000</td>
</tr>
<tr>
<td>$ 20,000,000</td>
<td>-----</td>
<td>$ 3,000</td>
</tr>
</tbody>
</table>

B. Liquidated Damages. If the Contractor fails to adequately correct substantial cited deficiencies within 24 hours of notification by the Engineer for any item under this section, or those deficiencies reoccur on a subsequent, but not necessarily concurrent calendar day, liquidated damages will be assessed for each calendar day or part thereof in addition to non-payment for deficiencies.

C. Major Non-Conformance. Where major non-conformance with the requirements of this specification is noted by the Engineer, and prompt Contractor compliance is deemed not to be obtainable, the Engineer may stop contract work.

Where major non-conformance with the requirements of this specification is noted by the Engineer, and the Contractor fails to correct deficiencies for a period of 24 hours, the Department may correct the adverse conditions by any means deemed appropriate, and will deduct the cost of the corrective work from any monies due the Contractor. The cost of this corrective work will be in addition to the non-payment for basic work zone traffic control, non-payment of any other items of work under this section and liquidated damages assessed.

619-5.02 Basic Work Zone Traffic Control. The lump sum price bid for basic work zone traffic control shall include all labor, materials and equipment necessary to complete the work. Construction signs; arrow panels; warning lights on signs, barricades and channelizing devices; the cost of temporarily terminating guide rail, median barrier, or bridge rail during non-work hours; work required to maintain drainage facilities during construction operations; and dust control shall be included in the lump sum price bid for basic work zone traffic control. Removal of debris from drainage features that was present at the time of contract award shall be paid for separately.

Progress payments will be made at 20 percent of the lump sum price bid when 10 percent of the contract work, excluding basic work zone traffic control, contingency items and mobilization, has been completed. The remaining 80 percent will be paid in subsequent contract payments, in proportion to the amount of other contract work completed, less any non-payment for deficient work zone traffic control. If the contract completion date is extended, no additional payment will be made for basic work zone traffic control.
619-5.03 Basic Work Zone Traffic Control (Daily Operations). The lump sum price bid for basic work zone traffic control (daily operations) shall include all labor, materials and equipment necessary to complete the work. Construction signs; arrow panels; warning lights on signs, barricades and channelizing devices; and the cost of temporarily terminating guide rail, median barrier, or bridge rail during non-work hours; shall be included in the lump sum price bid for basic work zone traffic control (daily operations).

Progress payments will be made at 20 percent of the lump sum price bid when 10 percent of the contract work, excluding basic work zone traffic control, contingency items and mobilization, has been completed. The remaining 80 percent will be paid in subsequent contract payments, in proportion to the amount of other contract work completed, less any non-payment for deficient work zone traffic control. If the contract completion date is extended, no additional payment will be made for basic work zone traffic control.

619-5.04 Business Signs. The unit price bid for temporary business signs shall include the cost of labor, materials and equipment necessary to complete the work, including sign supports.

619-5.05 Covering or Removal of Pavement Markings. The unit price bid for the covering or removal of pavement markings shall include the cost of all labor, materials and equipment necessary to complete the work, including the costs of any repairs or replacement of damaged pavement or existing pavement markings resulting from pavement marking removal operations.

619-5.06 Temporary Pavement Markings. The unit price bid for temporary pavement markings shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. Payment shall be provided each time temporary pavement markings are first applied on a pavement course in accordance with the contract requirements.

No additional payment shall be provided for the installation of construction signs, temporary delineators, and channelizing devices necessitated by the Contractor’s failure to place temporary pavement markings before the pavement is opened to traffic, or for temporary roadside pavement channelization, until edge lines are placed. No additional payment shall be provided for markings required because the Contractor failed to place the next pavement course or the final pavement markings within 14 calendar days.

619-5.07 Interim Pavement Markings. The unit price bid for interim pavement markings shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. The work to remove traffic paint or epoxy paint will be paid for separately.

619-5.08 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, asphalt concrete, and other materials used to form or fill in the rumble strips, and tack coat. On multiyear contracts where it is desired to have rumble strips in place for more than one construction season, the rumble strips will be paid for separately each year they are installed.

619-5.09 Interim Tubular Markers. The unit price bid for interim tubular markers shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including removal and the cost of replacing damaged markers. Interim tubular markers that are in satisfactory condition may be relocated. When interim tubular markers are relocated, payment will be made for another interim tubular marker.

619-5.10 Portable Variable-Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS). The unit price bid for PVMS or TMVMS shall include the cost of all labor, materials, testing and equipment necessary to complete the work, including cellular telephone service initial start-up and
monthly charges for the cellular communications option. The TMVMS does not require cellular communications service.

Progress payments for PVMS or TMVMS with a pay unit of each will be made for 90 percent of the unit price bid when each unit has been satisfactorily installed and is operational at the first location. The remaining 10 percent will be paid upon removal.

619-5.11 Type III Construction Barricades. The unit price bid for Type III construction barricades shall include all labor, materials and equipment necessary to complete the work, including lighting when required. When barricades are relocated or the diagonal stripes are changed to allow traffic to pass on the other side of the barricade, additional payment will be made for another barricade. Movements of the barricade from one side of the roadway to the other side, movements within 100 feet of the initial location, or daily replacement to approximately the same location, not requiring any change in the diagonal stripes, will not be considered as relocation and will not be paid for as additional barricades.

No payment will be made for Type III construction barricades used at the option of the Contractor in lieu of channelizing devices.

619-5.12 Temporary Concrete Barrier. The unit price bid for temporary concrete barrier shall include all labor, materials and equipment necessary to satisfactorily complete the work, including any required connection devices, end treatments, end section pinning, temporary delineation and repair of pavement after removal of temporary concrete barrier. Temporary impact attenuators, if required, will be paid for separately. When temporary concrete barriers are relocated, except movements necessary to maintain, realign, or replace damaged units and daily relocation of segments to allow access to the work area which are restored at the end of the work shift, additional payment will be made for additional length of temporary concrete barrier.

The unit price bid for pinned temporary concrete barrier shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including pinning.

The unit price bid for temporary concrete barrier stiffened with box beam shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including the box beam.

The unit price bid for temporary concrete barrier with warning lights shall include the cost of furnishing all labor, materials, equipment, and electrical power necessary to complete the work. Should a barrier that is equipped with warning lights be moved to a new location where temporary concrete barrier with warning lights is required, payment will be made for additional length of temporary concrete barrier with warning lights.

The unit price bid for Box Beam to Flared Temporary Concrete Barrier Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail; placement and removal of the temporary berm; seeding of the disturbed area; and replacement of rail with holes in its face. No separate payment will be made for box beam used to provide an overlap.

The unit price bid for Box Beam to Unflared Temporary Concrete Barrier Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail: furnishing of Transition End Pieces, rub rail heavy posts and blockouts; and replacement of rail with holes in its face.

The unit price bid for Temporary Concrete Barrier Face to Box Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail and furnishing of box beam tapered end piece. The unit price bid for Temporary Concrete Barrier Back to Box Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including removal and replacement or resetting of existing rail and replacement of rail with holes in its face. No separate payment will be made for box beam used to provide an overlap.

Progress payments will be made at the unit price bid for 90 percent of the quantity, after placement and demonstration of satisfactory operation. The remaining 10 percent will be paid upon removal.
payment will be made for temporary concrete barrier installed at the Contractor’s option, required solely due to a delay caused by the Contractor’s operations, or installed to protect pavement edge drop-offs, unless required in the contract documents.

619-5.13 Temporary Glare Screen. The unit price bid for temporary glare screen shall include all labor, materials and equipment necessary to complete the work. When glare screens are relocated, except movements necessary to maintain, realign, or replace damaged units and daily relocation of temporary concrete barrier segments with glare screen attached to allow access to the work area which are restored at the end of the work shift, additional payment will be made for the length of glare screen relocated. No payment will be made for repair or replacement of damaged components.

619-5.14 Temporary Impact Attenuator. The unit price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including the connection to temporary or existing barrier, the back-up system, the pad, if indicated, and any excavation or backfill. When attenuators are relocated, payment will be made for a new temporary impact attenuator, except minor movements within a site, such as movements to maintain, realign, or adjust an attenuator. No payment will be made to repair, restore or replace an attenuator damaged by public traffic or by the Contractor’s operations.

619-5.15 Temporary Sand Barrel Arrays. The unit price bid for temporary sand barrel arrays shall include the cost of all labor, materials and equipment necessary to complete the work, including the cost of the sand fill and salt additive. Replacement of individual modules damaged by public traffic will be paid for at the unit price bid for each temporary sand barrel. Relocation of barrels to a new location will be paid for as a new installation.

619-5.16 Vehicle Arresting Barrier. The unit price bid for vehicle arresting barrier shall include the cost of all labor, materials and equipment necessary to complete the work. No payment will be made to repair, restore or replace an attenuator damaged by public traffic or by the Contractor’s operations.

619-5.17 Maintain or Modify Traffic Signal Equipment. The unit price bid for maintaining traffic signal equipment shall include the cost of all labor, materials and equipment necessary to perform the work, with the exception of inductance loop replacement, if necessary, 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.

The unit price bid for modifying traffic signal equipment per location shall include the cost of all labor, materials and equipment necessary to perform the work.

619-5.18 Temporary Traffic Signals. The unit price bid for temporary traffic signals per location shall include the cost of all labor, materials and equipment necessary to complete the work, including the cost of electric power necessary to operate the signal until its removal is approved or directed by the Engineer. A location may be an intersection, a work zone with two or more signal faces interconnected and operating together, or other limits as defined in the contract documents. Portable or temporary traffic signals used at the Contractor’s option in lieu of flaggers shall be included in the lump sum price bid for basic work zone traffic control.

Progress payments will be made at 50 percent of the unit price bid for each location after installation and demonstration of satisfactory operation. The remaining 50 percent will be paid in progress payments per week of temporary traffic signal provided. The amount of such weekly payment will be determined by dividing 50 percent of the unit price bid by the number of weeks the temporary traffic signal is to remain in operation, as shown on the approved progress schedule.
619-5.19 Nighttime Operations. The lump sum price bid for portable lighting shall include all labor, materials and equipment necessary to complete the work.

Progress payments will be made based on the lump sum price bid as follows: 20 percent when the Nighttime Operations and Lighting Plan has been accepted and satisfactory lighting of nighttime operations has begun; the remaining 80 percent will be paid in progress payments per week of nighttime operations completed. The amount of such weekly payment will be determined by dividing 80 percent of the lump sum amount bid by the number of weeks of nighttime operations in the approved Nighttime Operations and Lighting Plan.

619-5.20 Traffic Control Supervisor. The unit price bid for traffic control supervisor shall include the cost of furnishing all labor, materials, equipment, training and direct supervision necessary to provide and support the activities of a traffic control supervisor.

619-5.21 Temporary Structures and Approaches. The unit price bid for temporary structures and approaches shall include the cost of all labor, materials and equipment necessary to complete the work including design preparation. Two temporary structures separated by a portion of an existing structure greater than 3 feet in length will be paid for as two separate structures.

Progress payments will be made at the unit price bid for 90 percent of the quantity after the temporary structures and approaches are complete and operable. The remaining 10 percent will be paid upon removal.

619-5.22 Pavement Patching. The unit price bid for pavement patching shall include the cost of furnishing all labor, materials and equipment necessary to patch pavement during periods of winter shutdown when work on the contract is inactive, or when hot mix asphalt material is not available, including mobilization of work crews and work zone traffic control.

The cost of all work associated with providing and installing suitable pavement patching materials to maintain pavements open to traffic in acceptable condition when work on the contract is active, or when hot mix asphalt material is available, will be paid under a hot mix asphalt sidewalk item if that item is in the contract, or alternatively, under a top course paving item, regardless of the material actually used.

619-5.23 Mailboxes. The unit price bid for mailboxes shall include all labor, materials and equipment necessary to complete the work. 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. Where multiple mailboxes are installed on a single post, payment will be based upon the number of individual mailboxes so installed.

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 Work Zone Traffic Control</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.0101</td>
<td>Basic Work Zone Traffic Control (Daily Operations)</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>619.04</td>
<td>Type III Construction Barricades</td>
<td>Each</td>
</tr>
<tr>
<td>619.06mn</td>
<td>Temporary Structures and Approaches</td>
<td>Each</td>
</tr>
<tr>
<td>619.0701</td>
<td>Temporary Business Signs</td>
<td>Square Feet</td>
</tr>
<tr>
<td>619.0801xx</td>
<td>Remove Pavement Marking Stripes</td>
<td>Feet</td>
</tr>
<tr>
<td>619.0802xx</td>
<td>Remove Pavement Marking Letters or Symbols</td>
<td>Each</td>
</tr>
</tbody>
</table>

\[
xx = \text{Material} \\
01 = \text{Traffic Paint,} \\
02 = \text{Epoxy Paint,} \\
06 = \text{Permanent Pavement Tape}
\]

619.0803 Cover Existing Pavement Marking Stripes (Removable Tape) Feet
### Cover Existing Pavement Marking Letters or Symbols (Removable Tape)

Each

### Temporary Pavement Markings, Stripes

Feet

- **xx = Material**
  - 01 = Traffic Paint,
  - 03 = Removable Tape,
  - 04 = Removable Wet Reflective Tape,

### Interim Pavement Markings, Stripes

Feet

### Interim Pavement Markings, Symbols

Each

### Interim Pavement Markings, Letters

Each

- **xx = Material**
  - 01 = Traffic Paint,
  - 02 = Epoxy Paint,
  - 03 = Removable Tape,
  - 04 = Removable Wet Reflective Tape,
  - 05 = Traffic Paint Supplemented with Raised Markers

### Portable Variable Message Signs (PVMS)

- **XY = Options**
  - X = Equipment Options
  - Y = Cellular Communication Options
  - 1 = No optional equipment specified
  - 2 = Radar
  - 3 = CCTV Camera
  - 4 = Radar & CCTV Camera
  - 1 = No Cellular Communications required
  - 2 = Cellular Communications
  - 3 = Cellular Communication with NTCIP compliance

### Truck Mounted Variable Message Signs (TMVMS)

Each

### Temporary Glare Screen

Feet

### Temporary Traffic Signals

Each Location

### Maintain Traffic Signal Equipment (Requirement A)

Intersection Month

### Maintain Traffic Signal Equipment (Requirement B)

Intersection Month

### Maintain Traffic Signal Equipment (Requirement C)

Intersection Month

### Modify Existing Traffic Signal Equipment (Temporary)

Each Location

### Temporary Concrete Barrier (Unpinned)

Feet

### Temporary Concrete Barrier (Unpinned) with Warning Lights

Feet

### Temporary Concrete Barrier (Pinned)

Feet

### Temporary Concrete Barrier (Pinned) with Warning Lights

Feet

### Temporary Concrete Barrier (Stiffened with Box Beam)

Feet

### Temporary Concrete Barrier (Stiffened with Box Beam) with Warning Lights

Feet

### Temporary Concrete Barrier (Stiffened with Box Beam and Pinned)

Feet
SECTION 620 - BANK AND CHANNEL PROTECTION

620-1 DESCRIPTION. This work shall consist of furnishing all labor, equipment, and materials to place a protective covering of erosion-resistant material in the locations indicated in the contract documents 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 in the contract documents or established by the Engineer.

620-1.01 Vacant.

620-1.02 Stone Filling. Stone filling shall consist of a layer of well graded stone.

620-1.03 Dry Rip-Rap. Dry rip-rap shall consist of a fitted layer of shaped and graded stone.

620-1.04 Grouted Rip-Rap. Grouted rip-rap shall consist of a layer of stone, similar to dry rip-rap, with the spaces between the stones filled with cement grout.

620-1.05 Bedding Material. Bedding material shall consist of a layer of granular material placed to prevent underlying finer material from passing into and through the stone filling or rip-rap.

620-1.06 Concrete Block Paving. Concrete block paving shall consist of concrete blocks placed on embankment slopes under structures as protection against erosion.

620-1.07 Gabions. Gabions shall consist of open wire mesh baskets, filled with stones.

620-2 MATERIALS

620-2.01 General. The requirements for bank and channel protection materials are described below. The procedure for acceptance or rejection of stone filling and rip-rap materials shall be in conformance with the procedures contained in the geotechnical control procedure “Procedure for the Control of Stone Filling and Rip-Rap Items”.

SECTION 620 - BANK AND CHANNEL PROTECTION

(Last Revised May 1, 2019)
620-2.02 Stone Filling. Provide material meeting the requirements of §733-21 Stone Filling for the type of stone filling specified in the contract documents.

620-2.03 Dry Rip-Rap. Provide material meeting the requirements of §733-22 Rip-Rap, except for §733-22D Grout.

620-2.04 Grouted Rip-Rap. Provide material meeting the requirements of §733-22 Rip-Rap.

620-2.05 Bedding Material. Bedding material shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing for the type of bedding material specified in the contract documents:

A. Bedding Material Type 1. Provide material meeting the requirements of §733-23 Bedding Material Type 1.

B. Bedding Material Type 2. Provide material meeting the requirements of §733-23 Bedding Material Type 2.

620-2.06 Concrete Block Paving. Provide concrete blocks meeting the requirements of §704-04 Concrete Block (Slope Paving). The blocks shall conform to the dimensions identified in Table 620-1 Concrete Block Dimensions:

<table>
<thead>
<tr>
<th>TABLE 620-1 CONCRETE BLOCK DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Dimension</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Length 16 to 20 in.</td>
</tr>
<tr>
<td>Thickness 6 in. (solid)</td>
</tr>
<tr>
<td>Width 8 in.</td>
</tr>
</tbody>
</table>

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 meet the requirements of §703-06 Cushion Sand. Grout, where used, shall conform to Table 620-2 Concrete Block Grout Requirements:

<table>
<thead>
<tr>
<th>TABLE 620-2 CONCRETE BLOCK GROUT REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Portland Cement Type 2</td>
</tr>
<tr>
<td>Mortar Sand</td>
</tr>
</tbody>
</table>

620-2.07 Gabions. Provide materials meeting the requirements of §712-15 Gabions.

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 in the contract documents and replaced with approved material. Filled areas shall be compacted in accordance with applicable provisions of Section...
203. 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 in the contract documents. Stone filling used for bank or channel protection shall be placed to its full course thickness in one operation, unless 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 in the contract documents, 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. Bedding material that becomes contaminated shall be removed and replaced with uncontaminated bedding material at no additional cost to the State.

620-3.06 Concrete Block Paving. Blocks shall be laid on a 3 in. bed of cushion sand in running bond with the long dimension transverse to the slope and all joints tight. Blocks shall be set slightly higher than their final position and carefully hand tamped into their final position to provide a uniformly even surface and solid bedding under each block.

In the areas where grouting is called for, the block shall be laid in running bond with the length parallel to the slope and with ¼ in. 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 4 in.
from the surface. The block shall be wetted 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 weather.

620-3.07 Gabions. Each gabion unit shall be assembled by binding together all vertical edges with wire
ties on approximately 6 in. spacing or by a continuous piece of connecting wire stitched around the
vertical edges with a coil about every 4 in. Empty gabion units shall be set to line and grade as shown in
the contract documents. 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 directed by the Engineer.

A 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 ensure 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 wire ties
or connective wire in the same manner described above for assembly.

620-4 METHOD OF MEASUREMENT

620-4.01 General. Vacant.

620-4.02 Stone Filling. Stone filling will be measured in cubic yards, measured to the nearest whole
cubic yard, computed from the payment lines shown in the contract documents.

620-4.03 Dry Rip-Rap. Dry rip-rap will be measured in cubic yards, measured to the nearest whole cubic
yard, computed from the payment lines shown in the contract documents.

620-4.04 Grouted Rip-Rap. Grouted rip-rap will be measured in cubic yards, measured to the nearest
whole cubic yard, computed from the payment lines shown in the contract documents.

620-4.05 Bedding Material. Bedding material will be measured in cubic yards, measured to the nearest
whole cubic yard, computed from the payment lines shown in the contract documents.

620-4.06 Concrete Block Paving. Concrete block paving will be measured in square yards, measured to
the nearest whole square yard, computed from the payment lines shown in the contract documents.

620-4.07 Gabions. Gabions will be measured in cubic yards, measured to the nearest whole cubic yard,
computed from the payment lines shown in the contract documents.

620-5 BASIS OF PAYMENT

620-5.01 General. Vacant.

620-5.02 Stone Filling. The unit price bid shall include the costs of furnishing all labor, material and
equipment necessary to complete the work except that any necessary excavation will be paid for
separately.
620-5.03 **Dry Rip-Rap.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

620-5.04 **Grouted Rip-Rap.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

620-5.05 **Bedding Material.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

620-5.06 **Concrete Block Paving.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

620-5.07 **Gabions.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation 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>620.02</td>
<td>Stone Filling (Fine)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.03</td>
<td>Stone Filling (Light)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.04</td>
<td>Stone Filling (Medium)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.05</td>
<td>Stone Filling (Heavy)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.06</td>
<td>Dry Rip-Rap</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.07</td>
<td>Grouted Rip-Rap</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.0801</td>
<td>Bedding Material, Type 1</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.0802</td>
<td>Bedding Material, Type 2</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.09</td>
<td>Concrete Block Paving</td>
<td>Square Yard</td>
</tr>
<tr>
<td>620.10</td>
<td>Galvanized Gabions</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.11</td>
<td>P.V.C. Coated Galvanized Gabions</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.02</td>
<td>Stone Filling (Fine)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.03</td>
<td>Stone Filling (Light)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.04</td>
<td>Stone Filling (Medium)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.05</td>
<td>Stone Filling (Heavy)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.06</td>
<td>Dry Rip-Rap</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.07</td>
<td>Grouted Rip-Rap</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.08</td>
<td>Bedding Material</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.09</td>
<td>Concrete Block Paving</td>
<td>Square Yard</td>
</tr>
<tr>
<td>620.10</td>
<td>Galvanized Gabions</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>620.11</td>
<td>P.V.C. Coated Galvanized Gabions</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

**SECTION 621 - CLEANING CULVERTS, DRAINAGE STRUCTURES AND EXISTING ROADSIDE SECTIONS**

621-1 DESCRIPTION
621-1.01 General. This work shall consist of cleaning and keeping clean, existing culverts, closed drainage systems, drainage structures, and existing roadside sections as shown in the contract documents.

621-1.02 Definitions. The following general definitions shall be used in conjunction with this section:

1. **Culvert.** A culvert is defined as an enclosed channel open at both ends carrying water from a stream or water course through an artificial barrier such as a roadway embankment.

2. **Closed Drainage System.** A closed drainage system is a collection system for stormwater runoff that carries water to a discharge point. A closed drainage system consists of enclosed channel(s) closed at either one or both ends by a drainage structure, and may include intermediate drainage structures at junction points.

3. **Drainage Structure.** A drainage structure includes catch basins, manholes, drop inlets, leaching basins and similar structures that collect and/or redirect runoff water.

4. **Materials Removed.** Materials removed have been presumed not to include non-hazardous industrial waste or hazardous waste in accordance with §107-10 Managing Surplus Material and Waste.

5. **Clean and Keeping Clean.** Clean and keeping clean is the activity of removing accumulated sediment, debris, and vegetation which impedes the flow of water to maintain a proper drainage path and re-establish the design capacity.

6. **Graded Surfaces.** Grading surfaces entails forming and trimming surfaces to the lines and grades shown in the contract documents.

621-2 MATERIALS. None specified.

621-3 CONSTRUCTION DETAILS

621-3.01. General. Provide appropriate control and discharge practices for all water throughout the cleaning process. Include methods and schedules to be consistent with the soil erosion and sediment control plan in accordance with §209-3.01 General and perform all work in accordance with §107-12 Water Quality Protection.

621-3.02. Cleaning Culverts. Culvert locations identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. Disposal of Surplus Excavated Materials. Removal of contaminated material shall be disposed of in accordance with Section 205 Contaminated Soil.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.

621-3.03 Cleaning Closed Drainage System. Closed drainage systems identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. Disposal of Surplus Excavated Materials. Removal of contaminated material shall be disposed of in accordance with Section 205 Contaminated Soil.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.
621-3.04 Cleaning Drainage Structures. Drainage structures identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. Disposal of Surplus Excavated Materials. Removal of contaminated material shall be disposed of in accordance with Section 205 Contaminated Soil.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.

621-3.05 Cleaning, Grading and Shaping Existing Roadside Section. The Contractor shall remove earth, turf, brush and debris, or provide necessary fill material to restore adequate roadside drainage. Ditches shall be shaped as shown in the contract documents. Material removed shall be disposed of in conformance with the provisions of §203-3.02 B. Disposal of Surplus Excavated Materials. Removal of contaminated material shall be disposed of in accordance with Section 205 Contaminated Soil.

The Contractor shall protect all fences, markers, culverts, underground structures, utilities and other appurtenances adjacent to the work area. Any damaged facilities and/or disturbed areas shall be replaced in kind at no additional cost to the state.

621-4 METHOD OF MEASUREMENT

621-4.01. General. None specified.

621-4.02. Cleaning Culverts. Cleaning culverts will be measured in linear feet of culvert cleaned, measured along the invert, to the nearest foot. Multiple barrel culverts will be measured along each individual barrel.

621-4.03 Cleaning Closed Drainage System. Cleaning closed drainage systems will be measured in linear feet of pipe cleaned, measured along the invert of the pipe, from the inside wall surface of the drainage structure to the inside wall surface of the next drainage structure, measured to the nearest foot.

621-4.04 Cleaning Drainage Structures. Cleaning drainage structures will be measured as the number of drainage structures cleaned.

621-4.05 Cleaning, Grading and Shaping Existing Roadside Section. Cleaning, grading, and shaping existing roadside section will be measured as the number of linear feet along the edge of the adjacent roadway.

621-5 BASIS OF PAYMENT

621-5.01. General. None specified.

621-5.02. Cleaning Culverts. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the culverts. Payment for cleaning culverts will be made only for those facilities designated in the contract documents. Only one payment for each length of facility will be made regardless of the number of times it is cleaned.

621-5.03 Cleaning Closed Drainage System. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the closed drainage system. Payment for cleaning closed drainage systems will be made only for those facilities designated in the
contract documents. Only one payment for each facility will be made regardless of the number of times it is cleaned. Cleaning intermediate drainage structures at junction points within a closed drainage system shall be paid for under its respective item.

**621-5.04 Cleaning Drainage Structures.** The unit price bid for each shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the drainage structures. Payment for cleaning drainage structures will be made only for those facilities designated in the contract documents. Only one payment for each facility will be made regardless of the number of times it is cleaned.

**621-5.05 Cleaning, Grading and Shaping Existing Roadside Section.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work including the cost of disposing the materials removed from the roadside section and/or fill material to restore the shape.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>621.01</td>
<td>Cleaning Culverts with Span of 50 in. or Less</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.02</td>
<td>Cleaning Culverts with Span of More Than 50 in.</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.03</td>
<td>Cleaning Closed Drainage Systems</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.04</td>
<td>Cleaning Drainage Structures</td>
<td>Each</td>
</tr>
<tr>
<td>621.05</td>
<td>Clean, Grade and Shape Existing Roadside Section</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.11</td>
<td>Cleaning Culverts (Contaminated Material) with Span of 50 in. or Less</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.12</td>
<td>Cleaning Culverts (Contaminated Material) with Span of More Than 50 in.</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.13</td>
<td>Cleaning Closed Drainage Systems (Contaminated Material)</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>621.14</td>
<td>Cleaning Drainage Structures (Contaminated Material)</td>
<td>Each</td>
</tr>
<tr>
<td>621.15</td>
<td>Clean (Contaminated Material), Grade and Shape Existing Roadside Section</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>

**SECTION 622 - BUILDINGS AND MISCELLANEOUS STRUCTURES**

**622-1 DESCRIPTION.** This work shall consist of special construction, reconstruction and maintenance of rest areas/comfort stations; pump houses; elevators; shade structures & canopies; construction, furnishing and placing bus shelters, kiosks and other miscellaneous structures.

**622-2 MATERIALS.** Materials shall be as specified in the special specifications.

**622-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**622-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**622-5 BASIS OF PAYMENT.** As specified in the special specifications.

**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

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 as shown 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 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 yards 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</td>
<td>Screened Gravel (By Weight)</td>
<td>Ton</td>
</tr>
<tr>
<td>623.02</td>
<td>Crushed Gravel (By Weight)</td>
<td>Ton</td>
</tr>
<tr>
<td>623.03</td>
<td>Crushed Stone (By Weight)</td>
<td>Ton</td>
</tr>
<tr>
<td>623.04</td>
<td>Crushed Slag (By Weight)</td>
<td>Ton</td>
</tr>
<tr>
<td>623.10</td>
<td>Screened Gravel (In-Place Measure)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>623.11</td>
<td>Crushed Gravel (In-Place Measure)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>623.12</td>
<td>Crushed Stone (In-Place Measure)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>623.13</td>
<td>Crushed Slag (In-Place Measure)</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

SECTION 624 - PAVED GUTTERS

624-1 DESCRIPTION. This work shall consist of the construction of Hot Mix Asphalt, 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 indicated in the Contract Documents and/or as directed by the Engineer.

624-2 MATERIALS

624-2.01 Hot Mix Asphalt Gutters. The materials for hot mix asphalt gutters shall meet the requirements specified for a 9.5 mixture designed for <0.3 million Equivalent Single Axle Loads, 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,” 6 inch to 10 inch 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 Hot Mix Asphalt 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 Hot Mix Asphalt 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, Material Designation 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 8 foot sections of the shapes and types shown on the plans and/or Standard Sheet with 1/4 inch joints between sections. 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 Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.

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 curing compound.

B. Machine Formed Gutter. The machine forming requirements of concrete curb as specified under §609-3.04 shall apply except that crack control joints, 1/4 inch wide, shall be formed or scored every 8 feet to depths sufficient to produce weakened planes in the concrete. All crack control joints shall be filled flush with material meeting the requirements of Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.
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 Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.

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 Hot Mix Asphalt Gutters. The quantity of asphalt gutters to be paid for will be measured by the number of tons of Hot Mix Asphalt furnished and placed in accordance with the Contract Documents and/or as directed by 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 feet of exposed surface of concrete gutters placed in accordance with the Contract Documents and/or as directed by the Engineer. No reduction in the number of square feet 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 feet of gutter (laying length) placed in the work in accordance with the Contract Documents and/or as directed by the Engineer.

624-4.04 Cobble Gutters. The quantity of cobble gutters to be paid for under this work will be the number of square feet of exposed surface laid in accordance with the Contract Documents and/or as directed by the Engineer.

624-5 BASIS OF PAYMENT

624-5.01 Hot Mix Asphalt Gutters. The unit price bid per ton of Hot Mix Asphalt 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:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>624.01XX</td>
<td>Conventionally Formed or Machine Formed Concrete Gutters</td>
<td>Square Foot</td>
</tr>
<tr>
<td>624.020101</td>
<td>Hot Mix Asphalt Gutter</td>
<td>Ton</td>
</tr>
<tr>
<td>624.020110</td>
<td>Plant Production Quality Adjustment to 624.020101</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>624.020601</td>
<td>Hot Mix Asphalt Gutters, as Detailed</td>
<td>Ton</td>
</tr>
<tr>
<td>624.020610</td>
<td>Plant Production Quality Adjustment to 624.020601</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>624.03XX</td>
<td>Precast Concrete Gutters</td>
<td>Foot</td>
</tr>
<tr>
<td>624.0401</td>
<td>Cobble Gutters</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

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

SECTION 625 - SURVEY OPERATIONS
(Last Revised May, 2018)

625-1 DESCRIPTION

625-1.01 General.
Some survey work is required be completed under the direction of a Land Surveyor or Professional Engineer in accordance with the professional license requirements contained in NYS Education Law.

625-1.02 Survey Operations.
This work shall consist of providing all necessary survey work to establish, spatially position, and verify the locations of existing and proposed terrain features and measure quantities of items in accordance with the contract documents or as directed by the Engineer. This work includes but is not limited to the establishment, reestablishment or localization of primary and secondary control, the stakeout or layout of proposed features, the initialization, calibration and navigation of automated equipment operations, the location or verification of existing terrain or of constructed features, the verification of geospatial data for proposed construction work and the coordination and sharing of engineering data with the Department or other contract stakeholders.

625-1.03 Right of Way Markers.
This work shall consist of furnishing, installing and certifying right of way markers at the positions described on the right of way appropriation maps, in accordance with the contract documents and the Standard Sheet.

625-1.04 Permanent Survey Markers.
This work shall consist of furnishing, installing, and certifying permanent survey markers in accordance with the details shown on the appropriate Standard Sheet.

625-1.05 Supplemental Site Survey.
This work shall consist of providing all necessary field survey and terrain mapping necessary to locate, spatially position, verify and digitally map the locations of existing above or below ground terrain features as described in the contract documents or as directed by the Engineer. The limits of this supplemental survey will be described in the contract documents.
625-1.06 GPS Inspection Units.
This work shall consist of furnishing, configuring, installing, maintaining and removing Global Positioning System (GPS) units as needed for use by the Engineer and their inspection staff, including the training of the Engineer and their representatives on the use of the GPS units provided.

625-2 MATERIALS

625-2.01 General. None specified.

625-2.02 Survey Operations. None specified.

625-2.03 Right of Way Markers.

A. Concrete Right of Way Markers.
Concrete ROW Markers shall conform to the requirements of §712-05 Precast Concrete Right-of-Way Markers, and shall be in accordance with the details shown on the Standard Sheet.

B. 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 §705-14 Longitudinal Joint Ties or §709-04 Epoxy Coated Bar Reinforcement.
The cap shall be aluminum or a corrosion resistant aluminum alloy. The cap shall weigh a minimum of 50 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.
Steel Pin and Cap-Type Markers shall be anchored into rock using Concrete Grouting Material meeting the requirements of §701-05 Concrete Grouting Material.

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. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to Class A Concrete. The Contractor has the option to use precast permanent survey markers in place of cast in place units. Precast units shall meet §712-24.

625-2.05 Supplemental Site Survey. None specified.

625-2.06 GPS Inspection Units.
Each GPS Unit shall include all necessary components, communication devices, integrated antennae and receiver, controller and/or data collector, cables, software, operating manuals, attachments, and fastening hardware to meet the minimum requirements described below.

A. All GPS Inspection Units.

1. All GPS units provided for a single contract shall be of the same model and manufacturer; and shall include, and be licensed to operate, the same versions of GPS planning software, data collection software, navigation software, stakeout software and post processing software. All software provided (including firmware) shall be the most current available from the manufacturer at the time of delivery of the GPS units. GPS units should be of the same manufacturer as those used by the Contractor. GPS units shall not be more than 2 years old from the date of
manufacturing to the time of delivery. To verify the age of the GPS units, the Contractor shall provide a dated copy of the manufacturer’s receipt(s) for the purchase, lease or rental of the units.

2. GPS units shall include both standard USB cable and Bluetooth wireless technology for data transfer.

3. Data shall be capable of being copied onto or from a removable industry standard data storage card (eg: secure digital SD Card). Each GPS Unit shall include 2 data storage cards, each with a minimum capacity of 4 GB.

4. GPS units shall include the ability to import/export and display point and alignment data which is in XML format, and also import graphics files which are in DGN or DXF format.

5. GPS units shall have an internal, or modular, rechargeable battery system capable of operating a minimum of 8 hours (may include interchangeable batteries), including the battery charger.

6. GPS units shall include a hard or soft shell carry case, and all appropriate operation manuals.

B. Survey Grade GPS Inspection Units.

1. GPS units shall be equipped to receive Global Positioning System (GPS), GLONASS and GNSS position data.

2. GPS units shall be equipped to receive, and be capable of utilizing, Real Time Kinematics (RTK) correctional data (current version of RTCM format) through internet protocol as provided from the NYS Continuously Operating Reference System (NYS CORS) Network. This shall include all necessary communication devices, repeaters and systems, data service plans and communications to meet the minimum required accuracy and not exceed a 2 second latency at the rover. Whichever communication method is utilized by the Contractor to broadcast the NYS CORS RTK correctional data, the Contractor shall ensure that the RTK data shall be available at all locations across the entire contract site during all hours of construction and inspection operations.

3. GPS units shall include the capability to “localize” both the horizontal and vertical control to local project monumentation (also known as calibrate), while utilizing RTK corrections from a reference network.

4. GPS units shall include either an integrated or modular communication device capable of receiving RTK correctional data to satisfy the requirement of using NYS CORS RTK corrections.

5. GPS units shall have the ability to display the number of satellites tracked at any one time, and indicate the accuracy quality of each measurement relative to the strength of signals, and the GDOP (Geometric Dilution of Precision).

6. GPS Unit shall include dual frequency receivers.

7. Minimum Required Kinematic Accuracy relative to primary project control (CORS):
   Horizontal: 0.033 ft + 1.0 ppm; Vertical: 0.065 ft + 1.0 ppm

8. All necessary hardware and software shall be included (including communication drivers) to connect the GPS unit to a Department provided Tablet PC and communicate/exchange positional data with Bentley™ OnSite software. Firmware used on the GPS unit shall be verified as interoperable with Bentley™ OnSite software. If the firmware cannot be verified as being interoperable with Bentley™ OnSite, the next older version may be used.

9. The data controller shall permit the user to program and store multiple configurations (also known as user preferences) prior to the actual field measurements. Configurations shall be capable of being stored and recalled in the field.

10. GPS units shall include one fixed height rover rod of 6.56 feet in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.

11. A GPS unit set up to operate as a base station shall include all necessary additional cables, hardware, fasteners or accessories necessary to install it in a fixed semi-permanent location. will not be considered as a rover unit, and therefore will not require a rover rod, a bi-pod, or a topo shoe.
C. Mapping Grade GPS Inspection Units.

1. Minimum Required Kinematic Accuracy: less than 3.0 feet in real time.
2. GPS units shall also provide standard support for the Wide Area Augmentation System (WAAS) position correction services.

625-3 CONSTRUCTION DETAILS

625-3.01 General.

A. Professional Responsibilities.

The following types of Survey Operations shall be completed by the Contractor under the direction of a Land Surveyor. This requirement is directly or indirectly associated with the professional license requirements contained in Article 145 of the NYS Education Law.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
   a. Establishing boundaries of new right of way appropriated for this contract.
   b. Location of property or highway boundary markers.
   c. Tie measurements to, or resetting of control points.
2. Location or resetting of existing highway and property boundary markers by reference ties to or from contract control to protect their integrity.
3. Establishment or certification of location of right of way markers and permanent survey markers.

The following types of Survey Operations shall be completed by the Contractor under the direction of either a Land Surveyor or Professional Engineer.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
   a. Establishing location for horizontal or vertical roadway alignment.
   b. Establishing location for the horizontal or vertical alignment of a structure.
   c. Establishing or localizing reference base station for Global Positioning System (GPS) control work.
2. Establishing new horizontal or vertical roadway alignment in the field from contract control either by conventional stakeout methods or by use of automated equipment operations.

B. Survey/Engineering Geospatial Data.

All establishments or reestablishment of contract primary or secondary control, and the survey collection of terrain data shall be performed in accordance with the standards and procedures required in the Department’s Land Surveying Standards and Procedures Manual. The Contractor shall incorporate the NYS CORS network into contract control to facilitate the use of GPS survey within the site and on the same datum by other project stakeholders, or to align with other adjacent projects.

When the Department provides electronic copies of engineering data to the Contractor, files should follow the standard file naming conventions listed in Appendix 14 of the Department’s Project Development Manual.

1. Existing Terrain Data. When an existing digital terrain model was developed during design and provided for construction purposes, and possibly updated during construction by supplemental survey, the Department and Contractor shall use that information as a basis from
which to develop contract pay item quantities. The Contractor shall consider all existing terrain data supplied by the Department as being within acceptable tolerances, except where changes or additions have been approved by the Engineer. If the Contractor questions the accuracy of the existing terrain data provided, the Contractor may verify any or all portion(s) of the existing terrain model, at no additional cost to the State, in accordance with §105-10 Survey and Stakeout. All exceptions or discrepancies found with the supplied existing terrain data shall be brought to the attention of the Engineer, in writing, and terrain data modifications shall be mutually agreed upon and shared with both parties prior to beginning construction operations within those areas being modified. Changes to existing terrain data will not be accepted by the Department where existing terrain is verified to be within Departmental accepted positional tolerances in accordance with the Department’s Land Surveying Standards and Procedures Manual, or after the Contractor has disturbed the existing ground surface.

2. Proposed Data. When proposed digital terrain models (or surfaces), proposed alignments and proposed graphics were developed during design and provided for construction purposes, or revised during construction due to site changes or redesign, the Department and Contractor shall use that information from which to position and compute applicable contract pay item quantities and to field verify positional locations of constructed items. When the Contractor and Department agree to utilize the proposed digital terrain data (surface), alignments or graphics the Contractor shall first review its consistency with all other contract information, and review for any perceived physical conflicts or inconsistencies of information prior to using the data in the field for any construction purpose. All exceptions or discrepancies with the supplied data shall be brought to the attention of the Engineer, in writing, and terrain data, alignment or graphics modifications shall be approved by the Engineer prior to beginning construction operations within those areas being modified. All approved changes shall be shared electronically with both the Department and the Contractor, and both parties shall acknowledge acceptance of such changes before beginning the work.

When proposed digital terrain model (or surfaces), alignments or graphics are not provided by the Department, the Contractor may choose to develop their own terrain model surfaces from the contract plans to facilitate their use of Automated Machine Guidance, at no additional cost to the State. A request by the Contractor to use Automated Machine Guidance shall be made as part of the Contract Control Plan. The Contractor developed terrain model surfaces shall be shared with the Engineer in a Department accepted format prior to beginning construction operations. Generation of proposed terrain model surfaces or other electronic engineering data does not constitute a redesign of the project, and the Contractor retains all responsibility to complete the work in accordance with the engineering intent conveyed in the contract documents unless otherwise agreed to in writing by the Engineer.

625-3.02 Survey Operations.

All Survey Operations shall follow either Traditional Survey Stakeout or Automated Stakeout and Automated Machine Guidance Operations, or a combination of both, for the establishment, positioning, equipment guidance or verification of construction items. The proposed method shall be approved by the Engineer as part of the Contract Control Plan prior to beginning any field construction operations. Both methods include the same basic requirements that: (1) both parties (Contractor and Department) utilize the same contract control, the same existing terrain data, and the same proposed feature data; (2) both parties utilize the same accuracy and tolerance limits; and (3) both parties utilize equivalent survey verification techniques to ensure that field features are constructed as proposed.

The Contractor shall establish the center line of bearings for all bridge abutments and piers, by setting offset hubs or reference points, so located and protected to ensure they remain undisturbed until such time as they are no longer needed. The Contractor shall mark the location of anchor bolts to be installed, establish the elevation of bearing surfaces and check bearing plates to ensure installation at their proper
elevation. Before the erection of structural steel or concrete beams the Contractor shall verify the locations, both vertically and horizontally, of all bearings and the distances between associated bearings. Control used to establish center line of bearings shall be included in the contract control plan.

On contracts which include proposed and existing roadway alignments and profiles, the Contractor shall verify the roadway tie-in locations of where existing and proposed alignments meet prior to beginning construction operations and report the results to the Engineer. This requirement is intended to verify that no changes have occurred to the existing roadway and that the proposed design is buildable as designed.

A. Contract Control Plan.

The Contractor shall develop and submit a Contract Control Plan for all contracts which include the contract pay item for Survey Operations. Contract control includes all statewide or local primary and secondary horizontal and vertical control which will be used for the geospatial positioning of work items. Upon the Contractor’s completion of initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document which is to be signed and sealed by a Land Surveyor or Professional Engineer in accordance with §625-3.01 A Professional Responsibilities, for acceptance by the Engineer. The Contract Control Plan shall include the below listed required control information and follow the acceptance procedure.

All revisions or additions to contract control for the purpose of stakeout or layout of proposed work items shall be provided in writing to the Engineer prior to beginning that revised portion of stakeout or layout work.

1. Acceptance Procedure.

a. The Contractor shall document required information and submit electronically to the Engineer at least 10 work days prior to beginning field operations.
b. The Engineer will coordinate review with the Regional Land Surveyor and provide comments.
c. Upon acceptance of the procedure by the Engineer, the Contractor shall submit 2 signed and sealed copies to the Engineer.

2. Control Information.

The Contractor shall list the following control information (tabular format is acceptable):

a. All contract control shown in the contract documents or in the Survey Control Report.
Note: The NYS CORS Network provides primary control for most Department contracts.
b. The following elements shall be submitted for all contract control points or benchmarks:
   (1) Recovered in the field and did it appear undisturbed?
   (2) Contract indicated coordinate or elevation.
   (3) Field determined coordinate or elevation.
   (4) Contractor adjusted coordinate or elevation, if necessary.
   (5) Point or benchmark intended to be used for construction purposes.
c. Adjustment method is used to balance or adjust the control (ex: Compass Rule for Baseline or Calibration Report for GPS, etc). Attach a copy of the adjustment/calibration report.
d. Control network diagram (drawn to a legible scale) with roadways indicated.
e. New York State Plane Coordinate System (NYSPCS) Zone utilized.
f. Horizontal Datum used.
g. Vertical Datum used.
h. Combined Factor used to account for the ellipsoidal reduction factor and the grid scale factor.

i. Additional (new) control is anticipated to be needed and where will they be set?

j. When a GPS base station(s) is utilized on a project either for inspection or stakeout, provide the determined coordinate and elevation value of the station, and the datum differential from that localized value to a NYS CORS determined value.

3. Methods or Procedures.
The Contractor shall document and provide the following survey information on methods or procedures to be used:

a. Survey method used to verify the control (ex: Total Station, GPS/RTK, Auto Level, etc).
b. Survey method(s) used to stakeout which types of proposed features.
c. Survey method(s) used to stakeout proposed ROW Markers.
d. Survey method used for stakeout of proposed bridge structures (if applicable). How will control be set up and maintained around the bridge(s)?
e. Proposed manufacturer, model and software version for GPS Inspection Units.
f. Automated Machine Guidance (AMG) proposed for use on this contract.
g. Type and frequency of quality control measures included to maintain the proper calibration and adjustment of the AMG systems.
h. If GPS will be used for stakeout or for AMG, will the NYS CORS Network be used as its reference network or will base station(s) be used?
i. If a base station is to be used, describe the mounting location, attachment technique, and instrumental protection included which ensures a sound and reliable reference station will be provided.

B. Traditional Survey Stakeout.
The Contractor shall field locate all features to be constructed from survey control points which are identified in the Contract Control Plan. Any error, apparent discrepancy or absence in the data shown or required to appropriately accomplish the stakeout survey shall be referred to the Engineer immediately for interpretation when such is observed or required.

The Contractor shall place two offset stakes or references points along the center line at maximum intervals of 50 feet and at such intermediate locations as required to determine location and direction. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the center line station number, offset and cut or fill from which the establishment of the centerline location and elevation can be determined. If markings become illegible for any reason the markings shall be restored by the Contractor. The Contractor shall locate and place all cut, fill, slope, fine grade, or other stakes and points for the proper progress of the work with a maximum station spacing of 50 feet. All control points shall be properly protected and flagged for easy identification.

The Contractor shall be responsible for the accuracy of the work and shall maintain all applicable reference points, stakes, etc. Damaged or destroyed reference points or bench marks made inaccessible by the progress of the construction shall be replaced or transferred by the Contractor. All control points shall be referenced by ties (4 minimum) to specific points on acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer. All stakeout survey work related to highway control shall be referenced to the control line (or survey baseline) shown in the contract documents. Computations and survey notes necessary to establish the position of the work from control points, shall be made and maintained in a neat, legible and acceptable format by the Contractor. Computations, survey notes and other survey information shall be made available to the Engineer within 3 work days from the request. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor.
Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.

**C. Automated Stakeout and Automated Machine Guidance Operations.**

Should the Contractor choose automated methods for the establishment, layout, measurement, equipment guidance or verification of work to be constructed, they shall submit their proposed automated methods including quality control measures as part of their contract control plan for acceptance by the Engineer. When utilizing these methods, all horizontal and vertical survey control, roadway alignment control, existing terrain data and proposed design engineering data shall be shared/exchanged electronically and kept current between the Contractor and the Engineer. All original version files of electronic contract data shall be maintained and stored by the Department. Prior to beginning field operations, the Contractor and Engineer shall mutually determine acceptable uses of and procedures for the technology being used, and how data can be exchanged for use in stakeout, automated machine operations, positional verification, quantity measurements and calculations. All record copies of engineering data shall be stored and shared in Department accepted standard formats, and shall be derived primarily from the original electronic data, when provided by the Department.

Automated survey operations have a high reliance on accurate control networks from which to make measurements, establish positions, and verify geospatial locations of features. Therefore, a strong contract control network in the field which is consistent with the project control used during the design of the contract is essential to the successful use of these technologies with the proposed digital terrain model and alignments. Consistent and well designed site calibration (localization) for all automated machine guidance, as described above under *Contract Control Plan*, is required to ensure the quality of the contract deliverables. The Contract Control Plan is intended to document which local horizontal and vertical control will be used for calibration during construction operations and how that calibration or adjustment will be maintained along the entire contract length. Continued incorporation of NYS CORS Network is essential to maintaining the integrity of positional locations and elevations of features.

The Engineer may perform quality assurance verifications of feature positions at any time during the contract. Dimensional tolerances shall hold a higher order of precedence than positional tolerances, but both may require verification. Quality assurance activities by the Engineer will not relieve the Contractor of any responsibilities for the quality control of the accuracy or completeness of the work.

The Department’s verification of the positional locations of features, calculation and merging of supplemental terrain data surfaces, and the measurement and calculation for quantity payments will be performed using Department standard software. Both the Contractor and the Department shall utilize the following standards: (1) All terrain data collected for the purpose of being used for or merged with Department provided terrain data for the calculation of pay quantities shall be delivered in a format and correctly display in accordance with the current Departmental CADD Standards. (2) The Department will maintain record copies of electronic data files which will be available to the Contractor using the Department’s designated file management system or other method. This will ensure that both parties utilize the same credible data from which to establish locations and measure quantities. The Department will provide all available CADD resource files for use by the Contractor.

The Contractor may choose to introduce an additional new automated survey method or technology which involves a new technique for positioning features, measuring quantities, or verifying constructed locations. The quality and accuracy of this data produced by this method shall be demonstrated to the Engineer, for acceptance, by a comparison of this method to previously accepted techniques over a mutually agreed upon portion of the work. The new technology shall meet or exceed the quality and accuracy results provided by previously accepted techniques, and the Engineer shall make the final determination as to the acceptability of its use based on the resulting performance, cost savings, safety and effectiveness of the operation. Previous uses of this same
method on other contracts or by other contractors are not acceptable evidence of a technology’s viability, due to inherent variations in operator’s experience levels, data availability, changing field conditions and differing technologies.

625-3.03 Right of Way Markers.

The Contractor shall verify with the Engineer that it has the most current vested Right of Way Acquisition Maps to determine the geospatial positions of all proposed right of way markers. Right of way markers are indicated in the contract for approximate locations and quantities, and shall not be positioned according to the contract information, but rather by the positions shown for the equivalent points on the ROW Maps.

Right of way marker locations shall be determined under the direction of a Land Surveyor from a closed traverse or GPS network which is included in the contract control plan and in accordance with Federal Geographic Data Committee (FGCC) C2-II, Second-Order, Class II (1 part in 20,000) accuracy, ensuring a local accuracy of 0.065 ft as described in the Department’s Land Surveying Standards and Procedures Manual.

The Contractor shall install right of way markers at the station/offset positions specified on the vested Right of Way Acquisition Maps in accordance with the Standard Sheets to within an absolute positional tolerance of 0.065 ft relative to the primary project control network.

The Land Surveyor shall certify the as-built location of each installed right of way marker on certification forms provided by the Engineer, including contract information, and control line station and offset (proposed and as-built) to the marker. The record location of all right of way markers shall be recorded to the nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy.

Prior to placing the cap on a steel pin right of way marker, 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.

625-3.04 Permanent Survey Markers.

The Contractor shall install permanent survey markers in accordance with the standard sheet at locations described in the contract documents and approved by the Engineer prior to installation. The Engineer will provide the Contractor with the sequential numbering required on the permanent survey marker caps in coordination with the Regional Land Surveyor.

When precast permanent survey markers are used, one of the following special excavation and backfill methods shall be used to insure stability. Within undisturbed areas, Method A or Method B may be used. Within disturbed areas, only Method B shall be used.

- **Method A.** The excavation shall allow a minimum clearance of 6 inches around the precast permanent survey marker 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 §203-2.06 Select Granular Fill, and compacted in accordance with §203-3.06 Select Granular Fill.

The Contractor shall provide the as-built location of each installed permanent survey marker on certification forms provided by the Engineer, including contract information, as-built NYSPCS values, control line and centerline station and offset to the 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, four physical ties to the
markers, and a north arrow. The certification form shall be sealed and signed by a licensed Land Surveyor. The record location of all permanent survey markers shall be recorded to the nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy as described in the Department’s “Land Surveying Standards and Procedures Manual.”

625-3.05 Supplemental Site Survey.

The Contractor shall perform supplemental site survey work in accordance with §625-3.01 General and §625-3.02 Survey Operations. The limits of the survey and mapping and the need for property line or right of way determination shall be as described in the Special Note entitled Supplemental Site Survey Requirements. Changes to the contract established limits by the Engineer shall be considered changes to the scope of work. The work shall include:

1. The Engineer shall determine what level of detailed information may need to be added to the Contract Control Plan for a supplemental site survey. Significant additional requirements will be considered extra work.
2. For new locations, a minimum of 3 inter-visible horizontal control points and 2 benchmarks shall be set at each site.
3. All survey control and terrain data collection shall be performed in accordance with the standards and procedures required in the Department’s Land Surveying Standards and Procedures Manual.
4. Survey shall include all readily identifiable surface and subsurface utilities, including, but not limited to drainage, sanitary, water supply, gas, electric and telephone. The Contractor shall contact the appropriate one call center to identify all underground utilities so they can be marked in the field at each site prior to survey.
5. If property or right of way markers are found inside of or within 30 ft of the survey limits, they shall be located and described as part of the survey.
6. For traffic signal intersection work, elevations of above-ground utilities at the poles and at sag points shall be provided for primary and secondary electric lines, telephone lines and cable television lines. Utility poles shall be identified, including pole numbers. The next pole by number, and next manhole or valve. Sign inventory shall include only a type designation (e.g. stop sign, no parking sign, etc.) without MUTCD code, or a brief description of a private sign.
7. For underground utility surveys, the horizontal positions and vertical elevations of all exposed public and private utilities within the described limits shall be located, mapped and appropriately identified by the Contractor according to the utility’s identification. Horizontal positions and vertical elevations shall be determined from project control to within 2 inches of its absolute location. Linear utilities shall be located at all bend or angle points, junctions or termini, and at a spacing of no more than 50 feet.
8. Copies of original survey field data, tie diagrams, and control diagrams shall be provided in Department accepted formats.
9. All terrain mapping deliverables (DGN & DTM) shall conform to the requirements included in Chapter 20 and 22 of the Department’s Highway Design Manual.
10. File naming convention shall conform to standards listed in Appendix 14 of the Department’s Project Development Manual.

625-3.06 GPS Inspection Units.

The Contractor shall furnish, configure, install, maintain and remove the GPS units, and provide the Engineer and/or their representatives with training on the operation of the GPS units. The Contractor shall ensure all GPS units are fully operational and training has been provided before construction begins. All projects shall utilize the NYS CORS as the spatial reference datum network from which RTK corrections are derived. The Contractor shall choose which communication technique and devices will be
used which will insure the consistent and reliable delivery of RTK correctional data from the NYS CORS to the GPS units. When geographic location or lack of a reliable communications network prohibits the use of the NYS CORS, the Engineer may approve the use of a Survey Grade GPS Inspection unit as a base station in place of the NYS CORS, which will be paid for separately. The Contractor shall semi-permanently mount the base station in a stable and secure location where it shall not be disturbed by construction activities nor be easily damaged by vandalism and where it shall be capable of providing radio signal coverage over the entire contract area. If the base station cannot broadcast a signal that covers the entire site, the Contractor shall provide adequate repeater radios or other communications. A GPS unit installed as a base station for inspection operations shall only be moved with the approval of the Engineer.

The GPS units shall be maintained and remain in service until either: (a) a maximum of one week after the Engineer requests its removal in writing, or (b) the State relinquishes the Engineer=s Field Office. The Contractor shall maintain all GPS units and software in good working condition and shall provide replacement due to breakdown, damage, or theft within 2 work days. The Contractor shall retain ownership of all supplied GPS units at the end of the contract.

A. GPS Training Provisions.

1. For all GPS units, the Engineer and/or their representatives shall be provided with a minimum of one 8 hour training session for GPS localization/calibration of the contract site.
2. For all Survey Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of two separate 8 hour minimum training sessions on the use and operation of the GPS units during the first year of the contract. One of these two sessions shall occur within one week of delivery of GPS units to the site. The second of the two classes shall occur upon the request of the Engineer. One additional 8 hour minimum training session shall be provided during each additional contract year that the GPS units are in service.
3. For all Mapping Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of one training session during the first year of the contract, being at least 8 hours in length, and to occur within one week of delivery of GPS units to the site. This training shall be separate from the Survey Grade GPS Unit training.
4. All training shall be performed by a manufacturer-verified trainer who is approved by the Engineer. The training shall occur at the Engineer’s Field Office or at a location agreed to by the Engineer.

625-4 METHOD OF MEASUREMENT

625-4.01 General. (Vacant)

625-4.02 Survey Operations. This work will be measured on a lump sum basis.

625-4.03 Right of Way Markers. The quantity to be measured for payment will be the number of right of way markers installed.

625-4.04 Permanent Survey Markers. The quantity to be measured for payment will be the number of permanent survey markers installed.

625-4.05 Supplemental Site Survey. This work will be measured on a lump sum basis for each site location.

625-4.06 GPS Inspection Units. The quantity to be measured for payment will be the number of GPS Inspection units provided.
625-5 BASIS OF PAYMENT

625-5.01 General. (Vacant)

625-5.02 Survey Operations. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including preparation of the contract control plan. Progress payments will be made in proportion to the amount of work completed.

625-5.03 Right of Way Markers. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

625-5.04 Permanent Survey Markers. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

625-5.05 Supplemental Site Survey. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work. Payment will be made upon the satisfactory submission of the completed and certified mapping deliverables. Substantive additions to the work limits described in the contract will be considered extra work.

625-5.06 GPS Inspection Units. The unit price bid shall include the cost of labor, materials and equipment necessary to satisfactorily complete the work, including the cost of the required training and necessary maintenance.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>625.01</td>
<td>Survey Operations</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>625.03</td>
<td>Concrete Right of Way Markers Type H (High)</td>
<td>Each</td>
</tr>
<tr>
<td>625.04</td>
<td>Concrete Right of Way Markers Type L (Low)</td>
<td>Each</td>
</tr>
<tr>
<td>625.05</td>
<td>Steel Pin and Cap Right of Way Markers</td>
<td>Each</td>
</tr>
<tr>
<td>625.06</td>
<td>Permanent Survey Markers</td>
<td>Each</td>
</tr>
<tr>
<td>625.07nmnn</td>
<td>Supplemental Site Survey</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>625.11nmnn</td>
<td>Survey Grade GPS Inspection Unit</td>
<td>Each</td>
</tr>
<tr>
<td>625.12nnnn</td>
<td>Mapping Grade GPS Inspection Unit</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTIONS 626 THRU 628 (VACANT)

SECTION 629 - PETROLEUM STORAGE TANK CLOSURE
(Last Revised January, 2017)

629-1 DESCRIPTION

629-1.01 General. This work shall consist of emptying, purging/inerting, cleaning, removing, and disposing of petroleum storage tanks; endpoint sample collection and analysis; and proper documentation of the work in accordance with the contract documents and as directed by the Engineer.
629-3 CONSTRUCTION DETAILS

629-3.01 General. All petroleum storage tanks shall be closed in accordance with the requirements of the NYS Department of Environmental Conservation (NYSDEC), as well as local fire and police agencies. NYSDEC shall be notified prior to the initiation of tank closure activities. For instances where tanks that have not been identified during the design process are discovered during construction, NYSDEC shall be notified as soon as possible after discovery of the tank(s). If evidence of a petroleum spill that was not previously reported is discovered during construction, the contractor shall call the NYSDEC Spills Hotline at 1 (800) 457-7362, within two hours of discovering the spill.

Excavation shall be performed in accordance with Section 206 Trench, Culvert and Structure Excavation. Segregation and stockpiling of contaminated soils shall be performed in accordance with Section 205 Contaminated Soil. If specified in the contract documents, or at the request of the Department in instances where tanks are not discovered until after construction has begun, the Contractor shall provide field organic vapor monitoring in accordance with §205-3.03 Field Organic Vapor Monitoring in the following instances: contaminated soil is present; there is a potential for nuisance petroleum odors; or if the work is being performed in close proximity to residences, schools, or other sensitive receptors.

The Contractor shall provide a schedule for tank closure activities to the Engineer a minimum of 35 calendar days prior to commencing work, except for when previously unidentified tanks are discovered during construction and the work will take place in less than 35 calendar days. In such instances, the Contractor shall notify the Engineer immediately upon discovery of the tank(s). The Department will notify appropriate NYSDEC personnel at least 30 calendar days prior to tank closure activities, except for when previously unidentified tanks are discovered as described above. In such instances, the Department will notify NYSDEC as soon as possible after discovery of the tank(s).

629-3.02 Removal/Disposal of Liquids from Petroleum Storage Tanks. Before the removal of any tank begins, it shall first be rendered free of product and water. All liquids shall be disposed of in accordance with §107-10 Managing Surplus Material and Waste. Product shall be managed with a preference toward recycling or beneficial reuse when such options are available. Liquids shall be transported to the disposal/recycling facility only by appropriately permitted haulers. During the removal operation (including cutting the tank open to remove product, if necessary) the following restrictions shall apply:

1. The work area shall be secured by, at a minimum, erecting a 4 foot construction fence to create a 25 foot controlled access perimeter around the tank pit and posting signs stating “Authorized Personnel Only” or equivalent. This perimeter shall be maintained until the tank has been disposed of and the tank pit has been backfilled.
2. All open-flame and spark producing equipment within the area shall be shut down.
3. All electrical and internal combustion equipment, unless it is designed to be “explosion proof” or “intrinsically safe”, shall be removed from the work area.
4. Only “non-sparking” tools shall be used.
5. Static electricity shall be controlled.
6. Smoking shall be prohibited in the work area.

629-3.03 Petroleum Storage Tank Closure. Tank closures shall consist of all of the following components, unless specifically noted in the contract documents.

A. Project Safety and Health. The Contractor shall ensure that all personnel directly involved in tank closure activities have been trained in conformance with the requirements of 29 CFR 1910.120 and
1926.65 (referred to hereafter as 1910.120). There shall be at least one person on site who has supervisor training as per 29 CFR 1910.120(E)(4) during all tank closure activities. The Project Safety and Health Plan (PSHP) required by §107-05B shall also meet the requirements of 29 CFR 1910.120 (b) (4).

**B. Tank Atmosphere Monitoring.** The contractor shall use a combustible gas indicator (CGI) or an explosion meter and an oxygen meter to monitor the tank atmosphere.

**C. Tank Purging/Inerting.** The Contractor shall make the tank atmosphere safe by purging the flammable vapors from the confined space to below 5% of the lower explosive limit (LEL) and, unless positive ventilation is used, the oxygen level is below 7%. Care shall be exercised to ensure that purging/inerting is completed before proceeding with tank cleaning and cutting. The Contractor shall purge/inert the tank atmosphere by using one of the following methods:

1. **Dry Ice.** The Contractor shall add dry ice (1.5 lb per 100 gallons of tank capacity) into the tank. The dry ice shall be crushed and distributed evenly over the greatest possible area of the tank interior. As the dry ice vaporizes flammable vapors will flow out of the tank, therefore, the Contractor shall observe all safety precautions regarding flammable vapors.

2. **Carbon Dioxide.** The Contractor shall add carbon dioxide gas directly into the tank to purge flammable vapors. A minimum of one, fully charged, 75 lb cylinder of carbon dioxide gas per 2,000 gallons of tank volume shall be used. Care shall be exercised to prevent buildup of any static charge. The nozzle shall be bonded or grounded and the gas introduced slowly to reduce static.

3. **Nitrogen.** The Contractor shall add nitrogen gas directly into the tank to purge flammable vapors. Vapors within the storage tank must be displaced with an amount of nitrogen gas equal to or greater than the volume of the tank atmosphere. Care shall be exercised to prevent buildup of any static charge. The nozzle shall be bonded or grounded and the gas introduced slowly to reduce static.

4. **Positive Ventilation.** With prior written approval from the Engineer, the Contractor may use positive ventilation to purge flammable vapors from a tank using an air eductor. If performed improperly, this can be a very dangerous procedure and is not recommended for on-site purging of flammable vapors especially in high density urban areas.

**D. Tank Removal.** Regardless of the method selected to purge/inert the tank atmosphere, removal work shall not start until the readings from the CGI or explosion meter indicate that a safe and non-explosive tank atmosphere has been achieved as evidenced by readings less than 5% of the LEL at all elevations within the tank and if dry ice, carbon dioxide, or nitrogen are used to purge/inert the tank, readings from the oxygen meter indicate that an atmosphere of less than 7% oxygen is present throughout the tank. Removal work shall be progressed diligently without interruption until its completion. The CGI or explosion meter shall be used to take subsequent readings continuously as work is progressing. If any reading indicates an atmosphere with greater than 10% of the LEL is present, or the LEL is rising steadily, work shall cease and purging/inerting shall be repeated. Tank-related piping and connecting lines shall either be disconnected and removed or securely capped and plugged.

The tank shall be removed from the tank pit and placed on 6 mil minimum plastic sheeting with the vents aligned at the top of the tank (the 12 o’clock position). The tank shall be blocked or chocked in order to prevent rolling.
Contaminated soil, if present in or around the tank, shall be handled and managed in accordance with provisions found in Section 205 Contaminated Soil.

E. Tank Interior Cleaning and Tank Cutting. Immediately after the tank has been removed from the ground and a safe atmosphere is confirmed, the tank shall be cut open with non-sparking equipment. Two large holes shall be made in the tank to allow for cross ventilation. The tank shall then be fully ventilated until the CGI or explosion meter indicates an atmosphere with less than 5% of the LEL and an oxygen concentration between 19.5% and 21.5% is present. All remaining sludge and residue shall be removed by vacuuming, non-flammable solvent washing, or sweeping with dry absorbents. The Contractor shall permit only trained and properly equipped personnel to enter the tank. Permit-required confined space entry procedures in accordance with 29 CFR 1910.120 shall be used for all tank entries. All product, product-soaked sorbents, cleaning solvents, and water generated by the operation, shall be transported by a hauler permitted under 6 NYCRR 364 and, disposed of in accordance with the waste disposal regulations of the receiving state.

In instances where there is insufficient work area available to safely perform tank interior cleaning and cutting on-site, the Engineer may permit the Contractor to move the tank to an alternative location for interior cleaning and cutting. Uncleaned tanks shall be transported only by transporters permitted under 6 NYCRR 364. Prior to transporting an uncleaned tank, all holes shall be plugged and the tank shall be placarded according to USDOT regulation 49 CFR 172.500. The tank shall be vented by means of a 1/8 inch hole in one of the plugs. The tank shall be securely fastened to the transporting vehicle, and oriented so that the plug with the hole in it is uppermost on the tank.

F. Documentation. Tank closure activities shall be documented both in written format and photographically. The Contractor shall document the number of tanks, tank capacities, tank types (i.e., steel, fiberglass, etc.) and conditions (i.e., sound, corroded but intact, leaking, etc.), products stored in tanks, soil conditions, presence/absence of field indications of soil/groundwater contamination, tank removal, and all subsequent tank closure activities until the tank has been loaded and secured for transportation off-site. The Engineer shall also be provided with copies of any chain-of-custody forms, laboratory reports, and documentation of the final disposition of the tank and any contaminated soil that was removed. When tank closure activities have been completed, the Department will submit a Tank Closure Report which includes all relevant documentation, including laboratory reports and tank disposal documents, to NYSDEC.

G. Tank Exterior Cleaning and Tank Disposal. All tanks shall be cleaned of all soil, residue and product clinging to their exterior surfaces prior to being transported off-site. All contaminated soil, product, cleaning solvents, and water generated by the operation, shall be transported by a transporter permitted under 6 NYCRR 364 and, disposed of in accordance with §107-10 Managing Surplus Material and Waste. A tank that has been rendered free of product and cleaned is considered scrap, and shall be recycled or disposed of by the Contractor.

H. Backfilling. After the completion of endpoint sampling and documentation activities which require the tank pit to remain open, the Contractor shall backfill any resulting holes and trenches with suitable material.

629-3.04 Endpoint Sample Collection and Analysis. NYSDEC personnel, if present during tank closure activities, may advise the Engineer that endpoint samples are not required in order to obtain tank closure. If NYSDEC personnel are not on-site during tank closure, or if NYSDEC personnel are on site and suggest that endpoint samples will be required in order to obtain tank closure, endpoint samples shall be collected as follows:

After contaminated soil, if present, is removed to the extent practicable, a person, whose qualifications have been submitted in accordance with §205-3.01 B. 3. Sampling Plan, shall collect a total
of five composite samples from the tank pit. A composite sample is defined as a sample composited from individual grab samples collected on an areal or cross sectional basis. Each composite sample shall be made up of equal volumes of grab samples collected in an identical manner. One composite sample shall be collected from each of the side walls at a distance approximately one third up from the bottom of the pit and one composite sample shall be collected from the bottom of the pit. Samples shall be collected into properly labeled laboratory provided glassware, which shall then be placed into re-sealable plastic bags and stored in a cooler with ice. The contractor shall deliver the samples, in accordance with appropriate chain-of-custody procedures and sample hold-times, to a NYS Department of Health Environmental Laboratory Approval Program (ELAP) Certified laboratory for the following analyses:

A. **Confirmed Gasoline Tanks:** Submit samples for analysis of volatile organic compounds (VOCs) by USEPA Method 8260 (STARS list compounds + MTBE).

B. **Fuel Oil/Diesel/Suspect Gasoline Tanks:** Submit samples for analysis of VOCs by USEPA Method 8260 (STARS list compounds + MTBE) and for analysis of polycyclic aromatic hydrocarbons (PAHs), also referred to as base/neutrals (B/N’s), by USEPA Method 8270.

C. **Waste Oil Tanks:** Submit samples for analysis of VOCs by USEPA Method 8260 + MTBE, semi-volatile organic compounds (SVOCs) by USEPA Method 8270, RCRA Metals by USEPA Methods 6010 and 7471, and for polychlorinated biphenyls (PCBs) using USEPA Method 8082.

D. **Tanks Containing Other Products:** Submit samples for analyses specified in the contract documents. For previously unidentified tanks containing products other than gasoline, #2 fuel-oil/diesel, or waste oil that are discovered during construction, the Contractor shall contact NYSDEC for the appropriate analytical methods.

The Contractor shall provide the Engineer with a copy of the completed chain-of-custody form before the samples are taken off-site for delivery to the laboratory, and a copy of the laboratory report within 14 calendar days of sample collection.

629-4 **METHOD OF MEASUREMENT**

629-4.01 **General.** (Vacant)

629-4.02 **Removal/Disposal of Liquids from Petroleum Storage Tanks.** The quantity of removed/disposed of liquids to be measured for payment will be in gallons, measured to the nearest whole gallon. The Contractor shall provide disposal receipts from an approved facility that accepts the material to verify the quantity disposed.

629-4.03 **Petroleum Storage Tank Closure.** The quantity of tanks closed to be measured for payment will be the number of tanks within the indicated size range closed.

629-4.04 **Endpoint Sample Collection and Analysis.** The quantity to be measured for payment will be the number of samples collected and analyzed according to the specified methods.

629-5 **BASIS OF PAYMENT.**

629-5.01 **General.** Soil Handling, Field Organic Vapor Monitoring other than within the tank atmosphere, and removing and disposing of contaminated soil, except soil contaminated during the tank removal operations, will be paid for separately.
629-5.02 Removal/Disposal of Liquids from Petroleum Storage Tanks. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including laboratory analyses required for the proper disposal of the liquids. The maximum amount of payment will be the unit bid price multiplied by the capacity of the tank.

629-5.03 Petroleum Storage Tank Closure. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, not including excavation and backfill.

Progress payments of 50% of the unit price bid will be paid after the tank removal has been completed, a completed Form HC 629 Tank Closure Form and, if endpoint samples were required, a completed chain of custody form showing that the samples were delivered to the laboratory. The remaining percentage will be paid after the Department has received from the Contractor all remaining documentation necessary for the Department to submit a complete Tank Closure Report to NYSDEC, including: invoices confirming the final disposition of: the tank, any liquids removed from the tank, any wastes generated during tank cleaning, and any contaminated soil that was removed; and, if endpoint samples were required, a final laboratory report.

629-5.04 Endpoint Sample Collection and Analysis. The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after all analytical data has been received by the Department, and a Department representative has reviewed the data to verify that it is correct.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>629.01</td>
<td>Removal/Disposal of Liquids from Petroleum Tanks</td>
<td>Gallon</td>
</tr>
<tr>
<td>629.02xx</td>
<td>Petroleum Storage Tank Closure (various size ranges)</td>
<td>Each</td>
</tr>
<tr>
<td>629.0301</td>
<td>Endpoint Sample Collection and Analysis (Confirmed Gasoline Tanks)</td>
<td>Each</td>
</tr>
<tr>
<td>629.0302</td>
<td>Endpoint Sample Collection and Analysis (Fuel Oil/Diesel/Suspect Gasoline)</td>
<td>Each</td>
</tr>
<tr>
<td>629.0303</td>
<td>Endpoint Sample Collection and Analysis (Waste Oil Parameters)</td>
<td>Each</td>
</tr>
<tr>
<td>629.0304</td>
<td>Endpoint Sample Collection and Analysis (Other Product Parameters)</td>
<td>Each</td>
</tr>
</tbody>
</table>

NOTE: xx -see Pay Item Catalog or Proposal for complete description.

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 and Manufacturing.

<table>
<thead>
<tr>
<th>Material</th>
<th>Item No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Posts</td>
<td>710-13</td>
</tr>
<tr>
<td>Galvanized Steel Barrier Posts</td>
<td>710-14</td>
</tr>
<tr>
<td>Corrugated Beam Guide Railing and Median Barrier</td>
<td>710-20</td>
</tr>
<tr>
<td>Reflective Sheeting</td>
<td>730-05</td>
</tr>
</tbody>
</table>

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 W6x15 or wood 6 x 8 inch (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 1/4 to 1/2 inch 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 feet of barricade outside to outside of end posts plus an allowance of 4 feet 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 foot 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.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>630.01</td>
<td>Barricade (Steel Posts)</td>
<td>Foot</td>
</tr>
<tr>
<td>630.02</td>
<td>Barricade (Wood Posts)</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTION 631 (VACANT)

SECTION 632 (VACANT)

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:

- Hot Mix Asphalt True & Leveling 401 and 402
- Hot Mix Asphalt Shim 401
- Asphalt Filler 702-0700 (Table702-2, Miscellaneous Asphalt Cements)
- Anionic or Cationic Asphalt Emulsion 702
- Fine Aggregate 703-01
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 80 psi gage 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 1 inch 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 1/4 inch are not required to be cleaned or sealed. Seal joints and cracks in the existing pavement from 1/4 to 1 inch 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 1 inch 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 45°F or greater. The minimum HMA placement temperature shall be 250°F.

If the total depth of the patch is greater than 3 inches, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. 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 1/4 inch 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 3 inches. 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 3 inches. 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 45°F or greater. The minimum HMA placement temperature shall be 250°F.

If the total depth of the patch is greater than 3 inches, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. 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 1/4 inch 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 15 feet 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 12 inches. 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 45°F or greater. The minimum HMA placement temperature shall be 250°F.

Compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. 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 1/4 inch 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 yards 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 feet 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 yards 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 yards of existing pavement surface removed and repaired.

633-4.06 Stress Relieving Pavement Repairs. The quantity measured will be the number of square yards 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 Yards</td>
</tr>
<tr>
<td>633.12</td>
<td>Cleaning, Sealing and/or Filling Cracks</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>633.13</td>
<td>Cleaning, Sealing and/or Filling Joints</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>633.14</td>
<td>Removal and Repair of Deteriorated HMA Pavement</td>
<td>Square Yards</td>
</tr>
<tr>
<td>633.15</td>
<td>Removal and Repair of Loose, Broken, or Spalled PCC Pavement</td>
<td>Square Yards</td>
</tr>
<tr>
<td>633.16</td>
<td>Stress Relieving Pavement Repairs</td>
<td>Square Yards</td>
</tr>
</tbody>
</table>

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 1 inch 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.

635-4 METHOD OF MEASUREMENT. Surface cleaning and preparation of pavement surfaces for lines will be measured in feet along the centerline of the prepared surface and will be based on a nominal 4 inches wide line. Measurement for cleaning surfaces for line widths greater than the nominal 4 inches will be made by the following method:

\[
\text{Nominal Existing Width of Line (inches)} \times \text{Length (feet)} / 4 \text{ (inches)}
\]

No payment will be made for the additional 1 inch of cleaning on each side of the line required by §635-3.02.

No payment will be made for cleaning the number of feet 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.

Pay Unit
Item No. Item
635.0103 Cleaning and Preparation of Pavement Surfaces-Lines Feet
635.0203 Cleaning and Preparation of Pavement Surfaces-Letters Each
635.0303 Cleaning and Preparation of Pavement Surfaces-Symbols Each

SECTION 636 (VACANT)

SECTION 637 - ENGINEER’S FIELD OFFICE, LABORATORY AND EQUIPMENT
(Last Revised May, 2017)

637-1 DESCRIPTION. This work shall consist of providing, furnishing and maintaining an Engineer’s Field Office and a Field Laboratory in good working condition and appearance for the exclusive use of, and occupancy by the inspection staff. The buildings shall be habitable environments, readily accessible.
to the public and free of any recognizable health or safety hazards. The work shall also consist of providing and maintaining equipment for use by the inspection staff.

637-1.01 Engineer’s Field Office. This work shall consist of providing for the Engineer’s use a building, or a portion thereof, or a modular trailer of a specified type erected at a location approved by the Engineer.

637-1.02 Field Laboratory. This work shall consist of providing a Field Laboratory for soils and materials testing at a location approved by the Engineer.

637-1.03 Concrete Cylinder Curing Box. This work shall consist of providing a concrete cylinder curing box.

637-1.04 Digital Camcorder. This work shall consist of providing and maintaining a fully operational digital camcorder system.

637-1.05 Rain Gauge. This work shall consist of providing and maintaining a wireless rain gauge system.

637-1.06 Inspection Vehicle. This work shall consist of providing and maintaining motor vehicle(s) for exclusive use by the Engineer and the Inspection Staff.

637-1.07 Inspection Boat. This work shall consist of providing and maintaining a motorized boat for exclusive use by the Engineer and the Inspection Staff.

637-1.08 Office Technology Supplies. This work shall consist of providing technology-related materials and supplies for use by the inspection staff.

637-1.09 Construction Testing Supplies - Consumables. This work shall consist of providing consumable testing supplies to be used by inspection staff.

637-1.10 Partnering Workshop. This work shall consist of a partnering workshop coordinated and facilitated by an independent facilitator. The Department and the Contractor will share the cost of the partnering workshop equally.

637-2 MATERIALS.

637-2.01 Engineer’s Field Office. The Engineer’s Field Office shall be within a secured, weatherproof building or mobile trailer. If two or more mobile trailer units are provided, they shall be joined with weatherproof connections. Mobile trailers shall be in new or like new condition. The Contractor may furnish equivalent facilities in an existing building, provided that the building is located to provide convenient service. The Contractor shall supply the Engineer with a copy of the Certificate of Occupancy for the existing building.

The Engineer’s Field Office shall be in accordance with the requirements of the New York State Uniform Fire Prevention and Building Code, 19 NYCRR, and any applicable local codes.

The electrical system shall be able to continuously operate all equipment and be provided with adequate receptacles. To accommodate computer equipment, the field office shall be provided with a dedicated 20 amp electrical service and a vacant floor-to-ceiling area with a 3 foot x 3 foot footprint along a wall for the installation of a computer hardware rack/cabinet. Electric light shall be provided by non glare-type luminaries to provide a minimum illumination level of 100 foot-candles at desk-height level. An ambient air temperature of 70°F ±5°F shall be maintained.
Fire extinguishers and smoke and carbon monoxide detectors shall be provided and installed. The Engineer’s Field Office shall be partitioned to provide separate rooms, defined as either “small” or “large”, with adjoining doors. Table 637-1 below contains the minimum area requirements for each of the office types.

<table>
<thead>
<tr>
<th>TABLE 637-1 ENGINEER’S FIELD OFFICE AREA REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Requirement</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Min. total floor area (sf)</td>
</tr>
<tr>
<td>Min. number of small rooms</td>
</tr>
<tr>
<td>Min. floor area of small rooms (sf)</td>
</tr>
<tr>
<td>Min. number of large rooms</td>
</tr>
</tbody>
</table>

**A. Potable Water.** From a local municipal water supply, certified well or bottled with a heating/refrigerator unit to provide hot and cold water. An exterior frost-free hose bib shall be provided in a location adjacent to the Engineer’s Field Office. The hose bib need not be installed on a potable water line, and if the water in the line is not potable, it shall be clearly marked as such.

**B. Restroom.** A separately enclosed room, lockable from the inside, that is properly ventilated and in compliance with applicable sanitary codes. The Contractor shall provide all lavatory amenities, necessary paper and soap products, hot and cold running water and a toilet. The toilet shall be flush-type where sanitary facilities are available, and a type approved by the Engineer prior to installation where sanitary facilities are not available. The minimum required number of restrooms to be provided is specified in Table 637-2.

**C. Parking Area.** The Contractor shall provide and/or construct paved or hard surfaced (gravel or bankrun material) secure parking area with dedicated parking spaces adjacent to the Engineer’s Field Office. Each parking space shall be 9 feet by 18 feet, and the minimum required number of spaces to be provided is specified in Table 637-2.

**D. Field Office Signs.** The sign panel material shall be aluminum, fiberglass, plywood or lightweight plastic. The sign sheeting shall be ASTM Type III. The sign panel shall be 36 inches high by 48 inches wide with white legend on green background with the phrases as positioned and described below. If erected at a location where the sign might be struck by an errant vehicle, the sign support shall be a breakaway type.

The letters in the phrase “FIELD OFFICE” shall be 6 inches C series with the top of the letters 6 inches below the top of the panel. The letters in the phrase “ENGINEER-IN-CHARGE” shall be 6 inches B series with the top of the letters 18 inches below the top of the panel. The letters in the phrase “N.Y.S. DEPT. OF TRANSPORTATION” shall be 1 1/2 inches E series with the top of the letters 30 inches below the top of the panel. All phrases shall be centered horizontally on the panel.

If the Engineer’s Field Office is not located within or adjacent to the contract limits, two additional signs shall be displayed conspicuously within the contract limits. The signs shall be similar to the above description, except that they shall be 48 inches high by 64 inches wide and have an additional bottom line of text containing the street address of the Engineer’s Field Office. The letters in the street address shall be 6 inch B series with the top of the letters 36 inches below the top of the panel and centered horizontally on the panel.

**E. Mailbox.** Standard mailbox (with post if necessary) or post office box meeting the requirements of the U.S. Postal Service.
**F. Telephone and Answering System.** A separate telephone and answering system for the exclusive use of the inspection staff. The minimum required number of telephone voice lines to be provided is specified in Table 637-2 (these lines are in addition to the separate line to be provided for the facsimile machine, and one of these lines must be made available for remote troubleshooting of computer equipment, if necessary). The telephone and answering system shall provide the ability to answer all voice lines from each voice line, transfer calls to all voice lines and be equipped with a single, dedicated answering system.

A minimum of one telephone shall be cordless and a minimum of one telephone shall be equipped with speaker and conference call capability. The remaining telephones, at least one per required voice line, shall be extension telephones with minimum 25 foot long cords. The answering system shall be capable of recording outgoing messages up to 60 seconds long and receiving a minimum of 40 incoming messages of 60 seconds duration. The system must include automated voice marking of time and day of each message received and provide a message mark so that new messages may be played back without erasing old messages. The system shall include remote programming of playback, backspace, and outgoing message re-record and allow for the retrieval of messages without a remote control unit.

**G. Facsimile Machine.** Plain paper laser or inkjet facsimile machine with a dedicated telephone line. The machine shall be capable of sending and printing a maximum paper size of 8 1/2 x 14 inches, have a minimum 20 page memory storage, a minimum 20-sheet document feeder, a minimum 50-sheet paper capacity, transmit at least 6 pages per minute and have an autodial/redial with a minimum of 50 phone number memory. The machine shall be capable of storing and printing outgoing message confirmation information and printing the sender’s name, fax number and page number on incoming faxes.

**H. Photocopier.** Heavy duty, electric, dry-process photocopying machine. The machine shall be capable of duplex copying paper sizes of 8 1/2 x 11 inches, 8 1/2 x 14 inches and 11 x 17 inches, and have separate trays for each paper size. It shall have a document feeder, collator and the capability to reduce/enlarge copies between each paper size. One (1) case (5,000 sheets, 20 lb, white) of each paper size shall be provided as initial stock.

**I. Paper Shredder.** Automatic start, heavy duty cross-cut paper shredder. The shredder shall be able to receive 8 1/2 inch wide paper and shred a minimum of 15 sheets simultaneously along with CDs and staples.

**J. Pencil Sharpener.** Manual or electric pencil sharpener, minimum 1 per room.

**K. Exterior Bulletin Board.** An installed 4 foot x 8 foot weatherproof bulletin board in front of or adjacent to the Engineer’s Field Office. The bulletin board may be attached to an outside wall of the office. The location selected must be handicapped accessible and clearly visible.

**L. Interior Bulletin Board.** An installed, wall-mounted 4 foot x 6 foot bulletin board made of cork or similar material in a large room, and one 2 foot x 4 foot wall mounted bulletin board installed per room.

**M. Dry Erase Board.** Installed, wall-mounted 2 foot x 4 foot dry erase boards, minimum one per room.
N. Storage Locker. Metal or wood storage locker with shelves, a tumbler lock and 2 keys for the storage of survey, GPS and testing equipment. The total locker space footprint provided shall be a minimum of 9 square feet with a minimum height of 6 feet.

O. Fire Resistant Cabinet. Fire resistant, legal size filing cabinet with locks and 2 keys each, meeting the requirements of ANSI/UL Standard 72 for Insulated Filing Devices, Class 350-1 hour. Each office shall be provided with two 2-drawer cabinets, and the required number of additional 4-drawer cabinets as specified in Table 637-2.

P. Bookcase. Self-standing, 3-shelf metal or wood bookcase, approximately 4 feet high, 4 feet wide and 1 foot deep. The minimum required number of bookcases to be provided is specified in Table 637-2.

Q. Wastebasket. Minimum 7 gallon wastebasket, minimum one per desk.

R. Refrigerator. Electric, top-freezer type providing a minimum storage space of 15 cubic feet for Engineer’s Field Office Types 1 and 2, and a minimum storage space of 21 cubic feet for Types 3, 4 and 5.

S. Kitchenette. To include a minimum 1 cubic foot, 1,300 watt microwave oven, a sink with hot and cold running water with minimum dimensions of 15 inch x 15 inch x 6 inch deep, usable counter space with minimum dimensions of 5 feet long x 2 feet deep and cabinet space with minimum dimensions of 5 feet long x 1 1/2 feet deep x 2 1/2 feet high. If the water in the sink is not potable, it shall be clearly marked as such.

T. Stove. Electric, propane or bottle gas stove with a minimum of two burners adequate for rapid drying of soil samples, including fuel or electrical supply. A stove is required when a separate Field Laboratory is not included.

U. First Aid Kit. A Type III kit in accordance with ANSI Z308.1 Minimum Requirements for Workplace First Aid Kits. The minimum number of first aid kits to be provided is specified in Table 637-2.

V. Thermometer. A minimum-maximum thermometer displaying in degrees Fahrenheit and mounted with an external probe to give the temperature both indoors and outdoors.

W. Coat Rack. A metal or wood coat rack or closet capable of holding at least 4 coats. The minimum required number of coat racks to be provided is specified in Table 637-2. A single coat rack may be provided as long as it holds the minimum number of coats as per Table 637-2.

X. Office Desk and Chair. Fully assembled freestanding office desks and chairs. Each desk shall have a 5 feet long by 2 1/2 feet wide work surface and a height of 30 inches, at least 2 lockable drawers and include an adjustable shelf approximately 1 foot wide and no less than 2 1/2 feet long. Each desk shall also be provided with an adjustable chair with arms, 5 legs with casters and be adjustable from approximately 16 inches to 24 inches in height. Each desk shall have a dedicated electrical outlet receptacle. The required number of office desks and chairs to be provided is specified in Table 637-2.

Y. Office/Conference Table. Commercial-grade rectangular table with weather/spill resistant top a minimum of 8 feet long by 2 1/2 feet wide by 30 inches high. The minimum required number of office/conference tables to be provided is specified in Table 637-2.
Z. Folding Chair. Commercial-grade, folding steel chair with approximate overall dimensions of 30 inches high by 19 inches wide by 21 inches deep. The minimum required number of folding chairs to be provided is specified in Table 637-2.

AA. Drafting Table. Adjustable height, tilting top drafting table with brackets and legs and approximate dimensions of 6 feet long by 3 feet wide by 3 feet high. The minimum required number of drafting tables to be provided is specified in Table 637-2.

<table>
<thead>
<tr>
<th>TABLE 637-2 ENGINEER’S FIELD OFFICE FURNISHING REQUIREMENTS</th>
<th>Required Number per Engineer’s Field Office Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnishing Description</td>
<td>1</td>
</tr>
<tr>
<td>Restrooms</td>
<td>1</td>
</tr>
<tr>
<td>Parking spaces</td>
<td>6</td>
</tr>
<tr>
<td>Telephone voice lines</td>
<td>2</td>
</tr>
<tr>
<td>Telephone line for facsimile</td>
<td>1</td>
</tr>
<tr>
<td>Fire resistant cabinets (4-drawer)</td>
<td>2</td>
</tr>
<tr>
<td>Bookcases</td>
<td>5</td>
</tr>
<tr>
<td>First aid kits</td>
<td>1</td>
</tr>
<tr>
<td>Coat racks</td>
<td>1</td>
</tr>
<tr>
<td>Office desks and chairs</td>
<td>4</td>
</tr>
<tr>
<td>Office/conference tables</td>
<td>2</td>
</tr>
<tr>
<td>Folding chairs</td>
<td>4</td>
</tr>
<tr>
<td>Drafting tables</td>
<td>1</td>
</tr>
<tr>
<td>Drafting stools</td>
<td>2</td>
</tr>
<tr>
<td>Vertical plan filing racks</td>
<td>1</td>
</tr>
<tr>
<td>Roll file units</td>
<td>1</td>
</tr>
</tbody>
</table>

BB. Drafting Stools. Adjustable height stool with backrest. The minimum required number of drafting stools to be provided is specified in Table 637-2.

CC. Vertical Plan Filing Rack. Constructed of metal, capable of hanging up to 12 sets of plan drawings up to 3 feet x 4 feet in size, 12 hanging clamps included. The minimum required number of vertical plan filing racks to be provided is specified in Table 637-2.

DD. Roll File Unit. Twelve (12) compartments, each measuring approximately 6 inches x 6 inches. The minimum required number of roll file units to be provided is specified in Table 637-2.

637-2.02 Field Laboratory. The Field Laboratory shall be a secured, weatherproof room, building or mobile structure not less than 100 square foot floor area in size. The floor covering shall be linoleum, tile or other serviceable finish. A local exhaust system shall be provided. An ambient air temperature of 70°F ±10°F shall be maintained. The Contractor may furnish equivalent facilities in an existing building, provided that the building is located to provide convenient service. The Contractor shall supply the Engineer with a copy of the Certificate of Occupancy for the existing building.

The Field Laboratory shall be in accordance with the requirements of the New York State Uniform Fire Prevention and Building Code, 19 NYCRR, and any applicable local codes.
The electrical system shall be able to continuously operate all equipment and be provided with adequate receptacles. Where an electric hotplate or stove is provided, service shall be increased over 20 amperes by an amount equal to the rating of the device provided.

The Field Laboratory shall be sufficiently anchored to prevent damage from vibration caused by the laboratory equipment.

Fire extinguishers and smoke and carbon monoxide detectors shall be provided and installed.

**A. Potable Water.** From an existing system or from an external 55 gallon (minimum) gravity-feed storage tank connected to the sink faucet and refilled as necessary.

**B. Sink.** A sink at least 36 inches long by 24 inches wide by 18 inches deep, equipped with water faucet and drain line.

**C. Counter.** A work counter next to sink at least 24 inches long by 24 inches wide.

**D. Cabinet.** A storage cabinet or locker at east 2 feet square by 6 feet high, equipped with at least 4 shelves, a lock and 2 keys.

**E. Table.** A heavy duty work table not less than 8 feet long by 2 1/2 feet wide by 3 feet high.

**F. Pedestal.** A heavy wooden block for soil compaction tests, nominally 10 inches square by 12 inches high.

**G. Stove.** As specified in §637-2.01U.

**H. Office Desk and Chair.** As specified in §637-2.01Y.

### 637-2.03 Concrete Cylinder Curing Box.

The concrete cylinder curing box shall be constructed of non corroding materials. A moisture proof seal shall be provided between the lid and body of the box. Provision for automatic control of water temperature to 72°F ±5°F shall be made when the box is located in an uncontrolled environment. A bimetallic thermometer shall be inserted with its sensing element in the storage water. The thermometer shall be capable of being read from the outside without opening the box. The thermometer shall have minimum gradations of 1°F and shall be protected from damage. Electric utility connections shall be made in a lockable switch box securely attached to the outside of the curing box.

A rustproof wire or metal rack shall be set above the bottom of the box to support cylinders in an upright position. The rack and all temperature control elements shall be positioned to allow free circulation of water around the cylinders. A combination hose connection and drain shall be provided at the lower front edge of the box so that it may be drained or water may be circulated. A drain shall also be provided on the box in such a position that when open will drain water to within 1 inch over the top of the cylinders. All areas of the box shall be easily drained and accessible for cleaning.

The concrete cylinder curing box shall be capable of maintaining the required water temperature through an ambient air temperature range of -10°F to +100°F. The box shall be capable of holding a minimum of nineteen (19) 6 inch x 12 inch cylinders. When filled with water, the box shall not leak enough so that the cylinders are exposed.

### 637-2.04 Digital Camcorder.

The digital camcorder shall meet the requirements below. All necessary hardware, cables, operating manuals, and other pertinent media for all the components shall be provided, including connecting the camera to the office computer system. The camera must be able to download the video to a computer without any proprietary software having to be installed on the computer. The equipment shall be no more than one (1) year old. To verify the age of the equipment, the Contractor...
shall provide the Engineer with a dated copy of the receipt(s) for the purchase of the equipment. Once equipment has been provided, it does not require replacement, as long as it is serviceable.

- Records video in .avi and/or .mpg format
- Autofocus operation
- 2 1/2 inch LCD screen and optical viewfinder
- Equipped with Electronic Image Stabilization
- Low-light recording capable
- Time/date stamp on recording
- AC adapter and all cables and connections necessary for computer interface
- Two rechargeable batteries (Lithium-Ion or NiMH) and charging unit
- Recording media to store 180 minutes of video footage
- Soft storage/carry case with shoulder strap

637-2.05 Rain Gauge. The wireless rain gauge system shall meet the requirements below. All necessary mounting materials and hardware, operating manuals and other pertinent media for the components shall be provided.

- Wireless remote transmission from outdoor weatherproof rainfall sensor to indoor display unit
- Self-emptying tipping bucket
- Display daily rainfall information and at least 9 day historical rainfall records
- Two sets of rechargeable batteries for each component and charging unit
- No computer software shall be necessary for rain gauge operation or rainfall data storage/viewing

637-2.06 Inspection Vehicle. The vehicles(s) provided shall not be over 4 years old or have over 35,000 miles on the odometer as of the delivery date. The supplied vehicle(s) shall be of such durability to carry occupants and equipment over rough terrain and contain sufficient weather protection for both the occupants and equipment. The vehicle(s) shall have sufficient cargo capacity to carry the equipment necessary for the work. The vehicle(s) shall be properly registered, maintained (including repairs, tires, lubrication, fuel, washing, etc.), and be provided with an owner’s policy of liability insurance in conformance with §107-06B. Insurance Requirements. The vehicle(s) shall be equipped with or meet the following minimum specifications:

- Manufacturer’s Standard 4 or 6 cylinder engine
- Automatic transmission
- Manufacturer’s Standard 4 wheel drive or all-wheel drive
- Power steering
- Air conditioning
- Manufacturer’s base level interior option
- Left, right and center mirrors
- Roof mount flashing yellow light
- All Standard Manufacturer equipment and accessories including spare tire, jack, owner’s manual, etc. shall be included with the vehicle(s), along with vehicle registration and insurance cards

637-2.07 Inspection Boat. The boat provided shall comply with the following minimum requirements:

- All required capacity, maximum horsepower, and identification plates shall be affixed in the manner required by Coast Guard regulations.
• The motor’s horsepower shall meet the rated requirements of the boat and be equipped with a forward, neutral, and reverse. The power train shall be equipped with an interlock so that the engine may not be started in gear. U.S. Coast Guard-approved fuel tanks shall be provided.

• All equipment required by Coast Guard regulations shall be provided for the boat. The equipment shall include, but not be limited to, the following:
  - Class B-1 fire extinguisher
  - Life jackets for all persons aboard
  - One anchor, Danforth-type or Navy stockless, suitable for the specified boat
  - Bailing device
  - Power operated whistle or horn
  - Visual distress signals
  - Means for accessing work sites not accessible from land from the water (piers, floating equipment, etc.)

• Registration, licenses, and other legal requirements for boat operation shall be obtained by the Contractor and kept current by the Contractor for the length of time the boat is in operation.

• Dockage facilities shall be maintained by the Contractor and shall be constructed (if necessary) so that easy access to the boat is provided at all times under all tidal conditions.

• The Contractor shall maintain the boat in good, clean condition at all times as required. Fuel tanks shall be maintained full at all times.

A. Inspection Boat – Type A

• Boat lengths up to and including 18 feet
• The boat will be operated by an appropriately trained and certified member of the inspection staff.

B. Inspection Boat – Type B

• Boat lengths in excess of 18 feet
• An appropriately trained, certified and licensed operator shall be provided.

637-2.08 Office Technology Supplies. Materials as specified in the bid documents or by the Engineer.

637-2.09 Construction Testing Supplies – Consumables. Consumable testing materials as specified by the Engineer.

637-2.10 Partnering Workshop. None specified.

637-3 CONSTRUCTION DETAILS. The equipment, with the exception of the office technology supplies, shall be maintained by, and remain the property of, the Contractor.

637-3.01 Engineer’s Field Office. The Contractor shall be responsible, until use and occupancy is relinquished by the State, for any and all damage, direct or indirect, of whatever nature, occurring to the property of the State and property of the inspection staff which is kept in the Engineer's Field Office. The Engineer will provide the Contractor with a detailed list of items kept in the office, with corresponding dollar values, and will provide the Contractor with updates when something on the list changes. Non-State-owned property shall only be those items used in the performance of contract-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 Contractor shall not be responsible for items kept in the Engineer's Field Office that are not on this list.
The Contractor shall install the Engineer’s Field Office sign at a location approved by the Engineer. If the Engineer’s Field Office is not located within or adjacent to the contract limits, two (2) additional signs shall be displayed conspicuously within the contract limits in locations directed by the Engineer.

The Engineer’s Field Office shall be fully equipped and made available for use and occupancy by the inspection staff prior to the start of any contract work, and shall be made available after contract final acceptance as directed in writing by the Regional Construction Engineer.

All furniture and equipment shall be fully assembled, operational, clean and serviceable. The Engineer’s Field Office shall be cleaned weekly or more often if required, and the timing of the cleaning operations shall be coordinated with the Engineer. The Contractor shall remove and dispose of all rubbish generated in the office and shall keep the office free from pests. The Contractor shall remove snow from all areas subject to vehicular circulation and parking.

After completion, all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location and the areas cleaned, loamed and restored as required.

### 637-3.02 Field Laboratory

The Contractor shall be responsible for any and all damage, direct or indirect, of whatever nature, occurring to the property of the State which is kept in the Field Laboratory. The Engineer will provide the Contractor with a detailed list of items kept in the laboratory, with corresponding dollar values, and will provide the Contractor with updates when something on the list changes. Non-State-owned property shall only be those items used in the performance of contract-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 Contractor shall not be responsible for items kept in the Field Laboratory that are not on this list.

The Field Laboratory shall be fully equipped and made available for use and occupancy by the inspection staff prior to the start of any contract work. Such use and occupancy shall be made available after contract final acceptance as directed in writing by the Regional Construction Engineer.

All furniture and equipment shall be fully assembled, operational, clean and serviceable. The Field Laboratory shall be cleaned weekly or more often if required, and the timing of the cleaning operations shall be coordinated with the Engineer. The Contractor shall remove and dispose of all rubbish generated in the laboratory and shall keep the laboratory free from pests.

After completion, all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location, the areas cleaned, loamed and restored as required.

### 637-3.03 Concrete Cylinder Curing Box

Prior to the placement of any structural concrete, the Contractor shall furnish the Engineer a concrete cylinder curing box and 2 locks with 2 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 a location approved by the Engineer. The Contractor shall provide and maintain all necessary utility connections to operate the curing box.

### 637-3.04 Digital Camcorder

The Contractor shall provide and maintain a digital camcorder system for the exclusive use of Department personnel and their authorized representatives. The digital camcorder shall be fully operational prior to the start of any contract work and the Contractor shall supply qualified instruction to the inspection staff regarding proper equipment operation. The Contractor shall provide replacement, due to breakdown, damage, loss, or theft within 24 hours of notification. The State may retain ownership of any data storage media, data storage containers and consumables.

### 637-3.05 Rain Gauge

The Contractor shall provide, install and maintain the wireless rain gauge system in accordance with the manufacturer’s instructions in a location approved by the Engineer. The Contractor shall make the system fully operational in a timely manner, at a minimum, prior to any soil disturbance at the site. The Contractor shall provide replacement due to breakdown, damage, loss, or theft within 24 hours of notification.
637-3.06 Inspection Vehicle. Prior to the start of any contract work, the Contractor shall make the inspection vehicle(s) available for inspection by the Engineer. The Contractor shall make arrangements for delivery to the site on the date specified by the Engineer. The vehicle(s) will be driven by the Engineer and other personnel authorized by the Engineer possessing a valid driver’s license.

The Contractor shall provide fuel, oil, proper maintenance, tires, and replacement parts as required to keep the vehicle(s) in safe operating condition, and undertake all repairs, including repairs arising from the vandalism, accidents or other damages. The Contractor shall either establish an account at a local gas station or provide the inspection staff with the monetary means to fuel the vehicles. If any vehicle requires maintenance or repairs which cannot be completed on the same day, a comparable replacement vehicle shall be provided while the vehicle is out of service. If the vehicle is lost or stolen, the Contractor shall replace the vehicle within 5 work days with a comparable vehicle.

637-3.07 Inspection Boat. The Contractor shall furnish the boat (and operator for Type B Inspection Boats) within 5 work days after written notification by the Engineer, and the boat (and operator for Type B Inspection Boats) shall, thereafter, be available at all times to the Engineer and other personnel authorized by the Engineer.

637-3.08 Office Technology Supplies. The Contractor shall provide office technology-related supplies for the exclusive use of Department personnel and their authorized representatives. The supplies shall be provided within 2 work days of the Engineer’s request, unless the Engineer agrees to a longer delivery time. The Department shall retain ownership of the technology-related materials and supplies.

637-3.09 Construction Testing Supplies - Consumables. The Contractor shall provide consumable testing materials for the exclusive use of Department personnel and their authorized representatives. The supplies shall be provided within 5 work days of the Engineer’s request, unless the Engineer agrees to a longer delivery time. The Department shall retain ownership of the consumable testing materials, both materials used and those materials unused for which the Contractor has been paid, at the completion of the contract.

637-3.10 Partnering Workshop. The Contractor and the Regional Construction Engineer will jointly select a facilitator and a location for the workshop. A list of potential facilitators is available from the Department. The facilitator shall present a one to two day Partnering Workshop for this contract between the time of award and the start of work. For long duration, multi year projects, a subsequent follow-up workshop may be convened, with the agreement of the Contractor and the Regional Construction Engineer, at an appropriate point during the progression of the work. The associated costs for this subsequent workshop will be reimbursed under this item.

637-4 METHOD OF MEASUREMENT

637-4.01 Engineer’s Field Office. The Engineer’s Field Office will be measured for payment as the number of months satisfactorily provided, measured to the nearest 0.25 months.

637-4.02 Field Laboratory. The Field Laboratory will be measured for payment as the number of units satisfactorily provided.

637-4.03 Concrete Cylinder Curing Box. The concrete cylinder curing boxes will be measured for payment as the number of units furnished and installed.

637-4.04 Digital Camcorder. The digital camcorder will be measured for payment on a fixed price Dollars-Cents pay unit basis.
637-4.05 Rain Gauge. The rain gauge will be measured for payment as the number of units furnished and installed.

637-4.06 Inspection Vehicle. The inspection vehicle(s) will be measured for payment on a monthly basis, measured to the nearest 0.25 months.

637-4.07 Inspection Boat. The inspection boat will be measured for payment on a monthly basis, measured to the nearest 0.25 months.

637-4.08 Office Technology Supplies. Office technology supplies will be measured for payment on a fixed price Dollars-Cents pay unit basis.

637-4.09 Construction Testing Supplies – Consumables. Construction testing supplies will be measured for payment on a fixed price Dollars-Cents pay unit basis.

637-4.10 Partnering Workshop. The Partnering Workshop will be measured for payment on a Dollars-Cents pay unit basis.

637-5 BASIS OF PAYMENT. For the items to be paid on a Dollars-Cents pay unit basis, the total cost shown in the itemized proposal will be considered the price bid even though payment will be made only for actual equipment and materials supplied. The unit price amount 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.

637-5.01 Engineer’s Field Office. The unit price bid per month for the Engineer’s Field Office shall include the cost of all labor, materials and equipment necessary to complete the work including property rental, utility charges and incidental expenses. Payment will be made for each month of availability for occupancy by the Engineer and inspection field staff.

No payment will be made under Engineer's Field Office for each calendar day during which there are deficiencies in compliance with these requirements. The first calendar day shall commence 24 hours after notice to the Contractor of such a deficiency. This nonpayment shall be deducted from the next contract payment. The amount of such calendar day nonpayment will be determined by dividing the unit price bid per month by 30.

If the cited deficiencies exceed 72 hours or is permitted to recur, liquidated damages will be assessed at 20% of the rate shown in Table 108-1 Schedule of Liquidated Damages of §108-03 Failure to Complete Work on Time for each subsequent calendar day or part thereof that the cited deficiency resulting in nonpayment is not corrected.

Monthly payments may be terminated prior to contract final acceptance by written notification by the Regional Construction Engineer that such office will no longer be required on the contract. Payment for each month's occupancy of the Engineer’s Field Office after the date of contract final acceptance will be made as part of the final contract payment. Failure of the Contractor to supply documentation required to complete the final estimate may result in nonpayment during this delaying period.

During periods of contract extension of time where Engineering Charges are assessed, no payment will be made for occupancy and services, except that payment for each month's occupancy after the date of final acceptance will be made as part of the final estimate.

637-5.02 Field Laboratory. The unit price bid for each Field Laboratory shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including property rental, utility charges and incidental expenses.

Payment will be made for each Field Laboratory when it has been placed on the work site and is fully operational.
637-5.03 Concrete Cylinder Curing Box. The unit price bid for each concrete cylinder curing box shall include the cost of all labor, materials and equipment necessary to complete the work including property rental, relocation, repair or replacement, painting, cleaning, maintenance, and utility charges.

637-5.04 Digital Camcorder. The digital camcorder is a “draw down” item. As materials are supplied, the receipts for the materials shall be submitted to the Engineer. The Contractor will be reimbursed for receipted costs of materials plus 5% for profit and overhead (“materials” includes all labor, materials and equipment, including services to furnish, maintain, and remove all of the components of the digital camcorder system).

If new equipment is not provided, the Engineer will determine a reasonable cost for the equipment. The Contractor shall provide a copy of the original receipt for the equipment to assist the Engineer in assessing the current value of the equipment. Used equipment less than one (1) year old shall be assessed at no more than 50% of the original receipted cost. Equipment over one (1) year old shall not be considered for approval.

637-5.05 Rain Gauge. The unit price bid for each rain gauge shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including installing and maintaining all components of the wireless rain gauge system.

Payment will be made for the rain gauge when it has been installed and is fully operational.

637-5.06 Inspection Vehicle. The unit price bid per month shall include all costs in connection with furnishing properly registered vehicles, maintaining the vehicles (including repairs, tires, lubrication, fuel, washing, etc.), and providing an owner’s policy of liability insurance for the vehicles in conformance with §107-06B. A deduction of 1/30 of a month will be made for each 24-hour period, or portion thereof, during which the vehicle is unavailable to the Engineer, or personnel authorized by the Engineer, regardless of the reason for the vehicle's unavailability. When directed in writing by the Engineer, payment for each month of use after the date of acceptance will be made as part of the final estimate. Payment will begin the first month the vehicle is furnished and made available for use. Monthly payments may be terminated on a specified date prior to acceptance of the Contract by written notification by the Engineer that the vehicle will no longer be required.

637-5.07 Inspection Boat. The unit price bid per month shall include the cost of furnishing all labor, fuel, maintenance, repairs, registration permits, the operator (for Type B Inspection Boats), and other necessary incidentals for operation of the boat. A deduction of 1/30 of a month will be made for each 24-hour period, or portion thereof, during which the boat is unavailable to the Engineer, or personnel authorized by the Engineer, regardless of the reason for the boat's unavailability. When directed in writing by the Engineer, payment for each month of boat use after the date of acceptance will be made as part of the final estimate. Payment will begin the first month the boat is furnished and made available for use. Monthly payments may be terminated on a specified date prior to acceptance of the Contract by written notification by the Engineer that the boat will no longer be required.

637-5.08 Office Technology Supplies. Office technology supplies is a “draw down” item. As the materials are supplied, the receipts shall be submitted to the Engineer. The Contractor will be reimbursed for receipted costs of materials plus 5% for profit and overhead (“materials” includes all labor, materials and equipment, including services and service contracts provided).

637-5.09 Construction Testing Supplies – Consumables. Construction testing supplies is a “draw-down” item. As the materials are supplied, the receipts shall be submitted to the Engineer. The Contractor will be reimbursed for receipted costs of materials plus 5% for profit and overhead (“materials” includes all labor, materials and equipment, including delivery charges from vendor sources).
**637-5.10 Partnering Workshop.** The Department will reimburse the Contractor for 50% of the costs for the facilitator and the facility upon submission of original receipts. Receipted costs eligible for 50% reimbursement include the fee for the facilitator and the costs for the facilitator’s travel and expenses; associated workshop costs such as charges for the rental of the meeting room, required audio/visual equipment and any handouts, notes or workshop materials. The costs for travel, lodging, meals and salaries of workshop attendees, other than those of the facilitator, will not be eligible for reimbursement 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>637.01</td>
<td>Field Laboratory</td>
<td>Each</td>
</tr>
<tr>
<td>637.03</td>
<td>Concrete Cylinder Curing Box</td>
<td>Each</td>
</tr>
<tr>
<td>637.11</td>
<td>Engineer’s Field Office – Type 1</td>
<td>Month</td>
</tr>
<tr>
<td>637.12</td>
<td>Engineer’s Field Office – Type 2</td>
<td>Month</td>
</tr>
<tr>
<td>637.13</td>
<td>Engineer’s Field Office – Type 3</td>
<td>Month</td>
</tr>
<tr>
<td>637.14</td>
<td>Engineer’s Field Office – Type 4</td>
<td>Month</td>
</tr>
<tr>
<td>637.15</td>
<td>Engineer’s Field Office – Type 5</td>
<td>Month</td>
</tr>
<tr>
<td>637.25</td>
<td>Digital Camcorder</td>
<td>Dollars-Cents</td>
</tr>
<tr>
<td>637.26</td>
<td>Rain Gauge</td>
<td>Each</td>
</tr>
<tr>
<td>637.32</td>
<td>Inspection Boat - Type A</td>
<td>Month</td>
</tr>
<tr>
<td>637.33</td>
<td>Inspection Boat - Type B</td>
<td>Month</td>
</tr>
<tr>
<td>637.34</td>
<td>Office Technology and Supplies</td>
<td>Dollars-Cents</td>
</tr>
<tr>
<td>637.35</td>
<td>Partnering Workshop</td>
<td>Dollars-Cents</td>
</tr>
<tr>
<td>637.36</td>
<td>Construction Testing supplies – Consumables</td>
<td>Dollars-Cents</td>
</tr>
</tbody>
</table>

**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. The general limits for the mix are as follows:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>General Limits (1)</th>
<th>Job Mix % Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 inch</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>1/8 inch</td>
<td>90–100</td>
<td>±5</td>
</tr>
<tr>
<td>No. 20</td>
<td>42–68</td>
<td>±7</td>
</tr>
<tr>
<td>No. 40</td>
<td>20–50</td>
<td>±6</td>
</tr>
<tr>
<td>No. 80</td>
<td>10–22</td>
<td>±3</td>
</tr>
<tr>
<td>No. 200</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>250°F –325°F</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 No. 200 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 250°F to 350°F and the temperature of the synthetic resin binder (one component) shall be maintained between the limits of 260°F and 300°F. 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 425°F. For
either method of binder addition, the resulting mix temperature shall be in the range of 250°F to 325°F.

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 0.03 to 0.05 gallons per square yard 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 250°F to 325°F as specified by the Engineer. All areas of uniform width of 4 feet 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) 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 10 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 10 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 10 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 tons of compacted material in place.

638-5 BASIS OF PAYMENT. The unit price bid per 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>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>638.0104</td>
<td>White Synthetic Resin Binder Concrete</td>
<td>Ton</td>
</tr>
</tbody>
</table>

SECTION 639 - CONSTRUCTION CONTRACT MANAGEMENT SYSTEMS

639-1 DESCRIPTION. The work in this section shall include work required for construction contract management systems.

639-2 MATERIALS. Materials shall be as specified in the special specifications.

639-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

639-4 METHOD OF MEASUREMENT. As specified in the special specifications.

639-5 BASIS OF PAYMENT. As specified in the special specifications.

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 MUTCD 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 MUTCD.
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 30 feet 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. At the time of paint application, the pavement surface and ambient temperature shall not be less than 50°F, the relative humidity shall not exceed 85%, and the pavement surface shall be dry. Traffic paint shall not be applied during periods of rain or if rain is imminent. Waterborne traffic paint shall not be applied if rain is expected within 4 hours after application.

Paint shall be applied in strict accordance with the manufacturer’s recommendations for use. In no case shall the paint be heated above 150°F.

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 6 lb/gal 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, traffic paint shall be applied before the end of the work shift. If the Contractor is unable to apply final pavement markings and traffic is to be maintained, then removable pavement markings offset from the final pavement markings shall be installed in accordance with Section 619 Work Zone Traffic Control at no additional cost to the State.

640-4 METHOD OF MEASUREMENT. Pavement striping will be measured in feet along the centerline of the pavement stripe and shall be based on a 4 inches wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown in the contract documents or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (inches) x Feet} / 4 \text{ inches}
\]

No payment will be made for the number of feet 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 feet of 4 inch 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.
Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>640.10</td>
<td>White Paint Reflectorized Pavement Stripes – 15 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>640.11</td>
<td>Yellow Paint Reflectorized Pavement Stripes - 15 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>640.12</td>
<td>White Paint Reflectorized Pavement Letters - 15 mils</td>
<td>Each</td>
</tr>
<tr>
<td>640.13</td>
<td>White Paint Reflectorized Pavement Symbols - 15 mils</td>
<td>Each</td>
</tr>
<tr>
<td>640.20</td>
<td>White Paint Reflectorized Pavement Stripes – 20 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>640.21</td>
<td>Yellow Paint Reflectorized Pavement Stripes - 20 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>640.22</td>
<td>White Paint Reflectorized Pavement Letters - 20 mils</td>
<td>Each</td>
</tr>
<tr>
<td>640.23</td>
<td>White Paint Reflectorized Pavement Symbols - 20 mils</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 641 - BRIDGE WASHING

641-1 DESCRIPTION. The work in this section shall include work required for bridge washing.

641-2 MATERIALS. Materials shall be as specified in the special specifications.

641-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

641-4 METHOD OF MEASUREMENT. As specified in the special specifications.

641-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 642 - ROADSIDE MAINTENANCE

642-1 DESCRIPTION. The work in this section shall include work required for roadside maintenance. Examples of the type of work are mowing, litter pick up, cleaning and shaping ditches. Work involving slope repair, asphalt patching, culvert repairs, etc shall be specified in other sections.

642-2 MATERIALS. Materials shall be as specified in the special specifications.

642-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

642-4 METHOD OF MEASUREMENT. As specified in the special specifications.

642-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 643 - NOISE BARRIERS

643-1 DESCRIPTION. The work in this section shall include work involved with construction of noise barriers.

643-2 MATERIALS. Materials shall be as specified in the special specifications.
643-3 **CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

643-4 **METHOD OF MEASUREMENT.** As specified in the special specifications.

643-5 **BASIS OF PAYMENT.** As specified in the special specifications.

**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 1/2 inch 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 1/4 inch.
Single-Arm Cantilever Structure

Single-Arm Butterfly Structure

Trussed-Arm Cantilever Structure

Trussed-Arm Butterfly Structure

Single Span Structure
A. Pipe. Pipe shall meet the requirements of one of the following specifications:

- ASTM A53, Welded and Seamless Steel Pipe, Grade B, Type E or S.
- ASTM A500, Welded and Seamless Steel Pipe, Grade B (Rounds Only)
- ASTM A252, Welded and Seamless Steel Pipe, Grade 2 or 3, provided that the chemical certifications meet the requirements for ASTM A53, 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:

\[
CE = \%C + \%\text{Mn}/6 + \%\text{Cu}/40 + \%\text{Ni}/20 + \%\text{Cr}/10 - \%\text{Mo}/50 - \%\text{V}/10
\]

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 F1554, 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 A325 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 F1554, 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 3.9 mils. 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 Concrete. 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 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 12 inches wide by 6 inches high, with the corners cut to a 1 1/2 inch radius. The numbers shall be cut out from White, Class A, Engineer Grade reflective sheeting and shall be 3 inches 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 6 feet 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 1/2 inch 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 50 feet in length shall be, at a minimum, supported at the midspan and end points. Sections 50 feet 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 Section 203, Disposal of Surplus Excavated Material.

   Excavation shall be backfilled as specified in Section 203, Select Structure Fill. The outline of all areas to be removed in sidewalks, driveways, and pavement shall be saw cut to a depth of at least 3 inches 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 + 1/4 inch, -0 inch.

Stripping of forms and subsequent loading of foundations shall be in accordance with §555-3, in Table 555-4, 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 3/8 inch.

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>Anchor Bolt Size (English)</th>
<th>Required Torque (±5%) (ft-lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½</td>
<td>650</td>
</tr>
<tr>
<td>1 ¾</td>
<td>1,000</td>
</tr>
<tr>
<td>2</td>
<td>1,500</td>
</tr>
<tr>
<td>2 ¼</td>
<td>2,200</td>
</tr>
<tr>
<td>2 ½</td>
<td>3,000</td>
</tr>
</tbody>
</table>
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 1/16 inch 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 yard 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 pound 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>Pound</td>
</tr>
<tr>
<td>644.20</td>
<td>Drilled Shaft for Overhead Sign Structures</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>644.30</td>
<td>Rectangular Footing for Overhead Sign Structures</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>644.41xyxy</td>
<td>Single Arm Cantilever Sign Structure</td>
<td>Each</td>
</tr>
<tr>
<td>644.42xyxy</td>
<td>Trussed Arm Cantilever Sign Structure</td>
<td>Each</td>
</tr>
<tr>
<td>644.43xyxy</td>
<td>Single Span Sign Structure</td>
<td>Each</td>
</tr>
<tr>
<td>644.44nn</td>
<td>Non-Standard Sign Structure</td>
<td>Each</td>
</tr>
</tbody>
</table>
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 yards. 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 yard increments.
3. yy denotes sign area in square yards. For Single Arm Cantilever Sign Structures, yy is 03, 05 or 08 square yards. For Trussed Arm Cantilever Sign Structures, yy varies from 05 to 30 in 5 square yard increments. For Single Span Sign Structures, yy varies from 30 to 90 in 30 square yard 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.

645-1.01 Definitions. The following definitions shall apply to all work equipment and materials included under this section:

1. Sign Face - the side of a sign panel with reflective sheeting attached.
2. Sign Face Layout - a dimensional representation of the sheeting mounted on the sign panel.
3. Sign Panel - a uniform sheet of aluminum or fiberglass reinforced plastic with reflective sheeting mounted on it. It may be constructed with or without additional sheets of aluminum or fiberglass reinforced plastic attached on the larger sheet. Multiple sheets of aluminum or fiberglass reinforced plastic may be used provided the sheets are of a uniform material and thickness and not separated.
4. Sign Panel Assembly - a group of contiguous sign panels with a maximum separation of 6 inches.
5. Sign Support System - the apparatus a sign panel is mounted.

645-2 MATERIALS

645-2.01 General. Materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing:

<table>
<thead>
<tr>
<th>Material</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Preservative - Water Borne</td>
<td>708-31</td>
</tr>
<tr>
<td>Stress Graded Timber and Lumber</td>
<td>712-14</td>
</tr>
<tr>
<td>Stainless Steel Connecting Products</td>
<td>715-16</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>
<tr>
<td>Aluminum Sign Panels</td>
<td>730-01</td>
</tr>
<tr>
<td>Reflective Sheeting</td>
<td>730-05</td>
</tr>
<tr>
<td>Reflectorized Sheeting Sign Characters (Type IV)</td>
<td>730-12</td>
</tr>
<tr>
<td>Reflectorized Sheeting Sign Characters (Type V)</td>
<td>730-13</td>
</tr>
<tr>
<td>Stiffeners, Overhead Brackets, and Miscellaneous Hardware</td>
<td>730-22</td>
</tr>
<tr>
<td>Fiberglass Reinforced Plastic Sign Panels</td>
<td>730-23</td>
</tr>
<tr>
<td>Type A Sign Supports</td>
<td>730-24</td>
</tr>
<tr>
<td>Type B Sign Posts</td>
<td>730-25</td>
</tr>
<tr>
<td>Breakaway Bases and Hinge Assemblies</td>
<td>730-26</td>
</tr>
<tr>
<td>U-Bolts</td>
<td>ASTM F1554, Grade 36</td>
</tr>
</tbody>
</table>

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.
Markings shall be a minimum of 1 inch 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.

1. **Ground-Mounted Sign Panels without Z-bars.** Ground-Mounted signs without Z-bars shall be 10 gauge thick meeting the requirements of '730-01 Aluminum Sign Panels. Or 0.135 inch thick meeting the requirements of '730-23 Fiberglass Reinforced Plastic Sign Panels for sign panels up to 4 feet x 4 feet.

2. **Ground-Mounted Sign Panels less than or equal to 30 square feet (with Z-bars).** Ground-Mounted signs with Z-bars less than or equal to 30 square feet shall be 10 gauge thick meeting the requirements of '730-01 Aluminum Sign Panels. Or 0.135 inch thick, meeting the requirements of '730-23 Fiberglass Reinforced Plastic Sign Panels for sign panels up to 4 feet x 4 feet.

3. **Ground-Mounted Sign Panels greater than 30 square feet (with Z-bars).** Sign panels for Ground-Mounted Sign Panels greater than 30 square feet shall be 8 gauge thick meeting the requirements of '730-01 Aluminum Sign Panels.

B. **Overhead-Mounted Sign Panels.** Sign panels for Overhead-Mounted Sign Panels shall be 8 gauge thick meeting the requirements of '730-01 Aluminum Sign Panels.

C. **Sign Panels with Multiple Sheeting types.** The panel thickness for sign panels with multiple types of sheeting types shall be determined using the total area of the sign panel, and meet the materials requirements above.

D. **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, R1-4, R1-5, R3-1, R3-2, R3-4, R3-18, R5-1, and R5-1a.

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: E11-1, E11-1a, E11-1b, E11-1c W1-6, W1-7, and W1-8.

3. **High-Visibility Fluorescent Yellow-Green Sheeting.** Signs with the following 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: NYR2-7, NYR2-8, S1-1, S3-1, S4-3, S4-5, W11-1, W11-2, W11-9, W15-1, W16-1, and W16-7p. In addition, signs with the following MUTCD codes mounted on
the same support system 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: W16-2, W16-2a, W16-3, W16-3a, W16-4, and W16-9p.

**E. 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.

**F. Sign Face Layouts.** Sign face shape, color, dimensions, and characters shall be in accordance with:

2. New York State Supplement to the National Manual on Uniform Traffic Control Devices for Streets and Highways

After contract award, two copies of non-standard sign face layouts will be provided to the Contractor. The Contractor shall verify dimensions on the sign face layouts prior to fabrication. (Standard sign face layouts for MUTCD codes without the prefix NY are shown in the Standard Highway Signs Book written by the Federal Highway Administration.)

**G. 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 2100 ft-lbs, 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 39 inches) 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 7800 ft-lbs. 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 1730-25 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 A588 or A242.
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 3900 psi 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 2 inches above the ground surface or above the steel tube insert, with a heavy coat (12 mil dry film thickness) of an emulsified asphalt conforming to AASHTO M140. All 3 1/2 inch x 5 1/2 inch posts shall have two 1 1/2 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches above grade and filled with flexible caulk. All 5 1/2 inch x 7 1/2 inch posts shall have two 3 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches 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 System. Bands, brackets, hardware, and fasteners necessary to mount a sign panel or a sign panel assembly on traffic signal poles, street lighting poles or other poles shall be stainless steel. Bands shall be a minimum of 0.75 inch x 0.02 inch. Other methods of attachment may be substituted with prior written approval of the Engineer. A sign panel assembly is defined as a group of contiguous sign panels with a maximum separation of 6 inches.

645-2.08 Illuminated Signs. Illuminated Sign Panels shall be aluminum alloy 8 gauge 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. (Vacant.)

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 of 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 29 feet and 49 feet 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>Type A Post</td>
</tr>
<tr>
<td>1, 2, 6, 8, and 9</td>
</tr>
<tr>
<td>3, 4, 5, 7, 10, and 11</td>
</tr>
<tr>
<td>Type B Post</td>
</tr>
<tr>
<td>1, 2, 6, 8, and 9</td>
</tr>
<tr>
<td>3, 4, 5, 7, 10, and 11</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. 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.

645-3.03 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 30 inches, at least two posts are required, except that the nominal 30 inch x 30 inch diamond panel and the nominal 36 inch wide "YIELD" panel require only one post.
2. The maximum number of posts installed within a 7 foot 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 7 feet 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>
<thead>
<tr>
<th>Table 645-2 Allowable Sign Areas (SF) on 2 Breakaway Wooden Posts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooden Post Section (inches)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>3.5 x 3.5</td>
</tr>
<tr>
<td>3.5 x 5.5</td>
</tr>
<tr>
<td>5.5 x 7.5</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, separate outer posts by more than 8 feet.

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 3/8 inch 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 System. Pole-Mounted Sign Support System, as defined in 645-2.07, shall be firmly attached to the pole in accordance with the standard sheets and/or manufacturer's instructions.

A. Panels without Z-bar stiffeners:
Sign panels less than or equal to 18 inches wide, shall be attached to the pole with at least two bands. Sign panels less than or equal to 18 inches wide and longer than 30 inches, shall be attached to the pole with at least three bands.

B. Panels and assemblies with Z-bar stiffeners:
Sign panels greater than 18 inches wide and sign panel assemblies shall be banded to the pole at each horizontal Z-bar stiffener, as shown on the standard sheets.

Sign Panels mounted with this type of sign support shall not be greater than 48 inches wide, and shall not be greater than 60 inches in height. Sign panel assemblies mounted with this type of sign support shall not be greater than 48 inches wide.

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. (Vacant.)
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 feet measured to the nearest 0.1 square feet of sign panel satisfactorily 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.

A. Panels with Multiple Sheeting types. Panels with multiple types of sheeting will be measured as the number of square feet measured to the nearest 0.1 square feet for each of the types of sheeting applied to the sign panel. The sum of the all the areas of the sheeting types measured shall equal the total area of the sign panel measured as the product of length and width.

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 (2100 ft-lbs 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: lb/ft of directed post divided by lb/ft 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.
**645-4.08 Illuminated Sign Panels.** The work will be measured as the number of square feet measured to the nearest 0.1 square feet 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, sheeting, 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.

* A. Panels with Multiple Sheeting types. Panels with multiple types of sheeting will be paid separately under their respective contract pay items.

**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 System.** The unit bid price for each pole-mounted sign support system shall include the cost of furnishing all labor, materials and equipment necessary to install the sign panel or sign panel assembly on a pole, regardless of the number of bands used. New or relocated sign panels or sign panel assemblies and any required Z-bar stiffeners will be paid under their respective items.

**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.** (Vacant.) *Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>645.5101</td>
<td>Ground-Mounted Sign Panels without Z-bars</td>
<td>Square Foot</td>
</tr>
<tr>
<td>645.5102</td>
<td>Ground-Mounted Sign Panels less than or equal to 30 SF with Z-bars</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
Section 646 - DELINEATORS, REFERENCE MARKERS AND SNOWPLOWING MARKERS

646-1 DESCRIPTION. Furnish and install delineators, reference markers and snowplowing markers in accordance with the MUTCD, contract documents and as directed by the Engineer.

646-1.01 Delineators. Delineators are retroreflective sheeting applied to panels mounted on posts or applied to flexible units, which are installed along the highway to serve as driving aids.

646-1.02 Reference Markers. Reference markers are panels with a legend, placed at approximately 528 ft (1/10 mile) intervals along the highway, to provide a numerical location reference.

646-1.03 Snowplowing Markers and Supplementary Snowplowing Markers. Snowplowing markers and supplementary snowplowing markers are reflective units installed along the highway to identify guidrail sections for snowplow operators.

646-2 MATERIALS.

Galvanized Coating and Repair Methods 719-01
Aluminum Sign Panels 730-01
Reflective Sheeting 730-05
Delineator, Reference Marker and Snowplowing Marker Posts 730-20
Flexible Delineator Posts  730-21
Stiffeners, Overhead Brackets and Miscellaneous Hardware  730-22

646-2.01 Posts. Galvanized steel posts as shown on the standard sheets and used for mounting panels.

646-2.02 Panels. Panels for backing of retro-reflective sheeting and installed on a post or other structure. Holes may be punched or drilled. Edges shall be smooth and true and free from burrs or ragged breaks. Panels shall be fabricated as shown on the standard sheets.

646-2.03 Flexible Delineator Posts. Plastic or other polymer units with retroreflective sheeting applied directly to the surface of the flexible delineator and installed directly along a highway.

646-2.04 Retro-Reflective Material.

<table>
<thead>
<tr>
<th>Delineators</th>
<th>730-05.05 ASTM Type IX (Class E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snowplowing Markers,</td>
<td>730-05.02 ASTM Type III (Class B), 730-05.03 ASTM Type V (Class C) or 730-05.05 ASTM Type IX (Class E)</td>
</tr>
<tr>
<td>Supplementary Snowplowing Markers,</td>
<td></td>
</tr>
<tr>
<td>and Reference Markers</td>
<td></td>
</tr>
</tbody>
</table>

On any one contract all of the delineators must be fabricated from the same material, all of the snowplowing markers and supplementary snowplowing markers must be fabricated from the same material and all of the reference markers must be fabricated from the same material but the material may differ between the delineators, the snowplowing markers, the supplementary snowplowing markers and the reference markers.

646-2.05 Fasteners. Stainless steel, galvanized steel or aluminum as shown on the standard sheets.

646-2.06 Brackets. Aluminum alloy, galvanized steel or polycarbonate as shown on the standard sheets.

646-2.07 Corrosion Protection. Provide and use either an approved mastic or ⅛ inch thick plastic pad placed between aluminum and steel to prevent dissimilar metals from coming in direct contact with each other.

646-3 CONSTRUCTION DETAILS

646-3.01 Fabrication. Delineators, reference markers, snowplowing markers, and supplementary snowplowing markers fabricated as shown on the standard sheets. Fabricate reference markers with legend content as shown on the contract documents.

646-3.02 Installation. Install at the locations and spacing as shown on the contract documents 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 contract documents.

Install reference markers at approximately 528 ft (1/10 mile) intervals along the highway on new construction, at existing locations for replacement units, or as ordered by the Engineer. The Contractor will be given the location of each marker.

Install flexible delineator posts as per the manufacturer’s recommendations and as directed by the Engineer.

Erect delineator, reference marker and snowplowing/supplemental snowplowing marker panels on posts, brackets, existing posts and structures in the manner shown on the standard sheets.
After the installation, an inspection by the Engineer will be made in the day time for proper location, line and grade, vertical post alignment and visibility. A night inspection will also be performed to evaluate orientation, retroreflectivity and defects more conspicuous at night. Correct all apparent defects disclosed after the day and night inspections at no additional cost to the State.

When panels are installed on walls, bridges, existing posts, poles or structures, do not damage the appearance or structural features of the existing facilities. Repair or replace all damaged features to the satisfaction of the Engineer and at no additional cost to the State.

646-3.03 Panel Relocation. Carefully remove panels to be relocated and stockpile them in a safe above ground location as shown in the Contract documents or at a location satisfactory to the Engineer. Protect the panels, including the retroreflective sheeting, from damage. Replace all damaged panels at no cost to the State.

Remove and dispose of all existing posts and/or hardware used only for the support of the existing panels. Removed posts shall become the property of the Contractor and shall be removed from the work site in a neat and skillful manner.

Re-erect relocated panels on new posts, brackets, or bands at the locations specified in the contract documents or as directed by the Engineer.

646-4 METHOD OF MEASUREMENT. Delineators, reference markers, snowplowing markers, supplementary snowplowing markers, flexible delineator posts, posts and brackets will be measured as the number of complete panels, brackets and posts 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 and posts furnished only. Relocated panels will be measured as the number of panels relocated.

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. Cost of mounting hardware will be included with the cost of the panels.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>646.21</td>
<td>Reference Marker Panel</td>
<td>Each</td>
</tr>
<tr>
<td>646.22</td>
<td>Delineator, Snowplowing Marker, Supplementary Snowplowing Marker Panels</td>
<td>Each</td>
</tr>
<tr>
<td>646.23</td>
<td>Large Delineator, Large Snowplowing Marker, Large Supplementary Snowplowing Marker Panel</td>
<td>Each</td>
</tr>
<tr>
<td>646.24</td>
<td>Reference Marker, Delineator, Snowplowing Marker, Supplementary Snowplowing Marker Panels Relocation</td>
<td>Each</td>
</tr>
<tr>
<td>646.31</td>
<td>Steel Post, 1.1 lb/ft</td>
<td>Each</td>
</tr>
<tr>
<td>646.32</td>
<td>Steel Post, 2.0 lb/ft</td>
<td>Each</td>
</tr>
<tr>
<td>646.40</td>
<td>Flexible Delineator, Single Unit, One Way</td>
<td>Each</td>
</tr>
<tr>
<td>646.41</td>
<td>Flexible Delineator, Single Unit, Back to Back</td>
<td>Each</td>
</tr>
<tr>
<td>646.42</td>
<td>Flexible Delineator, Double Unit</td>
<td>Each</td>
</tr>
<tr>
<td>646.50</td>
<td>Brackets for Barrier and Multidirectional Mounting</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 647 - REMOVING, STORING, AND RELOCATING SIGNS, SIGN PANEL ASSEMBLIES, SIGN SUPPORTS, AND FOUNDATIONS

647-1 DESCRIPTION. This work shall consist of removing and disposing, storing, and relocating individual sign panels, sign panel assemblies, sign supports, and sign support foundations.
647-1.01 Definition. Sign Panel Assembly – a group of contiguous sign panels attached by means of bars, on the same sign support(s).

647-2 MATERIALS. All new materials used shall comply with the requirements of §644, or 645 as applicable.

647-3 CONSTRUCTION DETAILS

647-3.01 General. Sign panels, sign panel assemblies, sign supports, and sign support foundations shall be removed, stored, or relocated in accordance with the contract documents, standard sheets, MUTCD and materials details. Sign locations in the contract documents are approximate.

647-3.02 Remove and Dispose Overhead Sign Structures. Removal of overhead sign structures shall be done in accordance with §644-3.06 A.

Lifting of overhead sign structures shall be done in accordance with §107-05P. Lifting. Lift Plans are required.

No lifting shall be permitted over traffic.

Designated sign structures and any attached pole-mounted sign panel assemblies or overhead signs requiring disposal, but not relocation or storage, shall become the property of the Contractor and shall be removed from the work site.

All concrete sign footings shall be removed to a minimum depth of 1 foot below existing ground and shall be restored to match the surrounding area to the satisfaction of the engineer.

Any work to relocate or remove and store existing sign panels from the overhead sign structure is performed under a separate item.

647-3.03 Relocate Overhead Sign Panel, Sign Panel Assembly. Overhead sign panels or sign panel assemblies shall be removed from the overhead sign structure by removing the bolts or other attachment device from the structure. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers or stiffeners. Any part damaged by the Contractor’s operations shall be replaced by the Contractor at no additional cost to the State. Signs, sign panel assemblies shall be reinstalled in accordance with §645-.3. All hardware, steel angles, and bearing pads needed to reattach the sign panel, sign panel assembly to the relocated sign shall be new. Existing stringers and stiffeners shall remain attached to the sign panel(s).

647-3.04 Remove and Store Overhead Sign Panel, Sign Panel Assembly. Overhead sign panels or sign panel assemblies shall be removed from the existing overhead structure by removing the bolts or other attachment device from the support structure. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers, structure or stiffeners. Signs shall be transported to the storage location(s) identified in the contract documents. Any part damaged by the Contractor’s operations shall be replaced by the Contractor at no additional cost to the State.

647-3.05 Remove and Dispose Overhead Sign Panel, Sign Panel Assembly. Overhead sign panels or sign panel assemblies shall be removed from the site and shall become the property of the contractor. Care shall be exercised to prevent damage to the sign structure or sign supports.

647-3.06 Relocation of Ground-Mounted Sign Panel, Sign Panel Assembly. Ground-mounted sign panels, sign panel assemblies shall be detached from the support structure or posts by removing the bolts or other attachment device from the support structure or posts. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to
the existing stringers or stiffeners. The existing stringers and stiffeners shall remain attached to the sign panel(s). Any part damaged by the Contractor’s operations shall be replaced by the Contractor at no additional cost to the State. Signs, sign panel assemblies shall be reinstalled in accordance with §645-3 on new posts and foundations. All hardware used to attach the sign panel(s), sign panel assembly to the post(s) shall be new.

647-3.07 Remove and Store Ground-Mounted Sign Panel, Sign Panel Assembly. Ground-mounted sign panels, sign panel assemblies shall be detached from the support structure or posts by removing the bolts or other attachment device from the support structure or posts. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers or stiffeners. Care shall also be exercised to avoid damage to any structures or supports that will not be removed. Signs shall be transported to the storage location(s) identified in the contract documents. Any part damaged by the Contractor’s operations shall be replaced by the Contractor at no additional cost to the State.

647-3.08 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly. Existing ground-mounted sign panels, sign panel assemblies shall be detached from the posts by removing the bolts or other attachment device from the posts. Ground-mounted sign panels, sign panel assemblies shall be removed from the site and become the property of the contractor. Care shall be exercised to prevent damage to the sign structure or sign supports.

647-3.09 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly, Type A Sign Supports and Foundations. Existing ground-mounted sign panels, sign panel assemblies and/or Type A sign supports shall be removed from the site and become the property of the contractor. Type A sign post foundations shall be completely removed. The disturbed area shall be restored to match the surrounding area to the satisfaction of the Engineer.

647-3.10 Remove and Dispose High-Capacity Type A and Type B Ground-Mounted Sign Supports and Foundations. Existing ground-mounted sign supports and/or foundations shall be removed from the site and become the property of the Contractor. High-Capacity Type A sign post foundations shall be completely removed. Type B footings shall either be completely removed or shall be cut to a depth of at least 1 foot below existing ground. Backfilling and surfacing shall be performed to match the surrounding area to the satisfaction of the Engineer.

647-4 METHOD OF MEASUREMENT.

647-4.01 General. The size of sign panels, sign panel assemblies shall be measured as the product of overall width and height equaling a number of square feet and rounded to the nearest square foot.

Overall width for sign panel assemblies shall be measured as the total width neglecting spaces between sign panels.

Vertical spaces less than one foot between panels, or sign panel assemblies shall be included in the calculation of overall height. For vertical spaces one foot or more, the panel, sign panel assembly heights shall be measured separately. The total area shall be the sum of the individual areas measured.

When ground-mounted sign panels, sign panel assemblies are mounted back to back, only the larger side shall be measured when the entire structure is to be removed. When one or both of two back to back panels are relocated or removed and stored, separate panel measurements shall be made.

647-4.02 Remove and Dispose Overhead Sign Structures. The work will be measured as the number of overhead sign structures completely removed and disposed, including any overhead sign panels that are also to be removed and disposed.
647-4.03 Relocate Overhead Sign Panel, Sign Panel Assembly. The work will be measured as the number of overhead sign panels, sign panel assemblies relocated.

647-4.04 Remove and Store Overhead Sign Panel, Sign Panel Assembly. The work will be measured as the number of overhead sign panels, sign panel assemblies removed and stored.

647-4.05 Remove and Dispose Overhead Sign Panel, Sign Panel Assembly. The work will be measured as the number of overhead sign panels, sign panel assemblies removed and disposed from structures or supports that will not be removed.

647-4.06 Relocation of Ground-Mounted Sign Panel, Sign Panel Assembly. The work will be measured as the number of ground-mounted sign panels, sign panel assemblies relocated.

647-4.07 Remove and Store Ground-Mounted Sign Panel, Sign Panel Assembly. The work will be measured as the number of ground-mounted sign panels, sign panel assemblies removed and stored.

647-4.08 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly. The work will be measured as the number of ground-mounted sign panels, sign panel assemblies removed and disposed.

647-4.09 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly, Type A Sign Supports and Foundations. The work will be measured as the number of ground-mounted sign panels, sign panel assemblies and foundations removed and disposed.

647-4.10 Remove and Dispose High-Capacity Type A and Type B Ground-Mounted Sign Supports and Foundations. The work will be measured as the number of ground-mounted sign supports and foundations removed and disposed.

647-5 BASIS OF PAYMENT. The unit price bid for removing, storing, and relocating signs shall be compensation in full for the furnishing of all labor, equipment and materials necessary to complete the work.

No additional payment will be made for the restoration of surfaces when foundations are removed.

Payment for new sign supports, and foundations will be made under separate pay items.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Pay</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>647.20</td>
<td>Removal of Cantilever Overhead Sign Panel(s), Structure, and Foundations</td>
<td>Each</td>
</tr>
<tr>
<td>647.21</td>
<td>Removal of Single Span Overhead Sign Panel(s), Structure, and Foundations</td>
<td>Each</td>
</tr>
<tr>
<td>647.22</td>
<td>Removal of Multi-Span Overhead Sign Panel(s), Structure, and Foundations</td>
<td>Each</td>
</tr>
<tr>
<td>647.23</td>
<td>Relocate Overhead Sign Panel, Sign Panel Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>647.24</td>
<td>Remove and Store Overhead Sign Panel, Sign Panel Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>647.25</td>
<td>Remove and Dispose Overhead Sign Panel, Sign Panel Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>647.31</td>
<td>Relocate Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.32</td>
<td>Relocate Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.33</td>
<td>Relocate Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.41</td>
<td>Remove and Store Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.42</td>
<td>Remove and Store Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.43</td>
<td>Remove and Store Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.51</td>
<td>Remove and Dispose Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.52</td>
<td>Remove and Dispose Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)</td>
<td>Each</td>
</tr>
<tr>
<td>647.53</td>
<td>Remove and Dispose Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)</td>
<td>Each</td>
</tr>
</tbody>
</table>
647.61 Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations Each
   - Size I (Under 30 Square Feet)
647.62 Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations Each
   - Size II (30-100 Square Feet)
647.63 Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations Each
   - Size III (Over 100 Square Feet)
647.64 Remove and Dispose High Capacity Type A Ground Mounted Sign Support and Foundation Each
647.65 Remove and Dispose Type B Ground Mounted Sign Support and Foundation Each

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 and Manufacturing:

- 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
- 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 U.S. Customary 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 300-lb (±3 percent) hammer falling freely 18 inches 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 12 inches 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 3 inch 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 5 feet. Continuous sampling may be directed by the Engineer. The sampler shall be placed on the bottom of the cleaned out hole and then driven 18 inches with a 300-lb (±3 percent) hammer falling freely 18 inches. 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 6 inches 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 6 inches of penetration for the 300-lb hammer. When the SPT is used, refusal shall be as defined in ASTM D1586-84.

When a recovery of less than 6 inches 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.

D. Acceptance. Samples having less than 6 inches of recovery or more than 2 inches of wash material will be considered unacceptable unless, in the judgment of the Engineer, the actual recovery represents the best sample obtainable. All samples shall become the property of the State.

648-3.03 Thin-Walled Tube Samples

A. Progressing the Hole. The hole shall be a minimum of 4 inches 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 2 inches 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 18 inches. 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 2 inch driven sample shall be taken. The bottom of the sample shall be carefully squared off at least 1 inch back from the end of the tube and a wax seal, approximately 1 inch 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 1/2 inch 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 Laboratories State Campus, Building 7 1220 Washington Avenue Albany, New York 12206

between the hours of 8:00 A.M. and 3:00 P.M., within five working days after obtaining the tubes, excepting holidays.

D. Acceptance. Thin-walled tubes having less than 12 inches 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 1 1/4 inches, 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 two 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 4 inch 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 12 inches and the bentonite pellets placed to form a 12 inch 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 5 feet 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</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 No. 200 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 12 inches 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>PROPORTION BY VOL.</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 feet drilled from which acceptable core was obtained. Measurement for payment shall be made in the presence of the Engineer.

648-4.05 Drill Hole (2 1/2 inch and 4 inch diameter). The quantity to be paid for will be the number of linear feet 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 feet 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 (2 1/2 inch and 4 inch diameter). The quantity to be paid for will be the number of linear feet 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 foot 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 (2 1/2 inch and 4 inch diameter). The unit price bid per foot 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 50 foot incremental depths as follows:

0 - 50 feet  50 - 100 feet  100 - 150 feet  150 - 200 feet  over 200 feet

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 (2 1/2 inch and 4 inch 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, 2 1/2 inch diameter 0 to 50 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.02</td>
<td>Drill Hole, 2 1/2 inch diameter 50 to 100 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.03</td>
<td>Drill Hole, 2 1/2 inch diameter 100 to 150 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.04</td>
<td>Drill Hole, 2 1/2 inch diameter 150 to 200 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.05</td>
<td>Drill Hole, 2 1/2 inch diameter greater than 200 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.06</td>
<td>Drill Hole, 4 inch diameter 0 to 50 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.07</td>
<td>Drill Hole, 4 inch diameter 50 to 100 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.08</td>
<td>Drill Hole, 4 inch diameter 100 to 150 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.09</td>
<td>Drill Hole, 4 inch diameter 150 to 200 feet Depth Range</td>
<td>Foot</td>
</tr>
<tr>
<td>648.10</td>
<td>Drill Hole, 4 inch diameter greater than 200 feet Depth Range</td>
<td>Foot</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>Foot</td>
</tr>
<tr>
<td>648.14</td>
<td>Rock Core Drilling BX</td>
<td>Foot</td>
</tr>
<tr>
<td>648.15</td>
<td>Rock Core Drilling NX</td>
<td>Foot</td>
</tr>
<tr>
<td>648.16</td>
<td>Rock Core Drilling HX</td>
<td>Foot</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>Foot</td>
</tr>
<tr>
<td>648.21</td>
<td>Grouting 2 1/2 inch Bore Hole</td>
<td>Foot</td>
</tr>
<tr>
<td>648.22</td>
<td>Grouting 4 inch Bore Hole</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTION 649 - AUDIBLE ROADWAY DELINEATORS
(Last Revised January, 2017)

649-1 DESCRIPTION. Audible delineators are depressions placed on the road surface to serve as driving aids. This work shall consist of installing audible roadway delineators where indicated on the contract documents.

649-2 MATERIALS. None specified.
649-3 CONSTRUCTION DETAILS

Milled-In Audible Roadway Delineators (MIARDs).

A. **Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the MIARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work on asphalt shoulders, the Contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt to be milled.

   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 shoulder and/or any irregularities in the shoulder surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each MIARD at the offsets from traveled way indicated on the project plans. Where directed by the Plans or EIC to mill in MIARDs in areas marked with crosshatching, the spacing of the MIARDs shall be adjusted to minimize damage to the markings. No milling shall be done within 4 inches of transverse joints.

B. **Installation and Dimensions.** The finished MIARDs shall conform to the dimensions and spacing shown on the Standard Sheets. The milling machine shall be capable of grinding to within 3 feet of an obstruction. The offset from traveled way may be changed at the EIC’s discretion.

   At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The pavement shall be cleaned by sweeping and the work area shall be reopened to traffic. The milled material shall be thoroughly removed from the shoulders. In uncurbed areas, the millings may be swept off the shoulder to serve as shoulder back-up material. In curbed areas, millings shall be removed from the project and disposed of in an acceptable manner.

Centerline Audible Roadway Delineators (CARDs).

A. **Scheduling and Coordination.** Because of the need to promptly replace pavement markings and reopen the highway to traffic, milling of CARDs shall not be conducted when conditions would not allow pavement markings to be placed soon after. To facilitate prompt placement of pavement markings by either the Department’s pavement marking crews or the Contractor as indicated in the contract documents, all work shall be done between April 1 and November 30 Downstate (in the counties of Dutchess, Orange, Rockland, Putnam, Westchester, Nassau, Suffolk, and the City of New York) and between May 1 and October 31 Upstate (all other counties). If the contract documents indicate that pavement markings will be installed by the Department, the Contractor shall inform the Engineer of the planned work schedule and the Engineer will coordinate with the Department’s pavement marking crew chief. If the contract documents indicate that pavement markings will be installed by the Contractor, pavement markings shall be installed within three calendar days, measuring from the date on which the markings at that point were first removed. Gaps: Prior to milling, the Contractor shall obtain EIC approval on where CARDs are to be installed and where gaps are to be included.

B. **Timing of CARD Placements.** New asphalt pavement should be allowed to harden for at least 24 hours before CARDs are milled in, so that the milling machine does not tear the asphalt and so that asphalt does not build up on the cutters. Temporary Pavement Markings, in conformance with Section 619-3.06, shall be installed during this hardening period. If tape is used, it shall be
removed before milling commences. After the CARDs have been milled and the millings have been removed, the permanent pavement markings can be installed.

C. **Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the CARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work, the contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt.

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 surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each CARD relative to the centerline markings.

D. **Installation and Dimensions.** The Contractor shall provide Work Zone Traffic Control as indicated in the contract documents.

CARDs shall be installed within the limits indicated in the contract documents. Unless indicated otherwise in the contract documents, CARDs shall be centered on the middle of the centerline marking pattern. No milling shall be done within 4 inches of sawn and sealed transverse joints. CARDs shall not be carried through any intersection where the CARD’s direction of travel is controlled by a yield sign, stop sign, or traffic light, or would encounter crosswalks. In those instances, the CARD shall stop before any stop line or crosswalk. CARDs shall not be carried through any crosswalks or across any concrete bridge deck or concrete culvert surface. Treatment for left turn lanes shall be as shown on the Standard Sheets.

At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The pavement shall be cleaned by sweeping and the work area shall be reopened to traffic. Millings shall be thoroughly removed from the work area and disposed of in an acceptable manner.

**Secondary Highway Audible Roadway Delineators (SHARDS).**

A. **Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the SHARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work involving asphalt pavement, the Contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt.

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 shoulder surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each SHARD.

B. **Installation and Dimensions.** The Contractor shall provide Work Zone Traffic Control as indicated in the contract documents.

SHARDS shall be installed within the limits indicated in the contract documents unless the limits are adjusted by the Engineer to meet existing field conditions. No milling shall be done within 4 inches of sawn and sealed transverse joints or longitudinal joints. SHARDS shall not be installed on bridge decks, concrete culvert surfaces, through crosswalks, through highway intersections, across commercial driveways, or as identified on the Plans or designated by the Engineer. SHARDS shall not be milled in over deteriorating pavement. Instead, the SHARDS
should be placed 4 inches away from the deterioration, provided the remaining shoulder width is at least 3'-6" and the length of that reduced width does not exceed 100 feet for any given deteriorated area. Where the line of SHARDS must be moved away from traffic, the transition should, to the extent practicable, be gently flared to maintain a smooth line.

As the work progresses, any portions of the shoulder or pavement that will accommodate traffic during the construction effort shall be cleaned by sweeping or flushing and the work area shall be reopened to traffic. At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The milled material shall be thoroughly removed from the shoulders. In areas with curbs or adjacent lawns or businesses, millings shall be removed from the project and disposed of in an acceptable manner. In uncurbed areas with no adjacent lawns or businesses, the millings may be swept off the shoulder to serve as shoulder back-up material.

649-4 METHOD OF MEASUREMENT. Audible Roadway Delineators will be measured as the sum of the lengths in linear feet of the individual segments where audible roadway delineators have been satisfactorily installed.

For milled-in audible roadway delineators, lengths will be measured along the inside edge of the shoulder from the center of the first milled-in audible roadway delineator in a segment to the center of the last milled-in audible roadway delineator in that segment. Where milled-in audible roadway delineators are provided on more than one shoulder, lengths will be measured separately for each segment and added to the sum. Individual gaps and exclusions under 100 feet in length will be included in segments identified for payment. Individual gaps and exclusions 100 feet or more in length will be excluded from segments identified for payment.

For centerline audible roadway delineators, lengths will be measured along the centerline of the CARDs from the center of the first centerline audible roadway delineator in a segment to the center of the last centerline audible roadway delineator in that segment. Individual gaps and exclusions under 100 feet in length will be included in segments identified for payment. Individual gaps and exclusions 100 feet or more in length will be excluded from segments identified for payment.

For secondary highway audible roadway delineators, lengths will be measured along the outside edge of the SHARDS from the center of the first SHARD to the center of the last SHARD. Individual gaps and exclusions under 300 feet in length will be included in segments identified for payment. Individual gaps and exclusions 300 feet or more in length will be excluded from segments identified for payment.

649-5 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>
</tr>
</thead>
<tbody>
<tr>
<td>649.01</td>
<td>Milled-In Audible Roadway Delineators (MIARDs)</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>649.11</td>
<td>Centerline Audible Roadway Delineators (CARDs)</td>
<td>Linear Foot</td>
</tr>
<tr>
<td>649.21</td>
<td>Secondary Highway Audible Roadway Delineators (SHARDs)</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>

SECTION 650 - TRENCHLESS INSTALLATION OF CASING

650-1 DESCRIPTION. Under this work the Contractor shall furnish and install a casing by trenchless installation methods in accordance with the contract documents and as directed by the Engineer. The casing length, type, and size shall be as indicated in the contract documents. Acceptable methods of trenchless installation include Auger Boring, Slurry Boring, Pipe Jacking, Microtunneling, or Horizontal Directional Drilling. Pipe Ramming or Soil Compaction methods will not be allowed. For an installation under a railroad, methods which leave an uncased bore hole through the embankment will not be allowed.
650-1.01 Definitions. The following definitions were obtained from the NCHRP Synthesis 242 Trenchless Installation of Conduits Beneath Roadways.

A. **Auger Boring (AB).** A technique that forms a bore hole from a drive shaft to a reception shaft by means of a rotating cutting head. Spoil is transported back to the drive shaft by helical-wound auger flights rotating inside a steel casing that is being jacked in place simultaneously. AB may provide limited tracking and steering capability. It does not provide continuous support to the excavation face. AB is typically a 2-stage process (i.e., casing installation and product pipe installation).

B. **Slurry Boring (SB).** A technique that forms a bore hole from a drive shaft to a reception shaft by means of a drill bit and drill tubing (stem). A drilling fluid (i.e., bentonite slurry, water, or air pressure) is used to facilitate the drilling process by keeping the drill bit clean and aiding with spoil removal. It is a 2-stage process. Typically, an unsupported horizontal hole is produced in the first stage. The pipe is installed in the second stage.

C. **Pipe Jacking (PJ).** A technique for installing a prefabricated pipe through the ground from a drive shaft to a reception shaft. The pipe is propelled by jacks located in the drive shaft. The jacking force is transmitted through the pipe to the face of the PJ excavation. The excavation is accomplished, and the spoil is transported out of the jacking pipe and shaft manually or mechanically. Both the excavation and spoil removal processes require workers to be inside the pipe during the jacking operation.

D. **Microtunneling (MT).** A remotely controlled, guided pipe-jacking process that provides continuous support to the excavation face. The guidance system usually consists of a laser mounted in the drive shaft communicating a reference line to a target mounted inside the MT machine’s articulated steering head. The MT process provides ability to control excavation face stability by applying mechanical or fluid pressure to counterbalance the earth and hydrostatic pressures.

E. **Horizontal Directional Drilling (HDD).** A 2-stage process that consists of drilling a small diameter pilot directional hole along a predetermined path and then developing the pilot hole into a suitable bore hole that will accommodate the desired utility and then pulling the utility into place. The HDD process provides the ability to track the location of the drill bit and steer it during the drilling process. The vertical profile of the bore hole is typically in the shape of an arc entrapping drilling fluid to form a slurry pathway rather than an open hole. This entrapped slurry provides continuous support to the bore hole.

F. **Utility Tunneling (UT).** A 2-stage process in which a temporary ground support system is constructed to permit the installation of a utility. The temporary tunnel liner is installed as the tunnel is constructed. Workers are required inside the tunnel to perform the excavation and/or spoil removal. The excavation can be accomplished manually or mechanically.

650-2 MATERIALS.

650-2.01 Casing.

A. **General.** Casing shall be of sufficient length and type and size as indicated on the contract documents.

B. **Pipe Jacking or Utility Tunneling Cutting Shield.** For a Pipe Jacking or Utility Tunneling operation, provide a steel cutting shield or poling plates designed to support the anticipated loading.
The design shall allow for the attachment of temporary louvers in case collapsible soil conditions are encountered.

1. **Full Tunnel Shield.** The advancing face shall be provided with a hood extending not more than 20” beyond the face and extending around no less than the upper two-thirds of the circumference. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. It shall conform to and not exceed the outside dimensions of the pipe being installed by more than 1” at any point on the periphery, unless otherwise approved. It shall be adequately braced and provided with necessary appurtenances for completely bulkheading the face.

2. **Partial Tunnel Shield.** The advancing face shall be provided with a hood extending not more than 20” beyond the face and extending around no less than the upper one-third of the circumference. It shall conform to and not exceed the outside dimensions of the pipe being installed by more than 1” at any point on the periphery, unless otherwise approved.

3. **Poling Plates.** Poling plates shall be designed to support the ground outside the bounds of the tunnel through beam action. The beam action shall be capable of extending not more than 20” beyond the face and extending around no less than the upper one-third of the circumference. The poling plates shall conform to the configuration of the pipe being installed.

**C. Utility Tunneling Liner Plates.** For a Utility Tunneling operation, provide tunnel liner plates designed to support the anticipated loading. When a shield is used, the tunnel lining shall be designed to withstand the thrust from jacking the shield.

1. **Steel Tunnel Liner Plates.** Provide tunnel liner plates manufactured from steel meeting the metallurgic requirements of ASTM A569 with the following mechanical properties before cold forming:
   - Minimum tensile strength: 42,000 psi.
   - Minimum yield strength: 28,000 psi.
   - Elongation, 2”: 30%.

   Tunnel liner plates shall be 2-flange with a minimum 0.209” thickness or 4-flange with a minimum 0.239” thickness. The nominal diameter shall be as indicated in the contract documents. Actual liner plate thickness shall be determined by the Contractor.

   All tunnel liner plates shall be formed to provide circumferential flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both longitudinal and circumferential seams or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer’s standard spacing and shall be a multiple of the plate length so the plates having the same curvatures will be interchangeable and will permit staggering of the longitudinal seams. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer’s standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer’s standard but not less than the required to meet the longitudinal seam strength requirements of AASHTO Standard Specifications for Highway Bridges, Section 15 Steel Tunnel Liner Plates.

   All liner plates in the tunnel shall be the same type, and shall be interchangeable.

   Liner plates shall be hot-dip galvanized in accordance with ASTM A123.

   Bolts and nuts shall be not less than 5/8” in diameter. The bolts and nuts shall conform to ASTM A307 Grade A with rolled threads on bolts. Circumferential seam bolts shall conform to ASTM A307 or better.
Grout holes shall be 2” minimum diameter tapped couplings welded into place over holes cut in the liner plate. Provide a minimum of three grout holes, one every ring alternating 10, 12 and 2 o’clock position. Grout holes shall be provided with steel or iron threaded plugs.

2. **Precast Concrete Tunnel Liner Plates.** Precast concrete tunnel liner plates shall conform to the details shown in the contract documents and requirements of AASHTO Standard Specifications for Highway Bridges, Section 8 Concrete Structures. If such details are not provided, the Contractor may elect to propose the use of precast concrete liner plates.

### 650-2.02 Filler Material.

**A. Controlled Low Strength Material (CLSM).** Fill any abandoned borings with controlled low strength material (CLSM) (no fly ash) meeting the requirements of Section 204.

**B. Grout.** Fill any voids/annular space between the casing and excavated boring with grout meeting the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Subsection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement, Type 1 or 2</td>
<td>701-01</td>
</tr>
<tr>
<td>Grout Sand</td>
<td>703-04</td>
</tr>
<tr>
<td>Water</td>
<td>712-01</td>
</tr>
<tr>
<td>Bentonite (Optional)</td>
<td></td>
</tr>
<tr>
<td>Bentonite Additives</td>
<td></td>
</tr>
</tbody>
</table>

There are no material requirements for bentonite, except that it shall be supplied in powdered form.

### 650-2.03 Equipment.

Furnish equipment of adequate capacity and power to install the casing by trenchless installation methods. Supplement each rig with the necessary auxiliaries, appurtenances, tools, and other equipment required for proper operation. Tunnels may be excavated manually or by the use of tunnel boring machines (TBM's or "moles").

**A. Safety Equipment for Tunnel Entry.**
For safe personnel entry to the confined space,
- Provide a four gas meter atmospheric testing device, including oxygen, explosive gases, hydrogen sulfide and carbon monoxide. Testing equipment shall be calibrated as required by manufacturer and be in proper working condition.
- Provide mechanical ventilation (portable blower with flexible duct work) to purge the confined space and provide continuous ventilation.
- Provide body harness, life line, and mechanical retrieval equipment. If the confined space working environment has obstructions or turns such that mechanical retrieval equipment is not practical or creates more of a hazard, on-site rescue shall be immediately available prior to entry.

### 650-3 CONSTRUCTION DETAILS

**650-3.01 Approval.** Construction drawings, showing the proposed method and procedure of trenchless installation, construction of entrance and exit pits, and schedule of activities required to perform all trenchless installations indicated in the contract documents shall be submitted to the Engineer for approval before work on the trenchless installation operation is started. Approval of construction drawings shall not relieve the Contractor’s responsibility to perform the work without damage to existing facilities. Field conditions may require changes in the approved drawings and such changes shall be subject to the approval of the Engineer. Approval will remain in force only as long as all conditions set forth in the approval are met and satisfactory results are obtained. In the event that unsatisfactory results
and/or damage occurs, the Contractor shall stabilize the area and stop work, modify the methods of installation, and submit them for review and approval.

Clear all drill hole(s) and path locations in accordance with 16 NYCRR 753 Protection of Underground Facilities. For an installation under a railroad, additionally contact the railroad company to identify the location of railroad underground facilities and the company’s additional requirements pertaining to the method of installation.

Install casing of the length(s), size(s), and type(s) specified in the contract documents to the alignment(s) and profile(s) shown on the plans. For an installation under a railroad, work shall be carried out under the joint supervision of the Department and the railroad company, in accordance with §105-09 Work Affecting Railroads.

A. Trenchless Installation Under Railroad. Construction drawings, methods, work and necessary precautions related to trenchless installation 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 commence until such approval has been received from the railroad company.

B. Submittal. Do not start work prior to receiving the Engineer’s written approval. Approval will be based on the decision of the Deputy Chief Engineer for Technical Services (DCETS) as to the acceptability of the proposed work plan and any variations to provide satisfactory installation of the casing and avoid damage to the surrounding area and/or structure(s)/utilities. Installation of casing under railroads shall be jointly approved by the Department and the railroad company.

Information in this work plan shall include, but not be limited to, the following:

1. General.
   a. Qualifications of the Contractor showing that all trenchless installation operations will be performed by a competent driller who has successfully installed casing on two projects in the past five (5) years, of similar size and type shown on the plans, via the proposed trenchless method. Completed projects with details of the types of installations, owner contact names, and telephone numbers shall be included.
   b. Designed drill path indicating compliance with the contract documents. Unless otherwise indicated in the contract documents or directed by the Engineer, the minimum separation below the existing road surface and the top of casing shall be 5 feet. The minimum separation between the final ground surface and the top of pipe outside the pavement area shall be 3 feet.
   c. Equipment list including make and model number and specifications (catalog cuts) of all major equipment proposed for use. The Contractor is responsible for the final determination of the drill rig size based on the length and depth of the actual runs, the subsurface conditions expected, etc.
   d. Monitoring plan for the proposed path of the casing installation, including location of monitoring points and surveying intervals.
   e. Method for CLSM placement, including CLSM mix design, used for abandoning a boring.
   f. Method for grouting (e.g. grout hole locations, attachment of grout tube to outer circumference of casing, grid pattern for ground surface approach, etc.), including grout mix design, used for filling voids/annular space between the casing and excavated boring.
   g. For instances where a utility is to be installed in the casing, method of installation and identification of the material to be placed between the casing and the utility carrier pipe. The material shall be nonconductive and retain its insulating properties during long-term submergence in water.
2. **Auger Boring.**

   a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, cuttings and pit spoil-handling areas, and final placement areas.
   
   b. Boring procedure, thrust block design, tooling for drilling. Include details on the mechanical device that will prevent the cutting head from protruding ahead of casing and the need for a cutting shield at the head of casing.
   
   c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau (DGEB).
   
   d. Steering (e.g. articulated steering head) and tracking equipment (e.g. sonde transmitter & receiver, water level line, etc.), procedures, and proposed locations requiring surface or subsurface access.

3. **Slurry Boring.**

   a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry, cuttings and pit spoil-handling areas, and final placement areas.
   
   b. Boring procedure, tooling for drilling, water source for drilling operations, method to control slurry.
   
   c. If pit launched, design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.
   
   d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.
   
   e. Steering (e.g. articulated steering head) and tracking equipment (e.g. sonde transmitter & receiver, water level line, electromagnetic down-hole navigational system, etc.), procedures and proposed locations requiring surface or subsurface access.

4. **Pipe Jacking.**

   a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry for pipe lubrication, cuttings and pit spoil-handling areas, and final placement areas.
   
   b. Boring procedure, thrust block design, tooling for drilling, verification that size and type of casing can withstand installation stresses and method to verify that installed casing is acceptable. Include details on the cutting shield at the head of casing and type of soil conveyance system to be utilized (e.g. wheeled carts, belt conveyor, slurry system, auger system, vacuum extraction system).
c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

d. Materials list including bentonite and bentonite additives proposed for pipe lubrication, along with material safety data sheets for all other materials used in the trenchless installation method.

e. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.

f. Outline of work in accordance with §107.05 Safety and Health Requirements, R. Confined Spaces and a written confined space plan (addresses prevention of unauthorized entry, type of hazard, work practices, monitoring, provision for attendant, duties of employees, rescue and emergency medical services, multi-employer operations, and provisions for review procedures).

5. Microtunneling.

a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry for pipe lubrication, cuttings and pit spoil-handling areas, and final placement areas.

b. Boring procedure, thrust block design, tooling for drilling, verification that size and type of casing can withstand installation stresses and method to verify that installed casing is acceptable. Include details on spoil removal system and controlling ground conditions via earth pressure balance at the face of the microtunneling boring machine (MTBM) (i.e. slurry or auger).

c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.

e. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.

6. Horizontal Directional Drilling.

a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry, cuttings and pit spoil-handling areas, and final placement areas.

b. Boring procedure, tooling for drilling, water source for drilling operations, method to control slurry.

c. If pit launched, design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State
Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.

e. Steering (e.g. offset jets incorporated into a direction sensing and steering head) and tracking equipment (e.g. sonde transmitter & receiver, electromagnetic down-hole navigational system, etc.), procedures and proposed locations requiring surface or subsurface access.

7. **Utility Tunneling.**

a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, cuttings and pit spoil-handling areas, and final placement areas.

b. Boring procedure and tooling for tunneling. Include details on how to control the tunnel face (i.e. design calculations for a full tunnel shield or poling plates) and type of soil conveyance system to be utilized (e.g. wheeled carts, belt conveyor, auger system, vacuum extraction system).

c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

d. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.

e. Outline of work in accordance with §107.05 Safety and Health Requirements, R. Confined Spaces and a written confined space plan (addresses prevention of unauthorized entry, type of hazard, work practices, monitoring, provision for attendant, duties of employees, rescue and emergency medical services, multi-employer operations, and provisions for review procedures).

f. Engage the services of a professional engineer currently registered in the State of New York to provide the design of the Utility Tunnel.

i. Steel tunnel liner plate(s) shall be designed in accordance with AASHTO Standard Specifications for Highway Bridges, Section 15 Steel Tunnel Liner Plates. The design of the tunnel shall incorporate the combined effects of live and dead loads, hydrostatic loads, and loads, both temporary and permanent caused by the Contractor’s methods of construction. The design shall meet the following minimum criteria:

- Tunnel liner design shall meet the following minimum factors of safety:
  - Minimum Stiffness: 3.0.
  - Critical Buckling: 2.0.
  - Seam Strength: 3.0.

ii. Precast concrete tunnel liner plate(s) shall be designed in accordance with AASHTO Standard Specifications for Highway Bridges, Section 8 Concrete Structures. The design of the tunnel shall incorporate the combined effects of live and dead loads, hydrostatic loads, and loads, both temporary and permanent caused by the Contractor’s methods of construction. Submit working drawings and design
calculations including descriptions of materials to be used, plate dimensions, reinforcement details, connecting details, and erection procedures.

**650-3.02 Trenchless Installation Procedures.** Shore entrance and exit pits in accordance with the approved design.

Adequately protect any utilities located within the thrust block’s zone of influence.

Survey the existing ground surface along the proposed path of casing installation prior to the start of work to set baseline data. Establish survey points in accordance with the approved design to determine presence/extent of ground movements.

**A. Installation.** Install the casing as follows:

1. The alignment of the casing shall conform to the following requirements:
   - Choose the ground entry and exit angles such that the casing can be installed along the alignment and profile indicated on the contract plans.
   - The entrance point(s) and exit point(s) shall be approved by the Engineer and physically located in the field by the Contractor.
   - The exit point shall be no more than ±1% of the bore length left or right of the location marked in the field.
   - The vertical depth, as specified in the contract documents, is the depth to which the casing shall be installed.
2. Direct all drilling operations using steering and tracking systems capable of producing the required alignment within an allowable accuracy of ±1% of the bore length. Maintain the grade within 2 inches throughout the bore length. The steering control system shall provide an angle of inclination reading and the direction in which the cutting tool is pointing. Provide access to the Engineer at all times to all measuring or gauging devices used for the drilling operations, including drilling logs maintained by the Contractor.
3. Closely monitor the trenchless installation process to eliminate ground movements. If ground movements occur, stop work and immediately stabilize the area of concern. If it is determined during the installation process that the proposed lines and grades for the casing cannot be achieved, stop work. The Contractor shall then modify the methods of installation and submit them for review and approval as stated in §650-3.01. Approval. Corrective stabilization actions are at the Contractor’s expense.
4. In the event that the drill hole must be abandoned before completion of the installation or the installation is out of tolerance, fill the abandoned drill hole with CLSM to prevent subsidence. Start pumping from the farthest point of progression of the abandoned drill hole back to the surface to eliminate encapsulating voids. The progression and restoration of the abandoned drill hole by CLSM placement will be at the Contractor’s expense. The location of the new drill hole shall be approved by the DCETS prior to progression of the operation as per §650-3.01. Approval.
5. For larger diameter casings, several passes with progressively larger cutting tools is allowable for producing the appropriate bore hole diameter.
6. For entry into casing by personnel:
   - Provide confined space training prior to entry, when there is a change in operations, or when deviation in policy occurs.
   - Entry Supervisor shall verify the requirements of the Entry Permit, ensure means of rescue are readily available, cancels or terminates entry as required, removes unauthorized personnel, and periodically monitors the Pipe Jacking operation for conformance.
   - Attendant shall maintain accurate account of authorized entrants, remains at entry site until relieved by another attendant or until work is complete, monitors conditions around
space and maintains communication with entrant(s), and performs non-entry rescue or summons rescue and medical services, as needed.

- Entrant(s) shall properly use required equipment, maintain communication with Attendant, and evacuate if emergency occurs.
- Confined spaces shall be monitored for oxygen, carbon monoxide, and explosive gases before and during entry. When organic material is present, hydrogen sulfide levels will be tested. Testing shall be conducted from top down as space allows at various levels. Test results shall be recorded on the permit. Entry shall not be made or the space shall be vacated when:
  - Oxygen levels are less than 19% or greater than 23%; or
  - Explosive gases are greater than 10% of lower explosion limit; or
  - Toxic gases greater than permissible exposure limits; or
  - Carbon Monoxide levels are greater than 35 ppm; or
  - Hydrogen Sulfide levels are greater than 10 ppm.
- Excavation shall not be advanced beyond the edge of the hood, except in rock, or with extreme care, to remove obstructions.

7. Grout voids/annular space between the casing and excavated boring in accordance with the methods approved in the submittal process as stated in §650-3.01 Approval.

8. For instances where a utility is to be installed in the casing, place the utility carrier pipe within the casing such that they are electrically insulated from each other.

B. Trenchless Installation Records. After completion of the casing installation(s), submit to the Engineer the installation records detailing the As-Built location of the casing(s).

C. Trenchless Installation Under Railroad. Rail hangers shall be installed in accordance with the Temporary Track Support System item prior to the trenchless installation operation if required by the railroad company. In instances where unforeseen ground movements have occurred as a result of the trenchless installation operation, the rail hangers will not be removed by railroad forces until all ground movements of the embankment have been stabilized by the Contractor to the satisfaction of the railroad company.

650-3.03 Subsidence. The Contractor shall be held responsible for surface subsidence and damage or disturbance to adjacent property and facilities that may result from the construction methods. In case loose material is encountered and cave-ins occur or are anticipated, all trenchless installations shall be discontinued, approved shoring shall be provided and all voids filled either by pressure grouting or other approved methods before installations is continued.

Field conditions may require that the actual trenchless installation operations be continued without interruption in order to prevent undermining the roadway or the railroad roadbed and tracks. Should the Engineer permit interruption of trenchless installation operations in these instances, 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 casing installation and occurring within one year from the date the work is completed, will be corrected by the railroad company.

650-4 METHOD OF MEASUREMENT. The quantity to be paid for under this work will be the number of feet of casing, measured to the nearest foot, satisfactorily installed to the required length, grade, and alignment in accordance with the contract documents and as directed by the Engineer.

650-5 BASIS OF PAYMENT
650-5.01 General. The unit price bid per linear foot shall include the cost of furnishing all labor, materials, and equipment (including dewatering if required) necessary to satisfactorily complete the work.

Rail hangers (if required) shall be furnished, installed, and removed as called for in the Temporary Track Support System item included in the contract documents. This work will be paid for separately.

Costs incurred by the railroad company to correct settlement or upheaval of the railroad tracks resulting from the casing 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.

Surveying for the presence/extent of ground movements during the trenchless installation shall 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>650.10XX</td>
<td>Trenchless Installation of Casing Under Highway with a diameter less than or equal to 24”.</td>
<td>Foot</td>
</tr>
<tr>
<td>650.11XX</td>
<td>Trenchless Installation of Casing Under Highway with a diameter greater than 24” and less than or equal to 42”.</td>
<td>Foot</td>
</tr>
<tr>
<td>650.12XX</td>
<td>Trenchless Installation of Casing Under Highway with a diameter greater than 42”.</td>
<td>Foot</td>
</tr>
<tr>
<td>650.20XX</td>
<td>Trenchless Installation of Casing Under Railroad with a diameter less than or equal to 24”.</td>
<td>Foot</td>
</tr>
<tr>
<td>650.21XX</td>
<td>Trenchless Installation of Casing Under Railroad with diameter greater than 24” and less than or equal to 42”.</td>
<td>Foot</td>
</tr>
<tr>
<td>650.22XX</td>
<td>Trenchless Installation of Casing Under Railroad with a diameter greater than 42”.</td>
<td>Foot</td>
</tr>
</tbody>
</table>

NOTE: XX denotes casing diameter size.

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 and Manufacturing:

- 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:

1 1/2 pounds per square yard per application
4 1/10 pounds per square yard per year

652-4 METHOD OF MEASUREMENT. Salt shall be measured by the number of the tons furnished and applied.

652-5 BASIS OF PAYMENT. The unit price bid per 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>Ton</td>
</tr>
<tr>
<td>652.02</td>
<td>Furnishing and Applying Sodium Chloride</td>
<td>Ton</td>
</tr>
</tbody>
</table>

SECTION 653 PAVEMENT RIDE QUALITY (VACANT)
(New Section May, 2019)

653-1 DESCRIPTION. Collect and report pavement ride quality data from PCC (Portland Cement Concrete) and/or HMA (Hot Mix Asphalt) pavements.

653-2 MATERIALS AND EQUIPMENT. Use a Department certified inertial profiler and operator certified in accordance with Materials Method 653. Provide a copy of the certification letter to the Engineer before data collection.

653-3 CONSTRUCTION DETAILS.

653-3.01 Pavement Ride Quality (PRQ) Data Collection. PRQ data consists of the longitudinal profile of the pavement. Perform PRQ data collection when the pavement can be opened to construction traffic and/or after corrective actions, such as diamond grinding, have been completed. Perform three PRQ tests per lane in accordance with Materials Method 653. Notify the Engineer before PRQ testing takes place. Submit ride quality results to The Engineer in accordance with Materials Method 653 within 45 days of completion of paving. Submit results to the Engineer in accordance to Materials Method 653. After the data is analyzed, calculate the corresponding quality units.

653-3.02 Corrective Action.
Correct all 0.1-mile sections that fail to meet the requirements of Tables 653-1 and 653-2. Perform PRQ testing again where corrective actions were performed to ensure that the International Roughness Index (IRI) values are below the values noted above. Perform additional corrective work until the IRI are below the above values.

A. Diamond Grinding: Diamond grind areas in accordance with Section 505 Diamond Grinding. All grinding must be performed for the full width of the driving lane.
1. **HMA Pavement**: The total amount of grinding can not be more than 5% of the lane-miles. The surface texture after diamond grinding is acceptable and no additional texturing is required.

2. **PCC Pavement**: If more than 20% of the reporting segment is ground for any reason, diamond grind 95%, minimum, of the entire reporting segment.

**B. Remove and Replace:**

1. **HMA Pavement**: Perform corrective work by removing and replacing to the depth necessary to correct the deviations.

2. **PCC Pavement**: Perform corrective work by removing and replacing full depth sections as necessary.

### 653-4 METHOD OF MEASUREMENT.

The quantity to be measured for payment will be in quality units.

**Quality Unit Calculation.** PRQ pay adjustments will be based on Total Quality Units (TQU). Total Quality Units is the summation of the IRI Quality Units (IRIQU) and the Localized Roughness Quality Units (LRQU):

\[
TQU = (IRIQU) + (LRQU)
\]

**A. International Roughness Index Quality Units (IRIQU)**

- Determine Quality Units for each PRQ lot using Table 653-01 for HMA Pavements and Table 653-02 for PCC Pavements and Materials Method 653.
- For PRQ lots of a length different from 528 ft, adjust the number of Quality Units as follows:

\[
IRIQU = \text{Quality Units from appropriate table } \times \left(\frac{\text{Length of PRQ lot (ft)}}{528(\text{ft})}\right)
\]

- Determine the total number of IRI Quality Units for the project by summing the Quality Units from all PRQ lots.

#### Table 653-01

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRQ lot IRI (in/mile)</td>
<td>Quality Units</td>
</tr>
<tr>
<td>≤45</td>
<td>8</td>
</tr>
<tr>
<td>46-59</td>
<td>(60-IRI)*0.5</td>
</tr>
<tr>
<td>60-74</td>
<td>0</td>
</tr>
<tr>
<td>75-90</td>
<td>(74-IRI)</td>
</tr>
<tr>
<td>&gt;90</td>
<td>Corrective action</td>
</tr>
</tbody>
</table>

#### Table 653-02

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRQ lot IRI (in/mile)</td>
<td>Quality Units</td>
</tr>
<tr>
<td>≤45</td>
<td>8</td>
</tr>
<tr>
<td>46-59</td>
<td>(60-IRI)*0.5</td>
</tr>
<tr>
<td>60-74</td>
<td>0</td>
</tr>
<tr>
<td>75-90</td>
<td>(74-IRI)</td>
</tr>
<tr>
<td>&gt;90</td>
<td>Corrective action</td>
</tr>
</tbody>
</table>
### B. Localized Roughness Measurement (LRQU)

- Determine the localized roughness lane lot percentage based on Materials Method 653 Localized Roughness Summary Report. Calculate the Localized Roughness Quality Units (LRQU) based on the following equation:

\[
LRQU = \text{lane percentage} \times \text{total quality units in contract} \times (-2)
\]

### 653-5 BASIS OF PAYMENT

Include the cost of all labor and equipment necessary to satisfactorily complete the work. Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed price for Quality Adjustment Items listed in the contract documents for the quantity placed on the day the Quality Units represent. Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>653.1010</td>
<td>Pavement Ride Quality Adjustment to HMA Level 1</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>653.1020</td>
<td>Pavement Ride Quality Adjustment to HMA Level 2</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>653.2010</td>
<td>Pavement Ride Quality Adjustment to PCC Level 1</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>653.2020</td>
<td>Pavement Ride Quality Adjustment to PCC Level 2</td>
<td>Quality Unit</td>
</tr>
</tbody>
</table>

### SECTION 654 - IMPACT ATTENUATORS - PERMANENT

(Last Revised May, 2019)

#### 654-1 DESCRIPTION

**654-1.01 General.** The work shall consist of furnishing and installing; removing and disposing; removing and storing; and relocating; impact attenuators, and installing foundations for impact attenuators, in accordance with the contract documents, the working drawings, and as directed by the Engineer.

**654-1.02 Inertial Barrier Modules.** An impact attenuator consisting of sand-filled modules (barrels) set in an array for site hazard protection.

**654-1.03 Expendable Impact Attenuator.** Impact attenuator which requires extensive repair, or replacement, to return the unit to its full operating capacity.

**654-1.04 Reusable Impact Attenuator.** Impact attenuator which requires minimal or no repair to return the unit to its full functional capability.

**654-1.05 Concrete Foundation for Impact Attenuator.** A new concrete foundation on which an attenuator is placed or, if required, anchored.
654-1.0 Transition Piece(s). Components of the attenuator system that are designed to connect between the attenuator and the shielded object in such a manner as to prevent an impacting vehicle from snagging on the shielded object. Not all installations require a transition piece and some transition pieces must be capable of handling opposite direction impacts.

654-2 MATERIALS. Materials shall conform to the following subsections of Section 700 Materials and Manufacturing:

- Class A Concrete
- Concrete Grouting Material
- Anchoring Material- Chemically Curing
- Precast Concrete
- Epoxy Coated Bar Reinforcement, Grade 420
- Expendable Impact Attenuator
- Inertial Barrier Modules
- Reusable Impact Attenuator
- Galvanized Coating and Repair Methods
- Anchor Bolts, Nuts and Washers
- Traffic Paint (White)
- Aluminum Sign Panels
- Reflective Sheeting

654-3 CONSTRUCTION DETAILS.

654-3.01 General.

A. Drawings: Manufacturer’s drawings, modified as necessary to reflect site conditions, will be referred to as “working drawings.” Working drawings will take precedence over manufacturer’s drawings. Working drawings shall show attenuator system: 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. Attenuator mounting surface or foundation slab details and limits, will be shown in the working drawings. Any component not supplied by the manufacturer will be labeled as “PROVIDED BY OTHERS”. A minimum of 7 calendar days prior to beginning work, the Contractor shall submit three (3) copies of working drawings to the Engineer. The submission shall include the manufacturer’s certification that modifications made to manufacturer’s drawings reflecting site conditions will not impair the satisfactory performance of the impact attenuator as designed and tested under NCHRP requirements. All aspects of the working drawings shall be implemented in the field, including any alterations of the concrete barrier or other obstruction being shielded.

B. Manuals. A minimum of 7 calendar days prior to beginning work, the Contractor shall deliver to the Engineer 3 copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type of impact attenuator being installed.

C. Coordination with Other Work. Coordinate the work under this section with removal and installation of shielded objects, barriers and guide rail in such manner as to limit the exposure of vehicular traffic to potential hazards to no more than 7 calendar days.

D. Excavation. Necessary excavation shall be performed in accordance with Section 203 Excavation and Embankment. Where the perimeter of the foundation slab will not be adjacent to pavement, the limit of excavation shall be 2 feet outside of the slab and forming shall be used. Where the perimeter of the foundation slab will be adjacent to pavement that is to remain in place, the limits of excavation
shall be the limits of the foundation slab and the existing pavement shall be saw cut full depth prior to removal of the pavement and performance of the excavation work. Sawcutting and excavation shall be included in the cost of the foundation.

**E. Anchorages.** The impact attenuator shall be anchored to the new foundation slab or existing concrete foundation as shown on 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, or approved chemically curing anchoring material. 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 or protected.

A backup structure, if required by the manufacturer, shall be installed as indicated in the approved Materials Details or working drawings.

**F. Transitions.** The Contractor shall install the appropriate standard transition piece(s). If a transition is needed, but there is no standard transition design, a manufacturer’s approved special transition piece, subject to the Engineer’s approval, shall be furnished and installed. Refer to §654-3.01A for submittal requirements.

**G. Directionality.** When the contract documents indicate that an attenuator must handle two-way traffic, rather than diverging traffic, the Contractor shall supply an attenuator that is approved for the two-way traffic.

**H. Reflectorization.** ASTM Type III (Class B), Type V (Class C), or Type IX (Class E) sheeting directly applied to plastic or aluminum sheeting, or other lightweight rigid material, shall be affixed to the front cylinder, module, or front face of the impact attenuator. The pattern and color of the reflectorization shall be as indicated in the contract documents.

If no dimensions are provided, the panel shall be approximately square with a minimum of 18 inches on a side (24 inches on Inertial Barrier Modules). Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing v-shaped striping, 4 inches wide, alternating between reflectorized yellow and opaque non-reflectorized black stripes, as indicated for Type 3 Object Markers in the MUTCD.

When traffic will be permitted on only one side, the pattern shall be diagonal 4 inch stripes, downward sloping to the side on which traffic is to be permitted.

**654-3.02 Inertial Barrier Modules.** The Contractor shall install Inertial Barrier Modules of the size and number required at the locations, and to the configurations, indicated in the contract documents. The Contractor shall also paint and label the layout pattern and weights on paved surfaces using traffic or other durable paint. The weight shall be marked. When either indicated in the contract documents or when the modules are placed on a bridge deck on any slope exceeding 6%, the 200 lb units shall be restrained from movement and overturning (vandalism) by mechanical means.

**654-3.03 Reusable Impact Attenuators.** The Contractor shall install Reusable Impact Attenuators on existing or new foundations, in accordance with the contract documents and the working drawings.

**654-3.04 Expendable Impact Attenuators.** The Contractor shall install Expendable Impact Attenuators on existing or new foundations, as indicated on the contract documents and the working drawings.
**654-3.045 Concrete Foundation.** When the existing concrete pavement is not sufficient to meet the anchorage requirements or there is not an adequate existing foundation, the Contractor shall remove the existing pavement and construct a reinforced concrete foundation slab and back-up structure to the dimensions indicated in the working drawings. The foundation slab shall be not less than the thickness indicated on the working drawings, or 8 inches, whichever is greatest.

The concrete shall be batched in accordance with Section 501 *Portland Cement Concrete*. If accelerators are needed, the Contractor shall submit the concrete mix design to the Materials Bureau for prior approval. The concrete shall be formed (when necessary), placed, and cured in accordance with Section 502 *Portland Cement Concrete Pavement*. The surface shall be hand finished.

The size, length, and bending details of reinforcement shall be as shown in the foundation slab details in the working drawings. The minimum allowable reinforcing shall be epoxy-coated #5 bars, with longitudinal spacing 16 inches on centers, and cross bar spacing 6 feet on centers. Longitudinal bars shall be placed such that they will not be cut during anchorage installation.

If foundation slab removal is specified, voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as specified in the contract documents or by the Engineer.

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.

**654-3.056 Removal and Disposal.** The Contractor shall remove impact attenuators of the indicated type, and if required the associated foundation slabs, from their existing locations. Upon removal, the impact attenuators and foundation slabs shall become the property of the Contractor. If foundation slab removal is specified, voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as specified in the contract documents or by the Engineer.

If the slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

**654-3.067 Removal and Storage.** The Contractor shall remove impact attenuators of the indicated type from their existing locations 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 that preserves their condition at locations within the contract limits. Parts damaged by the Contractor’s activities shall be replaced with like parts in satisfactory condition or repaired at no cost to the State.

If the slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

**654-3.078 Relocate.** The Contractor shall remove impact attenuators of the indicated type from their existing locations in a manner that preserves their condition, and reinstall them at the same location or install them at another designated location. The impact attenuators shall remain the property of the State during the course of the work.

If required, the Contractor shall construct a new foundation slab. The cost of the new foundations will be paid for separately. If intermediate storage is required during the relocation, the Contractor shall store and protect impact attenuators. Damaged parts shall be replaced with like parts in satisfactory condition or be repaired at no cost to the State. The cost of replacing or repairing parts having pre-existing damage will be considered Extra Work.

If the original slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.
654-4 METHOD OF MEASUREMENT.

654-4.01 General. (VACANT)

654-4.02 Inertial Barrier Modules. The quantity to be measured for payment will be the number of inertial barrier modules installed.

654-4.03 Expendable Impact Attenuator. The quantity to be measured for payment will be the number of expendable impact attenuators installed.

654-4.04 Reusable Impact Attenuator. The quantity to be measured for payment will be the number of reusable impact attenuators installed.

654-4.045 Concrete Foundation for Impact Attenuator. The quantity to be measured for payment will be in cubic yards of reinforced concrete foundation installed.

654-4.056 Remove and Dispose. The quantity to be measured for payment will be the number of impact attenuators removed.

654-4.067 Remove and Store. The quantity to be measured for payment will be the number of impact attenuators removed.

654-4.078 Relocate. The quantity to be measured for payment will be the number of impact attenuators relocated.

654-5 BASIS OF PAYMENT.

654-5.01 General. The unit prices bid for the work described in this section shall include the cost of all labor, materials, and equipment necessary to satisfactorily perform the work.

Pavement restoration: Pavement restoration will be paid for separately under the contract pay items for Truing and Leveling. If there are no contract pay items for Truing and Leveling, then pavement restoration will be paid under the contract pay item for the top course of hot mix asphalt. If no contract pay items exist in the contract for paving items, then no separate payment for pavement restoration will be made.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>654.xx</td>
<td>Inertial Barrier Module, ___ Pounds</td>
<td>Each xx =01 for 200 lb units; 02 for 400 lb units; 03 for 700 lb units; 04 for 1400 lb units; 05 for 2100 lb units.</td>
</tr>
<tr>
<td>654.05</td>
<td>Concrete Foundation for Impact Attenuators</td>
<td>Cubic Yards</td>
</tr>
<tr>
<td>654.06</td>
<td>Drill and Grout Anchoring System into Existing Foundation</td>
<td>Each</td>
</tr>
<tr>
<td>654.0701</td>
<td>Remove and Dispose Impact Attenuator Systems</td>
<td>Each</td>
</tr>
<tr>
<td>654.0702</td>
<td>Remove and Store Impact Attenuator</td>
<td>Each</td>
</tr>
<tr>
<td>654.08</td>
<td>Relocate Impact Attenuator</td>
<td>Each</td>
</tr>
<tr>
<td>654.5020</td>
<td>Expendable Impact Attenuator , TL 2, ≤ 2 ft Obstruction Width</td>
<td>Each</td>
</tr>
<tr>
<td>654.5022</td>
<td>Expendable Impact Attenuator , TL 2, &gt; 2 ft up to 5 ft Obstruction Width</td>
<td>Each</td>
</tr>
<tr>
<td>654.5025</td>
<td>Expendable Impact Attenuator , TL 2, &gt; 5 ft Obstruction Width</td>
<td>Each</td>
</tr>
<tr>
<td>654.5030</td>
<td>Expendable Impact Attenuator , TL 3, ≤ 2 ft Obstruction Width</td>
<td>Each</td>
</tr>
<tr>
<td>654.5032</td>
<td>Expendable Impact Attenuator , TL 3, &gt; 2 ft up to 5 ft Obstruction Width</td>
<td>Each</td>
</tr>
</tbody>
</table>
654.5035  Expendable Impact Attenuator, TL 3, > 5 ft Obstruction Width  Each
654.5120  Reusable Impact Attenuator, TL 2, ≤ 2 ft Obstruction Width  Each
654.5122  Reusable Impact Attenuator, TL 2, > 2 ft up to 5 ft Obstruction Width  Each
654.5125  Reusable Impact Attenuator, TL 2, > 5 ft Obstruction Width  Each
654.5130  Reusable Impact Attenuator, TL 3, ≤ 2 ft Obstruction Width  Each
654.5132  Reusable Impact Attenuator, TL 3, > 2 ft up to 5 ft Obstruction Width  Each
654.5135  Reusable Impact Attenuator, TL 3, > 5 ft Obstruction Width  Each

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; or §715-09, Malleable Iron Castings, Grade 32510, at the Contractor's option. No substitutions will be allowed.

655-2.02 Fabricated Articles. All frames, grates and appurtenant parts shall be fabricated from steel conforming to ASTM A36, AISI Grade 1020 Steel, AISI Grade 1025 Steel, or ASTM A529 Gr. 50, except that the longitudinal bars for grats G1, G2, G3, 10 PCB, 11 PCB and 12 PCB shall meet the requirements of ASTM A529, Gr. 50. The Contractor shall submit mill certifications, to the Engineer, for ASTM A529, Gr.50. 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. Alternate forms of locking will be approved by the office of Design.

Unless otherwise specified, the hole shall be drilled and tapped or the nut welded to the frame before any galvanizing. The threads shall be tapped sufficiently oversize to conform to the dimensions for coarse thread with class 2B tolerances prescribed in the American National Standards for Unified Screw Threads, ANSI B1.1., 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 will be rejected. 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 for payment will be the number of frames and grates satisfactorily installed.

655-5 BASIS OF PAYMENT

655-5.01 Frames and Grates. The unit price bid for each frame and grate shall include 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 Description</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>655.0701</td>
<td>Cast Frame F1, Mountable Curb Box CM1 &amp; Reticuline Grate G1</td>
<td>Each</td>
</tr>
<tr>
<td>655.0702</td>
<td>Cast Frame F2, Mountable Curb Box CM2 &amp; Reticuline Grate G2</td>
<td>Each</td>
</tr>
<tr>
<td>655.0703</td>
<td>Cast Frame F3, Mountable Curb Box CM3 &amp; Reticuline Grate G3</td>
<td>Each</td>
</tr>
<tr>
<td>655.0704</td>
<td>Cast Frame F1, UnMountable Curb Box CU1 &amp; Reticuline Grate G1</td>
<td>Each</td>
</tr>
<tr>
<td>655.0705</td>
<td>Cast Frame F2, UnMountable Curb Box CU2 &amp; Reticuline Grate G2</td>
<td>Each</td>
</tr>
<tr>
<td>655.0706</td>
<td>Cast Frame F3, UnMountable Curb Box CU3 &amp; Reticuline Grate G3</td>
<td>Each</td>
</tr>
<tr>
<td>655.0801</td>
<td>Cast Frame F1, Mountable Curb Box CM1 &amp; Parallel Bar Grate 6 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0802</td>
<td>Cast Frame F2, Mountable Curb Box CM2 &amp; Parallel Bar Grate 7 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0803</td>
<td>Cast Frame F3, Mountable Curb Box CM3 &amp; Parallel Bar Grate 8 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0804</td>
<td>Cast Frame F1, UnMountable Curb Box CU1 &amp; Parallel Bar Grate 6 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0805</td>
<td>Cast Frame F2, UnMountable Curb Box CU2 &amp; Parallel Bar Grate 7 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0806</td>
<td>Cast Frame F3, UnMountable Curb Box CU3 &amp; Parallel Bar Grate 8 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0901</td>
<td>Parallel Bar Frame 10 PCB &amp; Parallel Bar Grate 10 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0902</td>
<td>Parallel Bar Frame 11 PCB &amp; Parallel Bar Grate 11 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.0903</td>
<td>Parallel Bar Frame 12 PCB &amp; Parallel Bar Grate 12 PCB</td>
<td>Each</td>
</tr>
<tr>
<td>655.1003</td>
<td>Welded Frame &amp; Rectangular Grate 3</td>
<td>Each</td>
</tr>
<tr>
<td>655.1006</td>
<td>Welded Frame &amp; Rectangular Grate 6</td>
<td>Each</td>
</tr>
<tr>
<td>655.1111</td>
<td>Welded Frame &amp; Rectangular Grate 11</td>
<td>Each</td>
</tr>
<tr>
<td>655.1106</td>
<td>Welded Frame &amp; Rectangular Grate 16</td>
<td>Each</td>
</tr>
<tr>
<td>655.1022</td>
<td>Welded Frame &amp; Rectangular Grate 22</td>
<td>Each</td>
</tr>
<tr>
<td>655.1103</td>
<td>Welded Frame &amp; Reticuline Grate 3</td>
<td>Each</td>
</tr>
<tr>
<td>655.1106</td>
<td>Welded Frame &amp; Reticuline Grate 6</td>
<td>Each</td>
</tr>
<tr>
<td>655.1111</td>
<td>Welded Frame &amp; Reticuline Grate 11</td>
<td>Each</td>
</tr>
<tr>
<td>655.1116</td>
<td>Welded Frame &amp; Reticuline Grate 16</td>
<td>Each</td>
</tr>
<tr>
<td>655.1122</td>
<td>Welded Frame &amp; Reticuline Grate 22</td>
<td>Each</td>
</tr>
<tr>
<td>655.1201</td>
<td>Manhole Frame &amp; Grate</td>
<td>Each</td>
</tr>
<tr>
<td>655.1202</td>
<td>Manhole Frame &amp; Cover</td>
<td>Each</td>
</tr>
<tr>
<td>655.1301</td>
<td>Telescoping Manhole Frame &amp; Grate</td>
<td>Each</td>
</tr>
<tr>
<td>655.1302</td>
<td>Telescoping Manhole Frame &amp; Cover</td>
<td>Each</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 and Manufacturing:

- 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 data 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 pounds of metal furnished and placed in accordance with the plans and specifications.

656-5 BASIS OF PAYMENT. The unit price bid per pound 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>Pound</td>
</tr>
</tbody>
</table>

SECTION 657 – PAINTING GALVANIZED AND ALUMINUM SURFACES

(Last Revised May, 2018)

657-1 DESCRIPTION. This work shall consist of painting galvanized and aluminum surfaces that have not been previously painted.

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. Material for this work shall meet the requirements of §708-07 Paint for Aluminum Surfaces.

657-2.03 Paints.

A. Product Data. 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 product data and safety data sheet 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.

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. Shelf Life. Any container of paint more than 12 months old based on the date of manufacture shall not be used. Paint arriving at the work site shall be in new, unopened containers and labeled with the manufacturer’s name, product name, component part, batch number, color, and date of manufacture.

657-2.04 Water for Pressure Washing. Potable water shall be used.

657-2.05 Abrasive for Brush-Off Blasting Galvanizing Surfaces. Abrasive size shall range between 8 and 20 mils, and shall have a Mohs hardness of 5 or less. Steel grit, steel shot, or copper slag shall not be used.

657-2.06 Paint Inspection Equipment. The Contractor shall ensure that the Engineer is supplied and maintained with the following equipment in good working order, prior to the start of work:

- One bound copy of the Steel Structures Painting Council Surface Preparation Standard SSPC-SP 1 “Solvent Cleaning”.
- One bound copy of the Steel Structures Painting Council Surface Preparation Specification SSPC-SP 16 “Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals”.
- One bound copy of the Steel Structures Painting Council SSPC-PA 2, Paint Application-Standard No. 2 “Procedure for Determining Conformance to Dry Coating Thickness Requirements”.
- ASTM D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
- ASTM D4285 Standard Test Method for Indicating Oil or Water in Compressed Air.
- One Air Thermometer, pocket type, 10°F to 110°F.
- One Magnetic Dry-Film Thickness Gauge, Type 2 (fixed probe).
- Two Wet-Film Thickness Gauges, Prong-Type, capable of measuring 1 mil to 10 mils in 1 mil increments.
- Sling Psychrometer and US Weather Bureau Psychrometric Tables.
- Profile micrometer with coarse replica tape.
All equipment will be returned to the Contractor upon completion of the work.

657-3 CONSTRUCTION DETAILS

657-3.01 Classification and Surface Preparation of Surfaces. 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 1450 psi, a water temperature of 185°F to 200°F, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches 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-SP 1. 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 3000 psi, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches 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-SP 1. The areas shall be pressure washed again following this cleaning.

Once cleaned and allowed to dry, all galvanized surfaces shall receive an abrasive brush-off blast per SSPC-SP 16, using clean compressed air. The Contractor shall verify the compressed air cleanliness with a white blotter test in accordance with ASTM D4285 at least once per shift.

The brush-off blast shall remove zinc oxides from the galvanizing as well as etch the surface to impart an anchor profile of 1 to 1 ½ mils. The resultant anchor profile shall be confirmed by measuring using profile tape and a spring-loaded micrometer in accordance with ASTM D4417.

The brush-off blast shall be performed in a manner that does not result in debonding or flaking of the galvanizing. The brush-off blast shall not remove excessive amounts of zinc from the galvanized surface. The initial thickness of the galvanizing prior to brush-off blasting shall be established using a magnetic thickness gauge in accordance with ASTM A123. If the brush-off blast results in a 15% or greater loss of galvanized coating, the article shall be rejected. If an article is rejected, the Contractor shall strip, re-galvanize and brush-off blast it to conform to the requirements of this specification at no additional cost to the State.

After brush-off 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 using hand tools.

Brush-off blasting shall be completed no more than 1 hour prior to paint application. If more than 1 hour elapses prior to priming, the galvanized surfaces shall be re-blasted 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. All surfaces to be painted shall be pressure washed using equipment operating at a minimum pressure of 3000 psi, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches 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 in accordance with SSPC-SP 1. The areas shall be pressure washed again following this cleaning.
Once cleaned and allowed to dry, all aluminum surfaces shall receive an abrasive brush-off blast in accordance with SSPC-SP 16. All compressed air used to satisfy the requirements of this specification shall be clean. The cleanliness shall be verified with a white blotter test in accordance with ASTM D4285 at least once per shift.

The brush-off blast shall remove aluminum oxides as well as etch the surface. The brush-off blast shall impart a minimum anchor profile of 1 mil as measured using profile tape and a spring-loaded micrometer in accordance with ASTM D4417.

After brush-off blasting, the aluminum surfaces shall be thoroughly blown down with clean compressed air to remove all blast residue.

Brush-off blasting shall be completed no more than 1 hour prior to paint application. If more than 1 hour elapses prior to priming, the aluminum surfaces shall be re-blasted at no additional cost to the State.

657-3.02 Painting.

A. Atmospheric Conditions. Paint shall be applied only when surface and ambient temperatures are greater than or equal to 40°F and rising, and less than or equal to 100°F. If the temperature range listed on the manufacturer’s product data sheet is more restrictive, the manufacturer’s temperature range shall be used. 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% or the surface temperature is less than 5°F above the dew point. If the manufacturer’s requirements are more restrictive then they shall be followed.

Paint shall not be applied if ambient conditions are expected to become unfavorable prior to the paint drying “To Handle”, in accordance with the manufacturer’s product data sheet.

B. Mixing Paint. 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. The paint shall be periodically re-mixed if recommended by the manufacturer.

C. Solvents and Thinners. Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The paint shall not be thinned where the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205 for industrial maintenance coatings. The manufacturer shall advise the Contractor and Engineer as to the maximum amount of thinner allowed.

The Contractor shall not use unauthorized solvents and thinners, or excess amounts of solvents and thinners. Paint thinned excessively or incorrectly shall be removed at no additional cost to the State. The use of accelerator additives is prohibited.

D. Paint Application. The Contractor shall not begin painting until cleaned surfaces have been inspected. The Contractor shall also provide sufficient time for the work to be inspected at each stage of paint application. The item(s) shall cure in an environment that is free of airborne dust and dirt until the paint is dry to handle. 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, or if more than 1 hour elapses after brush-off blasting prior to priming, the surface preparation shall be redone at no additional cost to the State.
E. Paint Film Thickness. The Contractor shall apply paint to produce the specified dry film thickness in accordance with the paint manufacturer’s product data sheet.

The dry film thickness over galvanized steel shall be determined in accordance with SSPC-PA 2 using a Type 2 fixed-probe magnetic gauge. The gauge shall be properly calibrated over the galvanized steel surface in accordance with the manufacturer’s recommendation prior to paint application.

The 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 required dry film thickness. The overcoating shall be performed within the paint manufacturer’s specified recoat window.

657-3.03 Repair of Damaged Areas. The Contractor shall remove all visible dirt, grease, and other foreign matter by pressure washing and solvent cleaning in accordance with SSPC-SP 1 as needed. Areas exhibiting damaged or deteriorated paint not extending to the aluminum or zinc metal substrate shall be hand or power tool cleaned as necessary to remove damaged or deteriorated, loosely adhered paint, until the paint does not lift when scraped with a dull putty knife. All edges of paint surrounding the repair area shall be tightly adherent and feathered. These edges and the surrounding painted surfaces to receive a repair topcoat(s) shall be abraded to provide a suitable anchor profile for the paint.

Areas that exhibit damage of the paint system down to the metal substrate shall be cleaned with vacuum-shrouded tools to SSPC-SP 16, minimizing zinc galvanizing removal, and shall exhibit a suitable anchor profile for the primer paint. All surrounding structure that has been previously painted in the shop shall be protected from damage during the cleaning operation. Repairs shall be smoothly transitioned into surrounding new paint.

Areas of the structure exhibiting damage not extending down to the metal substrate shall be repainted with a finish coat only. Damage extending to the metal substrate shall be repainted with primer and finish coat. These coats of paint shall be applied at a dry film thickness as recommended by the paint manufacturer for such repair application.

657-4 Method of Measurement. The unit of 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 satisfactorily 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>657.01nnnn</td>
<td>Painting Weathered Galvanized Surfaces</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>657.02nnnn</td>
<td>Painting Newly Galvanized Surfaces</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>657.03nnnn</td>
<td>Painting Aluminum Surfaces</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

*nnnn Serialized number identified structure detailed in contract documents.

SECTION 658 - WATER WELLS

658-1 Description. The work in this section shall include work required for well drilling
658-2 MATERIALS. Materials shall be as specified in the special specifications.

658-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

658-4 METHOD OF MEASUREMENT. As specified in the special specifications.

658-5 BASIS OF PAYMENT. As specified in the special specifications.

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 Section 203, Select Granular Fill, 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 Section 203, *Select Granular Fill*, 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.

661-3.02 **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 Section 203, *Select Granular Fill*, 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 Section 203, Select Granular Fill, 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 Description</th>
<th>Code</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 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>
<tr>
<td>Stainless Steel Connecting Products</td>
<td>715-16</td>
</tr>
<tr>
<td>Ductile Iron Water Pipe, Fittings and Encasement</td>
<td>722-01</td>
</tr>
<tr>
<td>Steel Water Pipe and Fittings</td>
<td>722-02</td>
</tr>
<tr>
<td>Concrete Water Pipe</td>
<td>722-03</td>
</tr>
<tr>
<td>Water Valves and Hydrants</td>
<td>722-04</td>
</tr>
<tr>
<td>Plastic Water Pipe and Fittings</td>
<td>722-05</td>
</tr>
<tr>
<td>Water Service Pipe, Service Valves and Fittings</td>
<td>722-06</td>
</tr>
<tr>
<td>Wedge Type Mechanical Restraint Glands</td>
<td>722-07</td>
</tr>
<tr>
<td>Insulation for Water Mains</td>
<td>722-08</td>
</tr>
<tr>
<td>Steel Pipe</td>
<td>ASTM A53</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 inch diameter pipe 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 **Shutdowsn.** 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 eight (8) 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.** Unless modified by contract documents, the requirements of section 206 Trench, Culvert and Structure Excavation shall apply except for trench widths for which the standard sheet – “Water Main Pipe Installation Details” shall apply. 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 to 24 inch diameter shall provide a minimum of 6 inch clearance to rocks or boulders and trenches for pipe sizes from 30 to 64 inch diameter shall provide a minimum of 9 inch clearance to rocks or boulders. Longitudinal excavation and backfill limits shall be 3 feet beyond the connection or termination point with an existing main, and 2 feet beyond the barrel of a hydrant.

The Contractor shall meet the requirements of Section 203, Select Granular Fill. 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 3/4 inch.

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 inch diameter pipe 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 inch diameter shall be pressure class 350 or thicker, and the cement lining shall be 1/16 inch thick.

Unless otherwise noted in the Owners requirements, ductile iron pipe from 14 to 24 inch diameter shall be pressure class 250 or thicker, and the cement lining shall be 3/32 inch thick. Unless otherwise noted in the Owners requirements, ductile iron pipe from 30 to 64 inch diameter shall be pressure class 250 or thicker and the cement lining shall be 1/8 inch 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 6 inches 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 inch diameter main valve and be equipped with a 4 1/2 NST steamer nozzle and two 2 1/2 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 1 inch 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 4 inches above grade. The measurement will be taken over a 5 feet horizontal span when a change in grade occurs within 5 feet 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 (1/4 cubic yard 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 Manufacturer's 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 24 inches from a pipe end. Multiple taps should be a minimum of 18 inches 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 inch diameter 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 1 inch diameter may be directly tapped into a main, and taps from 1 1/4 to 2 inch diameter shall be tapped using a tapping saddle.

### TABLE 663-1 MAXIMUM ALLOWABLE DIRECT TAP SIZE FOR DUCTILE IRON PIPE (inches)

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Pressure Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>--</td>
</tr>
<tr>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>10</td>
<td>--</td>
</tr>
<tr>
<td>12</td>
<td>--</td>
</tr>
<tr>
<td>14</td>
<td>1-1/4</td>
</tr>
<tr>
<td>16</td>
<td>1-1/2</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>24</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 3/16 inch 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 inches. 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 150 psi 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 feet of laying length to the nearest 1/2 foot. 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 feet of laying length to the nearest whole foot. 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 feet of equivalent lengths of steel pipe, to the nearest 1/2 foot. 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 feet to the nearest 1/2 foot from a point 5 feet 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 pound. 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 Restraint 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 feet along the pipe axis measured to the nearest whole foot 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 feet along the pipe axis measured to the nearest whole foot 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 2 feet 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 6 1/2 feet 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 diameter size on that fitting (i.e. a 12 x 4 inch diameter Tee will be in the 10 - 16 inch diameter 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.

663-5.11 Relocate Existing Hydrant. The unit price bid for each hydrant relocation shall include a length of lateral pipe up to 6 1/2 feet 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>Foot</td>
</tr>
<tr>
<td>663.02xx</td>
<td>Steel Water Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.03xx</td>
<td>Concrete Water Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.04xx</td>
<td>Plastic Water Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.05xx</td>
<td>Bridge Mounted Water Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.06zz</td>
<td>Copper Water Service Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.07zz</td>
<td>Polyethylene Water Service Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td>663.08zz</td>
<td>Steel Water Service Pipe</td>
<td>Foot</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>
</tbody>
</table>
### SECTION 663 - WATER MAIN UTILITIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>663.12</td>
<td>Double Disk Gate Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.13</td>
<td>Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.14</td>
<td>Hydrant Fender</td>
<td>Each</td>
</tr>
<tr>
<td>663.15</td>
<td>Dry Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.16</td>
<td>Tapping Sleeve, Valve &amp; Valve Box Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>663.17</td>
<td>Line Stop Fitting</td>
<td>Each</td>
</tr>
<tr>
<td>663.18</td>
<td>Bolted, Sleeve Type Coupling</td>
<td>Each</td>
</tr>
<tr>
<td>663.20</td>
<td>Iron Water Main Fittings (3 - 8 inch diameter)</td>
<td>Pound</td>
</tr>
<tr>
<td>663.21</td>
<td>Iron Water Main Fittings (10 - 16 inch diameter)</td>
<td>Pound</td>
</tr>
<tr>
<td>663.22</td>
<td>Wedge Type Mechanical Restraint Glands (xx inch diameter)</td>
<td>Each</td>
</tr>
<tr>
<td>663.23</td>
<td>High Deflection Restrained Joint Fitting (xx inch diameter)</td>
<td>Each</td>
</tr>
<tr>
<td>663.24</td>
<td>Polyethylene Encasement for Water Pipe</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>Insulation for Buried Water Pipe (xx inch diameter</td>
<td>Foot</td>
</tr>
<tr>
<td></td>
<td>with gg Thick Insulation)</td>
<td></td>
</tr>
<tr>
<td>663.25</td>
<td>Water Service Connection</td>
<td>Each</td>
</tr>
<tr>
<td>663.26</td>
<td>Curb Stop &amp; Curb Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.27</td>
<td>Water Meter Pit, Type A</td>
<td>Each</td>
</tr>
<tr>
<td>663.28</td>
<td>Water Meter Pit, Type B</td>
<td>Each</td>
</tr>
<tr>
<td>663.29</td>
<td>Temporary Water Service for Water Main Installation</td>
<td>Lump Sum</td>
</tr>
<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>663.41</td>
<td>Remove and Dispose of Existing Water Main</td>
<td>Foot</td>
</tr>
<tr>
<td>663.42</td>
<td>Remove and Dispose of Existing Water Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.43</td>
<td>Remove and Dispose of Existing Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.44</td>
<td>Remove and Dispose of Existing Water Service Connection</td>
<td>Each</td>
</tr>
<tr>
<td>663.45</td>
<td>Remove and Store Existing Water Valve &amp; Valve Box</td>
<td>Each</td>
</tr>
<tr>
<td>663.46</td>
<td>Remove and Store Existing Hydrant</td>
<td>Each</td>
</tr>
<tr>
<td>663.47</td>
<td>Remove and Store Existing Curb Stop &amp; Curb Box</td>
<td>Each</td>
</tr>
</tbody>
</table>

**gg** = Insulation Thickness Code  
**nn** = Serialized item  
**xx** = diameter, inches  
**yy** = diameter, inches  
**zz** = Water Service Size, 01 = 1/2", 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 of section 206 Trench, Culvert and Structure Excavation shall apply except for trench widths for which standard sheet “Sanitary Sewer Main Pipe Installation Details” shall apply.

664-3.04 Backfill. The requirements specified in Section 203, Select Granular Fill, 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

(Last Revised September, 2016)

667-1 DESCRIPTION.

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.

   Surface Course. Surface quality material with a maximum particle size of 1 inch.

   Base Course. Base quality material with a maximum particle size of 2 inches.

   Subbase Course. Subbase quality material with a maximum particle size of 3 inches.

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

270
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: # 200, # 40, ¼ inch, ½ inch, ¾ inch, 1 inch, 1 ½ inch, 2 inch, 3 inch.

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 the following method:

**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 or T 90.

<table>
<thead>
<tr>
<th>Sieve (U.S. sieve)</th>
<th>Material Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
</tr>
<tr>
<td>3”</td>
<td>100</td>
</tr>
<tr>
<td>2”</td>
<td>100</td>
</tr>
<tr>
<td>1.5”</td>
<td>85-100</td>
</tr>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>¾”</td>
<td>85-100</td>
</tr>
<tr>
<td>½”</td>
<td>50-75</td>
</tr>
<tr>
<td>¼”</td>
<td>15-35</td>
</tr>
<tr>
<td>#40</td>
<td>8-15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Material Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
</tr>
<tr>
<td>Maximum Soundness loss (%)</td>
<td>20</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>2-9</td>
</tr>
</tbody>
</table>

**D. Elongated Particles.** Not more than 30 percent, by weight, of the particles retained on a ½ inch 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, Surface Course material shall have at least two fractured faces on 50 percent of the stone particles larger than ½ inch or at least one fractured face on 75 percent of the particles larger than ½ inch. Base Course material shall have at least one fractured face on 50 percent of the stone particles larger than ½ inch.

**667-2.03 Stockpiling.** Stockpile all material in accordance with the geotechnical control procedure “Procedure for the Control and Quality Assurance of Granular Materials”.

**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 15 inches, or as shown on the plans. In confined areas as defined by the Municipality the maximum compacted layer thickness is 6 inches. 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 Section 203, Compaction. Density tests are not required for the acceptance of these courses. If a subbase course has been disturbed by frost action prior to placing the next course, 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.

**667-3.05 Tolerance.**

**A. Surface and Base Course.** Place material so that after compaction the top surface of the course does not extend more than ¼ inch above nor more than ¼ inch 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 ½ inch above nor more than ½ inch below true grade for the course at any location.

**667-4 METHOD OF MEASUREMENT.** The quantity is the number of cubic yards 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</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>667.02</td>
<td>Local Road Gravel Base Course</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>667.03</td>
<td>Local Road Gravel Subbase Course</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

SECTIONS 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 and Manufacturing:

<table>
<thead>
<tr>
<th>Material</th>
<th>Subsection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Light Standards and Arms</td>
<td>723-01</td>
</tr>
<tr>
<td>High Mast Pole, Head Frame Assembly with Luminaire Ring and Lowering Device</td>
<td>723-02</td>
</tr>
<tr>
<td>Portable Power Drive for High Mast Luminaire 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>
</tbody>
</table>
All cast-in-place concrete bases, 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 latest version of “Division of Street Lighting Specifications”. Differences in standards or code requirements shall be resolved as determined by the Engineer.

670-3.02 Shop Drawings. The Contractor shall submit five copies of the Manufacturer’s Shop Drawings to the Engineer for approval. High Mast Lighting drawings will be approved by DCES. These drawings shall cover the following items and be submitted at least ten working days prior to ordering the light standards, breakaway transformer bases, arms, precast concrete foundations and high mast poles, head assemblies and lowering devices. The shop drawings shall be neatly drawn and clearly legible.

For luminaires and photovoltaic controls, catalog cuts may be submitted to the Engineer.

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 Section 203, Disposal of Surplus Excavated Material. Excavations shall be backfilled as specified in Section 203, Select Granular Fill. 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 12 to 20 inches 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 6 inches 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 §203-2.06 Select Granular Fill, and compacted in accordance with §203-3.06 Select Granular Fill. 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 10 foot by 5/8 inch diameter, copperclad ground rod shall be driven near each foundation, maintaining at least 2 inch 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 10 foot 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 1/4 inch 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 4 feet or as directed by the Engineer.

Underground conduit installations shall have a minimum cover of 18 inches except under roadways, where the minimum cover shall be 24 inches. 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 Section 203, Select Granular Fill. 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 1 1/4 inch 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 conduit run a No. 10 AWG galvanized steel drag line or nylon or polypropylene rope, with a tensile strength of at least 500 pounds, leaving at least 3 feet 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 2 feet 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 Section 203, *Select Granular Fill*, 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 1 inch 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 4 inches onto the undisturbed outer covering of each cable.

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, AOBE. (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.

670-4.03 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 foot 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 feet 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 foot 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 foot 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 foot 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 foot 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:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>670.01XX</td>
<td>Foundation for Light Standards</td>
<td>Each</td>
</tr>
<tr>
<td>XX = Foundation Length in whole feet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>670.11XX</td>
<td>Aluminum Light Standards for Single Member or Truss Arm(s)</td>
<td>Each</td>
</tr>
<tr>
<td>XX = Mounting Height in feet (26, 30, 36, 40, 43, 46, 53)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>670.12XX</td>
<td>Aluminum Single Member Bracket Arm</td>
<td>Each</td>
</tr>
<tr>
<td>XX = Arm Length in feet (4, 6, 8, 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>670.13XX</td>
<td>Aluminum Trussed Arm</td>
<td>Each</td>
</tr>
<tr>
<td>XX = Arm Length in feet (10, 12, 15, 18, 20)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
670.14XX Aluminum Bracket Arm, Wood Pole Mounted Each

XX = Arm Length in feet (6, 8, 12, 15, 18)

670.15XX Aluminum Light Standard for Single Davit Arm Each

XX = Mounting height in feet (30, 36, 40, 43, 46, 53)

670.16XX Aluminum Light Standard for Double Davit Arms Each

XX = Mounting height in feet (30, 36, 43, 46, 53)

670.17XX Aluminum Davit Arm Each

XX = Arm Length in feet (6, 12, 15, 18, 20)

670.0XXZZ High Mast Pole, Head Frame Assembly with Luminaire Ring and Lowering Device Each

XXX = Height of pole in feet (100, 120, 150)

ZZ = Number of luminaire tenons (03, 04, 05, 06, 10, 12)

670.010001 Portable Power Drive for High Mast Luminaire Lowering System Each

670.19 Breakaway Transformer Base (Aluminum) Each

670.20XX Galvanized Steel Conduit Foot

XX = 01 02 03 04 05 06 07 08

INCHES = 3/4 1 2 3 4 5 1 1/2 1 3/4

670.23XX Galvanized Steel Plastic Coated Conduit Foot

XX = 01 02 03 04 05 06 07 08 09 10 11 12

INCHES = 1/2 3/4 1 1 1/4 1 1/2 2 2 1/2 3 3 1/2 4 5 6

670.25XX Flexible Conduit Foot

XX = 01 02 03 04 05 06 07

INCHES = 3/4 1 1 1/4 1 1/2 2 3 4

670.26XX Rigid Plastic Conduit Foot

XX = 01 02 03 04 05 06

INCHES = 1 2 3 4 5 6

670.3001 Pullboxes less than 5 cubic feet, inside volume (Lighting) Each

670.3006 Pullboxes 5 to 7 1/2 cubic feet, inside volume (Lighting) Each

670.3010 Pullboxes over 7 1/2 to 10 cubic feet, inside volume (Lighting) Each

670.3020 Pullboxes over 10 to 15 cubic feet, inside volume (Lighting) Each

670.3030 Pullboxes over 15 cubic feet, inside volume (Lighting) Each

670.40 Cast Iron Junction Boxes Each

670.50TCWW Luminaire Each

T= Type of Lamp and Mounting:
1=High Pressure Sodium Vapor, Std. Mount; 2=High Pressure Sodium Vapor, Underbridge Mt.;
3=Low Pressure Sodium Vapor, Underbridge Mt.; 4=Mercury Vapor, Std Mount;
5=Mercury Vapor, Underbridge Mount

C= Cutoff Characteristics
1=Short, Cutoff; 2=Medium, Semi-cutoff; 3=Long, Non-cutoff;
4=Medium, Cutoff; 5= Long, Semi-cutoff; 6=Medium, Non-cutoff; 7=Short, Non-cutoff
8=Short, Full Cutoff; 9=Medium, Full Cutoff

WW= Wattages
03=35 watts; 05=50 watts; 07=70 watts; 15=150 watts;
20=200 watts 25=250 watts; 40=400 watts; 01=1000 watts;
55=55 watts; 09=90 watts; 10=100 watts; 13=135 watts; 17=175 watts; 70=700 watts

670.60 Photoelectric Controls Each

670.70XX Single Conductor Cable Foot

XX = 02 03 04 05 06 07 10 20 30 40

Gage = 2 4 6 8 10 12 1/0 2/0 3/0 4/0

670.71XX Single Conductor Direct Burial Cable Foot

XX = 01 02 03 04 05 06 07
670.7501 Ground Wire No. 6 AWG.  Foot
670.80 Remove and Store Lamppost Assembly  Each
670.81 Remove and Dispose of Lamppost Assembly  Each
670.82 Remove Lamppost Foundation  Each
670.90 Relocate Lamppost Assembly  Each
670.91 Relocate Bracket Arm With Luminaire  Each

SECTIONS 671 THRU 674 (VACANT)

SECTION 675 - RAILROAD TRACK AND APPURTEYNANCES

675-1 DESCRIPTION. The work in this section shall include work required for railroad track and appurtenances.

675-2 MATERIALS. Materials shall be as specified in the special specifications.

675-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

675-4 METHOD OF MEASUREMENT. As specified in the special specifications.

675-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTIONS 676 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 and Manufacturing:

- Bar Reinforcement, Grade 60
- Iron Castings
- Breakaway Transformer Base
- Rigid Plastic Conduit
- Metal Steel Conduit, Zinc Coated
- P.V.C. Coated Galvanized Steel Conduit
- Flexible Liquid-Tight Steel Conduit
- Cast Iron Junction Boxes
- Precast Reinforced Concrete Pullboxes
- Signal Cable
- Span Wire
- Traffic Signal Poles
- Traffic Signal Heads
- Shielded Communication Cable
- Signal Cable with Integral Messenger
- Shielded Communication Cable with Integral Messenger
- Fire Pre-emption Tell Tale Light
- Inductance Loop Wire
- Shielded Lead-in Cable
- Roadway Loop Embedding Sealer
- Pedestrian Push Button and Sign
- Fiberoptic Pedestrian Signal Heads
- Fiberoptic Dual Indication Arrow
- Strobing Signal Indication
LED Traffic Signal Modules 724-04
LED Pedestrian Signal Modules 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 Section 203, Disposal of Surplus Excavated Material.

Excavation shall be backfilled as specified in Section 203, Select Granular Fill. 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 3 inches 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 2200 psi. 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 18 inches except under roadways, where the minimum cover shall be 24 inches 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 Section 203, Select Granular Fill. 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 2 feet 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 500 lb. At least 3 feet 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 3 feet but not more than 5 feet 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 15 inches 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 1 inch 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 4 inches 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 16 inches 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</th>
<th>FUNCTION</th>
<th>PRIORITY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase 5</td>
<td>8</td>
<td>Phase 4</td>
</tr>
<tr>
<td>2</td>
<td>Phase 1</td>
<td>9</td>
<td>Overlap No. 1</td>
</tr>
<tr>
<td>3</td>
<td>Phase 6</td>
<td>10</td>
<td>Overlap No. 2</td>
</tr>
<tr>
<td>4</td>
<td>Phase 2</td>
<td>11</td>
<td>Overlap No. 3</td>
</tr>
<tr>
<td>5</td>
<td>Phase 7</td>
<td>12</td>
<td>Overlap No. 4</td>
</tr>
<tr>
<td>6</td>
<td>Phase 3</td>
<td>13</td>
<td>Double Clearance No. 1</td>
</tr>
<tr>
<td>7</td>
<td>Phase 8</td>
<td>14</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>
<th>GROUP NUMBER</th>
<th>INDICATION</th>
<th>WIRE COLOR CODE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
<td>14/19C-1-R</td>
<td>4</td>
<td>Red</td>
<td>14/19C-1-B/R</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>14/19C-1-0</td>
<td></td>
<td>Yellow</td>
<td>14/19C-1-O/R</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>14/19C-1-G</td>
<td></td>
<td>Green</td>
<td>14/19C-1-BL/R</td>
</tr>
<tr>
<td></td>
<td>Ground Wire</td>
<td>14/19C-1-W</td>
<td></td>
<td>Ground Wire</td>
<td>14/19C-1-W/R</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>3</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>3</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>3</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>3</td>
<td>14/5C-3-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>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>No. of Conductors</td>
<td>Cable No.</td>
<td>Color for the Given Conductor Size</td>
</tr>
</tbody>
</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>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Overlap No. 1</td>
<td>5</td>
<td>5</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, Signs. 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 3/8 inch 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 1 inch 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 2 feet with 1 inch (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 1 foot.

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 1 inch of the inductance loop wire tube. 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 40°F 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 6 feet 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-Signs.

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.
Controller Installed  |  Voltmeter Reading (Volts)  |  Equivalent Resistance (Ohms)
--- | --- | ---
2 Phase  | 20  | 2.0
Model 170 Microcomputer  | 20  | 2.0
All others  | 10  | 1.0

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
- Guy Assembly
- Pedestrian Signal Section
- Pullbox
- Cast Iron Junction Box
- Controller Assembly Component
- Fire Pre-Emption Tell Tale Light
- Concrete Base for Controller Cabinet
- Fiberoptic Dual Indication Arrow
- LED Pedestrian Signal Module
- Type I Pedestrian Signal Section
- Pedestrian Push Button and Sign
- Traffic Signal Section
- Strobing Signal Indication
- Traffic Signal Bracket Assembly
- Traffic Signal Disconnect Hanger
- Riser Assembly
- Traffic Signal Pole
- Overhead Sign Assembly
- Flashing Beacon Sign Assembly
- Fiberoptic Pedestrian Signal Section
- LED Traffic Signal Module
- Type I Traffic Signal Section

680-4.02 Linear Foot Measurements. The following items will be measured for payment as the number of feet actually installed in accordance with the contract documents or as directed by the Engineer:

- Inductance Loop Wire
- Shielded Lead-In Cable
- Inductance Loop Installation
- Messenger Assembly
- Signal Cable
- Shielded Communication Cable
- Signal Cable with Integral Messenger
- Shielded Communication Cable w/ Integral Messenger
- Conduit

Inductance loop wire shall be the actual number of feet of wire used and left in place. Measurement of inductance loop installation shall be the number of feet 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 yard 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 feet 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 “DONT 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.

680-5.04 **Pole Excavation and Concrete Foundation.** The unit price bid per cubic yard 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 mesh installation 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 foot 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 foot 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 foot 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 foot 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>
</thead>
<tbody>
<tr>
<td>680.5001</td>
<td>Pole Excavation and Concrete Foundation</td>
<td>Cubic Yard</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>680.52XXYY</td>
<td>Conduit</td>
<td>Foot</td>
</tr>
<tr>
<td>680.53</td>
<td>Conduit Jacking or Boring</td>
<td>Foot</td>
</tr>
<tr>
<td>680.54</td>
<td>Inductance Loop Installation</td>
<td>Foot</td>
</tr>
<tr>
<td>680.56</td>
<td>Emergency Pre-emption System</td>
<td>Each</td>
</tr>
<tr>
<td>680.60XXYY</td>
<td>Traffic Signal Pole--Span Wire</td>
<td>Each</td>
</tr>
<tr>
<td>680.61XXYY</td>
<td>Traffic Signal Pole--Span Wire with Lighting Arm</td>
<td>Each</td>
</tr>
<tr>
<td>680.62XXYY</td>
<td>Traffic Signal Pole--Mast Arm</td>
<td>Each</td>
</tr>
<tr>
<td>680.63XXYY</td>
<td>Traffic Signal Pole--Dual Mast Arm**</td>
<td>Each</td>
</tr>
<tr>
<td>680.64XXYY</td>
<td>Traffic Signal Pole--Mast Arm with Lighting Arm</td>
<td>Each</td>
</tr>
<tr>
<td>680.65XXYY</td>
<td>Traffic Signal Pole--Dual Mast Arm** with Lighting Arm</td>
<td>Each</td>
</tr>
<tr>
<td>680.67XX</td>
<td>Traffic Signal Pole--Post Top Mount</td>
<td>Each</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Unit</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>680.68XX</td>
<td>Traffic Signal Pole--Bracket Mount</td>
<td>Each</td>
</tr>
<tr>
<td>680.69XX</td>
<td>Traffic Signal Pole Bracket Mount with Lighting Arm</td>
<td>Each</td>
</tr>
</tbody>
</table>

*XX=Mounting height in feet*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>680.7001</td>
<td>Single Span Wire Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>680.7002</td>
<td>Dual Span Wire Assembly with Upper Tether Wire</td>
<td>Each</td>
</tr>
<tr>
<td>680.7003</td>
<td>Dual Span Wire Assembly with Lower Tether Wire</td>
<td>Each</td>
</tr>
<tr>
<td>680.7004</td>
<td>Messenger Assembly</td>
<td>Foot</td>
</tr>
<tr>
<td>680.7005</td>
<td>Guy Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>680.700602</td>
<td>Riser Assembly, 1/2 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700603</td>
<td>Riser Assembly, 1 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700604</td>
<td>Riser Assembly, 1 1/2 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700606</td>
<td>Riser Assembly, 2 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700607</td>
<td>Riser Assembly, 2 1/2 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700608</td>
<td>Riser Assembly, 3 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700609</td>
<td>Riser Assembly, 3 1/2 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700610</td>
<td>Riser Assembly, 4 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700612</td>
<td>Riser Assembly, 5 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.700613</td>
<td>Riser Assembly, 6 inch Diameter</td>
<td>Each</td>
</tr>
<tr>
<td>680.71</td>
<td>Shielded Lead-in Cable</td>
<td>Foot</td>
</tr>
<tr>
<td>680.72</td>
<td>Inductance Loop Wire</td>
<td>Foot</td>
</tr>
<tr>
<td>680.73XXX</td>
<td>Signa Cable</td>
<td>Foot</td>
</tr>
<tr>
<td>680.74XXX</td>
<td>Signa Cable with Integral Messenger</td>
<td>Foot</td>
</tr>
</tbody>
</table>

*XX = Number of Conductors

*YY = Wire Gauge*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>680.75XXX</td>
<td>Shielded Communication Cable</td>
<td>Foot</td>
</tr>
<tr>
<td>680.76XXX</td>
<td>Shielded Communication Cable with Integral Messenger</td>
<td>Foot</td>
</tr>
</tbody>
</table>

*XX = Number of Pairs

*YY = Wire Gauge*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>680.810101</td>
<td>Traffic Signal Module - 12 inch, Red Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810102</td>
<td>Traffic Signal Module - 12 inch, Red Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810103</td>
<td>Traffic Signal Module-12 inch Yellow Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810104</td>
<td>Traffic Signal Module-12 inch Yellow Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810105</td>
<td>Traffic Signal Module - 12 inch, Green Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810106</td>
<td>Traffic Signal Module - 12 inch, Green Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810107</td>
<td>Traffic Signal Section - Type I, 12 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.810108</td>
<td>Traffic Signal Module - 12 inch, Bi-Modal Yellow/Green Arrows, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.8102</td>
<td>Traffic Signal Section, Optically Programmed - 12 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.810301</td>
<td>Traffic Signal Module - 8 inch, Red Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810302</td>
<td>Traffic Signal Module - 8 inch, Red Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810303</td>
<td>Traffic Signal Module- 8 inch Yellow Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810304</td>
<td>Traffic Signal Module- 8 inch Yellow Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810305</td>
<td>Traffic Signal Module - 8 inch, Green Ball, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810306</td>
<td>Traffic Signal Module - 8 inch, Green Arrow, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.810307</td>
<td>Traffic Signal Section - Type I, 8 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.810308</td>
<td>Install Ball/Arrow LED Traffic Signal Module</td>
<td>Each</td>
</tr>
<tr>
<td>680.810309</td>
<td>Traffic Signal Section - Polycarbonate, Type I, 12 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.810701</td>
<td>Traffic Signal Section - Polycarbonate, Type I, 8 inch</td>
<td>Each</td>
</tr>
<tr>
<td>Item Number</td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>680.8111</td>
<td>Traffic Signal Bracket Assembly 1 Way</td>
<td>Each</td>
</tr>
<tr>
<td>680.8112</td>
<td>Traffic Signal Bracket Assembly 2 Way</td>
<td>Each</td>
</tr>
<tr>
<td>680.8113</td>
<td>Traffic Signal Bracket Assembly 3 Way</td>
<td>Each</td>
</tr>
<tr>
<td>680.8114</td>
<td>Traffic Signal Bracket Assembly 4 Way</td>
<td>Each</td>
</tr>
<tr>
<td>680.8115</td>
<td>Traffic Signal Bracket Assembly 5 Way</td>
<td>Each</td>
</tr>
<tr>
<td>680.8120</td>
<td>Traffic Signal Disconnect Hanger</td>
<td>Each</td>
</tr>
<tr>
<td>680.813101</td>
<td>Pedestrian Signal Module - 12 inch, Hand Symbol, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.813102</td>
<td>Pedestrian Signal Module - 12 inch by 12 inch MAN LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.813103</td>
<td>Pedestrian Signal Section - Type I, 12 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.813104</td>
<td>Install LED Pedestrian Signal Module</td>
<td>Each</td>
</tr>
<tr>
<td>680.813105</td>
<td>Pedestrian Signal Module - 12 inch, Bi-Modal Hand/Man Symbols, LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.813106</td>
<td>Pedestrian Signal Section - Polycarbonate, Type I, 12 inch</td>
<td>Each</td>
</tr>
<tr>
<td>680.813107</td>
<td>Pedestrian Signal Module – 16 inch by 18 inch Bi-Modal HAND/MAN LED</td>
<td>Each</td>
</tr>
<tr>
<td>680.813108</td>
<td>Pedestrian Signal Section, Type I - for 16 inch by 18 inch LED module</td>
<td>Each</td>
</tr>
<tr>
<td>680.813109</td>
<td>Pedestrian Signal Section - Polycarbonate, Type I- for 16 inch by 18 inch LED module</td>
<td>Each</td>
</tr>
<tr>
<td>680.8141</td>
<td>Pedestrian Signal Bracket Mount Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>680.8142</td>
<td>Pedestrian Signal Post Top Mount Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>680.82XX</td>
<td>Overhead Sign Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>XX = Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>680.8220</td>
<td>Flashing Beacon Sign Assembly</td>
<td>Each</td>
</tr>
<tr>
<td>680.8225</td>
<td>Pedestrian Push Button and Sign - without Post</td>
<td>Each</td>
</tr>
<tr>
<td>680.8226</td>
<td>Pedestrian Push Button and Sign - with Post</td>
<td>Each</td>
</tr>
<tr>
<td>680.8230</td>
<td>Fire Pre-Emption Tell Tale Light</td>
<td>Each</td>
</tr>
</tbody>
</table>

**NOTE:** SEE PAY ITEM CATALOG 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 AND 682 (VACANT)**

**SECTION 683 - INTELLIGENT TRANSPORTATION SYSTEMS**

**683-1 DESCRIPTION.** The work in this section shall include work required for intelligent transportation systems.

**683-2 MATERIALS.** Materials shall be as specified in the special specifications.

**683-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**683-4 METHOD OF MEASUREMENT.** As specified in the special specifications.
683-5 BASIS OF PAYMENT. As specified in the special specifications.

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 MUTCD 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 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 30 feet 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 pavement surface temperature shall be minimum of 50°F and the ambient temperature shall be a minimum of 50°F 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 100,000 feet 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 20 lb/gal 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 20 lb/gal 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 three feet 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, grayish 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 feet along the centerline of the pavement stripe and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (inches) x Feet} \\
\frac{4 \text{ inches}}{}
\]

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 (MUTCD Figure 8B-6) will be measured by feet of 4 inch 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 feet of skips in the dashed line.
Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>685.01</td>
<td>White Epoxy Reflectorized Pavement Stripes – 15 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>685.02</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes – 15 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>685.03</td>
<td>White Epoxy Reflectorized Pavement Letters – 15 mils</td>
<td>Each</td>
</tr>
<tr>
<td>685.04</td>
<td>White Epoxy Reflectorized Pavement Symbols – 15 mils</td>
<td>Each</td>
</tr>
<tr>
<td>685.11</td>
<td>White Epoxy Reflectorized Pavement Stripes – 20 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>685.12</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes – 20 mils</td>
<td>Feet</td>
</tr>
<tr>
<td>685.13</td>
<td>White Epoxy Reflectorized Pavement Letters – 20 mils</td>
<td>Each</td>
</tr>
<tr>
<td>685.14</td>
<td>White Epoxy Reflectorized Pavement Symbols – 20 mils</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 MUTCD 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 applicating 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 65,000 feet of longitudinal pavement marking lines will be striped using only mobile applicating equipment for the longitudinal lines. Longitudinal pavement marking lines are Broken Lines (skipline), Edge Lines, Barrier Lines, and Solid Lines as defined by the MUTCD Portable applicating 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 applicating 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 applicating equipment. The kettle(s) shall be capable of heating the thermoplastic composition temperatures greater than 400°F. 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 400°F, and at the widths and thicknesses specified herein. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 feet 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 400°F.

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 400°F; and shall be capable of extruding a line between 3 to 8 inches in width; and at a thickness of not less than 1/8 inch nor more than 3/16 inch, 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 400°F, of extruding a line of from 3 to 8 inches in width, and in thickness of not less than 1/8 inch nor more than 3/16 inch 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 MUTCD.

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 30 feet 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 55°F and the ambient temperatures shall be a minimum of 50°F and rising. The Engineer will determine when atmospheric conditions are such to produce satisfactory results (Note 2).

Note 2. To comply with the 55°F 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 400°F 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 1/8 inch nor more than 3/16 inch.

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 lb per 20 square feet 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 400°F 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 foot along the centerline of the pavement stripe, and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inch as shown on the plans or as directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (inches)} \times \text{Feet} \\
\quad \div 4 \text{ inches}
\]

No payment will be made for the number of feet 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 (MUTCD Figure 8B-6) will be measured by feet of 4 inch 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.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>687.0101</td>
<td>White Thermoplastic Reflectorized Pavement Stripes</td>
<td>Feet</td>
</tr>
<tr>
<td>687.0201</td>
<td>Yellow Thermoplastic Reflectorized Pavement Stripes</td>
<td>Feet</td>
</tr>
</tbody>
</table>
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 MUTCD 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 MUTCD.

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 30 feet 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 100°F and 170°F.

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 688-1 TEMPERATURE AND SEASONAL REQUIREMENTS
(§688–3.02b. ON COMPLETED PAVEMENTS)

<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) Region 8 (Ulster County only)</td>
<td>70°F, Min.</td>
<td>60°F, Min.</td>
<td>May 15 to September 1</td>
</tr>
<tr>
<td>Regions 8 &amp; 10 (except Ulster County)</td>
<td>70°F, Min.</td>
<td>60°F, Min.</td>
<td>May 15 to September 15</td>
</tr>
<tr>
<td>Region 11</td>
<td>70°F, Min.</td>
<td>60°F, Min.</td>
<td>May 1 to September 30</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 100± feet apart.
2. Ambient air temperatures shall be measured in the shade.

**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 200 lbs on each axle. Pneumatic rubber–tired rollers shall exert a minimum tire compression on the pavement of 28 psi. 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 one inch 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 applying 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 3.0 mph. 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 100°F and 170°F. 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 feet along the centerline of the pavement stripe and will be based on a 4 inch 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 500 feet long pavement section.
B. Dotted Line. 50 percent measured longitudinally of the total length of all dotted lines in any 100 feet 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 500 feet 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 500 feet pavement section, the edgeline will be measured as the full 500 feet of applied marking. No deduction will be made for the damaged 5% (25 feet) of striping).

Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or as directed by the Engineer, will be made by the following method:

\[ \text{Plan Width of Striping (inches) x Feet} \]
\[ \frac{\text{4 inches}}{\text{Feet}} \]

No payment will be made for the number of feet 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 (MUTCD Figure 8B-6) will be measured by feet of 4 inch 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>Feet</td>
</tr>
<tr>
<td>688.02</td>
<td>Yellow Preformed Reflectorized Pavement Stripes</td>
<td>Feet</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>

SECTION 689 (VACANT)
SECTION 690 - SPECIALTY WORK

690-1 DESCRIPTION. The work in this section shall include specialty work required for transportation projects.

690-2 MATERIALS. Materials shall be as specified in the special specifications.

690-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

690-4 METHOD OF MEASUREMENT. As specified in the special specifications.

690-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTIONS 691 THRU 695 - (VACANT)

SECTION 696 - CONTRACTOR CHARGES

696-1 DESCRIPTION. This section will provide for the accounting of charges assessed against the Contractor in accordance with the contract documents.

696-2 MATERIALS. None specified.

696-3 CONSTRUCTION DETAILS. The Department may assess the Contractor charges for Engineering Charges and/or Liquidated Damages against monies due the Contractor in accordance with §108-03 Failure to Complete Work On Time, or may make other charges in accordance with the contract. These charges will be assessed using the contract pay items in this section.

696-4 METHOD OF MEASUREMENT. These contract pay items will not be shown in the itemized proposal. Contractor charges will be measured on a Dollars-Cents basis.

696-5 BASIS OF PAYMENT. Should the Contractor be assessed charges, the amounts will be accounted for using the contract pay items in this section. Assessed charges will be deducted from a contract payment processed after the determination that charges will be made, or, if the Contractor is not due monies sufficient to recover the assessed charges, the State may utilize other methods of recovery.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>696.01</td>
<td>Engineering Charges</td>
<td>Dollars Cents</td>
</tr>
<tr>
<td>696.02</td>
<td>Liquidated Damages</td>
<td>Dollars Cents</td>
</tr>
<tr>
<td>696.03</td>
<td>Contractor Charges – Other</td>
<td>Dollars Cents</td>
</tr>
</tbody>
</table>

SECTION 697 - FIELD CHANGE PAYMENT

697-1 DESCRIPTION
697-1.01 General. The Field Change Payment (FCP) provides a contract contingency allowance for the timely payment of authorized extra work that was completed to fulfill the intent of the contract documents.

697-1.02 Eligible Work. Only the following extra work will be eligible for FCP item payments:

1. Work within the scope of the contract.
2. Completed additional quantities of existing contract items of work processed as unit bid prices:
   - Up to 200% of original contract quantity for Minor Items of work.
   - More than 200% of a Minor Item original contract quantity that results in an increase less than $1,000.00 from the original contract amount.
   - Up to 125% of original contract quantity for Major Items of work.
3. Completed additional quantities of existing contract items that have exceeded the threshold quantities, but have unit bid prices that are acceptable by comparison to the Weighted Average Awarded Prices or the Average of the Three Lowest Bidders.
4. Completed additional quantities of existing contract items that have exceeded the threshold quantities, which requires the use of new item numbers, and renegotiated prices that are acceptable by comparison to the Weighted Average Awarded Prices or the Average of the Three Lowest Bidders.
5. Completed quantities of new contract items of work with Agreed Prices that are acceptable by comparison to the Weighted Average Awarded Prices.
6. Fuel, Asphalt, or Steel Adjustment items calculated for eligible work completed.

697-2 MATERIALS. None specified.

697-3 CONSTRUCTION DETAILS. None specified.

697-4 METHOD OF MEASUREMENT. The unit price shown in the proposal for this item will be considered as the unit price bid and shall not be altered in any manner. Should the amount shown be altered, the figure entered will be disregarded and the original unit price will be used to determine the total amount bid for the contract.

697-5 BASIS OF PAYMENT. All work to be paid under the FCP item must receive prior authorization in conformance with §104-02 Changes, Contingencies, Extra Work and Deductions. Disputed work, force account work, work associated with §104-10 Value Engineering Change Proposals, or payments for time-related provisions are not eligible for FCP item payment.

FCP item payments will be determined from the quantities and unit prices of eligible work that have been completed. Work for which FCP item payments are processed will be paid in accordance with the specifications governing the work.

Prior to processing the final agreement, the FCP item payments will be reconciled through an Order-on-Contract, such that the amount of FCP item payments is converted to the corresponding quantities of the pertinent contract pay items. When the amount of FCP item payments is transferred to the appropriate items, the remaining amount of FCP 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>697.03</td>
<td>Field Change Payment (FCP)</td>
<td>Dollars-Cents</td>
</tr>
</tbody>
</table>

SECTION 698 - PRICE ADJUSTMENTS

(Last Revised September, 2016)
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.

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 contract 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 contract 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 eligible and identified by the Contractor which will be permanently incorporated into the work.

698-2 MATERIALS. None specified.

698-3 CONSTRUCTION DETAILS. 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.

The monthly average asphalt prices, monthly average fuel prices, steel cost basis and steel index values will be posted in the Engineering Bulletin entitled Fuel, Asphalt and Steel Price Adjustments.

If eligible items are installed after the contract completion date, when an extension of time without the assessment of engineering charges and/or liquidated damages is approved, the monthly average posted price or monthly steel index value will be used to compute price adjustments.

If eligible items are installed after the contract completion date, when an extension of time was approved with the assessment of engineering charges and/or liquidated damages, the monthly average posted price or monthly steel index in effect on the last contract completion date without the assessment of engineering charges and/or liquidated damages, or the value for the month of installation/purchase, whichever is less, will be used to compute price adjustments.

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 adjustment will be made if the monthly average posted price is within $15.00 of the asphalt index price. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price.

A. Prices. The asphalt index price and the monthly average posted price are defined as follows:

1. Asphalt Index Price. The asphalt index price is a price per ton of Performance Graded Binder (PGB) used solely as a basis from which to compute asphalt price adjustments. The asphalt index price for original contract bid price items and additional work at the original contract bid price will be the monthly average posted price for the month of the bid letting. The asphalt 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 terminal price for unmodified PG 64S-22 binder, without anti-stripping agent, determined by the Department, based on prices of approved primary sources of PGB.
**B. Quantity.** The quantity of asphalt in tons considered for adjustment will be determined by multiplying the quantity of eligible work completed by the conversion factors listed in the Special Note entitled *Asphalt Price Adjustment*.

**C. Adjustment.** Asphalt price adjustment will be based on the following formulas:

1. **When price increases:** Price Adjustment = (Quantity of Asphalt) x (Monthly Average Posted Price - PGB Index Price - $15.00)

2. **When price decreases:** Price Adjustment = (Quantity of Asphalt) x (Monthly Average Posted Price - PGB Index Price + $15.00)

**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 adjustment will be made if the monthly average posted price is within $0.10 per gallon of the fuel index price. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price.

**A. Prices.** The fuel index price and the monthly average posted price are defined as follows:

1. **Fuel Index Price.** A price per gallon of fuel used solely as a basis from which to compute fuel price adjustments. The fuel index price for original contract bid price items and 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 refinery or terminal price based on prices for ultra low sulfur diesel (ULSD) and gasoline.

**B. Quantity.** The quantity of fuel in gallons considered for adjustment will be determined by multiplying the quantity of eligible work completed by the fuel usage factor listed in the Special Note entitled *Fuel Price Adjustment*.

**C. Adjustment.** Fuel price adjustment will be based on the following formulas:

1. **When price increases:** Price Adjustment = (Quantity of Fuel) x (Monthly Average Posted Price - Fuel Index Price - $0.10)

2. **When price decreases:** Price Adjustment = (Quantity of Fuel) x (Monthly Average Posted Price - Fuel Index Price + $0.10)

**698-3.03 Steel/Iron Price Adjustment.** Within 30 calendar days after award, the Contractor shall provide the Engineer with a list of materials to which the Contractor opts to apply the steel price adjustment, identifying the materials by groups of similar material content within a core (3 digit) contract pay item (e.g. 564 *Structural Steel* or 603.05xxxx *Corrugated Steel Pipe*). For each material listed, the Contractor shall also identify the parties whose relationship establishes the invoice date. If the two parties are known, they shall be identified by name. If the two parties are not known, they shall be identified by role (Contractor, Subcontractor, Material Supplier, Fabricator, Manufacturer, Mill, etc.). Different parties may be identified for individual or groups of contract pay items for the purposes of establishing an invoice date. If the Contractor does not provide a list of materials to which to apply the steel price adjustment, no steel price adjustment will be made.
If the percentage change for a given month does not exceed 5% plus or minus, from the benchmark steel index, no adjustments will be made for materials invoiced that month. For lump sum or each items that are assembled from numerous components, such as overhead sign structures, the percentage change will be determined for the assembled contract pay item using the month that the largest value of materials were invoiced. For unit price items such as guiderail 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 exclude minor appurtenances individually weighing less than 5 lbs (i.e., nuts, bolts, washers, etc.). 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: Department established weights of steel/iron by contract pay item per pay unit; approved shop drawings; verified shipping documents; contract documents; Standard Sheets; industry standards (i.e., AISC Manual of Steel Construction, AWWA Standards, etc.); and manufacturer’s data.

A. Indexes and Prices. Adjustments are based on the Producer Price Index (PPI) for Semifinished Steel Mill Products (WPU 101702). PPI values are published by the US Department of Labor, Bureau of Labor Statistics (BLS). Recent PPI values are posted on the Office of Construction website at www.dot.ny.gov. A complete listing of PPI values can be found on the BLS website at http://data.bls.gov/PDQ/outside.jsp?survey=wp. The Cost Basis, Benchmark Steel Index, Monthly Steel Index, and the Percentage Change are defined as follows:

1. Cost Basis (CB). An average price of steel products in dollars per ton used solely as a cost basis from which to compute steel/iron price adjustments. The cost basis for original contract bid price items and 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.

2. Benchmark Steel Index (BI). The benchmark steel index for original contract bid price items and additional work at the original contract bid price will be the value of the preliminary PPI for the month of the bid letting. The benchmark steel index for additional work at agreed price will be the value of the preliminary PPI for the month the agreed price was submitted to the Engineer.

3. Monthly Steel Index (MI). Value of the preliminary PPI for the month the material is invoiced. If a preliminary PPI is not posted for a given month, the value will be the average of the preceding and following months that are posted.

4. Percent Change. The percent change in any given month will be determined as follows:

\[
\text{Percentage Change} = \left( \frac{MI - BI}{BI} \right) \times 100
\]

B. Quantity. The quantity of steel and/or iron for adjustment for each core (3-digit) contract pay item number (e.g., 564 – Structural Steel) will be measured to the nearest 0.1 Tons.

1. Percent Change Greater Than +5%. If the Percentage Change is greater than +5% from the benchmark steel index, 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 within 60 calendar days after installation, 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 is between -5% and +5%, inclusive, from the benchmark steel index, no adjustments will be made for materials invoiced that month.

3. **Percent Change Lower Than -5%**. If the Percentage Change is lower than -5% from the benchmark steel index, a Price Adjustment 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 within 60 calendar days after installation, including: the contract pay item, the weight of steel/iron, the month(s) of invoice, the source used to determine the weight, and copies of invoices to verify the month of invoice.

**C. Adjustment.** Steel/Iron price adjustment will be made for the materials which the Contractor opted to apply the steel price adjustment, based on the following formulas:

1. When price increases:
   
   \[
   \text{Price Adjustment} = \left( \frac{MI - BI}{BI} \right) - 0.05 \cdot (CB) \cdot \text{Qty}
   \]

2. When price decreases:

   \[
   \text{Price Adjustment} = - \left( \frac{MI - BI}{BI} \right) + 0.05 \cdot (CB) \cdot \text{Qty}
   \]

**698-4 METHOD OF MEASUREMENT. 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.** 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.

If price adjustments are based on estimated material quantities, and a revision to the estimated 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 adjustment factors initially used to calculate the price adjustment. 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.

**698-5.01 Asphalt Price Adjustment.** The asphalt price adjustment will be based on the monthly average posted price in effect at the time the work is completed, calculated using the price adjustment formula described above.

**698-5.02 Fuel Price Adjustment.** The fuel price adjustment will be based on the monthly average posted price in effect at the time the work is completed, calculated using the price adjustment formula described above.
698-5.03 **Steel/Iron Price Adjustment.** The steel/iron price adjustment will be based on the monthly steel index in effect at the time of invoice between the two parties previously identified by the Contractor, calculated using the price adjustment formula described above.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>698.04</td>
<td>Asphalt Price Adjustment</td>
<td>Dollars Cents</td>
</tr>
<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>
</tr>
</tbody>
</table>

SECTION 699 - MOBILIZATION

699-1 **DESCRIPTION.** Under this work the Contractor shall provide necessary bonds, insurance, and prefunding 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:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>699.040001</td>
<td>Mobilization</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>