NY ROUTE 347
(TERRY RD. TO GIBBS POND RD.)

PIN 0054.18, Contract D900033

DB CONTRACT DOCUMENTS
PART 8

SPECIAL SPECIFICATIONS

Final December 16, 2015
This Part 8 – Special Specifications provides access to, and details the Project-specific requirements for the use of, the following documents:

1. NYSDOT Standard Specifications and Construction Materials
2. NYSDOT Engineering Information Issuances
3. NYSDOT Special Specifications.

**NYSDOT Standard Specifications and Construction Materials**


The NYSDOT Standard Specifications Construction Materials can be accessed at the following internet link:


**NYSDOT Engineering Information Issuances**

The Design-Builder shall use the relevant NYSDOT engineering information issuances, which include:

1. Engineering Instructions (EI);
2. Engineering Bulletins (EB);
3. Engineering Directives (ED).

The above listed engineering information issuances can be accessed at the following internet link:


**NYSDOT Special Specifications**

The Design-Builder *may* use NYSDOT Special Specifications which are listed in the Electronic Pay Item Catalog (e-PIC) and which have received General Approval, and *shall* use any NYSDOT Special Specifications which are referenced in this Part 8 or elsewhere in the Contract Documents. Delete and ignore sections in the NYSDOT Special Specifications titled Method of Measurement and Basis of Payment from the NYSDOT Special Specifications.

NYSDOT Special Specifications can be accessed at the following internet link:


The NYSDOT e-PIC may be accessed at the following internet link:

[https://www.dot.ny.gov/pic](https://www.dot.ny.gov/pic)

The following Special Specifications are attached herein:
608.0102_05 - COLORED AND IMPRINTED PORTLAND CEMENT CONCRETE SIDEWALK
610.0110_10 – PLANTER BACKFILL MIX
610.14_11 – STRUCTURAL SOIL MIX
611.190X0024 – POST PLANTING CARE WITH REPLACEMENT
615.25153001 – BUS SHELTER (XX METERS X YY METERS)
615.27020010 – Bicycle Rack (DESIGN CAPACITY XX BICYCLES)
634.99010017 – BUILDING CONDITION SURVEY
634.99020017 – VIBRATION MONITORING (NONBLASTING)
645.03010011 - HIGH VISIBILITY OVERHEAD-MOUNTED SIGN PANELS
645.03020011 - HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS WITHOUT Z-BARS
645.03030011 - HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS GREATER THAN 30 SF WITH Z-BARS
645.03040011 - HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS LESS THAN OR EQUAL TO 30 SF WITH Z-BARS
645.92_11 - INTERPRETIVE SIGNS
670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION
670.95020010 - SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) DECORATIVE LUMINAIRE, POLE AND FOUNDATION
670.98000010 - SOLAR POWERED 25W LIGHT EMITTING DIODE (LED) BUS SHELTER LUMINAIRE
680.06040110 – Paint New Aluminum Traffic Signal Cabinets
680.20301003 – Painted Traffic Signal Pole – Span Wire 30 KN Load, 10m length
680.20401003 – Painted Traffic Signal Pole – Span Wire 40 KN Load, 10m length
680.20501003 – Painted Traffic Signal Pole – Span Wire 50 KN Load, 10m length
680.20601003 – Painted Traffic Signal Pole – Span Wire 60 KN Load, 10m length
680.20601203 – Painted Traffic Signal Pole – Span Wire 60 KN Load, 12m length
680.51050010 - RECTANGULAR REINFORCED CONCRETE PULLBOX
680.51400010 - CONCRETE FIBER OPTIC PULLBOX
680.67240309 – Pedestrian Pole Top Mount – Painted
680.80324515 - INSTALL MICROCOMPUTER CABINET
680.80326410 - TYPE E CABINET
680.81500010 - PEDESTRIAN COUNT-DOWN TIMER MODULE
680.82540009 - PREEMPT SYSTEM - DETECTOR CABLE, SHIELDED, 3 CONDUCTOR WITH STRANDED GROUND, AWG #20
680.94997008 - FURNISH AND INSTALL ELECTRICAL DISCONNECT / GENERATOR TRANSFER SWITCH
680.95020615 - SERVICE CABLE 2 CONDUCTOR, NO. 06 AWG
683.07010010 – FIBER OPTIC INNERDUCT, 2 CHANNEL
683.07207210 – SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
683.07250010 – FIBER OPTIC DROP CABLE
683.10120010 - CCTV DOME CAMERA ASSEMBLY
683.107X0010 - CCTV VIDEO AND PTZ FIBER OPTIC TRANSCEIVER  
683.10800010 - FIBER OPTIC VIDEO MULTIPLEXER PAIR8 CHANNEL  
683.93530010 - WIRELESS BROADBAND RADIO ASSEMBLY - INTEGRATED UNIT  
685.0720XX18 - EPOXY REFLECTORIZED PAVEMENT MARKINGS – 20 MILS (WET NIGHT VISIBILITY SPHERES)  
685.0815XX08 - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)  
800.01000015 – DESIGN BUILD – DESIGN SERVICES  
800.02000015 – DESIGN BUILD – CONSTRUCTION INSPECTION SERVICES  
800.03000015 – DESIGN BUILD – QUALITY CONTROL SERVICES  
800.04000015 – DESIGN BUILD – FORCE ACCOUNT WORK  
800.05000015 – DESIGN BUILD – SITE MOBILIZATION  
800.06000115 – DESIGN BUILD – CONSTRUCTION WORK  

In the event of a discrepancy between the version of any Special Specification attached herein and the version available from the NYSDOT web site listed above, the version included in these Contract Documents shall apply.
ITEM 608.01020005 – COLORED AND IMPRINTED PORTLAND CEMENT CONCRETE SIDEWALK
ITEM 608.01030005 – COLORED PORTLAND CEMENT CONCRETE SIDEWALK
ITEM 608.01040005 – IMPRINTED PORTLAND CEMENT CONCRETE SIDEWALK

DESCRIPTION

Construct Portland cement concrete sidewalks as shown on the contract documents according to §608 of the Standard Specifications, using colored and/or imprinted concrete, including color matching joint material, when specified.

MATERIALS

Apply §608-2.01 with the following modifications:

Colored Concrete

All coloring agents shall produce a color conforming to the Federal Standard 595B. The color shall be as indicated on plans.

Color admixtures for integrally colored concrete will be certified by the manufacturer as meeting the requirements of ASTM C979 Standard Specifications for Pigments for Integrally Colored Concrete and be packaged such that one dose is the proper dosage for one cubic yard of concrete.

Imprinted Concrete

Use imprinting tools capable of imprinting the surface of the concrete with a uniform and aligned pattern and/or texture. Use a clear release agent as specified by the imprinting tool manufacturer. These materials shall be approved by the Engineer prior to their use.

Color Matching Joint Material

When specified for any location, use a color matched caulking compound designed for joint sealing.

CONSTRUCTION DETAILS

Apply §608-3.01 with the following modifications:

Test Panels

Prior to the start of work, the Contractor shall show evidence of successful completion of similar installations. The Contractor shall construct a job site test panel for each individual color and pattern or combination of color and pattern specified in the contract documents. The test panel(s) shall be 5 feet x 5 feet, minimum, and constructed at a location selected by the Engineer. As many test panels will be constructed as are necessary to produce sample panels that meet the approval of the Engineer. The permanent work shall be consistent with the appearance of the approved test panel(s) as determined by the Engineer. The test panel(s) shall not be incorporated into the work and will be removed when ordered by the Engineer.
Colored Concrete

Apply color admixtures and dry shake additives at the manufacturers recommended dosage rate. This rate is to remain constant for all batches of concrete produced. Prior to placing concrete, protect adjacent surfaces and structures from spatters. Once a portion of the batch has been placed, no additional water shall be added to the remaining batch.

To integrally color the concrete, introduce the color additive into the mixer drum in a manner recommended by the manufacturer. The quantity of concrete being delivered shall be no less than one-third the capacity of the mixer drum. Batch the concrete in full cubic yard increments.

After the concrete is placed, apply a color matching hardener evenly to the plastic surface by the “dry shake” method as recommended by the manufacturer.

Imprinted Concrete

Screed concrete to the finished grade and apply release agent. Using methods as recommended by the manufacturer, apply pre-approved imprinting tools to the surface while the concrete is still plastic. The requirement for a lightly broomed surface is waived.

Unless otherwise specified, score or saw cut the surface to a minimum depth of ¼ the thickness of the slab at intervals of 5 feet. Tool the edges, joints and scored areas in a manner consistent with the imprinting pattern. If the saw cut option is used, the Contractor shall be responsible for performing the saw cut operation at such time as to minimize the possibility of spalling and/or cracking.

Within 24 hours, remove release agent with pressure wash and apply a pre-approved sealer, recommended by the coloring manufacturer, at a rate consistent with manufacturer’s specifications.

Color Matching Joint Material

Install pre-molded resilient joint filler (§705-07) where the sidewalk line intersects a building, walk, permanent structure or other location designated by the Engineer, to within 1-inch of the top of the slab. Caulk the top 1-inch of the joint with color matching caulking compound.

**METHOD OF MEASUREMENT**

Apply §608-4.01
ITEM 608.01020005 – COLORED AND IMPRINTED PORTLAND CEMENT CONCRETE SIDEWALK
ITEM 608.01030005 – COLORED PORTLAND CEMENT CONCRETE SIDEWALK
ITEM 608.01040005 – IMPRINTED PORTLAND CEMENT CONCRETE SIDEWALK

BASIS OF PAYMENT

Apply §608-5.01

The cost of construction and removal of the test panel(s) is to be included in the price bid for the specified item(s).

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>608.01020005</td>
<td>Colored and Imprinted Portland Cement</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td></td>
<td>Concrete Sidewalk</td>
<td></td>
</tr>
<tr>
<td>608.01030005</td>
<td>Colored Portland Cement Concrete Sidewalk</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>608.01040005</td>
<td>Imprinted Portland Cement Concrete Sidewalk</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
ITEM 610.0110XX10 - PLANTER BACKFILL MIX

DESCRIPTION
Under this item the Contractor shall furnish and place planter backfill mix in accordance with the contract documents and as approved by the Engineer.

The mix shall be used in all landscape locations indicated in the contract documents.

When using the “as specified” payment item, refer to a special note in the contract documents titled, “Planter Backfill Mix”. This note will include the
- specifications for the mix,
- material requirements,
- references to NYSDOT standard material specifications,
- references to ASTM specifications,
- mix components and proportions,
- acceptance criteria, and
- other construction details.

MATERIALS
The following sections of the standard specifications shall apply:

  Topsoil 713-01
  Moisture Retention Additive 713-10
  Compost 713-15

The following ASTM specifications shall apply:

    Structural Concrete
  Standard Specification for Lightweight Aggregates for ASTM C331
    Concrete Masonry Units

Refer to the contract documents for replacement/additional material requirements when the “as specified” payment item is used.

Planter Backfill Mix - Standard
The “standard” planter backfill mix shall contain the following components:

1. Compost shall be as per §713-15 D. Leaf Compost OR E. Well Rotted Manure.
2. Topsoil shall be as per §713-01 B.2. – Topsoil – Lawns.
3. Moisture Retention Additive (MRA) shall be as per §713-10.
4. Expanded Shale shall:
   - be a lightweight aggregate
   - meet size gradation of 0.35 inch to 1.0 inch
   - comply with ASTM Standards C-330 and C-331.
   - weigh approximately 1215 lbs/ cubic yard.
   - be accompanied by a producer’s or supplier’s certification as per §10 of ASTM C330 and ASTM C331. Certification must be received prior to including this material in
Planter Backfill Mix – “As Specified”
Refer to the contract documents for replacement/additional planter backfill mix components when the “as specified” payment item is used.

CONSTRUCTION DETAILS
Planter backfill material shall be thoroughly premixed in the proportions stated in this specification or in the contract documents and shall be placed to the depths and dimensions shown in the contract documents. The planter backfill mix shall be thoroughly settled by firming or tamping in an approved manner. All other construction details shall be as per the contract documents.

Planter Backfill Mix - Standard
- The topsoil shall be premixed with MRA at a rate of 1.5 lbs of MRA/cubic yard of topsoil prior to mixing with other materials.
- The resulting topsoil/MRA mix shall be combined with compost material and expanded shale in the following proportions:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Shale</td>
<td>60%</td>
</tr>
<tr>
<td>Topsoil with Moisture Retention Additive</td>
<td>25%</td>
</tr>
<tr>
<td>Compost</td>
<td>15%</td>
</tr>
</tbody>
</table>

Planter backfill mix areas shall be accepted when:

- The materials to be incorporated into the mix satisfy the material requirements described above or in the contract documents and are approved.
- The topsoil is properly premixed with the MRA in the manner described above and is approved. If the topsoil and MRA are mixed off-site, the Contractor needs to provide the state access to the mix to verify the mix materials, as previously approved, and proportions.
- The planter backfill mix is thoroughly premixed in the proportions described above and approved. If the planter backfill mix is prepared off-site, the Contractor needs to provide the state access to the mix to verify the materials, as previously approved, and proportions.
- The planter backfill mix is installed at the locations indicated and in the manner described in this specification and in the contract documents.

Planter Backfill Mix – “As Specified”
Refer to the special note in the contract documents titled, “Planter Backfill Mix” for replacement/additional planter backfill mix proportions, acceptance criteria and other construction details when the “as specified” payment item is used.

METHOD OF MEASUREMENT
The work will be measured as the number of cubic yards of planter backfill mix furnished and placed. Measurement shall be made “in place”.

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May, 2014
**ITEM 610.0110XX10 - PLANTER BACKFILL MIX**

**BASIS OF PAYMENT**
The unit price bid per cubic yard for planter backfill mix shall include the cost of furnishing all labor, material and equipment necessary to complete the work.

No direct payment will be made for losses of material resulting from compaction, foundation settlement, erosion or any other cause. The cost of such losses shall be included in the price bid for this item. No deductions will be made for the volumes occupied by light poles, sign pedestals and any other such objects.

Payment will be made under the following pay items:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>610.01100110</td>
<td>Planter Backfill Mix – Standard</td>
<td>CY</td>
</tr>
<tr>
<td>610.01100210</td>
<td>Planter Backfill Mix – As Specified</td>
<td>CY</td>
</tr>
</tbody>
</table>
ITEM 610.14000011 – STRUCTURAL SOIL MIX

DESCRIPTION
Under this item the Contractor shall furnish and place Structural Soil Mix in accordance with the contract documents and as directed by the Engineer.

MATERIALS
Structural Soil Mix shall be a mixture of crushed stone, clay loam, hydrogel and amendments meeting the requirements of “CU Structural Soil®” patented by Cornell University (Patent #5,849,069) also known as “CU SoilTM” The material shall be obtained from a Producer sub-licensed by Amereq, the exclusive Licensee of Cornell University for CU-Structural Soil®. Proof of such sub-licensing shall be submitted to the Engineer along with a sample of the finished mix, prior to delivery to the site. A list of sub-licensed Producers can be obtained from:

Amereq Inc.
“CU SoilTM” Division
19 Squadron Blvd. New City, New York 10956,
phone: (800) 832-8788 ext. 11
contact: bkalter@amereq.com

Water: Shall comply with Standard Specifications Section 712-01.

CONSTRUCTION DETAILS

Mixing and Quality Control Testing: All Structural Soil components, including any organic material, water, or other amendments necessary to meet the requirements of CU-Structural Soil® shall be mixed by a licensed Producer at that Producer’s yard prior to delivery. No mixing shall be done at the project site. Sufficient time must be allowed prior to delivery for the Producer’s internal quality control, independent laboratory testing, analysis and (if necessary) amendment of the mix.

Delivery, Storage and Handling: The Contractor shall arrange for delivery of the Structural Soil Mix to the site, either by the Producer, or the Contractor’s own forces. The Contractor shall ensure that the delivered Mix is received from the Producer at or near optimum compaction moisture content as determined by AASHTO T-99 (ASTM D698) and shall protect the Mix from drying out or from excess moisture until placed. The Mix shall also be protected from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution.

Structural Soil Mix shall not be transported when rain is expected. If not placed the day of delivery, it shall be stored and protected from excess water absorption and/or potential erosion.

The Engineer shall obtain and furnish to the EIC, a ticket ensuring that the delivered Structural Soil Mix was obtained from and mixed by a licensed Producer. The delivered Structural Soil Mix should also be compared to the original sample to ensure consistency.
ITEM 610.14000011 – STRUCTURAL SOIL MIX

**Placement:** The Contractor shall notify the Engineer of any subsurface conditions which may affect the Contractor’s ability to install the Structural Soil Mix. If subsurface drain lines are included, they shall be installed prior to placement of the mix.

The Mix shall not be worked when frozen, excessively wet, or under otherwise unsatisfactory conditions nor shall it be placed on frozen, wet or muddy sites. The Mix must not be excessively or incorrectly handled to the point of separation of the clay loam soil from the crushed stones.

Structural Soil Mix shall be placed in 6 inch lifts, each compacted to at least 95% Proctor Density. If compaction moisture content exceeds the optimum per AASHTO T 99 (ASTM D 698), delay compaction and protect Mix until sufficiently dry to compact.

**METHOD OF MEASUREMENT**
The quantity to be measured for payment will be in cubic yards to the nearest cubic yard of Structural Soil Mix installed.

**BASIS OF PAYMENT**
The unit bid price shall include the cost of all labor, materials and equipment necessary to complete the work satisfactorily.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>610.14000011</td>
<td>Structural Soil Mix</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
ITEM 611.19010024 - POST-PLANTING CARE WITH REPLACEMENT - MAJOR DECIDUOUS TREES
ITEM 611.19020024 - POST-PLANTING CARE WITH REPLACEMENT - MINOR DECIDUOUS TREES
ITEM 611.19030024 - POST-PLANTING CARE WITH REPLACEMENT - CONIFEROUS TREES
ITEM 611.19040024 - POST-PLANTING CARE WITH REPLACEMENT - DECIDUOUS SHRUBS
ITEM 611.19050024 - POST-PLANTING CARE WITH REPLACEMENT - EVERGREEN SHRUBS
ITEM 611.19060024 - POST-PLANTING CARE WITH REPLACEMENT– VINES, GROUNDCOVERS
ITEM 611.19070024 - POST-PLANTING CARE WITH REPLACEMENT - HERBACEOUS PLANTS

DESCRIPTION

This work consists of the care of newly planted and transplanted trees, shrubs, vines, groundcovers and other plants and replacement of plants in kind and as necessary, in accordance with the contract documents and as directed by the Engineer.

MATERIALS

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
- Trees, Shrubs and Vines 713-06
- Materials for the Protection of Plants 713-08
- Pesticides 713-13

CONSTRUCTION

Post-Planting Care. The Contractor shall perform all work as specified under Standard Specification section 611-3.05 Post-Planting Care.

Replacement Planting. Plants that die, become diseased or badly impaired during Post-Planting Care shall be removed and replaced in kind once with new, healthy plant material, in the same location as the initial planting. Replacement planting shall occur within the planting seasons shown in Standard Specification Table 611-1. For any plants replaced during the Post-Planting Care period, Post-Planting Care shall continue to the end of the period.

Replacement plants shall be planted, maintained and accepted per Standard Specification Section 611-3.01. Planting soil used in the initial planting shall be reused for replacement plants and shall be supplemented with topsoil at no additional cost if additional material is needed to meet grade and surface finish. Watering shall accompany backfilling, at no additional cost. No replacement tree shall be staked, guyed or anchored.
ITEM 611.19010024 - POST-PLANTING CARE WITH REPLACEMENT - MAJOR DECIDUOUS TREES  
ITEM 611.19020024 - POST-PLANTING CARE WITH REPLACEMENT - MINOR DECIDUOUS TREES  
ITEM 611.19030024 - POST-PLANTING CARE WITH REPLACEMENT - CONIFEROUS TREES  
ITEM 611.19040024 - POST-PLANTING CARE WITH REPLACEMENT - DECIDUOUS SHRUBS  
ITEM 611.19050024 - POST-PLANTING CARE WITH REPLACEMENT - EVERGREEN SHRUBS  
ITEM 611.19060024 - POST-PLANTING CARE WITH REPLACEMENT – VINES, GROUNDCOVERS  
ITEM 611.19070024 - POST-PLANTING CARE WITH REPLACEMENT - HERBACEOUS PLANTS  

**METHOD OF MEASUREMENT.**

The quantity to be measured for payment will be the number of plants of each type cared for and, if necessary, replaced in kind.

**BASIS OF PAYMENT.**

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>611.19010024</td>
<td>Post Planting Care with Replacement - Major Deciduous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.19020024</td>
<td>Post Planting Care with Replacement - Minor Deciduous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.19030024</td>
<td>Post Planting Care with Replacement - Coniferous Trees</td>
<td>Each</td>
</tr>
<tr>
<td>611.19040024</td>
<td>Post Planting Care with Replacement - Deciduous Shrubs</td>
<td>Each</td>
</tr>
<tr>
<td>611.19050024</td>
<td>Post Planting Care with Replacement - Evergreen Shrubs</td>
<td>Each</td>
</tr>
<tr>
<td>611.19060024</td>
<td>Post Planting Care with Replacement – Vines, Groundcovers</td>
<td>Each</td>
</tr>
<tr>
<td>611.19070024</td>
<td>Post Planting Care with Replacement - Herbaceous Plants</td>
<td>Each</td>
</tr>
</tbody>
</table>
ITEM 615.25XXYY01 – BUS SHELTER (XX METERS X YY METERS)

DESCRIPTION
Under this item, the Contractor shall erect prefabricated bus shelters of the type specified and at
the location shown on Contract Documents.

MATERIALS
As specified under special note entitled “Bus Shelter”.

CONSTRUCTION DETAILS
Within 30 days following the award of the Contract, the Contractor shall submit to the Engineer
for approval, drawings and samples of the material he wishes to install. Manufacturer warranties
and guarantees normally given as customary trade practice of materials shall be assigned to the
State of New York Department of Transportation.

The shelter shall be so erected as shown on the Plans, be true to line and grade, truly vertical and
erected in a workmanlike manner. Any parts of the shelter damaged during delivery or
installation shall be removed from the site and replaced by the Contractor at his own expense.

METHOD OF MEASUREMENT
The quantity to be paid for under this item shall be the number of shelters installed.

BASIS OF PAYMENT
The unit price bid for each shelter shall include the cost of all materials and labor necessary to
satisfactorily complete the work.

XX: Width in meters and tenths of a meter.
YY: Length in meters and tenths of a meter.
ITEM 615.27XX0010 - BICYCLE RACK (DESIGN CAPACITY XX BICYCLES)

DESCRIPTION:
This work shall consist of furnishing and installing bicycle racks in accordance with the plans and specifications or as directed by the Engineer.

MATERIALS:
The bicycle rack shall be constructed of ASTM F1083 schedule 40 steel pipe or approved equal. The Contractor shall submit shop drawings and/or catalog cuts to the Engineer for review and approval prior to the installation of the bicycle rack. Drawings shall show clearly all materials, finishes, and connecting methods.

Class A concrete shall be used for the footing.

CONSTRUCTION DETAILS:
Bicycle racks shall be constructed in accordance with this specification, the contract documents, and as directed by Engineer.

Each bicycle rack shall be permanently installed on the surface by embedding the bottom portion of the galvanized steel frame, or an extension of the frame, into concrete or by installing a surface flange mount as recommended by the manufacturer.

Assembly of bicycle rack components shall be performed in strict accordance with manufacturer’s recommendations for installation if applicable. All work shall be free of blemishes or defects, which can affect durability, strength, safety or appearance. Bicycle racks or parts that are received chipped, scratched, bent, dented, stained, or damaged or are damaged during installation as determined by the Engineer will not be accepted and shall be removed immediately from the project site and replaced with new bicycle racks or parts, which are free from all defects.

The contractor shall set the bicycle rack plumb to the height indicated in the contract documents or as directed by the Engineer.

The contractor shall protect all parts of the bicycle rack and maintain it in an undamaged condition until completion and acceptance of the contract. Any sections damaged at any time prior to final acceptance shall be repaired or replaced at the contractor’s expense.

All sidewalk restoration and excavation shall be included in the price bid for this item.

METHOD OF MEASUREMENTS:
This work will be measured as the number of bicycle racks satisfactorily furnished and installed at the locations shown on the plans or ordered by the Engineer.

BASIS OF PAYMENT:
The unit price bid for each bicycle rack shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including sidewalk restoration where necessary.
DESCRIPTION

A. Building Condition Survey. This work shall consist of performing a building condition survey(s) and preparing permanent records as indicated in the contract documents prior to the commencement of work, after completion of work, and at locations and times during construction as directed by the Engineer.

B. Vibration Monitoring (Nonblasting). This work shall consist of performing vibration monitoring of background and construction activities and preparing daily and summary report(s) of vibration readings.

MATERIALS

A. Building Condition Survey. Provide general photography and video equipment, analog or digital, capable of superimposing the date and time on all images.

B. Vibration Monitoring (Nonblasting). Provide a 3-component seismograph, capable of measuring particle velocity data in three mutually perpendicular directions. Annual factory calibration is required throughout the duration of the work.

CONSTRUCTION DETAILS

A. General. The Contractor shall engage the services of a firm capable of furnishing a New York State licensed Professional Engineer to conduct a condition survey of the existing building(s) indicated in the contract documents in the Special Note entitled Vibration Criteria and an experienced vibration monitoring Consultant to measure peak particle velocities prior to, and during, construction operations. Submit as proof to the Deputy Chief Engineer Technical Services (DCETS) the experience and qualifications of the firm’s personnel conducting the work.

B. Building Condition Survey. Provide, as a minimum, the following information:

1. Photographic and videotape documentation of the interior and exterior condition of the building(s).
2. Extent and location of existing signs of building distress such as cracks, spalling, signs of settlement, flooding, leaking, etc.

The Engineer may accompany the Contractor on each building condition survey for verification of the data recorded. Provide two copies of all documentation of each building condition survey to the Engineer.

C. Vibration Monitoring (Nonblasting). The DCETS may waive the requirements of vibration monitoring based on the results of the building condition survey.

Perform continuous vibration monitoring during construction operations when adjacent construction activities make monitoring prudent. The Contractor shall perform contract work in
a manner that will limit construction vibration at the specified locations to within the limits set within the contract documents.

1. **Submittal of Written Vibration Monitoring Plan.** Prior to performing work adjacent to specified locations, a written Vibration Monitoring Plan prepared by the Contractor shall be submitted to the Engineer a minimum of 10 work days in advance for approval. The Engineer will send a copy of the Vibration Monitoring Plan to the Geotechnical Engineering Bureau, Engineering Geology Section, for review and written comment. The vibration monitoring plan may be returned to the Contractor for revision or clarification.

The vibration monitoring plan shall include the necessary information to outline the recording collection. The vibration monitoring plan shall include, but not be limited to, the following items:

a. **Contract Designations**
   - The name of vibration monitoring specialist(s).
   - The scheduled start date and length of construction operations which require vibration monitoring.
   - The limits of vibration monitoring work, including sites on or off State-owned right-of-way.
   - The location of all structures to be monitored in proximity to the construction operation.
   - The location of any underground utilities in proximity to the construction operation.

b. **Experience and Equipment**
   - Submit proof and details, as references, of two projects in the past five years where the vibration monitoring consultant performing the work has satisfactorily monitored construction operations by recording maximum peak particle velocities (PPVs). Include contact information for each reference.
   - Submit information on the required 3-component seismograph, capable of measuring particle velocity data in three mutually perpendicular directions, including: the manufacturer’s name, model number, and documentation of factory calibration performed within the last 12 months.

c. **Methods and Procedures**
   - The location of adjacent structures to be monitored and maximum allowable PPVs as indicated in the contract documents. If not otherwise specified, a maximum allowable PPV in accordance with the United States Bureau of Mines (USBM) Vibration Criteria (Figure 1) shall be observed at all structures.
   - The location of seismograph(s) placements, as directed by the Contractor’s Professional Engineer. Recording seismographs may be installed on selected structures.
   - Appropriate details for anchoring the geophone(s).
The procedure for tracking PPV throughout construction operations (e.g., Pile Driving Operations: pile tip vs. vibrations may be correlated through time of day. A record of the time of day at each depth interval, included on the pile driving records, would be required to correlate to a time-based readout of PPV).

Figure 1 — USBM Vibration Criteria (after Siskind et al, 1980)
The figure provides a “threshold damage” limit, defined as cosmetic damage (e.g., cracking) within the structure, categorized by both frequency ranges and particle velocity
ITEM 634.99010017 – BUILDING CONDITION SURVEY
ITEM 634.99020017 – VIBRATION MONITORING (NONBLASTING)

2. Measuring Vibrations. The Contractor shall inform the Engineer immediately each time measured particle velocities exceed 85% of the allowable peak particle velocity. The Contractor shall make equipment or procedural modifications as required to avoid exceeding the allowable vibration intensity.

If the measured velocities exceed the maximum allowable PPVs, the Contractor shall stop operations immediately and revise equipment and procedures to reduce vibrations to allowable levels.

The Contractor shall be in communication with his monitoring firm’s personnel during vibration monitoring at all locations to verify the data recorded.

The Contractor shall provide the Engineer with the results of daily vibration monitoring, one work day after the readings are taken. Upon completion of the construction operations for those locations requiring vibration monitoring, the daily submittals shall be synthesized into a final report.

If the seismographs show any indication of damage or vandalism, the seismographs shall be immediately recalibrated or replaced.

METHOD OF MEASUREMENT

A. Building Condition Survey. This work will be measured on a lump sum basis.

B. Vibration Monitoring (Nonblasting). This work will be measured on a lump sum basis.

BASIS OF PAYMENT

The unit price bid for building condition survey(s) and vibration monitoring shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Vibration Monitoring (Nonblasting). Progress payments will be made for this item paid proportionally in accordance with the amount of work completed, measured on a workday basis.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</thead>
<tbody>
<tr>
<td>634.99010017</td>
<td>Building Condition Survey</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>634.99020017</td>
<td>Vibration Monitoring (Nonblasting)</td>
<td>Lump Sum</td>
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ITEM 645.03010011 HIGH VISIBILITY OVERHEAD-MOUNTED SIGN PANELS
ITEM 645.03020011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
  WITHOUT Z-BARS
ITEM 645.03030011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
  GREATER THAN 30 SF WITH Z-BARS
ITEM 645.03040011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
  LESS THAN OR EQUAL TO 30 SF WITH Z-BARS

DESCRIPTION

This work shall consist of furnishing and installing High Visibility Signs, designed in accordance
with the MUTCD, as well as in accordance with Department directives, the contract documents
and as directed by the Engineer.

MATERIALS

Meeting the requirements of §645 Signs except as modified in this specification:

Sign Sheeting:

All reflective sign sheeting §730-05 Reflective Sheeting, §730-12 Reflectorized Sheeting and
Sign Characters (Type IV) and §730-13 Reflectorized Sheeting and Sign Characters (Type V)
used in the manufacture of signs under this specification shall meet the requirements of §730-05
Reflective Sheeting except as modified below:

- Be constructed of unmetallized microprismatic fully-retroreflective material
- Be applied and adhere to the appropriate panel type using standard procedures
- Have a service life of 10 years, minimum
- Meet the requirements of Table 1 and Table 2 below
- Show no signs of shrinkage, delamination, cracking or other surface defects and maintain
  a coefficient of retroreflection no less than 80% of values listed in Table 1 throughout its
  service life.
- Be listed in Table 3 of this specification.

<table>
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<th>0.2°/+30°</th>
<th>0.5°/-4°</th>
<th>0.5°/+30°</th>
<th>1.0°/-4°</th>
<th>1.0°/+30°</th>
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<tr>
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<td>215</td>
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<td>162</td>
<td>220</td>
<td>100</td>
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<td>Green</td>
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<td>Fl. Yellow/Green</td>
<td>325</td>
<td>170</td>
<td>236</td>
<td>110</td>
<td>64</td>
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</table>
ITEM 645.03010011 HIGH VISIBILITY OVERHEAD-MOUNTED SIGN PANELS
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ITEM 645.03040011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
LESS THAN OR EQUAL TO 30 SF WITH Z-BARS

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Minimum Daytime Luminance (Y%)</th>
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</thead>
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<tr>
<td>White</td>
<td>35</td>
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<tr>
<td>Yellow</td>
<td>24</td>
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<td>Red</td>
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</tr>
<tr>
<td>Blue</td>
<td>1</td>
</tr>
<tr>
<td>Fluorescent Yellow-Green</td>
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<tr>
<td>Fluorescent Yellow</td>
<td>45</td>
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</table>

<p>| Table 3 |
|---------|--------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>BRAND NAME</th>
<th>COLOR</th>
<th>SERIES NUMBER</th>
<th>SUPPLIER/LOCATION(s)</th>
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<tr>
<td>3M Diamond Grade - DG³</td>
<td>Blue</td>
<td>4095</td>
<td>3M Traffic Control Materials Division Brownwood, TX; Guin, AL</td>
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<tr>
<td>3M Diamond Grade™ - VIP</td>
<td>Fluorescent Yellow</td>
<td>4081</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluorescent Yellow-Green</td>
<td>4083</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>4097</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>4092</td>
<td></td>
</tr>
<tr>
<td></td>
<td>White</td>
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<td></td>
</tr>
<tr>
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<td>Blue</td>
<td>3995</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluorescent Yellow</td>
<td>3981</td>
<td></td>
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<tr>
<td></td>
<td>Fluorescent Yellow-Green</td>
<td>3983</td>
<td></td>
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<tr>
<td></td>
<td>Green</td>
<td>3997</td>
<td></td>
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<tr>
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<td>Red</td>
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<td>White</td>
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<tr>
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<td>Yellow</td>
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<td>Avery Dennison Reflective Films Division Niles, IL</td>
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<td>Fluorescent Yellow</td>
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</tr>
<tr>
<td></td>
<td>Fluorescent Yellow-Green</td>
<td>T-9513</td>
<td></td>
</tr>
</tbody>
</table>
Signs requiring brown reflective sheeting will use the requirements of §730-05. All cut out sign characters must meet the requirements of this specification.

Other products may be submitted to the Materials Bureau for consideration. Other products must certify they meet the requirements of this specification and provide acceptable 3 year test data from AASHTO’s National Transportation Product Evaluation Program (NTPEP) or other corresponding independent test data. Additional testing may be required by the Department.

**Sign Panels**

Meeting the requirements of 645-2.02 except as modified herein.

All signs manufactured under this specification shall be manufactured using sign sheeting meeting the requirements noted above EXCEPT the following signs shall be manufactured using Type III (Class B) sheeting: parking signs; bus stop signs; tourist-oriented directional signs; specific service signs; acknowledgement signs; and signs used exclusively by non-motorized traffic.

**Basis of Acceptance:**

Signs will be accepted on the basis of material certification that the products are the same as appears on the NYSDOT Approved List and within this specification, and that they conform to the requirements of this and all other relevant specifications.

**CONSTRUCTION DETAILS**

All the provisions of §645-3.02 Sign Panels shall apply

**METHOD OF MEASUREMENT**

All the provisions of §645-4.02 Sign Panels shall apply

**BASIS OF PAYMENT**

All the provisions of §645-5.02 Sign Panels shall apply
DESCRIPTION
This work shall consist of furnishing and installing INTERPRETIVE SIGNS in accordance with the contract documents and as directed by the Engineer.

MATERIALS
Unless otherwise specified herein, all materials for this work shall meet the requirements of the NYSDOT Standard Specifications. All materials for this work shall be new stock, free from defects impairing strength, durability, and appearance.

Sign Panel: Shall be exterior grade solid phenolic resin that is resistant to ultraviolet (UV) radiation deterioration and graffiti-proof. The size and thickness of the panels shall be as shown on the plans or as directed by the Engineer. The embedded graphic panels shall have digitally printed subsurface images fused into a single panel and under the effect of high temperature and pressure. All exterior signage shall be weather tight.

The panels shall be of a consistent thickness for all sizes. The finish of all panels is to be opaque and matte. The panels are to be rigid and flat. No warped areas or bowing will be accepted. All sign panels must be obtained from a single manufacturer.

The panels must be resistant to scratching, ink, paint, crayon, steam, acids, and aromatics. All ink, crayon, or paint markings should be readily removable with soap and water or solvents without harm. The panels shall also be resistant to burning by cigarettes.

Panels shall not break, separate, flake, or fray under impact from thrown objects such as rocks.

Panels must be resistant to mold and fungus

The Contractor, with the approval of the Engineer and/or Regional Landscape Architect, will provide a digital file to sign panel manufacturer with images, fonts and artwork. Custom colors shall match those specified.

The sign panels shall be as follows or approved equal:

1. Model CD 224 by Fossil Graphics Corp.- 44 Jefryn Blvd., Deer Park, NY 11729 631-254-9200 or
2. Model POD –01 by Folia Industries, Inc. - 58 York Street, Huntington, QC, Canada, 888-264-6122 or
3. Model 24x36 DHPL ½” XT w/ Stainless Steel Posts by Izone Imaging – 2526 Charter Oak Drive, Suite 100, Temple, TX 76502 888-464-9663.

The New York State Department of Transportation shall retain full rights to all designs shown or specified. Designs may not be manufactured, reproduced, or exhibited without the written permission of the New York State Department of Transportation.

Mounting Hardware:

All mounting hardware shall be stainless steel. The types and sizes shall be as indicated on the plans.
**ITEM 645.92  11 - INTERPRETIVE SIGNS**

**Sign Support Post:** The sign support post shall be manufactured as detailed in the plans. All materials shall be stainless steel. All welds shall be free of porosity, inclusions, foreign matter, cracks, and pinholes. All welds shall be ground and sanded smooth. All sharp and ragged edges shall be eased smooth to eliminate all sharp edges.

**Art Copyright Approvals:** The Contractor shall obtain all approvals from the appropriate copyright holders of full-scale artwork, photographs, or other images prior to reproduction. The necessary forms and estimates of fees for the individual signs are included in the special note for interpretive signs in the proposal.

**Anchor Bolts:** Anchor bolts shall be stainless steel and meet the requirements of Section 709-13. The lengths and diameters shall be as indicated on the drawings.

**Concrete Foundation:** The cast-in-place concrete for the footings and foundations shall conform to the requirements of Section 500 Portland Cement, 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 the Director and Materials Bureau, a mix at least equivalent to the specified Class A Concrete. The Engineer shall approve the formwork prior to placement of the concrete.

**Steel Bar Reinforcement:** The steel reinforcement shall conform to the requirements in Section 556 Reinforcing Steel for Concrete Structures. Sizes as indicated on the drawings.

**CONSTRUCTION DETAILS**

The Contractor shall verify the quantity, location, and details of each sign with the Engineer, in consultation with the Regional Landscape Architect or designee prior to ordering.

**Shop Drawings:** The Contractor shall submit Shop Drawings for each proposed sign location for review and approval of materials and methods by the Engineer and the Regional Landscape Architect, or designee prior to ordering materials and commencing with fabrication.

**Samples:** Samples of each type of material, finish, and color shall be submitted to the Engineer for approval prior to fabrication.

**Fabrication:** All fabrication and installation shall be in accordance with the highest standards of the trade. All signs and components shall be complete and free from visual, structural and mechanical defects. All source materials shall be inspected upon arrival. The Engineer shall be notified immediately if any source material is inadequate or unacceptable for reproduction.

The State shall be notified of any discrepancies in the drawings, changes required in construction details, and/or field dimensions or special conditions prior to fabrication.
ITEM 645.92    11 - INTERPRETIVE SIGNS

No fabrication or installation material or procedure shall be used that will in any way change the visual quality or in any manner have an adverse effect on existing materials and surfaces.

The Contractor shall arrange a meeting with the Engineer and/or other State Representatives at the site for confirmation of the final locations of sign elements.

All mechanically fastened signs shall incorporate provisions for attachment and removal as required using no visible screws or fasteners except where noted on the drawings.

Protection of Sign Panels: The sign panels shall be protected during transportation, handling, and storage. The panels shall be stored above ground on level, non-staining blocking and covered with weatherproof coverings to prevent staining by weather, dirt, mud, oils, and grease. All damaged materials shall be immediately removed from the job site.

Installation: The Contractor shall excavate for the sign foundations and install the steel bar reinforcement as indicated on the approved Shop Drawings prior to placing the concrete. Using a jig to ensure proper alignment, the stainless steel anchor bolts shall be installed in the concrete prior to setting. The top of the foundation shall be properly finished and leveled to provide good bearing for the sign support post. All formwork for the foundations shall be removed after the concrete has been sufficiently cured. The Contractor shall dispose of all formwork from the site. The excavation shall be backfilled with suitable material, and graded as required. The Contractor shall remove any excess material from the site.

The sign support post shall be attached to the foundation as shown on the plans. The post shall be plumb in all directions. After the nuts have been tightened, the threads of the anchor bolt above the nut shall be damaged to prevent removal of the nut. The anchor bolt shall be cut off at a distance not to exceed 25 mm above the top of the nut, and ground smooth to remove all sharp edges.

The sign panels shall be mechanically fastened to the sign support post as required using no visible screws or fasteners except where noted on the drawings. The panel shall be mounted such that it is true, plumb, and level in its required position.

Cleaning: Upon completion of the installation work, each sign and post shall be thoroughly cleaned, removing all dirt, mortar, and stains and left in a condition acceptable to the Engineer. Temporary protection shall be provided during the remainder of the construction to protect the finished work from damage. All damaged work shall be removed and replaced at no cost to the State prior to final acceptance.

METHOD OF MEASUREMENT
This work will be measured as the number of INTERPRETIVE SIGNS satisfactorily furnished and installed.

BASIS OF PAYMENT
The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.
ITEM 670.94010010 - SINGLE SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94020010 - SINGLE SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

DESCRIPTION

Under this item the Contractor shall furnish and install Solar Powered Light Emitting Diode (LED) Corba Head Luminaire, Pole with mast arm and Foundation at the designated wattage in accordance with the Plans, specifications and as directed by the Engineer.

The luminaire Item shall be equipped with a LED type luminaire fixture at the designated wattage, controller, batteries, solar panels, cabinet, pole, mast arm, foundation, grounding and wiring harness for the wattage and operating time of eight (8) hours minimum per day. This Item shall be provided with mechanical mounts to the pole for the luminaire, solar panel, cabinet, for a complete installed working assembly and engineering shop drawings signed by a registered New York State engineer of the components and mounts.

DEFINITIONS OR TERMS

Within this specification the following definition or terms apply:

1. Luminaire shall be defined as the entire light assembly including but not limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED module, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

2. LED module or LED array is the modular replaceable cluster of LEDs assembled together on a circuit board or assembly and inserted in the luminaire. One or more LED modules shall provide the illumination of the luminaire.

3. LEDs are the individual diodes that produce the illumination.

MATERIALS

1. Luminaire

The components comprising the luminaire shall include but not limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED modules, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

The luminaires shall be of the Light Emitting Diode (LED) type designed for outdoor use, modular in design with high-intensity white LEDs, and fully weatherproof.

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The luminaires shall be modular and constructed so they provide a complete self contained insect resistant, shock resistant and vandal resistant unit.

The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation.

All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust resistant finish. Weep holes shall be provided for drainage. Easy access to the LEDs and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes.

The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire’s LED passive cooling system shall consist of a heat sink with no fans, pumps or liquids and shall resist debris buildup.

The luminaire casing shall be precision die-cast aluminum for the specified wattage and painted inside and out with a coat of baked on epoxy enamel, or polyester powder, virtually pinhole free, leaving no exposed metal. The luminaire color shall be as specified on the contract plans and details; a color chip shall be provided to the engineer for color approval.

The underside of the luminaire shall be marked with the standard NEMA decal, visible from the ground, indicating the type LED and wattage of the luminaire.

The luminaire shall contain a complete power assembly to which are mounted the necessary electrical components for DC operation, solid state starting, adjustable twistlock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.

The power assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius to sixty degrees Celsius. The modular power assembly shall be readily removable as a single unit and utilize quick disconnect plugs.
ITEM 670.94010010 - SINGLE SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94020010 - SINGLE SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

The luminaire shall be designed for roadway lighting. The luminaire shall operate on 12 volt DC or 24 volt DC power. The luminaire and batteries shall operate at similar voltages.

The luminaire shall provide Ingress Protection rating of IP-66 as detailed in IEC60529.

The slipfitter shall be suitable for mounting on a 2in. standard pipe bracket and capable of securely fastening flush to the mounting brackets without the need of separate mounting parts or rearrangement of mounting components. Leveling and clamping of the luminaire to the bracket shall be accomplished by the tightening of bolts and be capable of adjusting the luminaire at least three degrees above and below horizontal. Bird shields shall be supplied and installed on all slipfitter installations.

The luminaire shall have an IESNA light distribution as specified on the plans. The luminaire shall be available in a Type II, III or IV light distribution measured per the requirements of IESNA LM-79-08.

The luminaire shall be “Dark-Sky Friendly” compliant directing no illumination above horizontal.

LED module(s)/array(s) and the luminaire shall deliver at least 70% of initial lumens, when in use for a minimum of 50,000 hours as measured per the requirements of IESNA LM-80-08.

Luminaires shall have a minimum Color Rendering Index (CRI) of 65 as measured per the requirements of IESNA LM-79-08.

The Off-state Power Consumption power draw of the luminaire (including PE or remote control devices) shall be minimal, under 2 watts, when in the off state.

The light source will be of white LED type. Multiple LEDs can be used. The color temperature of white LEDs used in the system should be in the Correlated Color Temperature (CCT) range of 5000 degrees K – 6000 degrees K as measured per the requirements of IESNA LM-79-08. Use of LEDs which emit ultraviolet light is not permitted.

The light output from the white LED light source should be constant throughout the duty cycle.

The LEDs should be mounted in a LED module or array that is suitable for outdoor use. The LED modules shall be mounted in the luminaire housing suitable for outdoor use.
Access to the LEDs shall be by a cast aluminum door. The door assembly shall be hinged to the unit and protected by a safety chain. The door shall be equipped with stainless steel pressure latches and weatherproof, bug resistant gaskets. The latches shall secure the lamp access door and hold it firmly against the gaskets. The latches and door assembly shall be designed so that tools are not required to gain entrance to the luminaire for relamping purposes.

The luminaire shall be equipped with an adjustment to simplify beam angle setting.

The luminaire wattage (30 watts, 50 watts, 60 watts or 75 watts) as indicated in the Item Description is a nominal, minimal value. The luminaire description of the proper size and type shall be submitted for approval by the engineer prior to being furnished.

The luminous performance of luminaire used should not be less than 50 lumen/watt delivered, where the total light output is divided by the total power input.

It should be possible to mount the luminaire on a metallic mast arm attached to the pole. The metallic mast arm for holding the light assembly should be extended from the pole and set at a suitable angle to maximize uniform illumination of desired level over the specified area.

2. Controller

The controller shall monitor the luminaire light output, battery usage, charging and power consumption and provide a timer for time of day on-off operation. The controller clock shall provide time of day operation for powering the luminaire on at dusk and off at a specified time after continuous operation for a number of hours, adjusted for seasonal and daylight savings time operation. It shall also be controlled by the optional Photo-Electric Cell if called for on the plans.

The controller timer shall be a multi-purpose digital single channel timer design specifically for lighting applications. It shall be programmable in AM/PM and 365 day format with a separate schedule for each day for the week. It shall have daylight saving or standard time, automatic leap year correction and astronomic 1-99 minute, plus or minus offset from sunrise to sunset. It shall have a manual ON/OFF override and a 30-day back up using a replaceable 9V lithium Battery.
ITEM 670.94010010 - SINGLE SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94020010 - SINGLE SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

The total electronic efficiency should be at least 80%.

Electronics should operate at 12 VDC or 24 VDC and should have temperature compensation for proper charging of the battery throughout the year. The operating voltage shall match the luminaire voltage.

The controller shall manage the light output that should remain constant with variations in the battery voltages.

Necessary lengths of wires / cables, switches suitable for DC use and fuses should be provided.

The controller should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.

Fuses should be provided to protect against short circuit conditions.

A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the Photovoltaic (PV) module(s), in case such a diode is not provided with the PV module.

Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

3. Battery

The batteries shall be sized to power the luminaire for a minimum of three (3) days of eight (8) continuous hours of use. The batteries shall have an additional 30% excess storage capacity beyond the three (3) day requirement.

The batteries shall be self contained gel type, maintenance free and provide power at 12 volts DC.

The batteries shall be wired to provide 12VDC or 24 VDC power as needed. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The luminaire and batteries shall be provided with similar operating voltages.

Each battery shall not exceed 77 lbs.
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ITEM 670.94020010 - SINGLE SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRIES WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINARE WITH TWO MAST ARMS, POLE AND FOUNDATION

The batteries shall be housed with the controller in the cabinet.

4. Cabinet

The pole cabinet shall be sized to house the controller, batteries and miscellaneous power equipment. It shall be constructed of 1/8in. thick aluminum alloy type 5052-H32 to provide a strong rigid construction and weatherproof with a NEMA 3R rating. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The cabinet shall be constructed to accommodate the weight of the components enclosed, reinforced and heliarc welded for rigidity and mounting.

Doors and Door Hardware. The cabinet door openings shall be double flanged on all four edges to increase strength around the openings and keep dirt and liquids from entering the enclosure when the doors are open. The front and rear doors shall be constructed of 1/8 in. thick type 5052-H32 aluminum alloy to provide a strong rigid construction. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The door hinges shall be minimum 3/32 in. thick aluminum and shall have a ¼ in. diameter stainless steel hinge pin, and no hinge leaves shall be exposed externally when the door is closed. The hinge pin shall be capped top and bottom by weld to render it tamper proof.

A door restraint shall be provided to prevent door movement in windy conditions. The doors shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall be a weather tight seal between the cabinet and door.

Door Latching Mechanism. The door latching mechanism shall be a three-point draw roller type. Pushrods will be turned edgewise at the outward supports and shall be ¼ in. x ¾ in. aluminum, minimum. Rollers shall have a minimum diameter of 7/8 in. and shall be made of nylon.

Door Handles. Each door shall include one (1) stainless steel handle with a ¾ in. diameter shank, a Corbin #1548-1 keyed deadbolt type lock or equivalent, and shall have provisions for a padlock when the handle is in the closed position. Two (2) keys shall be furnished with each lock.
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ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

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Sun Shields. A sun shield shall be provided on the top, the two sides and the doors of the Cabinet to reduce the cabinet internal ambient temperature. The shield shall be in the form of 1/8 in. aluminum sheets installed on 1 in. spacers, mounted with tamper-proof hardware to the cabinets. The areas described above shall be covered, except for the handle and the padlock locations, and the top sun shield shall be crowned in a similar manner to the cabinet top.

Ventilation. The cabinet shall be provided with a passive ventilation system. Louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Exhaust air will be vented out between the top of the cabinet and door. The exhaust area shall be screened with a material having a minimum hole diameter of 1/8 in.

Cabinet Finish. The cabinet exterior including sun shields shall be finished as indicated in the plans. The Contractor shall submit a sample and description of the finish application process for approval by the Engineer. The cabinet shall be painted powder coated to a color as specified on the contract plans and details, a color chip shall be provided to the engineer for color approval.

Cabinet Grounding. A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. When installed, the cabinets shall be grounded in accordance with Sub-section 680-3.12 of the New York State Standard Specifications. The grounding shall consist of a conduit through the foundation, # 6 AWG ground wire from the pole ground lug to the ground rod and 5/8 in by 10 ft minimum, copper clad ground rod.

5. Pole and Mast Arm

The pole and mast arm shall be manufactured of aluminum of the height, diameter and wall thickness as necessary to support the lighting, battery cabinet and solar equipment and as shown on the plans. Each complete pole, foundation, solar panel, cabinet, luminaire unit shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The pole shall accommodate two luminaires with mast arms, two solar panels atop the pole and battery cabinets the mounted 2 ft from the pole base. Each luminaire shall be furnished with a mast arm of the length specified on the plans.
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COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94020010 - SINGLE SOLAR POWERED 50W LIGHT EMITTING DIODE (LED)
COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94030010 - SINGLE SOLAR POWERED 60W LIGHT EMITTING DIODE (LED)
COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED)
COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED)
COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED)
COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

The solar panel shall be mounted atop the pole, facing south at a 45 degree angle with the horizon and not interfere with the luminaires or mast arms. The pole shall be provided with a solar panel mount that is adjustable horizontally and vertically to adjust toward the sun.

The pole shall be supplied with a handhold near the base of the pole. The pole shall be supplied with a handhold, a wire inlet with bushing and ground lug at the cabinet elevation shown on the plan or directed by the Engineer. Each pole shall be grounded through the foundation to a ground rod.

The luminaire should be available with a variety of standard length mast arms of 3ft, 4ft, 6ft, 8ft, 12ft, and 15ft. The luminaire shall be provided with a mast arm of the length specified on the contract plans and details.

The pole and mast arm shall be powder coated to a color as specified on the contract plans and details, a color chip shall be provided to the engineer for color approval.

6. Foundation

All cast-in-place concrete base and foundations shall conform to the requirements of Section 501, Portland Cement Concrete - General.

The concrete shall be Class A concrete 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.

Each foundation shall be provided with grounding. The grounding shall consist of a conduit through the foundation, # 6 AWG ground wire from the pole ground lug to the ground rod and 5/8 in. by 10 ft. minimum, copper clad ground rod.

All concrete bases, foundations and pullboxes shall conform to the dimensions and details shown on the plans, standard sheets and specifications.

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ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

7. Solar Panels

One or two solar panels shall supply the power to the batteries. This solar panel array shall be properly sized for the total luminaire wattage for the daily operating time, geographic location, area sunlight intensity (insolation) associated losses and with 30% excess capacity. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The associated power calculations for the solar array and battery size and quantity shall be submitted for approval by the engineer prior to being furnished.

The solar panel array shall be mounted atop the pole, facing south at a 45 degree angle with the horizon and not interfere with the luminaires or mast arms. The solar panel mount shall be adjustable horizontally and vertically to adjust toward the sun.

Metallic frame structure (with corrosion resistance paint) shall be fixed on the pole to hold the Solar panel module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle. The frame structure shall also have provisions to adjust for a 360 degree horizontal orientation, so that it can be installed at the specified orientation toward the sun.

The solar panel array mount and frame shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The panel shall be made of monocrystalline or polycrystalline solar cells.

Ingress Protection rating of IP-65 as detailed in IEC60529.

BASIS OF ACCEPTANCE

Acceptance of the luminaire will be based on manufacturer's certification of compliance and independent laboratory test results with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

Measurement/Performance/Safety Standards:

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ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRES WITH TWO MAST ARMS, POLE AND FOUNDATION

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3. IESNA LM-80-08 IESNA Approved Method for Measuring Lumen Maintenance of LED Lighting Sources.
6. IEC 60529 Ingress Protection rating.

Acceptance testing of the Solar Powered LED Cobra Head Luminaire system occurs after installation and final inspection and acceptance of the unit and shall last for a period of two (2) weeks. Any failure of the unit shall be repaired and defective components replaced by the contractor during this period at no expense to the State and the acceptance test shall restart for another two (2) week period.

CONSTRUCTION DETAILS

The Solar Powered LED Cobra Head Luminaire of the type and wattage specified, complete with luminaire, controller, cabinet, batteries, pole, foundation, mast arm and solar panel arrays shall be installed and made operational as shown on the Plans.

Each solar panel, cabinet, pole, foundation, mast arm and luminaire unit shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and NFPA 70 NEC requirements.

The mechanical mounts to the pole for the luminaire, solar panel, cabinet shall not affect the structural integrity of the pole and shall meet AASHTO requirements.

QUALITY AND WARRANTY

The original manufacturers of the white LED based solar lighting system are required to provide to the engineer a detailed report on the tests performance by independent laboratory and the actually measured values of Solar Panel (photovoltaic) module, electronics, LEDs, luminaire and battery and other related parameters, as per Measurement/Performance/Safety Standards.
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ITEM 670.94040010 - SINGLE SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH MAST ARM, POLE AND FOUNDATION

ITEM 670.94050010 - TWIN SOLAR POWERED 30W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

ITEM 670.94060010 - TWIN SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) COBRA HEAD LUMINAIRE WITH TWO MAST ARMS, POLE AND FOUNDATION

TRAINING

The contractor shall conduct an 8-hour maintenance training class demonstrating operation, inspection, general maintenance, diagnostics, and repair of all system components. The Training shall occur at a location within NYSDOT Region 10 at the engineer's direction after the installation and prior to final inspection and acceptance. The contractor shall provide 2 week notice prior to the start of the training.

DOCUMENTATION

Complete cut-sheets and shop drawing of all components, mounting procedures and calculations signed by a registered New York State engineer shall be submitted to the engineer for approval prior to installation.

Shop drawings showing structural compliance with these specifications of the pole, mast arm, luminaire, solar panel array, cabinet and foundations and signed by a registered New York State engineer shall be furnished to the Engineer for approval.

Shop drawings showing compliance with these specifications of the power system and load calculations shall be furnished to the Engineer for approval.

Shop drawings shall have luminaire documentation in the form of independent laboratory testing showing compliance ANSI C78.377.2008, IESNA LM-80-08, IESNA LM-79-08 and IEC 60529.

An Operation, Instruction and Maintenance Manual should be provided with the solar street lighting system. The following minimum details must be provided in the Manual:

1. White LED solar street lighting system - its components and expected performance
2. Photovoltaics (PV). The manufacturer, make, model number, country of origin and technical characteristics.
3. PV module
4. Clear instructions about mounting of PV module.
5. White LED Lights. The manufacturer, make, model number, country of origin, full binning number and technical characteristics of LEDs should be stated in the product data sheet and furnished with IESNA test results.
6. Battery and electronics used
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7. Charging and significance of indicators.
8. Clear instructions on controller operation, settings and trouble shooting.
9. Clear instructions on operation, regular maintenance and trouble shooting of solar street lighting system.
10. Name and address of the person or service center to be contacted in case of failure or complaint.

METHOD OF MEASUREMENT

The Solar Powered LED Cobra Head Luminaire of the designated wattage shall be measured by the number of each unit of the type specified, complete in place, in accordance with the Plans, specifications, or as directed by the Engineer.

BASIS OF PAYMENT

The unit price bid for each Solar Powered LED Cobra Head Luminaire shall include the cost of the luminaire of the type at the designated wattage, luminaire(s), controller, batteries, solar panels, cabinet, pole, mast arm(s), foundation, grounding, wiring harness and any and all hardware, mountings, fittings, expansion fittings, straps, clamps, labor and other material necessary to complete the work.

Payment schedule shall be as follows:
1. 75% of the bid price after installation and successful inspection by the Engineer.
2. 15% of the bid price after receipt of all documentation (manuals) and completion of the training.
3. 10% of the bid price after successful completion of acceptance testing.
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DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95020010 - SOLAR POWERED 50W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95030010 - SOLAR POWERED 75W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

DESCRIPTION

Under this item the Contractor shall furnish and install Solar Powered Light Emitting Diode (LED) Decorative Luminaire, Pole with mast arm and Foundation at the designated wattage in accordance with the Plans, specifications and as directed by the Engineer.

The luminaire Item shall be equipped with a LED type decorative luminaire fixture at the designated wattage, controller, batteries, solar panels, cabinet, pole, mast arm, foundation, grounding and wiring harness for the wattage and operating time of eight (8) hours minimum per day. This item shall be provided with mechanical mounts to the pole for the luminaire, solar panel, cabinet, for a complete installed working assembly and engineering shop drawings signed by a registered New York State engineer of the components and mounts.

DEFINITIONS OR TERMS

Within this specification the following definition or terms apply:
1. Luminaire shall be defined as the entire light assembly including but not limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED module, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.
2. LED module or LED array is the modular replaceable cluster of LEDs assembled together on a circuit board or assembly and inserted in the luminaire. One or more LED modules shall provide the illumination of the luminaire.
3. LEDs are the individual diodes that produce the illumination.

MATERIALS

1. Luminaire

The components comprising the luminaire shall include but not be limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED modules, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

The luminaires shall be of the Light Emitting Diode (LED) type designed for outdoor use, modular in design with high-intensity white LEDs, and fully weatherproof.

The luminaires shall be modular and constructed so they provide a complete self contained insect resistant, shock resistant and vandal resistant unit.

The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation.

All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust resistant finish. Weep holes shall be provided for drainage. Easy access to the LEDs and
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DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95020010 - SOLAR POWERED 50W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95030010 - SOLAR POWERED 75W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes.

The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire’s LED passive cooling system shall consist of a heat sink with no fans, pumps or liquids and shall resist debris buildup.

The luminaire casing shall be precision die-cast aluminum for the specified wattage and painted inside and out with a coat of baked on epoxy enamel, or polyester powder, virtually pinhole free, leaving no exposed metal. The luminaire color shall be as specified on the contract plans and details; a color chip shall be provided to the engineer for color approval.

The underside of the luminaire shall be marked with the standard NEMA decal, visible from the ground, indicating the type LED and wattage of the luminaire.

The luminaire shall contain a complete power assembly to which are mounted the necessary electrical components for DC operation, solid state starting, adjustable twistlock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.

The power assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius to sixty degrees Celsius. The modular power assembly shall be readily removable as a single unit and utilize quick disconnect plugs.

The luminaire shall be designed for roadway lighting. The luminaire shall operate on 12 volt DC or 24 volt DC power. The luminaire and batteries shall operate at similar voltages.

The luminaire shall provide Ingress Protection rating of IP-66 as detailed in IEC60529.

The slipfitter shall be suitable for mounting on a 2in. standard pipe bracket and capable of securely fastening flush to the mounting brackets without the need of separate mounting parts or rearrangement of mounting components. Leveling and clamping of the luminaire to the bracket shall be accomplished by the tightening of bolts and be capable of adjusting the luminaire at least three degrees above and below horizontal. Bird shields shall be supplied and installed on all slipfitter installations.

The luminaire shall have an IESNA light distribution as specified on the plans. The luminaire shall be available in a Type II, III or IV light distribution measured per the requirements of IESNA LM-79-08.

The luminaire shall be “Dark-Sky Friendly” compliant, directing no illumination above horizontal.

LED module(s)/array(s) and the luminaire shall deliver at least 70% of initial lumens, when in use for a minimum of 50,000 hours as measured per the requirements of IESNA LM-80-08.

Luminaires shall have a minimum Color Rendering Index (CRI) of 65 as measured per the requirements of IESNA LM-79-0.
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The Off-state Power Consumption power draw of the luminaire (including PE or remote control devices) shall be minimal, under 2 watts, when in the off state.

The light source will be of white LED type. Multiple LEDs can be used. The color temperature of white LEDs used in the system should be in the Correlated Color Temperature (CCT) range of 5000 degrees K – 6000 degrees K as measured per the requirements of IESNA LM-79-08. Use of LEDs which emit ultraviolet light is not permitted.

The light output from the white LED light source should be constant throughout out the duty cycle.

The LEDs should be mounted in a LED module or array that is suitable for outdoor use. The LED modules shall be mounted in the luminaire housing suitable for outdoor use.

Access to the LEDs shall be by a cast aluminum door. The door assembly shall be hinged to the unit and protected by a safety chain. The door shall be equipped with stainless steel pressure latches and weatherproof, bug resistant gaskets. The latches shall secure the lamp access door and hold it firmly against the gaskets. The latches and door assembly shall be designed so that tools are not required to gain entrance to the luminaire for re-lamping purposes.

The luminaire shall be equipped with an adjustment to simplify beam angle setting.

The luminaire wattage (25 watts, 50 watts or 75 watts) as indicated in the Item Description is a nominal, minimal value. The luminaire description of the proper size and type shall be submitted for approval by the engineer prior to being furnished.

The luminous performance of luminaire used should not be less than 50 lumen/watt delivered, where the total light output is divided by the total power input.

It should be possible to mount the luminaire on a metallic mast arm attached to the pole. The metallic arm for holding the light assembly should be extended from the pole as shown on the plans and set at a suitable angle to maximize uniform illumination of desired level over the specified area.

2. Controller

The controller shall monitor the luminaire light output, battery usage, charging and power consumption and provide a timer for time of day on-off operation. The controller clock shall provide time of day operation for powering the luminaire on at dusk and off at a specified time after continuous operation for a number of hours, adjusted for seasonal and daylight savings time operation. It shall also be controlled by the optional Photo-Electric Cell if called for on the plans.

The controller timer shall be a multi-purpose digital single channel timer design specifically for lighting applications. It shall be programmable in AM/PM and 365 day format with a separate schedule for each day for the week. It shall have daylight saving or standard time, automatic leap year correction and astronomic 1-99 minute, plus or minus offset from sunrise to sunset. It shall have a manual ON/ OFF override and a 30-day back up using a replaceable 9V lithium Battery.

The total electronic efficiency should be at least 80%.
Electronics should operate at 12 VDC or 24 VDC and should have temperature compensation for proper charging of the battery throughout the year. The operating voltage shall match the luminaire voltage.

The controller shall manage light output that should remain constant with variations in the battery voltages.

Necessary lengths of wires / cables, switches suitable for DC use and fuses should be provided.

The controller should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.

Fuses should be provided to protect against short circuit conditions.

A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the Photovoltaic (PV) module(s), in case such a diode is not provided with the PV module.

Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

3. Battery

The batteries shall be sized to power the luminaire for a minimum of three (3) days of eight (8) continuous hours of use. The batteries shall have an additional 30% excess storage capacity beyond the three (3) day requirement.

The batteries shall be self contained gel type, maintenance free and provide power at 12 volts DC.

The batteries shall be wired to provide 12 VDC or 24 VDC power as needed. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The luminaire and batteries shall be provided with similar operating voltages.

Each battery shall not exceed 77 lbs.

The batteries shall be housed with the controller in the cabinet.

4. Cabinet

The pole cabinet shall be sized to house the controller, batteries and miscellaneous power equipment. It shall be constructed of 1/8in. thick aluminum alloy type 5052-H32 to provide a strong rigid construction and weatherproof with a NEMA 3R rating. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The cabinet shall be constructed to accommodate the weight of the components enclosed, reinforced and heliarc welded for rigidity and mounting.
Doors and Door Hardware. The cabinet door openings shall be double flanged on all four edges to increase strength around the openings and keep dirt and liquids from entering the enclosure when the doors are open. The front and rear doors shall be constructed of 1/8 in thick type 5052-H32 aluminum alloy to provide a strong rigid construction. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The door hinges shall be minimum 3/32 in. thick aluminum and shall have a ¼ in. diameter stainless steel hinge pin, and no hinge leaves shall be exposed externally when the door is closed. The hinge pin shall be capped top and bottom by weld to render it tamper proof.

A door restraint shall be provided to prevent door movement in windy conditions. The doors shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall be a weather tight seal between the cabinet and door.

Door Latching Mechanism. The door latching mechanism shall be a three-point draw roller type. Pushrods will be turned edgewise at the outward supports and shall be ¼ in. x ¾ in aluminum, minimum. Rollers shall have a minimum diameter of 7/8 in and shall be made of nylon.

Door Handles. Each door shall include one (1) stainless steel handle with a ¾ in. diameter shank, a Corbin #1548-1 keyed deadbolt type lock or equivalent, and shall have provisions for a padlock when the handle is in the closed position. Two (2) keys shall be furnished with each lock.

Sun Shields. A sun shield shall be provided on the top, the two sides and the doors of the Cabinet to reduce the cabinet internal ambient temperature. The shield shall be in the form of 1/8 in aluminum sheets installed on 1 in. spacers, mounted with tamper-proof hardware to the cabinets. The areas described above shall be covered, except for the handle and the padlock locations, and the top sun shield shall be crowned in a similar manner to the cabinet top.

Ventilation. The cabinet shall be provided with a passive ventilation system. Louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Exhaust air will be vented out between the top of the cabinet and door. The exhaust area shall be screened with a material having a minimum hole diameter of 1/8 in.

Cabinet Finish. The cabinet exterior including sun shields shall be finished as indicated in the plans. The Contractor shall submit a sample and description of the finish application process for approval by the Engineer. The cabinet shall be painted powder coated to a color as specified on the contract plans and details, a color chip shall be provided to the engineer for color approval.

Cabinet Grounding. A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. When installed, the cabinets shall be grounded in accordance with Sub-section 680-3.12 of the New York State Standard Specifications. The grounding shall consist of a conduit through the foundation, # 6 AWG ground wire from the pole ground lug to the ground rod and 5/8 in by 10 ft minimum, copper clad ground rod.
5. Pole and Mast Arm

The pole and mast arm shall be manufactured of aluminum of the height, diameter and wall thickness as necessary to support the lighting, battery cabinet and solar equipment. Each complete pole, foundation, solar panel, cabinet, luminaire unit shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The pole shall accommodate a decorative luminaire with mast arm, two solar panels atop the pole and a battery cabinet the mounted 2 ft from the pole base. Each luminaire shall be furnished with a mast arm of the length specified on the plans.

The solar panel shall be mounted atop the pole, facing south at a 45 degree angle with the horizon and not interfere with the luminaire or mast arm. The pole shall be provided with a solar panel mount that is adjustable horizontally and vertically to adjust toward the sun.

The pole and mast arm shall have an ornamental style and have the architectural treatments that correspond with the decorative features as shown on the plans. The pole shall be supplied with a handhold, a wire inlet with bushing and ground lug at the cabinet elevation shown on the plan or directed by the Engineer. Each pole shall be grounded through the foundation to a ground rod.

The pole shall be supplied with a breakaway transformer base that has a hinged panel to access the pole base wiring.

The pole and mast arm shall be powder coated as specified on the contract plans and details, a color chip shall be provided to the engineer for color approval.

6. Foundation

All cast-in-place concrete base and foundations shall conform to the requirements of Section 501, Portland Cement Concrete - General.

The concrete shall be Class A concrete 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 and foundations shall conform to the dimensions and details shown on the plans, standard sheets and specifications.

Each foundation shall be provided with grounding. The grounding shall consist of a conduit through the foundation, # 6 AWG ground wire from the pole ground lug to the ground rod and 5/8 in by 10 ft minimum, copper clad ground rod.
7. **Solar Panels**

One or two solar panels shall supply the power to the batteries. This solar panel array shall be properly sized for the total luminaire wattage for the daily operating time, geographic location, area sunlight intensity (insolation) associated losses and with 30% excess capacity. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The associated power calculations for the solar array and battery size and quantity shall be submitted for approval by the engineer prior to being furnished.

The solar panel array shall be mounted atop the pole, facing south at a 45 degree angle with the horizon and not interfere with the luminaires or mast arms. The solar panel mount shall be adjustable horizontally and vertically to adjust toward the sun.

Metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the Solar panel module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle. The frame structure shall also have provisions to adjust for a 360 degree horizontal orientation, so that it can be installed at the specified orientation toward the sun.

The solar panel array mount and frame shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The panel shall be made of monocrystalline or polycrystalline solar cells.

Ingress Protection rating of IP-65 as detailed in IEC60529.

**BASIS OF ACCEPTANCE**

Acceptance of the luminaire will be based on manufacturer's certification of compliance and independent laboratory test results with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

Measurement/Performance/Safety Standards:
3. IESNA LM-80-08 IESNA Approved Method for Measuring Lumen Maintenance of LED Lighting Sources.
6. IEC 60529 Ingress Protection rating.
ITEM 670.95010010 - SOLAR POWERED 25W LIGHT EMITTING DIODE (LED) DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95020010 - SOLAR POWERED 50W LIGHT EMITTING DIODE (LED) DECORATIVE LUMINAIRE, POLE AND FOUNDATION

ITEM 670.95030010 - SOLAR POWERED 75W LIGHT EMITTING DIODE (LED) DECORATIVE LUMINAIRE, POLE AND FOUNDATION

Acceptance testing of the Solar Powered LED Decorative Luminaire system occurs after installation and final inspection and acceptance of the unit and shall last for a period of two (2) weeks. Any failure of the unit shall be repaired and defective components replaced by the contractor during this period at no expense to the State and the acceptance test shall restart for another two (2) week period.

CONSTRUCTION DETAILS

The Solar Powered LED Decorative Luminaire of the type and wattage specified, complete with luminaire, controller, cabinet, batteries, pole, foundation, mast arm and solar panel arrays shall be installed and made operational as shown on the Plans.

Each solar panel, cabinet, pole, foundation, mast arm and luminaire unit shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and NFPA 70 NEC requirements.

The mechanical mounts to the pole for the luminaire, solar panel, cabinet shall not affect the structural integrity of the pole and shall meet AASHTO requirements.

QUALITY AND WARRANTY

The original manufacturer of the white LED based solar lighting system are required to provide to the engineer a detailed report on the tests performance by independent laboratory and the actually measured values of Solar Panel (photovoltaic) module, electronics, LEDs, luminaire and battery and other related parameters, as per Measurement/Performance/Safety Standards.

TRAINING

The contractor shall conduct an (8) eight-hour maintenance training class demonstrating operation, inspection, general maintenance, diagnostics, and repair of all system components. The Training shall occur at a location within NYSDOT Region 10 at the engineer’s direction after the installation and prior to final inspection and acceptance. The contractor shall provide 2 week notice prior to the start of the training.

DOCUMENTATION

Complete cut-sheets and shop drawing of all components, mounting procedures and calculations signed by a registered New York State engineer shall be submitted to the engineer for approval prior to installation.

Shop drawings showing structural compliance with these specifications of the pole, mast arm, luminaire, solar panel array, cabinet and foundations and signed by a registered New York State engineer shall be furnished to the Engineer for approval.

Shop drawings showing compliance with these specifications of the power system and load calculations shall be furnished to the Engineer for approval.
 ITEM 670.95010010 - SOLAR POWERED 25W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

 ITEM 670.95020010 - SOLAR POWERED 50W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

 ITEM 670.95030010 - SOLAR POWERED 75W LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, POLE AND FOUNDATION

Shop drawings shall have luminaire documentation in the form of independent laboratory testing showing compliance ANSI C78.377-2008, IESNA LM-80-08, IESNA LM-79-08 and IEC 60529.

An Operation, Instruction and Maintenance Manual, in English should be provided with the solar street lighting system. The following minimum details must be provided in the Manual:

1. White LED solar street lighting system - its components and expected performance
2. Photovoltaics (PV). The manufacturer, make, model number, country of origin and technical characteristics.
3. PV module
4. Clear instructions about mounting of PV module.
5. White LED Lights. The manufacturer, make, model number, country of origin, full binning number and technical characteristics of LEDs should be stated in the product data sheet and furnished with IESNA test results
6. Battery and electronics used
7. Charging and significance of indicators.
8. Clear instructions on controller operation, settings and trouble shooting.
9. Clear instructions on operation, regular maintenance and trouble shooting of solar street lighting system.
10. Name and address of the person or service center to be contacted in case of failure or complaint.

METHOD OF MEASUREMENT

The Solar Powered LED Decorative Luminaire of the designated wattage shall be measured by the number of each unit of the type specified, complete in place, in accordance with the Plans, specifications, or as directed by the Engineer.

BASIS OF PAYMENT

The unit price bid for each Solar Powered LED Decorative Luminaire shall include the cost of the luminaire of the type at the designated wattage, luminaire, controller, batteries, solar panels, cabinet, pole, mast arm, foundation, grounding, wiring harness and any and all hardware, mountings, fittings, expansion fittings, straps, clamps, labor and other material necessary to complete the work.

Payment schedule shall be as follows:

1. 75% of the bid price after installation and successful inspection by the Engineer
2. 15% of the bid price after receipt of all documentation (manuals) and completion of the training.
3. 10% of the bid price after successful completion of acceptance testing.
ITEM 670.98000010- SOLAR POWERED 25W LIGHT EMITTING DIODE (LED) BUS SHELTER LUMINAIRE

DESCRIPTION

Under this item the Contractor shall furnish and install Solar Powered 25W LED Bus Shelter Luminaires in accordance with the Plans, specifications and as directed by the Engineer.

The luminaire Item shall be equipped with a LED type luminaire fixture at the designated wattage, controller, batteries, solar panels, cabinet, grounding and wiring harness for the wattage and operating time of eight (8) hours minimum per day. This item shall be provided with mechanical mounts to the shelter for the luminaire, solar panel, cabinet, for a complete installed working assembly and engineering shop drawings signed by a registered New York State engineer of the components and mounts.

DEFINITIONS OR TERMS

Within this specification the following definition or terms apply:

1. Luminaire shall be defined as the entire light assembly including but not limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED module, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

2. LED module or LED array is the modular replaceable cluster of LEDs assembled together on a circuit board or assembly and inserted in the luminaire. One or more LED modules shall provide the illumination of the luminaire.

3. LEDs are the individual diodes that produce the illumination.

MATERIALS

1. Luminaire

The components comprising the luminaire shall include but not be limited to the painted metal housing, reflector, refractor, LEDs, LED modules, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

The luminaires shall be of the Light Emitting Diode (LED) type designed for outdoor use, modular in design with high-intensity white LEDs, and fully weatherproof.

The luminaires shall be modular and constructed so they provide a complete self contained insect resistant, shock resistant and vandal resistant unit.

The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation.

All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust resistant finish. Weep holes shall be provided for drainage. Easy access to the LEDs and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes.

The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire’s LED passive cooling system shall consist of a heat sink with no fans, pumps or liquids and shall resist debris buildup.
The luminaire casing shall be precision die-cast aluminum for the specified wattage and painted inside and out with a coat of baked on epoxy enamel, or polyester powder, virtually pinhole free, leaving no exposed metal. The luminaire color shall be as specified on the contract plans and details; a color chip shall be provided to the engineer for color approval.

The underside of the luminaire shall be marked with the standard NEMA decal, visible from the ground, indicating the type LED and wattage of the luminaire.

The luminaire shall contain a complete power assembly to which are mounted the necessary electrical components for DC operation, solid state starting, adjustable twistlock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.

The power assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius to sixty degrees Celsius. The modular power assembly shall be readily removable as a single unit and utilize quick disconnect plugs.

The luminaire shall be designed for use on ceiling or wall mounted lamp and shall be fully waterproof. The luminaire shall operate on 12 volt DC power. The luminaire and batteries shall operate at similar voltages.

The luminaire shall provide Ingress Protection rating of IP-66 as detailed in IEC60529.

The luminaire shall have an IESNA light distribution as specified on the plans. The luminaire shall be available in a Type II, III or IV light distribution measured per the requirements of IESNA LM-79-08.

The luminaire shall be “Dark-Sky Friendly” compliant directing no illumination above horizontal.

LED module(s)/array(s) and the luminaire shall deliver at least 70% of initial lumens, when in use for a minimum of 50,000 hours as measured per the requirements of IESNA LM-80-08.

Luminaires shall have a minimum Color Rendering Index (CRI) of 65 as measured per the requirements of IESNA LM-79-08.

The Off-state Power Consumption power draw of the luminaire (including PE or remote control devices) shall be minimal, under 2 watts, when in the off state.

The light source will be of white LED type. Multiple LEDs can be used. The color temperature of white LEDs used in the system should be in the Correlated Color Temperature (CCT) range of 5000 degrees K – 6000 degrees K as measured per the requirements of IESNA LM-79-08. Use of LEDs which emit ultraviolet light is not permitted.

The light output from the white LED light source should be constant throughout the duty cycle.

The LEDs should be mounted in a LED module or array that is suitable for outdoor use. The LED modules shall be mounted in the luminaire housing suitable for outdoor use.

Access to the LEDs shall be by a cast aluminum door. The door assembly shall be hinged to the unit and protected by a safety chain. The door shall be equipped with stainless steel pressure latches and weatherproof, bug resistant gaskets. The latches shall secure the lamp access door and hold it firmly.
against the gaskets. The latches and door assembly shall be designed so that tools are not required to gain entrance to the luminaire for re-lamping purposes.

The luminaire shall be equipped with an adjustment to simplify beam angle setting.

The luminaire wattage (25 Watt) as indicated in the Item Description is a nominal, minimal value. The luminaire description of the proper size and type shall be submitted for approval by the engineer prior to being furnished.

The luminous performance of luminaire used should not be less than 50 lumen/watt delivered, where the total light output is divided by the total power input.

2. Controller

The controller shall monitor the luminaire light output, battery usage, charging and power consumption and provide a timer for time of day on-off operation. The controller clock shall provide time of day operation for powering the luminaire on at dusk and off at a specified time after continuous operation for a number of hours, adjusted for seasonal and daylight savings time operation. It shall also be controlled by the optional Photo-Electric Cell if called for on the plans.

The controller timer shall be a multi-purpose digital single channel timer design specifically for lighting applications. It shall be programmable in AM/PM and 365 day format with a separate schedule for each day for the week. It shall have daylight saving or standard time, automatic leap year correction and astronomic 1-99 minute, plus or minus offset from sunrise to sunset. It shall have a manual ON/ OFF override and a 30-day back up using a replaceable 9V lithium Battery.

The total electronic efficiency should be at least 80 %.

Electronics should operate at 12 VDC and should have temperature compensation for proper charging of the battery throughout the year. The operating voltage shall match the luminaire voltage.

The controller shall manage the light output that should remain constant with variations in the battery voltages.

Necessary lengths of wires / cables, switches suitable for DC use and fuses should be provided.

The controller should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.

Fuses should be provided to protect against short circuit conditions.

A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the Photovoltaic (PV) module(s), in case such a diode is not provided with the PV module.

Full protection against open circuit, accidental short circuit and reverse polarity should be provided.
3. **Battery**

The batteries shall be sized to power the luminaire for a minimum of three (3) days of eight (8) continuous hours of use. The batteries shall have an additional 30% excess storage capacity beyond the three (3) day requirement.

The batteries shall be self contained gel type, maintenance free and provide power at 12 volts DC.

The batteries shall be wired to provide 12 VDC power. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The luminaire and batteries shall be provided with similar operating voltages.

Each battery shall not exceed 77 lbs.

The batteries shall be housed with the controller in the cabinet.

4. **Cabinet**

The cabinet shall be sized to house the controller, batteries and miscellaneous power equipment. It shall be constructed of 1/8 in. thick aluminum alloy type 5052-H32 to provide a strong rigid construction and weatherproof with a NEMA 3R rating. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The cabinet shall be constructed to accommodate the weight of the components enclosed, reinforced and heliarc welded for rigidity and mounting.

Doors and Door Hardware. The cabinet door openings shall be double flanged on all four edges to increase strength around the openings and keep dirt and liquids from entering the enclosure when the doors are open. The front and rear doors shall be constructed of 1/8 in thick type 5052-H32 aluminum alloy to provide a strong rigid construction. All welds shall be neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

The door hinges shall be minimum 3/32 in. thick aluminum and shall have a ¼ in diameter stainless steel hinge pin, and no hinge leaves shall be exposed externally when the door is closed. The hinge pin shall be capped top and bottom by weld to render it tamper proof.

A door restraint shall be provided to prevent door movement in windy conditions. The doors shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall be a weather tight seal between the cabinet and door.

Door Latching Mechanism. The door latching mechanism shall be a three-point draw roller type. Pushrods will be turned edgewise at the outward supports and shall be ¼ in. x ¾ in aluminum, minimum. Rollers shall have a minimum diameter of 7/8 in. and shall be made of nylon.

Door Handles. Each door shall include one (1) stainless steel handle with a ¾ in. diameter shank, a Corbin #1548-1 keyed deadbolt type lock or equivalent, and shall have provisions for a padlock when the handle is in the closed position. Two (2) keys shall be furnished with each lock.

Sun Shields. A sun shield shall be provided on the top, the two sides and the doors of the Cabinet to reduce the cabinet internal ambient temperature. The shield shall be in the form of 1/8 in aluminum sheets installed on 1 in. spacers, mounted with tamper-proof hardware to the cabinets. The areas described above
shall be covered, except for the handle and the padlock locations, and the top sun shield shall be crowned in a similar manner to the cabinet top.

Ventilation. The cabinet shall be provided with a passive ventilation system. Louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Exhaust air will be vented out between the top of the cabinet and door. The exhaust area shall be screened with a material having a minimum hole diameter of 1/8 in.

Cabinet Finish. The cabinet exterior including sun shields shall be finished as indicated in the plans. The Contractor shall submit a sample and description of the finish application process for approval by the Engineer. The cabinet shall be painted powder coated to a color as specified on the contract plans and details, a color chip shall be provided to the engineer for color approval.

Cabinet Grounding. A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. When installed, the cabinets shall be grounded in accordance with Sub-section 680-3.12 of the New York State Standard Specifications. The grounding shall consist of a conduit through the foundation, # 6 AWG ground wire from the cabinet ground lug to the ground rod and 5/8 in by 10 ft minimum, copper clad ground rod.

5. Solar Panels

One or two solar panels shall supply the power to the batteries. This solar panel array shall be properly sized for the total luminaire wattage for the daily operating time, geographic location area sunlight intensity (insolation) associated losses and with 30% excess capacity. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to charge the batteries. The associated power calculations for the solar array and battery size and quantity shall be submitted for approval by the engineer prior to being furnished.

The solar panel array shall be mounted atop the shelter, facing south at a 45 degree angle with the horizon. The solar panel mount shall be adjustable horizontally and vertically to adjust toward the sun.

Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the Bus shelter to hold the Solar panel module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle. The frame structure shall also have provisions to adjust for a 360 degree horizontal orientation, so that it can be installed at the specified orientation toward the sun.

The solar panel array mount and frame shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

The panel shall be made of monocrystalline or polycrystalline solar cells.

Ingress Protection rating of IP-65 as detailed in IEC60529.

BASIS OF ACCEPTANCE.

Acceptance of the luminaire will be based on manufacturer's certification of compliance and independent laboratory test results with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

Measurement/Performance/Safety Standards:
ITEM 670.98000010- SOLAR POWERED 25W LIGHT EMITTING DIODE (LED) BUS SHELTER LUMINAIRE

3. IESNA LM-80-08 IESNA Approved Method for Measuring Lumen Maintenance of LED Lighting Sources.
6. IEC 60529 Ingress Protection rating.

Acceptance testing of the Solar Powered 25W LED Bus Shelter Luminaire system occurs after installation and final inspection and acceptance of the unit and shall last for a period of two (2) weeks. Any failure of the unit shall be repaired and defective components replaced by the contractor during this period at no expense to the State and the acceptance test shall restart for another two (2) week period.

CONSTRUCTION DETAILS

The Solar Powered LED Bus Shelter Luminaire of the type and wattage specified, complete with luminaire, controller, cabinet, batteries, and solar panel arrays shall be installed and made operational as shown on the Plans.

Each solar panel, cabinet, luminaire unit shall meet the latest requirements of AASHTO’s Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and NFPA 70 NEC requirements.

The mechanical mounts to the bus shelter for the luminaire, solar panel, cabinet, etc. shall not affect the structural integrity of the bus shelter and shall meet AASHTO requirements. The Contractor shall provide shop drawings of the solar panel mounting to the bus shelter roof design signed by a licensed Professional Engineer registered in the State of New York for approval by the Engineer-In-Charge.

QUALITY AND WARRANTY

The original manufacturer of the white LED based solar lighting system are required to provide to the engineer a detailed report on the tests performance by independent laboratory and the actually measured values of Solar Panel (photovoltaic) module, electronics, LEDs, luminaire and battery and other related parameters, as per Measurement/Performance/Safety Standards.

TRAINING

The contractor shall conduct an (8) eight-hour maintenance training class demonstrating operation, inspection, general maintenance, diagnostics, and repair of all system components. The Training shall occur at a location within NYSDOT Region 10 at the engineer’s direction and after the installation of a unit and prior to final inspection and acceptance. The contractor shall provide 2 week notice prior to the start of the training.

DOCUMENTATION

Complete cut-sheets and shop drawing of all components, mounting procedures and calculations signed by a registered New York State engineer shall be submitted to the engineer for approval prior to installation.
ITEM 670.98000010- SOLAR POWERED 25W LIGHT EMITTING DIODE (LED) BUS SHELTER LUMINAIRE

Shop drawings showing structural compliance with these specifications of the shelter, luminaire, solar panel array, cabinet and foundations and signed by a registered New York State engineer shall be furnished to the Engineer for approval.

Shop drawings showing compliance with these specifications of the power system and load calculations shall be furnished to the Engineer for approval.

Shop drawings shall have luminaire documentation in the form of independent laboratory testing showing compliance ANSI C78.377.2008, IESNA LM-80-08, IESNA LM-79-08 and IEC 60529.

An Operation, Instruction and Maintenance Manual, in English should be provided with the solar street lighting system. The following minimum details must be provided in the Manual:
1. White LED solar street lighting system - its components and expected performance
2. Photovoltaics (PV). The manufacturer, make, model number, country of origin and technical characteristics.
3. PV module
4. Clear instructions about mounting of PV module.
5. White LED Lights. The manufacturer, make, model number, country of origin, full binning number and technical characteristics of LEDs should be stated in the product data sheet and furnished with IESNA test results.
6. Battery and electronics used
7. Charging and significance of indicators.
8. Clear instructions on controller operation, settings and trouble shooting.
9. Clear instructions on operation, regular maintenance and trouble shooting of solar street lighting system.
10. Name and address of the person or service center to be contacted in case of failure or complaint.

METHOD OF MEASUREMENT

The Solar Powered 25W LED Bus Shelter Luminaire shall be measured by the number of each unit of the type specified, complete in place, in accordance with the Plans, specifications, or as directed by the Engineer.

BASIS OF PAYMENT

The unit price bid for each Solar Powered 25W LED Bus Shelter Luminaire shall include the cost of the luminaire of the type at the designated wattage, luminaire, controller, batteries, solar panels, cabinet, grounding, wiring harness and any and all hardware, mounting design and mounting hardware, fittings, expansion fittings, straps, clamps, labor and other material necessary to complete the work.

Payment schedule shall be as follows:
1. 75% of the bid price after installation and successful inspection by the Engineer.
2. 15% of the bid price after receipt of all documentation (manuals) and completion of the training.
3. 10% of the bid price after successful completion of acceptance testing.
ITEM 680.06030110 - PAINT NEW ALUMINIUM PEDESTRIAN POLES (SIZE UNDER 14 FEET)

ITEM 680.06040110 – PAINT NEW ALUMINIUM TRAFFIC SIGNAL CABINETS

DESCRIPTION

This work shall consist of painting new aluminum cabinets and pedestrian poles at the locations indicated on the plans or where directed by the Engineer. All painting work, except field touch-up and bolt painting, shall be done in the shop. All work shall be in accordance with NYSDOT Standard Specifications section 657 as contained herein, and as shown on the plans and in the special note for these item numbers.

MATERIALS

Painting shall consist of a series of three (3) coats: prime coat, intermediate coat, and finish coat. All materials relating to the surface preparation shall be as per section 657 of the Standard Specifications. The finish coat color shall be specified in the contract documents.

CONSTRUCTION DETAILS

The painting procedures the contractor employs to complete this work shall comply with the requirements of section 708-07 (Paint for Aluminum Surfaces) and section 657 of the Standard Specifications, except for the number of coats of paint as specified in the Materials section of this specification. The following surfaces shall be prepared and shop painted according to the above mentioned requirements of Standard Specifications:

A. Pedestrian Poles (size under 14 feet) - The post, transformer base and all hardware.
B. Traffic Signal Cabinets – The cabinets and all hardware.

At least five working days prior to the start of work, the Contractor shall provide the Engineer with one copy of the paint manufacturer’s current technical data sheets for the paint furnished. Instructions, suggestions and precautions contained in the data sheet shall be followed to the extent that they do not contradict the provisions of this specification. The color of the finish coat shall be such that a properly prepared color chip shall be a reasonable visual match to the color specified in the contract documents when viewed under sunlight.

Exposed surfaces of attachment hardware such as bolts, nuts and washers shall be prepared and painted in accordance with the requirements specified above for shop-applied paint except that paint application shall be brush only.

Handling, shipping and erection of coated members shall not be performed until the paint is thoroughly dry and has met the paint manufacturer’s recommended dry-to-handle time period for the temperature and humidity experienced in the shop during painting and curing. All members shall be handled, loaded for shipment, delivered and installed in such a manner as to avoid abrading the coatings. Wood blocks and nylon slings are recommended for securing, loading, hoisting or storing members. Steel chains and slings shall not be directly attached to the coated members.
ITEM 680.06030110 - PAINT NEW ALUMINIUM PEDESTRIAN POLES (SIZE UNDER 14 FEET)
ITEM 680.06040110 – PAINT NEW ALUMINIUM TRAFFIC SIGNAL CABINETS

METHOD OF MEASUREMENT

A. Pedestrian Pole - This work will be measured as the number of traffic signal poles painted in accordance with the specification.
B. Traffic Signal Cabinets - This work will be measured as the number of traffic signal cabinets painted in accordance with this specification.

BASIS OF PAYMENT

The unit price bid for each item shall include the cost of all labor, materials and equipment necessary to complete the work including painting all miscellaneous hardware.
ITEM 680.20AABB 03 - PAINTED TRAFFIC SIGNAL POLE - SPAN WIRE
ITEM 680.21XXYY03 - PAINTED TRAFFIC SIGNAL POLE - MAST ARM
ITEM 680.22XXYY03 - PAINTED TRAFFIC SIGNAL POLE - DUAL MAST ARM
ITEM 680.23ZZ-----03 - PAINTED TRAFFIC SIGNAL POLE - POST TOP MOUNT

AA - SPAN WIRE POLE LOAD IN 10 KILONEWTON INCREMENTS
BB - SPAN WIRE POLE LENGTH IN WHOLE METERS
XX - MAST ARM MOUNTING HEIGHT IN METERS AND TENTHS (FROM 4.2m to 7.2m)
YY - MAST ARM LENGTH IN WHOLE METERS (RANGING FROM 04m to 15m)
ZZ - TOP MOUNT POST LENGTH IN METERS

DESCRIPTION: This work shall consist of furnishing and installing shop painted traffic signal poles and shop painted pedestrian poles.

MATERIALS: The galvanized and shop painted poles shall meet all the material requirements of NYS Standard Specifications for Section 680 - TRAFFIC SIGNALS, Section 724.03 - TRAFFIC SIGNAL POLES, and Section 572 - STRUCTURAL STEEL PAINT SYSTEM, with the following exceptions:

1. Round, untapered span wire traffic signal poles will not be allowed.
2. The maximum span wire pole diameter at the base shall be 46mm per meter of pole length.
3. Delete subsection 724-03.B.3.d - Arm Construction and substitute the following:
   d. Arm Construction - Mast arms of any length shall only be constructed by Method 1, 2, or 3 as indicated under Materials Requirements, paragraph B,1.d, Pole Construction. They may be of two piece construction with a telescoping joint secured by thru-bolt and locknut.
4. Delete Section 572-2.01. Abrasive for Blast Cleaning .
5. Paint color will be specified on the plans. Paint chips shall be submitted to the Engineer-in-Charge for review and approval prior to the commencement of painting.

CONSTRUCTION DETAILS: The poles shall be installed in accordance with NYS Standard Specifications, Section 680 - TRAFFIC SIGNALS 724.03 - TRAFFIC SIGNAL and Section 572 - STRUCTURAL STEEL PAINT SYSTEM, SHOP APPLIED, except:

   delete Section 572-3.01 - Cleaning, and substitute Section 740-03 - PAINTING GALVANIZED SURFACES.

METHOD OF PAYMENT: This work will be measured as each pole furnished and installed in accordance with the contract documents or as directed by the Engineer.

BASIS OF PAYMENT: The unit price bid for each pole shall be in accordance with Standard Specifications, Section 680-5.18, Traffic Signal Poles.
DESCRIPTION

Under this item the Contractor shall furnish and install a rectangular reinforced concrete pullbox in accordance with this specification and the directions of the Engineer.

MATERIALS

Subsections 680-2.01, 680-2.02, and 680-2.05 shall apply.

CONSTRUCTION DETAILS

The requirements of Subsections 680-3.01, 680-3.04, 680-3.06, 680-3.09 and 680-3.14 shall apply with the following modifications:

The pullbox cover text shall read “NYS TRAFFIC” on the first line and “_SIGNALS” on the second line in place of the text “TRAFFIC SIGNALS” as shown on the State Standard Sheet titled “Precast Standard Rectangular Pullboxes, Frames and Covers.”

METHOD OF MEASUREMENT

This work will be measured for payment as the number of rectangular reinforced concrete pullboxes installed in accordance with the contract documents to the satisfaction of the Engineer.

BASIS OF PAYMENT

Subsection 680-5.05 shall apply.
ITEM 680.51400010-CONCRETE FIBER OPTIC PULLBOX

DESCRIPTION:
Under this item, the contractor shall furnish and install concrete fiber optic pullboxes in accordance with this specification and as shown on the plans.

MATERIALS:
In addition to the requirements shown on the plans, the pullbox, frame and cover shall be in accordance with the minimum requirements specified in sub-section 680-2.02 and .05 of the Standard Specifications.
The minimum internal dimensions of the pullbox shall be 36 inches L x 36 inches W x 36 inches D. The pullbox, frame and cover shall have sufficient mechanical strength to withstand the impact of the repeated MS-23 vehicle live loads without damage. The cover of the pullbox shall have “NYSDOT - FIBER” embossed on it. At least two (2) Penta bolts shall be used to lock the cover in place.

CONSTRUCTION DETAILS:
The pullbox shall be installed in accordance with the details shown on the plans. Subsections 680-3.01, .04, .06, .09, .12, .13 and .14 of the Standard Specifications shall apply to the work of this item.
The pullbox shall be constructed in conformance to this specification and as shown in the plans. Any holes for conduit and cable entry shall be carefully drilled or punched into the side of the pullbox. After insertion of conduits or cables, holes shall be tightly and thoroughly sealed to the satisfaction of the engineer.
Soil in the vicinity of the pullbox shall be vibrated and thoroughly compacted around the entire pullbox up to grade.
The top of the cover shall be set at grade. A concrete lock-in feature shall be provided around the top of the pullbox.

METHOD OF MEASUREMENT:
The item 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.

BASIS OF PAYMENT:
The unit price bid for the concrete fiber optic pullbox shall include the cost of furnishing all equipment, materials, incidentals, labor, tools and documentation required to complete the work. All concrete, frames, covers, reinforcing steel, crushed stone or gravel, extensions, saw cutting, excavation, backfill and restoration of adjacent surfaces shall be included in the cost of this item.

05/20/97; REV 11/04/97
ITEM 680.67XX0309 - PEDESTRIAN POLE TOP MOUNT - PAINTED
ITEM 680.68XX0309 - PEDESTRIAN POLE BRACKET MOUNT - PAINTED

DESCRIPTION
The contractor shall furnish and install galvanized, powder coated steel anchor base pole as indicated in the contract documents.

Top mount and bracket mount poles are as defined on the “Standard Traffic Signal Poles” standard sheets and in the Standard Specifications Section 724-03 - Traffic Signal Poles.

MATERIALS
The poles shall meet all the requirements of Standard Specifications for Section 680 - Traffic Signals and Section 724-03 - Traffic Signal Poles, with the following exceptions and/or modifications:

1. Each pole shall be designed to have four (4) anchor bolts.

2. A hand hole cover plate, fastened by two screws, shall be provided with each pole.

3. Pole shall be galvanized, primed and finish painted before delivery to the project site (No field painting). Painting of the steel galvanized surfaces shall be in accordance with the manufactures recommendations.

4. Pole color and finish shall be as indicated in the contract documents.

5. Break-away bases shall be provided when specified in the contract documents. When break-away bases are specified, the height of the pole shall include the height of the break-away base. Painting of aluminum break-away base shall be in accordance with 708-07- Paint For Aluminum Surfaces, or in accordance with the manufactures recommendations for Powder Coat. Painting of galvanized break-away base shall be in accordance with 708-06-Paint For Galvanized Surfaces, or in accordance with the manufactures recommendations for Powder Coat.

CONSTRUCTION DETAILS
The poles shall be installed in accordance with Standard Specifications Section 680 - Traffic Signals.

METHOD OF MEASUREMENT
The poles shall be measured as the number of poles of the specified loads and lengths satisfactorily furnished and installed.

BASIS OF PAYMENT
The unit price bid for each pole shall include the cost of all labor, materials (including, but not limited to, necessary grounding system, four anchor bolts, anchor bolt covers, pole cap, pole assembly), and equipment necessary to satisfactorily complete the work. The pole foundation shall be paid separately under other appropriate contract items.

Note: In the item description, XX= Height of pole in whole feet.
ITEM 680.80324515 - INSTALL MICROCOMPUTER CABINET

DESCRIPTION:

Under this item the contractor shall install Microcomputer Cabinets, which are supplied by the State, at locations shown on the plans or where directed by the Engineer. The State will supply and install the microprocessor, peripheral equipment and software.

MATERIALS:

The State will supply the Microcomputer Cabinets to the Contractor to install. The Contractor shall provide conduit nipples, grounding bushing, L. B. fitting and mounting hub for wiring entrance interface panel between the steel pole and the aluminum cabinet base. The wiring entrance interface panel shall be of sufficient size to accommodate a minimum 4” conduit and may be larger if required to accommodate the traffic signal wiring. Cabinet features, dimensions and location of interface panel for field wiring are detailed in the NEW YORK STATE TRANSPORTATION MANAGEMENT EQUIPMENT SPECIFICATIONS.

CONSTRUCTION DETAILS:

The requirements of section 680-3 of the Standard Specification shall apply with the following additions:

1. The Contractor's request for delivery of the Microcomputer Cabinets supplied by the State shall be made, in writing, five weeks in advance, to the Engineer. The Microcomputer Cabinets will be delivered to the Contractor at the Regional Signal Shop. The Engineer will advise the Contractor of the location of the Regional Signal Shop. At least one week in advance of delivery, the Contractor shall make an appointment through the Engineer as to the time and date the Microcomputer Cabinets will be available to the contractor.

2. The Contractor shall mount the Microcomputer Cabinet to the steel signal pole as shown on the contract plans, Standard Sheets or as directed by the Engineer.

3. The Contractor shall enlarge the hole for conduit located in the bottom of the Microcomputer Cabinet, if necessary, to accommodate the traffic signal wiring.

4. In unpaved areas, the Contractor shall install a concrete work pad in front of the cabinet door as specified on the Standard Sheets or the plans. The work pad shall meet the requirements of section 608 of the Standard Specifications for concrete sidewalk, and include concrete, fill or excavation and all grading as necessary.

5. The Contractor shall establish ground as shown on the contract plan and further defined in the N.Y.S. Standard Specifications of Construction and Materials. The Contractor shall run number six copper stranded wire from the ground lug connection at the base of the pole to the EARTH ground bus within the Cabinet. The Contractor shall connect the power line common to the minus AC ground bus.

6. The Contractor shall arrange with the utility company and the Engineer to have the power hooked up to the Microcomputer Cabinet(s).

7. The Contractor shall perform all tests listed under Section 680-3.32, Tests, of the N.Y.S. Standard Specifications for Construction and Materials with the exception of the Functional Test, when all of his
ITEM 680.80324515 - INSTALL MICROCOMPUTER CABINET

Traffic signal installation work on the entire project, has been complete. The State may, at its option, have the Contractor perform the required testing at each individual signal installation location as soon as he completes his signal installation work at that location. The State will assume responsibility for the Functional Test.

8. Within 30 days of the Contractor successfully completing the required testing on his installation work, the State will install the microprocessor, peripheral equipment and software into the Microcomputer Cabinet. The State may, at its option, perform tests on the traffic signal equipment before installing the microprocessor, peripheral equipment and software.

9. Upon completion of the microcomputer installation, the Engineer may, at his option, conduct a functional test of the signal system for a period not to exceed 14 days. During this testing period, the existing signal system may be turned off or on as directed by the Engineer.

METHOD OF MEASUREMENT:

This work will be measured as the number of Microcomputer Cabinets installed in accordance with the plans, specifications and directions of the Engineer.

BASIS OF PAYMENT:

The unit price for each Microcomputer Cabinet installed shall include the cost of all labor, material, testing and equipment necessary to complete the work.

The concrete work pad, if required, and any necessary fill, excavation or grading, is to be paid for under this item.

Payment for connecting all input and output wiring to the interface panel of the Microprocessor Cabinet shall be included in the bid price for each specific cable item.
DESCRIPTION:
Under these items, the Contractor shall furnish and install Type A, B, C, D, and E Cabinets at the locations shown by the Contract Documents and as ordered by the Engineer. These cabinets shall house control equipment furnished and installed under other contract items.

MATERIALS:
Each cabinet shall be provided complete with all internal components and all mounting hardware necessary to provide for the installation of control equipment as described herein. Interconnections for the field equipment complement, specified in the Contract Documents, shall be provided via the terminal facility harness, provided by the Contractor, by means of mating "MS" type connectors.

All cabinets of the same type shall be identical in size, shape, and quality throughout the entire contract. In addition, the cabinets shall be equipped internally as specified herein, and as required to suit the specific complement of equipment shown on the plans.

All cabinets shall be of welded sheet aluminum construction, 3/16 inch thickness 5052-H32 sheet aluminum.

All equipment under this item is to be in full conformance with the New York State Standard Specifications unless otherwise stated herein.

The equipment design shall utilize the latest available techniques, minimum number of different parts, subassemblies, circuits, cards and/or modules to maximize standardization and commonality.

Electronic Components

All components used shall be the industrial equivalent of military grade, meeting all the requirements contained herein, and shall, at a minimum, comply with Electronic Industries Association (EIA) Specifications.

No component shall be of such design, fabrication, nomenclature, or other identification as to preclude the purchase of said component from any wholesale electronics distributor or from the component manufacturer.

Any electrical component weighing more than two ounces shall be supported firmly by supports other than its own pins or electrical connectors.

All components shall be down rated by 50 percent with regard to ambient temperature, applied voltage, and power dissipation, so material shortening of life or shift in values is minimized. All circuits shall be designed for reliability and maximum performance.
The design life of all components, under 24-hour a day operating conditions in their circuit application, shall not be less than ten (10) years.

All components such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable.

The electronic circuitry shall be designed to insure a reserve in the adjustment range from normal adjustment settings of all variable components.

The equipment shall meet all of its specified performance requirements when the input power is AC power, 60 + 1 Hz, single phase, 115 volts + 20 volts.

The equipment shall be designed such that the failure of the equipment shall not cause the failure of any other.

Mechanical Components
Hardware

All external screws, nuts, and locking washers shall be stainless steel; no self tapping screws shall be used unless specifically approved by the Engineer. All screws, nuts, and locking washers used internally shall be of corrosion resistant material, or suitably plated to resist corrosion. All material furnished shall be new, first quality, and used in accordance with the highest industry practices.

Material
All parts shall be made of corrosion resistant material, such as plastic, stainless steel, aluminum, or brass; or shall be treated with corrosion resistance such as cadmium plating or galvanizing.

All materials used in construction shall be resistant to fungus growth and moisture deterioration.

Dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified shall be separated by an inert material. The equipment shall be modular in design such that major portions may be readily replaced in the field.

Modules of unlike function shall be mechanically keyed to prevent insertion into the wrong socket or connector.

All modules and assemblies shall be clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.
All equipment shall be designed for ease of maintenance. All component parts shall be readily accessible for inspection and maintenance. The only tools and test instruments required for maintenance by Maintenance personnel shall be simple hand held tools and basic meters.

The equipment shall be designed so that it can easily be installed and maintained. Fault location, accessibility, and serviceability features which will lead to simplified maintenance shall be a prime consideration.

The Contractor shall be required to furnish and install galvanized steel safety hasps on specific equipment cabinets as indicated on the plans.

Functional Requirements
These cabinets shall be provided with fully wired back and side panels with all necessary terminal boards, wiring harnesses, connectors, and attachment hardware for each cabinet location. All equipment, with the exception of the coaxial amplifiers, shall be shelf mounted. All terminals and panel facilities shall be placed on the lower portion of the cabinet walls below all shelves. All cabinets shall be keyed alike with one key to be provided for each cabinet.

The Contractor shall submit a cabinet layout for each cabinet type for review by the Engineer. Only cabinets with approved layouts will be accepted under this Contract. Each field cabinet shall, as a minimum, be supplied with the following:

- Fan and Thermostat (Type C, D, and E Cabinets)
- Left Side Power Distribution Panel
- Air Filter
- Adjustable Shelves (1-3 as required)
- Back Panel
- Right Side Panel
- Locking Mechanism
- Lock
- Ground Bus (2)
- Surge Protection (for Solid State Equipment)
- Terminal Blocks
- Interconnect Harnesses with Connectors
- All Necessary Installation and Mounting Hardware

Specific Requirements
Refer to Figures 1 thru and including 8 for suggested cabinet and panel layouts.
Electrical

Left Side Panel

The cabinets shall be furnished with a power distribution panel mounted on the lower left hand inside wall when facing the front door opening of the cabinet.

This panel shall include the following equipment:

**Duplex Outlet** (Type B, C, D, and E Cabinets)
115 VAC convenience outlet with integral ground fault interrupt, protected by a circuit breaker. The receptacle shall be a NEMA Type 5-15R duplex receptacle located so that no electrical hazard shall exist when used by service personnel.

**Lamp** (Type B, C, D, and E Cabinets)
A panel mounted 40 watt weatherproof incandescent lamp with an on-off switch. This lamp shall be positioned to provide light to the face of the equipment installed in the cabinet.

**Circuit Breaker(s)**
The circuit breaker shall be approved and listed by Underwriter’s Laboratories. The operating mechanism shall be enclosed, trip free from operating handle on overload, and trip indicating. Contacts shall be silver alloy enclosed in an arc quenching chamber. Each cabinet shall have, as a minimum, a circuit breaker to protect the lamp, vent fan (Type C, D, E) and duplex outlet. In addition, a properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans. At each cabinet that houses VMS control equipment, a 220 VAC circuit breaker shall be furnished and installed, sized to suit the power cables which provide power to the VMS luminaires.

Circuit breakers shall be unaffected by ambient temperature range, relative humidity, applied power, shock, and vibration range specified in NEMA TS1. Breakers shall have a minimum interrupt capacity of 5000 amperes.

**Radio Interference Suppressor**
All cabinets shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kilocycles to 75 megacycles. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound.
The suppressor terminals shall be nickel plated, brass studs of sufficient external length to provide space for connection of two appropriately sized AWG conductors and shall be so mounted that the terminals cannot be turned in the case. The suppressors shall be designed for operation at the proper current rating as determined by the Contractor per the equipment complement as indicated on the plans, 125/240 Volts, 60 Hertz, operation and shall be approved by UL and EIA.

**Power Cable Input and Junction Terminals**

Power Distribution Blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits as indicated on the plans. The line side of each circuit shall be capable of handling the number of #6, #2, 2/0, or 4/0 AWG wire sizes as shown on the plans.

**Right Side Panel**

Each cabinet shall include a fully wired communications and/or communications and detector distribution panel to be mounted on the lower right hand inside wall when facing the front inside of the door opening of the cabinet. This panel should include the following:

**Power Distribution**

The necessary 120 VAC power shall be distributed from a power distribution terminal board (located on the back or right side panel) which is fed from the equipment circuit breaker branch on the power panel.

**Communications Terminal**

One or more appropriately sized quick connect telephone type terminal facilities with a minimum of four (4) common terminals across shall be part of the right side panel. This terminal facility shall provide for termination of the multi-pair cables as well as distribution of the particular associated cabinet pairs. A separate terminal board(s) shall be used for each communications equipment harness installed in the cabinet. In addition, at the locations where actuation detectors are also used as system detectors, isolation circuits as shown in Figure 1 shall be incorporated on the side panel.
Back Panel
Each cabinet shall include a fully wired equipment panel to be mounted on the lower rear inside of the wall of the cabinet. This panel shall include the following:

Detector Unit Terminals
One terminal board for each four (4) channel loop amplifier or per single or pair of two (2) channel loop amplifiers shall be part of the right side panel in Type C, D, and E cabinets and part of the back panel in Type A and B cabinets. The terminal board shall be set up to accept the loop lead-in cable, power, and the detector amplifier unit(s) cable harness.

Other Electronic Equipment Terminals
The back panel shall be utilized to distribute and properly interconnect all cabinet wiring related to the specific complement of equipment as indicated on the plans. Each piece of equipment specified shall have its cable harness properly terminated at terminal boards on the back panel. All functions available at the equipment connector shall be carried in the connector cable harness to a terminal board point on the back panel.

Wiring
Cabinet wiring shall be provided for the equipment complement as specified on the plans.

All cabinet wiring where connected to terminal strips, flasher, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or making the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing. Cables shall be secured with nylon cable clamps. The grounded side of the electric service shall be carried throughout the cabinet without a break.

All electrical connections in the cabinet, including relays, flashers, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The lay of the interconnect cable between the components must be such that when the door is closed,
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

it does not press against the cables or force the cables against the various components inside the cabinets. Sufficient length of cable harnesses shall be provided to easily reach the electronic equipment placed anywhere on the shelves.

All wiring containing line voltage A.C. shall be routed and bundled separately and/or shielded from all low voltage, i.e. control circuits. All conductors and live terminals or parts, which could be hazardous to maintenance personnel, shall be covered with suitable insulating material.

All conductors used in the cabinet wiring shall be #22 AWG or larger with a minimum of 19 strands. Conductors shall conform to MIL SPEC #MIL-W-16878D, type B or D. The insulation shall have a minimum thickness of 0.01 inch. All wiring containing line voltage shall be a minimum size of #14 AWG.

The A.C. return and equipment ground wiring shall be electrically isolated from each other and the A.C. + wiring by an insulation resistance of at least 10 Megohms when measured at 250 V.A.C. Return and equipment grounding wiring shall be color coded white and green respectively.

**Terminal Blocks**

Terminal strips located on the panels shall be accessible to the extent that it shall not be necessary to remove the electronic equipment from the cabinet to make an inspection or connection.

Terminal blocks shall be two position multiple pole barrier type. Shorting bars shall be provided in each of the positions provided along with an integral marking strip. Terminal blocks shall be so arranged that they shall not upset the entrance, training, and connection of incoming field conductors. All terminals shall be suitably identified by legends permanently affixed and attached to the terminal blocks. Not more than three conductors shall be brought to any one terminal screw. No electrically alive parts shall extend beyond the protection afforded by the barriers. All terminal blocks shall be located below the shelves.

A.C. terminal blocks shall be Underwriter’s Laboratory approved for 600 volts A.C. minimum and shall be suitable for outdoor use. Terminals used for field connections shall secure conductors by means of a #10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, shall secure conductors by means of a #6-32 nickel or cadmium plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment shall terminate to an interwiring type block. These blocks will act as intermediate connection points for...
all electronic equipment inputs and outputs.

Signal lamp circuit terminals shall be marked as required by the Table of Switch Packs or in conformance to the New York State Standard Wiring Code.

All return and equipment grounding wiring shall terminate to the ground bus installed in the cabinet.

Surge Protection

Protector and Cabinet Configuration

Communications cable pairs, which are wired to loop amplifiers, remote communications units, or other electronic equipment harnesses within the cabinet shall have surge protectors installed between the cable pairs and the above noted equipment. The conductor leads and the surge protector leads shall be kept as short as possible with all conductor bends formed to the maximum possible radius. The protector units shall be located as near as possible to the entry point and as far as possible from any electrical equipment. The protector ground lead shall be made directly to the cabinet wall or ground plane.

The surge protectors utilized for AC power shall not dissipate any energy and shall not provide any series impedance during stand-by operation. The units shall return to non-shunting mode after the passage of any surge and shall not allow the shunting of AC power.

Power Line Surge Protector

A power line surge protector shall be installed in each cabinet between the load side of the input power circuit breaker or fuse and ground. The surge protector shall have the following characteristics:

(a) Working Voltage

The unit shall be rated for operation on AC power lines with a voltage rating of 130 volts RMS and 184 volts peak or 275 volts RMS and 389 volts peak for nominal 115/240 VAC respectively.

(b) Surge Voltage

The unit shall limit the surge voltage applied to the equipment to 650 volts peak while conducting a peak surge current of at least 6000 amperes. The surge current shall be an unsymmetrical triangular wave (designated 8 x 20 microseconds) that requires 8 microseconds to reach the peak value and at 20 microseconds will have half the peak value.
(c) **Energy Rating**
   The unit shall be capable of dissipating 50 joules (37 ft-lbf) of surge energy without damage to itself. The unit shall have a 15 watt power dissipation rating.

**Signal Interconnect Cable (120 Volt)**
All signal interconnect conductors shall be provided with surge protectors at both the transmitting and receiving cabinet. The surge protector shall have the same characteristics as that specified for power lines.

**Signal Head Lamp Wires**
All signal light interconnect conductors shall be provided with surge protectors at the equipment cabinet. The surge protector shall have the same characteristics as that specified for power lines.

**Communications Signal Conductors (Twisted Pair)**
Each pair of a group of twisted pairs shall be provided with primary and secondary surge protectors located between the cabinet entry point and the individual use equipment. If the individual equipment input circuitry is provided with secondary protectors, the corresponding secondary protector need not be provided. The primary and secondary protectors may be packaged in the same housing, provided that sufficient impedance is provided between the protector segment to allow proper operation.

**Primary Protector**
The primary protector shall have the following characteristics:

(a) **Working Voltage**

   The unit shall not introduce a series or shunt impedance to the signal path such that it interferes with the operation of the equipment.

(b) **Surge Voltage**

   The unit shall limit the surge voltage between the signal leads and ground to 300 volts or less while conducting a peak surge current of at least 20,000 amperes. The surge current shall cause both signal leads to be grounded simultaneously under surge conditions and shall not allow a transient transverse signal to appear on the protected output signal conductors. The surge operation delay shall not exceed one micro-second.
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

(c) **Energy Rating**

The unit shall be capable of dissipating 100 joules (74 ft-lbf) of surge energy without damage to itself.

Secondary Protector

The secondary protector shall have the following characteristics:

(a) **Working Voltage**

The unit shall not introduce a series or shunt impedance to the signal path such that it interferes with the operation of the equipment.

(b) **Surge Voltage**

The unit shall limit the surge voltage to a level that is less than the maximum specified operating voltage of the equipment being protected. This surge voltage shall occur when the primary protector is being subjected to its rated surge current.

(c) **Energy Rating**

The unit shall be capable of dissipating 20 joules (15 ft-lbf) of energy without being damaged.

Coaxial Cable Drop

Each coaxial cable drop shall be provided with a surge protector located within the equipment the cable is connected to. No separate cabinet surge protector shall be required.

Cabinet Thermostat

For cabinets equipped with a cooling fan (Types C, D, and E), a surge and transient noise suppressor in the form of a varistor shall be installed across the thermostat that is used to control the fan. The varistor shall have characteristics equal to or better than the following:

GE Model Number VI5OLAIOA
Stetron 250NRO7-1
Siemens SIOK150

Cabinet Grounding
A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. The point of contact between the ground bus and cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #10 conductor. A.C. return and equipment ground wiring shall return to the ground bus bar. Where multiple bus bars are used, they shall be bonded to each other with bare stranded #10 copper wire. When installed, the cabinets shall be grounded in accordance with Sub-section 680-3.12 of the New York State Standard Specifications.

Mechanical
Size and Construction

The cabinets shall be clean-cut in design and appearance and have minimal internal dimensions for the various type cabinets as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Depth</th>
<th>Width</th>
<th>Height</th>
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</thead>
<tbody>
<tr>
<td>A</td>
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<td>14 inches</td>
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<td>B</td>
<td>14 inches</td>
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<td>C</td>
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<td>36 inches</td>
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<td>D</td>
<td>22 inches</td>
<td>36 inches</td>
<td>72 inches</td>
</tr>
<tr>
<td>E*</td>
<td>17 inches</td>
<td>20 inches</td>
<td>47 inches</td>
</tr>
</tbody>
</table>

* Type E cabinets shall be mechanically identical on the outside to Model 170 microcomputer cabinets with the exception that a Police Panel is not required.

Types A, B, and E shall be pole or pedestal mounted cabinets. Types C and D shall be foundation mounted cabinets.

All parts of the cabinet shall be cleaned, smoothed, and free from flaws, cracks, dents, and other imperfections. The cabinet shall be rigidly constructed to provide vibration free and satisfactory operation of the field equipment when installed. The cabinets shall be dust and rain tight and capable of maintaining a dry internal condition when subject to rain and wind gusts.

Doors
All doors shall be securely gasketed to prevent the entrance of dust and moisture. The
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.8032620 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

main door of all cabinets shall include substantially the full area of the front of the cabinet. The door shall be provided with a catch to hold the door open at 135 degrees, plus or minus 25 degrees. The catch shall hold the door securely open until released. Doors shall be hinged on the right-hand side by means of three (3) butt hinges with ¼ inch (minimum) stainless steel hinge pins.

Ventilation
Type C, D, and E cabinets shall be furnished with a thermostatically controlled ventilation fan or fans mounted within a rain-snow, and insect tight housing. The electric fan(s) shall have a rated capacity of at least 201 cubic feet per minute. The louver area shall be of sufficient size to permit the free flow of air corresponding to the rated capacity of the associated cabinet fan. (Type A and B cabinets shall be furnished with suitable vents and louvers properly designed to provide natural ventilation to the interior.) Filters shall be provided on all louvers. The fan and cabinet ventilation louvers shall be located with respect to each other so as to direct the bulk of the air flow throughout the entire cabinet and in particular over the field equipment units as approved by the Engineer. The thermostat shall be adjustable to turn on between 90 degrees and 122 degrees Fahrenheit.

Exterior Finish
The exterior or all equipment cabinets furnished shall be of bare, unpainted aluminum.

Locks
The lock for the door shall be of the self-locking heavy duty (5) five pin tumbler cylinder rim type. Locks shall be keyed identical to existing INFORM cabinets as follows: Locks shall be keyed to Corbin #B4R01365 using #8690 heavy-duty key blanks and shall be mastered to #B4R87965. Type B, C, D, and E shall be furnished with a 3 point positive locking door. One key shall be provided for each cabinet.

Shelves
Adjustable shelves shall be provided to hold the equipment specified on the plans. Shelf adjustment shall be 2 inch intervals in the vertical positions. The shelves shall be positioned from the internal top of the cabinet in accordance with the actual equipment configuration of the particular cabinet. See Figures 2 - 8 for suggested cabinet equipment layout.

Mounting Hardware
All cabinets shall be furnished with mounting plates and other necessary hardware to

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mount the cabinet on a pole or foundation.

Panels

All panels shall be designed to mount in the cabinet on mounting studs. It shall not be necessary to remove the panel to replace any panel mounted equipment. The panels shall be capable of supporting the following equipments when they are mounted on the panel:

- Coaxial Cable Amplifier
- Load Switches
- Relays
- Switches
- Miscellaneous Equipment
- All Necessary Mounting Hardware

CONSTRUCTION DETAILS:
Prior to cabinet installation, an INFORM approved pre-installation test for each cabinet shall be successfully completed and the required test form shall be submitted to the Engineer. The approved INFORM test procedure and forms are available at the INFORM Control Center in the Region 10 State Office Building.

Connection of Paired Cable
Connection of the telephone type paired cable to the communications terminal boards shall be accomplished in the following manner:

The cable shall be properly dressed into position, skinned back, leaving an excess length of wire pairs to reach any point on the communications terminal block. The pairs shall be twisted together with 13 twists per meter.

A fast setting sealer kit shall be utilized to seal the end of each communication cable in order to keep the filling compound from leaking out.

Cable pairs shall then be fastened to the communications terminal boards, using the approved tool, in accordance with the approved wiring plan. All pairs shall be terminated on the terminal board.

Unused communications cable pairs shall be grounded to the ground bus in each cabinet.
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

Connection of Lead-In Cable
Connection of the detector lead-in cable to the detector unit terminal boards shall be accomplished in the following manner:

   Each cable shall be properly dressed into position in accordance with the approved lead-in cable position on the panel (cables shall be bundled together and broken out by their position on the terminal boards).

   The cable shield shall be brought as close to the terminal points as possible and left floating.

Connection of Miscellaneous Cables
Connection of signal wires, sign control wires, and any other wires required to complete connections for an operational system shall be accomplished in the following manner:

   All wiring shall be of such size to satisfy good engineering practices and meet the requirements of the National Electric Code. All wiring connected to terminal boards shall be identified by the use of insulated pre-printed sleeving slipped over the wire before final attachment, or other suitable identification.

   All wires shall be cut to proper length before assembly. No wire shall be doubled back to take up the slack. Wires shall be neatly laced into cables with nylon lacing or plastic straps. Cables shall be secured with suitable clamps.

   All wires entering or leaving a field cabinet shall be terminated on their proper terminal boards.

   The communications cable harness required between Model 170 signal controllers, and Type A or E cabinets installed immediately adjacent to the Model 170 cabinets shall be routed in a 1 NPS, flexible, liquid-tight conduit between these cabinets.

   The RS-232 communications cable provided shall be a PVC jacketed, six conductor cable, and shall be furnished with a fourteen pin connector for the 170 controller C-2 connection.

Documentation
Each field cabinet shall be supplied with three (3) copies of the Final Cabinet Wiring Diagram. One (1) copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) copies shall be delivered to the Engineer. Mylar reproducibles of the cabinet wiring diagrams shall be delivered to the Engineer.

Quality Assurance Provisions

The following water spray tests shall be performed on each type of empty cabinet:

Water shall be sprayed from a point directly overhead at an angle of 60° from the vertical axis of the cabinet. This procedure shall be repeated for each of eight equally spaced positions around the cabinet for a period of not less than five minutes in each position. The water shall be sprayed using a domestic type sprinkling nozzle at a rate of not less than 1 gal per minute per square feet of surface area. The cabinet shall then be inspected for leakage. Evidence of water leakage shall be cause for rejection.

A Manufacturers certification of successful completion of the water spray test and that the cabinet conforms to this specification, shall be the basis of acceptance of the cabinet. Separate submission of test cabinets shall not be required.

METHOD OF MEASUREMENT:

Each Type A, B, C, D, or E Cabinet will be measured as the number of complete units furnished and installed in accordance with the Contract Documents or as directed by the Engineer.

BASIS OF PAYMENT:

The unit price bid for each Type A, B, C, D, or E Cabinet shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Payment for cabinet grounding, isolation diodes, equipment harnesses and interconnect cables, documentation and services, and the testing referenced herein shall be included under the price bid for these items.
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
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ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

ISOLATION DIODE, 1 MODULE FOR ACTUATION TO 170 ISOLATION 1 SYSTEM SENSOR IS USED FOR ACTUATION PER DETECTOR TO BE LOCATED AT REQUIRED IF ONLY CABINET PANEL. NONE TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

FIGURE 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO VEH. DET. 1 VEH. DET. 2 VEH. DET. 1

COMM. EQUIPMENT CABINET

ISO DIODE 1 PER DETECTOR TO BE LOCATED AT TERMINAL BLOCK ON CABINET PANEL. NONE REQUIRED IF ONLY 1 SYSTEM SENSOR IS USED FOR ACTUATION

DIODE 3

DIODE 2

DIODE 1

TERMINAL BLOCK ON ACT AS ACTUATION DETECTORS CONNECTION OF SYSTEM SENSORS THAT ALSO
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

**SUGGESTED TYPE A CABINET CONFIGURATION**

**FIGURE 2**
ITEM 680.80326010 - TYPE A CABINET
ITEM 680.80326110 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

SUGGESTED TYPE B CABINET CONFIGURATION

FIGURE 3
ITEM 680.80326010 - TYPE A CABINET
ITEM 680.80326110 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

VMS CONTROLLER
LOCAL CONTROL PANEL

V D
# 2
BACK PANEL
SUGGESTED TYPE C CABINET CONFIGURATION I
FIGURE 4

LEFT INSIDE PANEL
POWER

VC

COM

TB 7
COM

TB 2
R E T

TB 6
P E M

TB 4
O D

TB 5
R E O

TB 3
A R E

TB 8
S C

915mm
36-5/8 in
36
22-3/8 in
55 in
1372mm
36-5/8 in
55-3/8 in
3/8 in
959mm

RIGHT INSIDE PANEL

CONV
OUTLET

RCU

559mm

25 in

55 in

53 in

22-3/8 in

M VMS

22-3/8 in

53 in

58 in

915mm
ITEM 680.80326010 - TYPE A CABINET
ITEM 680.80326110 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

SUGGESTED TYPE C CABINET CONFIGURATION II

FIGURE 5
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.8032620 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

SUGGESTED TYPE D CABINET CONFIGURATION

FIGURE 6
ITEM 680.803260 - TYPE A CABINET
ITEM 680.8032610 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

SUGGESTED TYPE E CABINET CONFIGURATION

FIGURE 7
ITEM 680.80326010 - TYPE A CABINET
ITEM 680.80326110 - TYPE B CABINET
ITEM 680.80326210 - TYPE C CABINET
ITEM 680.80326310 - TYPE D CABINET
ITEM 680.80326410 - TYPE E CABINET

SUGGESTED TYPE E CABINET CONFIGURATION II

FIGURE 8
1.0 DESCRIPTION.
The purpose of this specification is to provide the minimum performance requirements for a Pedestrian LED Countdown Timer Module to be used in conjunction with Pedestrian Signal Indications. The unit will provide Pedestrians with numerical Pedestrian timing of the Pedestrian Clearance Interval. The unit will be connected in parallel with LED Pedestrian Signal Indications, Hand and Walking Person, and in series with the Model 200 switch packs controlling the LED Pedestrian Signal Indications.

This specification refers to definitions and practices described in “Vehicle Traffic Control Signal Heads” referred to in this document as “VTCSH,” and “Pedestrian Traffic Control Signal Indications”, referred to in this document as “PTCSI”, published in the Equipment and Materials Standards of the Institute of Transportation Engineers.

2.0 MATERIALS.

A. PHYSICAL AND MECHANICAL REQUIREMENTS

A.1 The countdown timer shall be designed to fit in the message bearing area of a 12 inch pedestrian traffic signal housing built to the PTCSI Standard.

The unit shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing and not require special tools for installation. The timer module shall fit into Pedestrian Traffic Signal housings that are void of any incandescent lamp components - bulb sockets, gaskets, and reflector - and without the need to modify the housing. The module shall be sealed to provide a weather tight enclosure and an insulating covering for all electrical connections and electronic components. The unit shall fit securely in the housing and shall connect directly to existing electrical connections inside of the housing by means of push on type connectors.

A one piece “U” shaped cross section rubber gasket or other suitable means shall be provided with each module to insure a weather tight fit between the door of the signal housing and the module. The quality of gasketing supplied, and any method used to adhere the gasketing to the module if the gasketing is affixed to the module using adhesive, shall be such that the gasketing and adhesion technique shall not appreciably deteriorate over the life of the module when the module is used in its intended application.

The message bearing surface of the module shall be supplied with two numerical LED displays to display a count from “00” to “99”. These displays shall be a minimum 7 inches high and 3.75 inches wide. The display segments that comprise the numbers shall be approximately 0.5 inches wide and be formed by two or more rows of LED’s.

Materials used for the lens and signal module construction shall conform to ASTM specifications for those materials.

The lens of the LED countdown timer shall be polycarbonate UV stabilized and a minimum of 1/8” thick

Each module shall be identified on the back side with the following:
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

---- Manufacturer’s Trade Mark/Name
---- Part number as shown in the NYS DOT’s Transportation Management Equipment QPL
---- Serial number
---- Voltage rating
---- Power consumption (Watts and Volt-Ampere)
---- Each module shall have a sticker stating compliance to FCC Title 47 Subpart B, Section 15 regulations
---- An Indication to orient the user to the Top of the Unit (such as an Arrow symbol or the word top)

A.2 Barcoding. All Modules shall be barcoded using Barcode type 128. Barcodes shall be printed on a quality polyester white label (Black print only) where the print on the label and adhesion of the label to the surface shall be weather, UV and temperature resistant. Size of the label shall be 0.5 inch wide by 1.75 inch long. All barcodes shall be printed entirely on the label and be completely legible. Text of the Barcode Information shall also be legibly printed on the label.

Information on the Barcode shall be separated into the following four parts, but printed continuously on the label in the order shown:

---- Model Number - 2 Digits (Assigned Model Number for Pedestrian LED Countdown Timers is CT)
---- Manufacturer - 2 Digits. Digits assigned by NYSDOT upon Product Qualification
---- Date of Manufacture - 4 Digits. First two digits represents Month of Manufacture, Second two digits represent Year of Manufacture
---- Serial Number - minimum 6 digits assigned, maximum 10 digits assigned

An example of the information printed on the barcode for a Pedestrian LED Countdown Timer built to these specifications manufactured in June of 2008 with a serial number of 018356 by a company whose manufacturers’ code is XX would be CTXX0608018356.

Barcode labels, meeting the same requirements of the labels above, shall also be placed on the outside of all shipping boxes. Example: Should the shipping box contain six modules, individual barcode labels for all of the six modules inside the box shall be affixed to the outside of the box. The labels shall also be grouped together so that they can be easily and quickly scanned by a barcode reader.

A.3 The contractor shall provide the barcode ID numbers for all LED’s installed. This information shall be provided in the form of an electronic file (Excel Spreadsheet) and summarized by intersection. Barcode IDs will be collected by one of the following methods selected by NYSDOT:

1) Scanning the bar codes of each module with a bar code scanner provided by NYSDOT for use on this project only. The information will be downloaded to a spreadsheet.

2) Manually entering the bar code IDs of each module into an electronic spreadsheet.

This information shall be provided to the EIC on a weekly basis. The cost for this work shall be included...
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

in the bid price for various LED modules.

B. ENVIRONMENTAL REQUIREMENTS

B.1 The Countdown Timer signal module shall be rated for use in the ambient temperature range of -40 deg F to +165 deg F. The module shall be sealed to prevent dust and moisture intrusion and to protect all internal LED and electrical components. The module shall be capable of operating at rated voltage in an environment of +74 degrees Centigrade / 85% Relative Humidity for 1000 hours without the formation of internal condensing moisture.

C. OPTICAL REQUIREMENTS

C.1 The measured chromaticity coordinates of the individual led light sources used in the module shall conform to the chromaticity requirements of the Pedestrian “Hand” symbol of the PTCSI standard.

C.2 The module shall be designed so that when operated over the specified ambient temperature and voltage ranges during the warranty period of the unit, the numeric display shall attract the attention of, and be readable to, a viewer (both day and night) at all distances from 3 m to the full width of the area to be crossed.

C.3 To minimize luminous degradation over the life of the unit, the individual led light sources used in the unit shall be manufactured using AlInGaP technology or equal.

C.4 Variations in operating line voltage of between 80 and 135 volts rms shall have minimal effect, less than +/- 10 percent, on the luminous output of the module.

D. OPERATIONAL REQUIREMENTS

D.1 The module will be designed to countdown to zero only the “Clearance” time of the Pedestrian Interval. During the Steady Don’t Walk Indication the display will always be dark.

D.2 The module, when connected to the appropriate Pedestrian switch pack outputs, shall have an automatic learn mode in order to learn and store the Pedestrian clearance times in its memory and to self-adjust for subsequent changes in Pedestrian Clearance time.

D.2.1 Following power restoration to the unit after a power outage of greater than two seconds the unit will remain dark for one pedestrian cycle to learn, acquire the current pedestrian clearance timing, replace any values that were stored in memory prior to the power outage with the newly acquired values and display the newly acquired times on the next pedestrian cycle.

D.2.2 The unit shall detect changes in pedestrian clearance timing during normal operation and act upon them as described below:

D.2.2.1 The unit will automatically re-program itself should it detect any increase in Pedestrian clearance timing. The increased timing shall be displayed on the subsequent pedestrian cycle.
D.2.2.2 The unit will detect any reductions in pedestrian clearance timing (such as those occurring during a traffic Preemption cycle) and display on the subsequent pedestrian cycle the timing stored in its memory prior to the shortened pedestrian cycle.

D.2.2.3 The unit will re-program itself should it detect two consecutive identical shortened pedestrian clearance cycles and display this timing on the next pedestrian cycle.

D.3 The unit shall be designed to suspend any timing and go dark when, for any reason, the timing of the Ped Clearance cycle is terminated before reaching the “zero” count and the clearance switchpack output reverts to a steady “On” condition.

D.4 The unit shall be capable of timing consecutive complete Pedestrian cycles outputted by the traffic control system.

D.5 The unit shall be designed to retain the Pedestrian timing stored in its memory for all power outages of less than one second and to continue timing of the Pedestrian timing if the traffic control system has resumed Pedestrian timing following this duration outage. For outages of between one and two seconds memory may or may not be retained. For all power outages greater than two seconds the unit will resume operation as described in Paragraph 4.2.

E. ELECTRICAL

E.1 All wiring shall meet the requirements of Section 13.02 Wiring of the VTCSH standard. Each wire shall be approximately 1 m long. All wiring shall be rated for use over the temperature range of -40 deg F to +165 deg F. Under normal handling of the module over the specified temperature range, the wiring insulation shall not crack or fray along its entire length. The wires of the module shall be terminated in insulated 0.250 inch female quick disconnect push on terminals.

Units shall be supplied with three colored coded wires as defined below:

Red (Connection to Pedestrian Hand Switch pack output), Brown (Connection to Pedestrian Man Switch pack output) & White (AC Neutral)

E.2 The module shall operate with 603 Hz AC line voltage ranging from 80 volts to 135 volts rms. The circuitry shall prevent flicker over this voltage range. Rated voltage for all optical and power measurements shall be 1203 volts rms.

E.3 The on-board circuitry of the module shall include voltage surge protection, to withstand high-repetition noise transients and low-repetition high-energy transients as stated in Section 2.1.8, NEMA Standard TS 2-2003.

E.4 Each module shall be designed so that the timer and displays do not function when connected to any voltage between 80 and 135 volts rms and in series with an impedance of 15 kohm (either resistive or capacitive) or greater.
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

E.5 The individual LED light sources of the unit shall be wired so that a catastrophic failure of one LED light source will not result in the loss of illumination of more than one display segment.

E.6 All modules shall contain filtering dedicated to prevent inducing electronic noise into the AC power lines. In addition the module and associated on-board circuitry shall meet the requirements of the Federal Communication Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices.

E.7 All Modules shall be fused. The fuse shall be located before any electronic component used in the module and placed in series with the colored wire of the unit. Should fusing be external to the unit by placing inline fuse holders into the wiring of the unit, the fuse holder shall be installed so that it is between six to ten inches from the housing of the unit. Each individual circuit in the unit shall be fused separately. Fuse selection shall be such that it provides reliable operation for its intended operation.

E.8 All unit types shall be operationally compatible with the traffic signal equipment that each type is designed and intended to interface with. This equipment includes all controllers, conflict monitors, current monitors, switch packs and flashers and LED Signal Modules currently in use by the New York State Department of Transportation.

E.9 Power Requirements. The maximum power consumption of each circuit in the unit, when on, shall not exceed 10 Watts at rated voltage.

F. PERFORMANCE TESTS

F.1 Prior to shipment, each module shall be energized (burned-in), for a minimum of 24 hours, at rated voltage, and at a 100 percent on-time duty cycle. This test shall be conducted in an ambient temperature of 60 degrees Centigrade. Any failure of the module occurring during burn-in shall be cause for rejection.

F.2 Each timer module shall be visually inspected for any exterior physical damage or assembly anomalies. Careful attention shall be paid to the surface of the lens to ensure there are no scratches (abrasions), cracks, chips, discoloration, or other defects.

F.3 Each shipment from the manufacturer shall be furnished with a Certificate of Compliance. The certificate shall certify that the modules comply with the requirements of these specifications. The certificate shall include the signature of the person responsible for certifying the tests. In addition to the certificate, the modules shall be supplied with copies of all applicable test reports.

G. SAMPLE SUBMISSION

Low bidder(s) may be required to submit a sample unit. In the event that a sample is required, it shall be provided within ten (10) working days of receipt of the request. Each device submitted shall be accompanied by five copies of the complete circuit schematic for the unit, one standard catalog cut and one manufacturers specification sheet for the individual LED light sources used in the unit. Documentation shall also be provided describing the techniques used to ensure the units will satisfy the luminous intensity requirements over the life of the warranty. This documentation may include items such as the description of circuitry incorporated in the module needed to meet this requirement or literature from the LED manufacturer describing the expected degradation of luminous intensity of the individual...
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

LED light sources used in the fabrication of the module over the life of the unit and operating temperature range.

3.0 CONSTRUCTION DETAILS

The contractor shall install the Pedestrian Count-Down Timer Module in new or existing traffic signal heads as shown on the plans or as ordered by the engineer. 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 proposes to install.

4.0 METHOD OF MEASUREMENT

This item will be measured for payment as the number of Pedestrian Count-Down Timer Modules furnished, installed in accordance with the contract documents or as ordered by the Engineer.

5.0 BASIS OF PAYMENT

The unit price bid shall include the cost of all labor, material, and equipment necessary to complete the work as shown on the plans, on the standard sheets, or as ordered by the Engineer. The cost of the pedestrian signal heads shall be paid for under their respective items.
ITEM 680.82540009 - PREEMPT SYSTEM - DETECTOR CABLE, SHIELDED,
3 CONDUCTOR WITH STRANDED GROUND, AWG #20

DESCRIPTION

This work shall consist of furnishing and installing a detector cable for an emergency preemption
system, in accordance with the contract documents, standard sheets, manufacturer's instructions
and as directed by the Engineer.

MATERIALS

The specific component used shall be for an Optical Priority Control Preemption System. The
cable shall conform to the requirements of the National Electrical Code and be Underwriter’s
Laboratory approved. The cable shall be rated for 600 volt service minimum and the conductors
shall be stranded, individually tinned copper and color coded in accordance with manufacturer’s
wiring connections.

CONSTRUCTION DETAILS

The cable shall be installed to deliver sufficient power from the phase selector to the detector and
will deliver the necessary quality signal from the detector to the phase selector over a non-
spliced distance of 1000 feet in length.

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. 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. A wire numbering
system is to be used for identification; the key to the system shall be placed along with the wiring
diagram in the controller cabinet.
ITEM 680.82540009 - PREEMPT SYSTEM - DETECTOR CABLE, SHIELDED, 3 CONDUCTOR WITH STRANDED GROUND, AWG #20

Splices in the cable shall not be allowed between the equipment terminals. Where cable is installed on a span wire, it shall be supported at intervals not greater than 15 inches, by 3-inch copper clad cable rings. Place any existing signal cables in these ring hangers, and remove any cable straps from the span wire.

The contractor shall install the equipment in accordance with the contract documents, standard sheets, and manufacturer's instructions. The contractor shall assist in the performance of all tests, necessary to confirm acceptable operation, in the presence of the engineer and the fire department representative.

METHOD OF MEASUREMENT

The measurement for payment is the number of linear feet actually installed in accordance with the contract documents or as directed by the engineer.

BASIS OF PAYMENT

The unit price bid shall include the connectors, 3-inch copper clad cable rings, any drilling of the signal pole or mast arms, removing old cable straps, testing, cable markers, and incidental fittings to install the cable connections.
ITEM 680.94997008 – FURNISH AND INSTALL ELECTRICAL DISCONNECT / GENERATOR TRANSFER SWITCH

**DESCRIPTION** - Under this item, the Contractor shall furnish and install a electrical disconnect / generator transfer switch as shown on the plans, or the standard sheets or as ordered by the Engineer.

**MATERIALS** – The Contactor shall furnish a electrical disconnect / generator transfer switch from a manufacture listed on the current New York State Department of Transportation Traffic Signal Laboratory’s Approved Product List.

**CONSTRUCTION DETAILS** - The electrical disconnect / generator transfer switch shall be attached to the pole or cabinet as shown on the plans or the standard sheet or as ordered by the Engineer.

**METHOD OF MEASUREMENT** - This item will be measured for payment as the number of electrical disconnects / generator transfer switches furnished installed and accepted by the Engineer-in-Charge.

**BASIS OF PAYMENT** - The unit price bid shall include the cost of all labor, material and equipment necessary to complete the work as shown on the plans, on the standard sheets, or as ordered by the Engineer.
Description. Under this item the Contractor shall furnish and install in a raceway or conduit service entrance cable which is suitable for wet or dry locations at the location indicated on the plans and as directed by the Engineer. This cable will transmit current from the power source to the signal controller cabinet.

Material. The cable shall conform to the requirements for service entrance cable of the National Electrical Code and be Underwriters Laboratory approved. The cable shall be rated for 600 volt service and the conductors shall be stranded copper wire or as specified in the contract documents.

Construction Details. Service cable shall be installed in accordance with Details: the contract documents and as directed by the Engineer. A sufficient length of cable, not less than 24 inches, shall be left at the end of the run to allow for the tap to be made by the utility company at the power source entrance. The Contractor shall make all connections at the fused disconnect and the ground bar in the signal controller cabinet.

Method of Measurement. Service cable will be measured as the number of linear feet actually installed in accordance with the contract documents or as directed by the engineer.

Basis Of Payment. The unit price bid per linear foot shall include the cost of all materials, labor, connections, incidental fittings, equipment, tools, and all necessary tests to complete the installation.
ITEM 683.07010010 - FIBER OPTIC INNERDUCT, 2 CHANNEL

DESCRIPTION:
Under this item, the Contractor shall furnish and install fiber optic innerduct at locations as shown in the Contract Documents and as directed by the Engineer.

MATERIALS:
All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details shown on the plans and in this Special Specifications.

The fiber optic innerduct shall be a multi-port conduit liner containing 2 separate, individual channels as specified on the plans. The individual channels shall be extruded together to form one continuous innerduct segment.

The innerduct shall be flexible polyethylene and shall conform to the following material requirements:

- Low temperature flex less than -170°F (ASTM D-746)
- Tensile yield – 1.6 ksi (ASTM D-638)
- Flexural modulus – 36 ksi (ASTM D-790)
- Dielectric strength - 18 volts/micron (ASTM D-149)
- VICAT softening point - 212°F (ASTM D-1525)
- Elongation - greater than 780% (ASTM D-638)

The innerduct shall have a kinetic coefficient of friction of 0.25 with steel, in accordance with ASTM D-1894.

The individual channels of the innerduct shall have a nominal diameter of 1 inch.

The innerduct segment sizes and channel arrangement shall allow for the installation of the following number of 2 Channel innerduct:
- into 3NPS conduit - One
- into 4NPS conduit - Two

The Contractor shall provide a drag line through the entire length of each of the individual channels of innerduct installed. The drag line shall be muletape or mylar tape and shall have tensile strength of 1 kip minimum.

The fiber optic innerduct will be accepted upon the basis of the manufacturer's certification that it meets the requirements of this specification.

CONSTRUCTION DETAILS:
ITEM 683.07010010 - FIBER OPTIC INNERDUCT, 2 CHANNEL

The innerduct shall be installed in existing or proposed 3NPS or 4 NPS conduits. Prior to the installation of the innerduct, the Contractor shall clean all existing conduit and pullboxes as required and as specified under separate contract items. If existing pullboxes require resetting or other modifications, this work shall be completed prior to the installation of innerduct into the subject pullbox.

The Contractor shall install the innerduct between pullboxes as shown on the plans and as directed by the Engineer. The innerduct shall run continuously through pullboxes, except at locations where slack fiber optic cable will be stored. At these pullboxes, the innerduct shall be extended at least 6 inches into the pullbox and secured or anchored in an approved method to prevent movement during cable pulling operations.

At pullboxes where the innerduct will run continuous, the Contractor may break the innerduct if cable lubricant injections are required. If this occurs, the innerduct shall be reconnected to form a continuous run using manufacturer approved compression couplings. All proposed fiber optic cable lubricants shall be compatible with the innerduct material and shall be an approved product of the innerduct manufacturer. The Contractor shall provide certification of the lubricant compatibility to the Engineer for approval prior to installation.

The Contractor shall pull the specified innerducts in accordance with manufacturer recommended installation procedures which shall be submitted to the Engineer prior to the installation. Guide wheels, bending shoes or quadrant guides shall be used to achieve a smooth transition from road grade to conduit depth. The innerduct shall have a 24 inches bend radius minimum. The Contractor shall fill the end of the innerducts with scrap cables or equivalent in order to avoid collapsing of the innerduct within compression grips.

The Contractor shall apply manufacturer approved pulling lubricants as necessary to ensure smooth, even pulls. Each of the innerduct channels shall be tested for clear bore and correct installation in the presence of the Engineer. The maximum pulling force shall be 1 kip.

At all locations where innerduct will terminate, the Contractor shall install sealing and termination plugs on all innerduct channels in order to prevent water and foreign matter ingress. The plugs shall be installed immediately after the innerduct is installed. If the Contractor's proposed fiber optic installation schedule coincides closely with the innerduct installation, the Engineer may waive end plug requirement for innerduct channels to be used in this project.

METHOD OF MEASUREMENT:
The Fiber Optic Innerduct, 2 Channel will be measured for payment as the number of linear feet of innerduct furnished and installed in accordance with the Contract Documents or as directed by the Engineer. The linear measurement will include the 6 inches extensions into the pullbox.

BASIS OF PAYMENT:

REV. 11/05/10
12/26/08E 02/06/96
03/18/97 M Revised 02/24/03

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ITEM 683.07010010 - FIBER OPTIC INNERDUCT, 2 CHANNEL

The unit price bid per foot of Fiber Optic Innerduct shall include the cost of furnishing all labor, materials, tools and equipment necessary to complete the work. Payment for all miscellaneous hardware, couplings, connectors, anchors, lubricants and drag line shall be included under this item.

All conduit and necessary pullbox cleaning will be paid for under separate contract items.
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ITEM 683.07201210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 12 FIBERS
ITEM 683.07202410 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 24 FIBERS
ITEM 683.07203610 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 36 FIBERS
ITEM 683.07204810 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 48 FIBERS
ITEM 683.07206010 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 60 FIBERS
ITEM 683.07207210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.07250010 - FIBER OPTIC DROP CABLE

DESCRIPTION:

This work shall consist of the furnishing and installation of fiber optic cables, passive components and miscellaneous equipment required for a complete cable plant in accordance with the contract documents and as directed by the Engineer.

MATERIALS

Equipment to be installed as part of these bid items include the following:

1. Single Mode Fiber Optic Cable
2. Fiber Optic Cable Connectors and Splices
3. Fiber Optic Splice Trays
4. Fiber Optic Splice Cases
5. Fiber Optic Breakout Kits

Other passive components that are required to form a complete communication system include (1) terminators and (2) moisture and water sealants and cable caps for below grade applications. The components supplied shall be commercially available components whose specifications indicate state-of-the-art capability for the application.

1. Single-mode Fiber Optic Trunk Cable

The single-mode fiber optic cable shall incorporate a water swellable tape and be of a loose buffer tube cable design as specified herein. The fiber optic cable shall be all dielectric suitable for conduit and aerial installation in an outside cable plant environment and for indoor cabling environments when installed in accordance with the current NEC and local building code requirements. All cable shall consist of the number of fibers specified in the contract documents.

The cable shall meet the requirements of the United States Department of Agriculture Rural Utility Service (RUS) 7 CFR1755.900 and the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1999 at a minimum, and shall be new, unused and of current design and manufacture. The cable manufacturer shall have a minimum of three years experience in manufacturing fiber optic cable of similar design.

Optical Requirements

The fiber shall meet the requirements of EIA/TIA-492C AAA “Detail Specification for Class Iva
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Attenuation: The nominal attenuation shall not exceed 0.4 dB/km at a wavelength of 1310 nm and and
0.3 dB/km at a wavelength of 1550 nm. Fiber attenuation shall be uniform with no discontinuities greater
than 0.1 dB. The attenuation at 1383 ± 3 nm shall not exceed 2.1 dB/km. The attenuation measurements
shall be in accordance with EIA/TIA Standards FOTP-20, 59, 61 and 78. The average change in
attenuation at extreme operational temperatures (-40° F to 158° F) shall not exceed 0.05 dB/km at 1550
nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than
0.15 dB/km at 1550 nm. The change in attenuation measurements shall in accordance with EIA/TIA
Standard FOTP-3.

Cutoff Wavelength: Not to exceed 1250 nm.

Mode-Field Diameter:
9.30 ± 0.50 μm at 1310 nm.
10.50 ± 1.00 μm at 1550 nm.

Zero Dispersion Wavelength: 1312 nm ±10 nm.

Zero Dispersion Slope: Not to exceed 0.092 ps/(nm²•km).

Polarization Mode Dispersion: Not to exceed 0.5 ps/(km)½

Dispersion: Less than 3.5 ps/(nm•km) for 1285 nm through 1330 nm and less than 18 ps/(nm•km) at 1550
nm as measured in accordance with EIA/TIA Standard FOTP-169.

Mechanical Requirements

Fibers

All optical fibers shall be Corning glass fibers or approved equivalent. All fibers within a given cable
shall be from the same manufacturer, and shall contain no factory splices. Each fiber shall conform to the
following minimum requirements:

- Typical Core Diameter: 8.3 μm (0.327mil)
- Cladding Diameter: 25.0±1.0 μm (1 mil to 0.04mil)
- Core-to-Cladding Offset: Not to exceed 0.5 μm(0.02 mil)
- Cladding Non-Circularity: Not to exceed 1.0 %

Color Coating
Each fiber shall have a color coating applied to it by the manufacturer. The coating shall not affect the optical characteristics of the fiber. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:


The nominal colored fiber diameter shall be 250 μm.(10 mil).

Primary Coating

Each fiber shall have a dual layered, UV acrylate coating applied to it by the manufacturer. The coating shall be mechanically strippable without damaging the fiber. The coating diameter shall be 245±10 μm(10 mil±0.4 mil).

Central Strength Member: The strength member shall consist of a dielectric, glass-reinforced plastic rod.

Buffering

All fibers shall be enclosed in non-conductive loose buffer tubes. Each buffer tube shall contain up to twelve (12) fibers. The Contractor shall submit the fiber count per buffer tube and the buffer tube count configuration to the Engineer for approval. The fiber shall not adhere to the inside of the buffer tube. Each buffer tube containing fibers shall be color coded in a similar scheme as the fiber color. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:


In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together. Buffer tubes shall be of dual-layer construction.

The buffer tubes shall be filled with a non-hygroscopic gel to prevent water and moisture penetration. The gel shall contain anti-oxidant additives, and the gel shall be readily removable with conventional solvents. The gel shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive.
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Filler Rods: Filler rods shall be used to fill all unused buffer tubes, or shall be used instead of unused buffer tubes. The filler rod shall be a solid polyethylene material and shall be natural in color. The filler rods shall maintain the concentricity of the cable cross section where required.

Stranding: The buffer tubes shall be stranded around the central strength member using the reverse oscillarion (S-Z) stranding process. Water swellable yarns shall be applied longitudinally along the central member during stranding.

Water Swellable Tape: A water swellable tape shall be applied longitudinally over the stranded tubes/fillers. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter.

Tensile Strength Provisions: Aramid yarn shall be helically stranded evenly around the cable core to provide tensile strength. The yarn shall enable the cable to withstand a maximum pulling force of 607 lbs during installation and 200 lbs long term installed without changing the characteristics of the optical fibers. Each length of cable shall have sufficient strength to be installed in continuous lengths as specified on the plans.

Outer Jacket:

A medium density polyethylene (or approved equal) outer jacket shall be applied over the entire cable assembly. The outer jacket shall have a minimum nominal jacket thickness of 1/16 inch. The polyethylene shall contain carbon black and shall not promote the growth of fungus. Jacketing material shall be applied directly over the strength members and the water swellable tape. The outer jacket shall contain no metallic elements and shall be of a consistent thickness.

The MDPE jacketet material shall be as defined in ASTM D1248, Type II, Class C and Grades J4, E7 and E8.

The jacket shall be marked in contrasting color at 2 feet intervals with the following information:

NYSDOT - INFORM FIBER OPTIC CABLE - XXX - YYZZ

where XXX shall equal the number of optical fibers in the cable and YYZZ shall be the month and year that the cable was manufactured. The height of the markings shall be approximately 3/32 inch.

In addition, the outer jacket shall have sequential meter markings as approved by the Engineer. The actual length of the cable shall be within -0% +1% of the length markings.

Ripcord: The cable shall contain a ripcord under the sheath to facilitate cable preparation.
Bend Radius: The cable shall be capable of withstanding a minimum bending radius of ten (10) times its outer diameter during operation and fifteen (15) times its outer diameter during installation without changing the characteristics of the optical fibers.

Diameter: The outer diameter of the cable shall be less than 19/32 inch.

Other Requirements

Manufacturer's Certification: The cable manufacturer shall certify that each reel of cable furnished, meets or exceeds the following specifications:

Fluid Penetration: When a one meter static head of water or equivalent continuous pressure is applied at one end of a one meter length of filled cable for one hour, no water shall leak through the open cable end. The water penetration testing shall be performed in accordance with EIA/TIA Standard FOTP-82.

Filling Compound Flow: When tested in accordance with EIA/TIA Standard FOTP-81, the cable shall exhibit no flow (drip or leak) of filling or flooding compound at 158° F.

Compressive Strength: When tested in accordance with EIA/TIA Standard FOTP-41, the cable shall withstand a minimum compressive load of 126 lb/inch applied uniformly over the length of the sample and applied at the rate of 0.1 inch per minute. The load shall be maintained for a period of 1 minute and then decreased to 63 lb/in. The 63lb/in load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 63 lb/in load. The change in attenuation shall not exceed 0.15 dB at 1550 nm.

Tensile Loading and Bending: When tested in accordance with EIA/TIA Standard FOTP-33, using a maximum mandrel and sheave diameter of 22 inch, the cable shall withstand a rated tensile load of 600 lbs and a residual load of 30% of the rated installation load. The axial fiber strain shall be ≤ 20% of the fiber proof level after completion of 10 minutes of conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm.

Impact Resistance: When tested in accordance with EIA/TIA Standard FOTP-25 except that the number of cycles shall be two at three locations along a one meter cable length and the impact energy shall be at least 3.24lbf ft (in accordance with ICEA S-87-640), the change in attenuation shall not exceed 0.15 dB at 1550 nm.

Cable Flex: When tested in accordance with EIA/TIA Standard FOTP-104, the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The fibers shall not experience an attenuation change greater than 0.15 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.
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ITEM 683.07250010 - FIBER OPTIC DROP CABLE

Temperature Cycling: When tested in accordance with EIA/TIA Standard FOTP-3, the change in attenuation at extreme temperatures (-40°F to +158°F) shall not exceed 0.15 dB/km at 1550 nm.

Low or High Temperature Bending: When tested in accordance with EIA/TIA Standard FOTP-37, the cable shall withstand four full turns around a mandrel of ≤ 20 times the cable diameter for four hours at test temperatures of -22°F and +140°F. Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears or other openings. The fibers shall not exhibit a change in attenuation greater than 0.30 dB/km at 1550 nm.

Cable Twist: When tested in accordance with EIA/TIA Standard FOTP-85, a length of cable no longer than 6 1/2 ft shall withstand 10 cycles of mechanical twisting. The fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.

2. Fiber Optic Drop Cable

Fiber optic drop cables shall be installed in conduit, between the mainline fiber optic backbone cable and equipment cabinets patch panels as shown on the plans. They shall be spliced to the appropriate fiber within approved splice cases in pullboxes adjacent to equipment cabinets as specified.

Optical Requirements: The fiber optic drop cables shall have identical optical characteristics as the single-mode fiber optic trunk cable specified above.

Material Requirements

The drop cable shall have the identical physical configuration as the single-mode fiber optic trunk cable specified above. The fiber optic drop cable shall contain twelve (12) or more fibers. The number of fibers per drop cable shall be selected to allow for a minimum of 50% spare for the drop location.

The drop cable shall be able to withstand a minimum of 100 lbs of pulling force during installation.

The Contractor shall submit the drop cable buffer tube count configuration and fiber count per buffer tube to the engineer for approval.

The individual fibers in each drop cable shall be unterminated on one end and have a factory installed ST connector on the other end. The unterminated end shall be fusion spliced to the appropriate mainline fiber in a splice case and the terminated end shall interface with the cabinet distribution rack specified under a separate contract item. The manufacturer shall factory test the cable assembly with connectors and provide results to the Engineer for approval prior to field installation.

The drop cable shall be of sufficient length to be installed as shown on the plans, with a minimum of 10
The Contractor shall follow the drop cable manufacturer's recommendation in the installation of the drop cables, including the individual breakout fibers.

3. Fiber Optic Connectors:
Fiber optic connectors shall be factory installed. Field installation of connectors shall only be permitted with the express consent of the Engineer and will be considered on a case by case basis. The connectors shall meet the following requirements:

- Type ST twist lock (bayonet).
- Uses ceramic ferrules
- Fiber secured within the ferrule with epoxy, as specified by the connector or epoxy manufacturer.
- Operating temperature: -4°F to +158°F
- Insertion loss: 0.5 dB maximum
- Return loss: 55 dB minimum

4. Splice Cases
The Contractor shall furnish and install fiber optic splice cases in locations where splices require protection. The typical location where they will be required is in pullboxes where the fiber optic trunk cable will be spliced to fiber optic drop cables. The splice cases shall meet the following minimum requirements:

- The case shall be constructed of a rigid, high strength plastic material. The case shall be waterproof with the appropriate gaskets and protection to provide moisture integrity. When installed, the case shall be capable of withstanding severe conditions of moisture, vibration, impact, cable stress and temperature extremes.
- The case shall be capable of holding the type of splice trays specified herein, for fusion and ribbon splices. The case shall have the capability of holding trays from various manufacturers. The basic case shall have the capacity to hold three (3) splice trays with 24 splices per tray.
- The basic case shall have the input/output capacity for 6 cables.
- The case shall be re-enterable without disturbing the fibers or the fiber splices. No special tools shall be required for installation of maintenance of the case. All hardware and miscellaneous parts shall be standard industry equipment.
- The splice case shall be mountable to standard U-shaped sign channels using stainless steel hardware, or manufacturer approved hardware. Mounting shall be as shown on the details.
5. Splice Trays
The Contractor shall furnish and install fiber optic splice trays to organize and store splices within splice cases. The trays shall be compatible with the fiber optic splices and splice cases specified herein and shall meet the following minimum requirements:

- The tray shall have the capacity for 24 splices. It shall be compatible with the fusion splices specified herein but shall also be adaptable to hold mechanical splices.
- The tray shall accommodate up to 8 loose tube buffers. No cable ties are to be used. The loose tube buffers shall be secured with a tube guide or channel snap.
- The tray shall accommodate both 250 micron and 900 micron fiber.
- Slack fiber within the tray shall be placed in an oval shape along an inside wall of the tray.
- The fiber optic splice trays shall be stackable within the splice case. Any tray within a stack shall be accessible without disassembly of any of the other trays.
- The nominal dimensions of the splice tray shall be 16 inch long by 4 ½ inch wide by ½ inch high.

6. Fiber Optic Breakout Kits
The fiber optic breakout kits contain all the tools and materials necessary to complete the installation of the fiber optic backbone and drop cables. It shall include, as a minimum, the following equipment:

- Pulling eyes with protective covering for the installation of preterminated fiber optic drop cable.
- Fiber optic installer test equipment, fusion splicers, test cables, connector adapters, inspection tools, attenuators, tracers, continuity checkers, consumables and all ancillary equipment.

Quality Assurance Provision
All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 ksi.
All optical fibers shall be attenuation tested. The attenuation of each fiber shall be provided to the Engineer with each reel of cable furnished.

The fiber optic cable shall conform to the following requirements:
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ITEM 683.07207210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.07250010 - FIBER OPTIC DROP CABLE

Environmental Requirements

The cable shall function within specifications over the following temperature ranges:

- Shipping/Storage: -58°F to 158°F
- Installation: -22°F to 158°F
- Operation: -40°F to 158°F

CONSTRUCTION DETAILS:

All fiber optic cable will be installed in innerduct placed in steel conduit, steel conduit, lashed to or messenger cable, or overlashed to existing cables as indicated in these contract documents or otherwise directed by the Engineer. All fibers in the fiber optic cable shall be spliced and/or terminated in designated field cabinets or pullboxes only.

Prior to the installation of the fiber optic cable the Contractor shall submit his proposed cable plant design to the Engineer for approval. No cable shall be installed until the proposed cable plant design submission is approved by the Engineer. The cable plant design shall include the following:

- Catalog cuts and shop drawings for all cable, connectors, splice equipment, splice enclosures, splice trays and cable installation and test equipment.
- Preliminary locations of all proposed splices.
- Proposed pullbox locations where hand assists or intermediate assist winches will be required during installation.
- Proof of the experience requirements as defined in this special specification.
- Cable manufacturer's recommended cable installation techniques, both in conduit and overlashed to messenger or existing cable, such that the optical and mechanical properties of the cables are not degraded at the time of installation. The proposed recommendations shall include the following:
  - Cable manufacturer's approved pulling lubricant for use on the cable and method of application. No other lubricants will be permitted.
  - Installation set-up including size and types of rollers, feeder guides, tension gauge make and model number, attachment of pulling jig to jacket and direction of pull.
  - Method to overlash the cables to existing cables including spacing of drip loops, lashing material, slack cable storage.
  - Maximum pulling tensions, which shall specify both pulling from the cable's conductors and for pulling from the cable's outer jacket.
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ITEM 683.07207210 - Single mode fiber optic trunk cable, 72 fibers
ITEM 683.07250010 - FIBER OPTIC DROP CABLE

- Minimum bend radii, which shall specify a radius both loaded and unloaded.
- Method to install multiple cables.

The cable plant design shall be submitted at the Milestone specified in the Special Note of the Contract Documents.

Experience Requirements
Personnel involved in the installation, splicing and testing of the fiber optic cable shall meet the following requirements:

- A minimum of seven (7) years experience in the installation of fiber optic cables, including fusion splicing, terminating and testing single mode fibers.
- Five (5) installed systems where fiber optic cables are installed in outdoor conduits and aerial plants and the systems are in continuous satisfactory operation for at least two (2) years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the fiber optic systems.
- One (1) fiber optic cable system (which may be one of the five in the preceding paragraph) which the Contractor can arrange for inspection and demonstration to INFORM representatives and the Engineer. Test records for the system including cable and splice loss shall be furnished for examination by the Engineer. A system splice enclosure and a patch panel selected at random by the Engineer shall be opened by the Contractor for inspection of workmanship. All inspection activities shall be approved in writing by the system owner prior to actual field inspection.
- Splicers shall have been trained and certified by the manufacturer of the fiber splice material to be used, in fiber optic splicing procedures. Proof of this training must be submitted to the Engineer for approval.
- Installers shall have been trained and certified by the manufacturer of the fiber optic cable to be used, in fiber optic cable installation and handling procedures. Proof of this training must be submitted to the Engineer for approval.
- Personnel involved in testing shall have been trained and certified by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training must be submitted to the Engineer for approval.

Slack Cable Storage
Slack cable shall be stored underground on approved racks in fiber optic pullboxes, at grade in equipment.
cabinets, and overhead on pairs of approved cable snowshoes. Quantity of slack cable to be stored shall be as indicated in the contract documents and as approved by the Engineer.

**Splicing Requirements**

All optical fibers shall be spliced to provide continuous runs. Splices shall be allowed only at locations designated in the approved cable plant layout or as approved by the Engineer. All splices shall be performed in a controlled, clean environment such as a Contractor designated splicing truck/or van.

The splices shall meet the following requirements:

a. All splices shall use the fusion technique. Fusion splicing equipment shall be provided by the Contractor and shall be cleaned, calibrated and specifically adjusted to the fiber and environmental conditions at the start of each shift. Splice enclosures, tools and procedures, shall be approved by the cable manufacturer as being compatible with the cable type being delivered.

b. Only buffered tubes containing fibers to be spliced shall be opened. The other tubes shall be neatly looped and stored in the enclosure.

c. Each spliced fiber shall be packaged in a protective sleeving or housing. Bare fibers shall be completely re-coated with a protective RTV, gel or similar substance, prior to application of the sleeve or housing, so as to protect the fiber from scoring, dirt or microbending.

d. Rack mounted organizer trays shall be used to hold the spliced fibers, with each fiber neatly secured to the tray.

e. Splice loss shall not exceed a mean of 0.1 dB per link. A link is defined as the fiber optic path between two active components. No splice loss shall exceed 0.15 dB. If a splice is measured to exceed 0.15 dB during the splicing process, it shall be remade until its loss falls below 0.15 dB or the Engineer waives the 0.15 dB requirement. Each attempt shall be recorded for purposes of acceptance. If the mean exceeds 0.1 dB in any link, splices in the link shall be remade until the mean loss does not exceed 0.1 dB

f. All splice losses shall be recorded in tabular form and submitted to the Engineer in paper and electronic formats for approval. If an optical time domain reflectometer (OTDR) is used to record splice loss, chart recordings of the "signature" shall be submitted with the splice data with a record of all OTDR settings and the OTDR locations written on the trace.

**Installation**

Fiber optic cable shall be installed in accordance with the approved manufacturer's recommendations. In addition the following requirements shall be met:

a. The number of pullboxes and their locations shall be as shown on the Contract Documents. The
Contractor may be required to install the cable one pullbox at a time. The direction of the cable pull shall be determined by the Contractor and shall require the approval of the Engineer.

b. A minimum of 30 ft of cable slack, or as approved by the Engineer, shall be provided in pullboxes containing splices or otherwise designated on the Contract Documents or as directed by the Engineer. Additional slack, as indicated on the approved cable installation plan, may be provided for closure preparation and splicing.

c. No fiber optic cable shall be pulled through more than one 90 degree bend unless so indicated on the approved Contract Documents or specifically approved by the Engineer.

d. The cable shall not be pulled over edges or corners, over or around obstructions, or through unnecessary curves or bends.

e. The cable shall be looped in and out of cabinets and pull boxes to provide adequate slack and the least amount of stress on the fibers. The Contractor shall ensure that the cable is not damaged during storage or installation.

f. Fiber optic cable ends shall be kept sealed at all times during installation, using a method recommended by the cable manufacturer and approved by the Engineer. The cable end shall remain sealed until the Contractor terminates the fiber cables. Cables that are not immediately terminated shall have a minimum of 6 ½ ft of slack.

g. When using lubricants, the Contractor shall adhere to the cable manufacturer's requirements for the proper amount, application tools and method, and removal of the lubricant from the exposed cable.

h. Optical fiber cable shall be installed in continuous lengths without intermediate splices throughout the project except where splices are indicated on the Contract Documents or approved by the Engineer. Splices shall only be in reenterable splice enclosures mounted in pullboxes, junction boxes and underground vaults.

i. The fiber optic drop cable shall be spliced to either the backbone or distribution cable at the locations indicated in the Contract Documents or as directed by the Engineer.

j. The maximum pulling tensions and minimum bending radii shall not be violated at any time during installation. The Contractor shall consult with the Engineer concerning existing conduit, pull boxes, and risers, which could force the violation of the minimum bending radius for the fiber optic cable. The Contractor shall obtain approval from the Engineer if modifications to these existing facilities are required. Violation of these parameters shall be cause for rejection of the installed cable.

k. Prior to any installation of cable, the Contractor shall clean existing conduit in accordance with the requirements of these special provisions.

l. Prior to overlashing cable, the Contractor shall inspect the existing aerial cable plant and report any deficiencies that may hinder the proper installation of the new cable to the Engineer who will
ITEM 683.07200610 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 6 FIBERS
ITEM 683.07201210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 12 FIBERS
ITEM 683.07202410 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 24 FIBERS
ITEM 683.07203610 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 36 FIBERS
ITEM 683.07204810 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 48 FIBERS
ITEM 683.07206010 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 60 FIBERS
ITEM 683.07207210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.07250010 - FIBER OPTIC DROP CABLE

determine, what, if any, action should be taken.

m. Slack cable and innerduct where pulled through a pullbox shall be racked to the pullbox wall.

Splicing Requirements

a. All optical fibers shall be spliced to provide continuous runs.
b. Prior to splicing the Contractor shall test each fiber of the installed cable for continuity, anomalies (events above 0.3 dB) and attenuation using an Optical Time Domain Reflectometer (OTDR) at wavelengths of 1310 nm and 1550 nm.
c. Only the fibers designated for splicing shall be spliced. All other fibers shall be routed through the splice enclosure with at least 1 ft of slack left within the enclosure. Only buffer tubes containing fibers to be spliced shall be opened.
d. Splices shall be made only at locations designated in the approved cable plant layout or as approved by the Engineer.
e. Where two backbone cables are routed in the same duct bank, both cables shall not be spliced in the same pull box.

Termination Requirements

The connector loss for complete connection to the terminal equipment shall not exceed a mean of 0.5 dB. No connector losses above 1.0 dB shall be permitted.

Unused optical fibers shall be properly protected with sealed end caps.

Documentation Requirements

Ten (10) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

- Complete and accurate as-built schematic diagrams showing the fiber optic cable plant and locations of all splices.
- Complete performance data of the cable plant showing the losses at each splice joint and each terminal connector.
- Installation, splicing, terminating and testing procedures.
- Complete parts list including names of vendors.
- Complete maintenance and trouble-shooting procedures.
- One (1) month prior to installation, ten (10) copies of the Contractors Installation Practices shall be submitted for approval. This shall include practices, list of installation equipment, and splicing
and test equipment. Field quality control procedures shall be detailed as well as procedures for corrective action.

**Testing Requirements**

The following tests shall be conducted. All tests shall conducted in accordance with approved test procedures. The Contractor shall submit test procedures and forms in paper and electronic formats for approval to the Engineer.

**Existing Fiber Cable Verification Test**: Prior to splicing fibers installed under this contract to existing fibers (where designated in the plans), the Contractor shall verify the loss characteristics of the existing fiber. Any anomalies shall be reported to the Engineer.

**Pre-Installation Tests**

The fiber optic cable shall be inspected and tested at the site storage area prior to installation.

Proper fiber cladding and fiber tube colors shall be verified by visual inspection. Any difference discovered from approved fiber optic cable plant layout or approved catalogue cut sheets for the cable shall be grounds for rejection of the cable.

Each optical fiber in the cable shall be tested from one end with an OTDR compatible with wavelength and fiber type. Testing shall check for continuity, length, anomalies, and approximate attenuation at both 1310nm and 1550nm wavelengths. Each measurement shall be recorded with color, location and type of fiber measure. In the event that a meaningful measurement cannot be made from one end, it shall be performed from the opposite end of that fiber.

**Post-Installation Tests**

Pre-splice and Post-splice testing shall be performed as follows:

**Pre-Splice Testing**

After installation and prior to splicing or terminating each optical fiber in the cable shall be tested again for the loss characteristics at both 1310nm and 1550nm wavelengths. Both directions of operation of the fiber shall be tested.

**Post-Splice Testing**

After each splice and connector installation, each optical fiber span including all black/spare fibers shall undergo the following tests after installation of all connectors and splices. A span is defined as a
continuous length of fiber including all splices and connectors:

- Using an OTDR test each span at 1310 nm and 1550 nm for fiber attenuation, continuity, length, and anomalies. Each optical fiber shall meet the following acceptance criteria:
  - Attenuation: Not to exceed 0.4 dB/km + 0.1 dB/splice + 0.5 dB/connector. The number of splices and cable attenuation shall be based upon the approved cable plant layout.
  - Anomalies: No event shall exceed 0.3 dB. If any event is detected that value, the contractor shall repair or replace that section of cable.
- Using an optical source and a power meter measure the attenuation from both ends. The measured attenuation shall meet the criteria defined for the attenuation using the OTDR.

All cable that fails to meet the aforementioned requirements shall be replaced.
The Contractor shall submit to the Engineer a tabulated list of fibers and the actual end-to-end measured values from the above tests and all traces and loss length printouts.

Each fiber shall be listed according to the color code and span. This test data shall be the basis of acceptance for the fiber.

For optical fibers spliced to existing fibers this test shall be repeated between the control center and the field termination after the new and existing fibers have been spliced together. If a fiber fails to meet the loss characteristics for the spliced section fiber, the Contractor shall determine whether the excessive loss is the result of an anomaly in the new section of fiber, splice or existing section of fiber. The Contractor will not be responsible for repairing the existing fiber. The Contractor shall, however, be responsible for the new section of fiber and the splice between the two sections.

**METHOD OF MEASUREMENT:**

The fiber optic cable will be measured for payment as the number of linear feet of each size actually furnished and installed in accordance with the contract documents.
ITEM 683.07200610 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 6 FIBERS
ITEM 683.07201210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 12 FIBERS
ITEM 683.07202410 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 24 FIBERS
ITEM 683.07203610 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 36 FIBERS
ITEM 683.07204810 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 48 FIBERS
ITEM 683.07206010 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 60 FIBERS
ITEM 683.07207210 - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.07250010 - FIBER OPTIC DROP CABLE

BASIS OF PAYMENT:

The unit price bid per foot for Single Mode Fiber Optic Trunk Cable and Fiber Optic Drop Cable shall include the cost of furnishing all labor, material, tools and equipment and testing of the fiber optic cable to complete the work. The cost of furnishing and installing all passive components shall be incidental to and included in the pay item for fiber optic cable. All splicing, including set-up and individual terminations and connectors shall also be included in the pay item for fiber optic cable. All cable racks, snowshoes and other miscellaneous hardware necessary for slack cable storage shall also be included in the pay item for fiber optic cable.

Progress payment will be made as follows:

- Sixty percent of the bid price of the completed cable plant will be paid upon completion of installation and satisfactory completion of the post-installation tests.
- Twenty-five percent of the bid price will be paid upon satisfactory completion of all subsystem tests as described in the Special Provisions.
- Fifteen percent of the bid price will be paid upon satisfactory completion of Final System Acceptance.
ITEM 683.10120010 – CCTV DOME CAMERA ASSEMBLY

DESCRIPTION:

This work shall consist of furnishing and installing Closed Circuit Television (CCTV) Dome Camera Assemblies at the field locations shown in the contract documents and in accordance with the contract documents.

MATERIALS:

All materials furnished, assembled, fabricated, or installed shall be new, corrosion resistant and in strict accordance with the details shown in the contract documents. The CCTV Dome Camera Assembly shall be fully compatible with and shall have the capability of being controlled by the existing INFORM CCTV control switcher located in the INFORM Control Center in Hauppauge.

General Requirements

The equipment shall deliver high quality full-motion video during day or night operation with the video transmitted over either the INFORM RF and fiber optic networks or over wireless video links installed as part of this project as indicated in the contract documents. Each CCTV Dome Camera Assembly consists of a solid state color CCTV Camera, zoom lens, camera enclosure, pan/tilt drive, built in Receiver Driver Unit (RDU) and all cabling required to interface the CCTV Dome Camera Assembly with equipment in the field equipment cabinet. When the light level drops below a programmable level, the camera shall be capable of switching to black and white from color or remaining in color mode.

Mounting hardware and all interconnecting cabling between the camera assembly and the field cabinet shall also be provided as part of this item. The camera assembly shall be designed for mounting on a CCTV pole, span or light pole, structure or wall as specified in the contract documents. Adapter plates, where required, shall be provided as part of this item. Connections between the equipment shall be through weather proof connectors to provide easy replacement. Servicing of the camera assembly shall be available in the continental United States or Canada.

Specific Requirements

The CCTV camera shall utilize digital signal processing (DSP) techniques and shall meet the following requirements:

a. Format: NTSC 1VPP @ 75 ohms, unbalanced composite.
b. Scanning: 2:1 interlace.
c. Imager: Interline transfer CCD.
d. Horizontal resolution (minimum): 460 TV lines.
e. Sensitivity: 0.28 fc at 1/60 second shutter speed color and 0.028 fc at 1/60 shutter speed black and white at 50 IRE and 1/60 second shutter speed.
f. Signal to Noise ratio (AGC off): 50 dB minimum.
g. White balance compensation: Automatic.
h. Back light compensation

i. Electronic shutter speeds: Auto and programmable 1/4 to 1/10,000 second with programmable setting for minimum shutter speed.
j. IR lens filter can be switched in and out automatically or manually. When filter is in, color video shall be produced. When filter is out, black and white video shall be produced. The light level that the filter shall be switched in or out shall be programmable.

k. Iris: Auto with manual override.

l. Focus: Auto with manual override.

m. Automatic gain control (AGC.)

n. Optical zoom: 0.15in – 3.26 in (23X) for ¼” format. Other zoom ranges are subject to approval by the Engineer.

o. Aperture: f1.6.

p. Sunshield: Shroud type.

q. Lower dome: The lower dome shall provide a viewing area such that unrestricted camera views are obtained for all camera and lens positions.

r. Material: With exception of the lower dome, the enclosure shall be painted anodized aluminum. The lower dome shall be optically clear, uv treated polycarbonate a minimum of 3/32 inch thick. The hardware shall be stainless steel.

s. Capable of continuous, simultaneous pan and tilt movements and meeting the following requirements:

t. Movement: pan - 360° continuous rotation.
   tilt - 0° to 90°.

u. Speed: Variable from 0.1 to 20°/second and fixed as commanded by the camera controller.

v. Limit stops: To limit the range of horizontal and vertical movements limit stops shall be provided that are externally adjustable for pan and tilt.

w. Settable addresses: One-hundred (100) minimum. Each unit shall be assigned a unique address. A unit shall only respond when it is addressed.

x. Presets: Minimum of thirty-two (32) stored in non-volatile memory.

y. Dome shall be pressurized with dry nitrogen to prevent entry of dust and moisture. The enclosure shall contain a Schrader valve for recharging of the nitrogen gas.

z. Built in thermostatically controlled heater/defroster/defogger. The defroster/defogger shall prevent icing and fogging of the viewing window. The heater shall be sized and thermostat set to permit operation of the camera over the specified environmental conditions. A minimum of 41° F hysteresis shall be provided in the thermostat to prevent continuous cycling of the heater, defroster or defogger. Either snubbers or Metal Oxide Varistors (MOV) of appropriate ratings shall be installed across the switch outputs of all thermostats. The MOVs shall be connected to ground.

aa. Data interface: RS-232 to the Video Fiber Optic Transceiver with Bi-Directional Data furnished as part of other bid items.

bb. Camera control data rates: 1200-9600 bps as required.

cc. Camera control: Compatible with existing INFORM switcher

dd. Connectors: Video - BNC.

ee. Electrical connections shall be through a pre-wired feed-through rather than through a wiring harnesses.
ITEM 683.10120010 – CCTV DOME CAMERA ASSEMBLY

Electrical
- Voltage: 24 VAC ±20%.
- Power (maximum): 70 VA with heater, fan and defroster turned on.

As part of this item a transformer shall be provided in the equipment cabinet to convert 120 VAC to 24 VAC. The transformer shall be rated at 100 VA minimum.

Mechanical
- Height (maximum): 12 in (H) x 10-5/8 in (Diameter).
- Weight (maximum): 15.4 lb.
- Mounting: Pendant.

Environmental
- Temperature (operating): -22°F to +122°F ambient.
- Humidity: 0 to 95% noncondensing.
- Wind: Meet all performance requirements when subjected to a 90 mph wind and able to withstand a 127 mph wind.

Power and Control Cable: The power and control cable between the CCTV Camera Assembly and the field cabinet shall be in accordance with the CCTV equipment manufacturer’s recommendation. Shop drawings showing the configuration of the harness along with the manufacturer’s recommendation shall be submitted to the Engineer for approval prior to fabrication.

Coaxial Cable: Type RG59 Coaxial cable with a dual shield shall be used to connect the camera to Video Fiber Optic Transceiver With Bi-Directional Data housed in the equipment cabinet.

Field Controller: Either software that runs on a notebook computer under the Windows operating system or a camera controller shall be provided to permit local programming and control of the camera and lens from the equipment cabinet. All programmable camera parameters shall be stored in either non-volatile memory or in a file on a notebook computer. Three copies of all software required for local operation and storage of programmable camera parameters shall be provided.

CONSTRUCTION DETAILS

The Contractor shall install and program the specified CCTV field equipment at locations shown in the contract documents and as ordered by the Engineer. The camera assembly shall be installed such that the line of sight of the camera is in the center line of the desired field of view when the camera is in the mid point of the desired motion between the limit stops. The Engineer will provide the field of view for each camera, the limit settings of its vertical and horizontal movements and the programmable parameters prior to installation. The Contractor shall furnish and install the mounting hardware, connectors and weather heads required for the installation of the camera assembly.

The Contractor shall electrically bond the camera assembly and the pole mounted adapter to the pole when mounted to a pole and to the nearest ground rod when mounted on a structure. The camera assembly shall be connected to the pole mounting adapter through a No. 6 AWG braided conductor.
ITEM 683.10120010 – CCTV DOME CAMERA ASSEMBLY

Documentation

Six (6) advance copies of equipment manuals furnished by the manufacturer shall be submitted to the Engineer for review at least ten (10) days prior to the scheduled start of the first Stand-Alone Test. The Engineer will verify the manufacturer’s equipment manual as part of the test and integration process. The equipment manual incorporating the Engineer’s corrections and comments shall be integrated by the Contractor into the operations and maintenance manual as described in the contract documents. The manuals shall, as a minimum, include the following:

1. Complete and accurate schematic diagrams.
2. Complete installation and operation procedures.
3. Complete performance specifications (functional, electrical, mechanical and environmental) of the unit.
4. Complete list of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA or EIA.
5. Complete maintenance and troubleshooting procedures.
6. Setup and configuration data for each camera location including the camera address, day/night threshold setting, horizontal and vertical limit settings and shutter speed.

Testing

The CCTV dome camera shall be subjected to the levels of testing described in the Special Note for this Contract.

METHOD OF MEASUREMENT:

CCTV Dome Camera Assembly will be measured for payment as the number of assemblies satisfactorily installed.

BASIS OF PAYMENT:

The unit price bid for each CCTV Dome Camera Assembly shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work including testing.
ITEM 683.10700010 - CCTV VIDEO AND PTZ FIBER OPTIC TRANSCEIVER, RACK MOUNT

ITEM 683.10710010 - CCTV VIDEO AND PTZ FIBER OPTIC TRANSCEIVER, SHELF MOUNT

DESCRIPTION:

This work consists of the furnishing and installation of video and bi-directional pan-tilt-zoom (PTZ) fiber optic transmitters/receivers (transceivers) in designated cabinets in the field as shown in the Contract documents and as directed by the Engineer. The transceivers shall be used to transmit baseband video signals from CCTV camera locations to the field communications node locations and EIA-232 data for PTZ control and monitoring between the Video Hub locations and the camera controller's receiver/driver.

MATERIALS:

All materials furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with all of the details shown in the Contract documents and in the Special Specifications. The transceivers shall be fully compatible with each other and shall be from the same manufacturer. In addition, they shall be fully compatible with the Video Multiplexors, CCTV cameras and CCTV camera controller receiver/drivers provided under other contract items.

Functional Requirements

The bi-directional fiber optic transceivers shall provide for transmission of NTSC baseband video signals from CCTV cameras to Video Multiplexors in the field Video Hub cabinets and for transmission between the field Video Hub cabinets and the CCTV camera controller's receiver/driver of EIA-232 data that contains PTZ monitor and control information. The optical wavelength shall be 1310 nm, nominal.

To insure compliance and interchangeability with equipment installed as part of previous projects, the CCTV Video and PTZ Fiber Optic Transceivers shall be the following:

| VT9930WDM  |
| VR9930WDM-R3 and an R3 rack |
| manufactured by International Fiber Systems, Inc. |
| 16 Commerce Road |
| Newtown CT 06470 |
| 203 426-1180 |

or equal as approved by the Engineer.

Special Requirements

The specific fiber optic transceiver equipment shall match the requirements of the CCTV/PTZ equipment selected by the Contractor and approved by the Engineer. Bi-directional EIA-232 data transmission shall be used to control the selected PTZ equipment. The fiber optic transceiver selected for this application shall operate over only one fiber.

The rack mounted transceivers shall be installed in field Video Hub cabinets and shall provide NTSC outputs. These transceivers shall be in the form of cards that plug into and are powered from rack chassis provided from the same manufacturer. The rack chassis with associated power supplies shall be included in the CCTV Video and PTZ Fiber Optic Transceiver - Rack Mount item.

The shelf mounted transceivers shall be installed at the CCTV camera locations in cabinets provided under another contract item. The input to the shelf mounted transceivers shall be NTSC video signals.
from the CCTV cameras. These transceivers shall be powered by separate power supplies that shall be provided under this contract item.

The equipment shall meet the following requirements:

**Electrical/Optical Requirements**

- **Video Input:** 75 Ohm nominal impedance, 1.0 Volt peak-to-peak typical. The transmitter shall be NTSC compatible.
- **Data Input:** EIA-232 at data rates up to and including 19,200 bits per second.
- **Link Loss Budget:** 23 dB minimum.
- **Receiver Optical Dynamic Range:** Sufficient range to preclude the possibility of receiver saturation. The use of external fiber optic attenuators shall not be permitted.
- **Receiver Video Output:** 75 S nominal impedance, 1.0 Volt peak-to-peak output level.
- **Modulation:** Either frequency modulation or digital
- **Signal to Noise Ratio:** Greater than 57 dB measured in accordance with EIA-250
- **Linearity:** Less than 1%.
- **Field Tilt:** Less than 1%.
- **Differential Phase:** Less than 2E at 10 to 90% average picture level (APL).
- **Differential Gain:** Less than 2% at 10 to 90% APL.
- **Frequency Response:** Within ±1 dB, from 10 Hz to 5 MHz.
- **Optical Fiber Compatibility:** The transmitter and receiver shall be compatible with the single mode optical fiber of the type specified in the Contract documents.

**Power Requirements:** The transceivers shall operate at 24 Volts or less either AC or DC, from a separate power supply. The power required shall not exceed 5 Watts each. The power supply shall operate from 115±20 VAC. For rack mounted cards, the card cage shall contain the power supply

**Mechanical Requirements**

- **Connectors:** Type ST
- **Housing:** The housing of the transceivers shall be suitable for mounting in a field cabinet. The rack mounted cards shall occupy a maximum of two card slots.
- **Rack:** The rack shall contain an integral power supply and
provide a minimum of fourteen (14) card slots.

Environmental Requirements

The equipment shall meet all of its specified requirements during and after being subjected to any combination of the following conditions:

- Ambient temperature range of -4°F to +158°F
- Relative humidity from 0% to 95%, non-condensing

CONSTRUCTION DETAILS:

The Contractor shall install the CCTV Video and PTZ Fiber Optic Transceivers in the designated cabinets as shown in the Contract documents.

Documentation Requirements

Ten (10) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

- Equipment operation
- Complete installation procedures
- Complete performance specifications (functional, electrical, mechanical and environmental)
- Complete and accurate troubleshooting, diagnostic and maintenance procedures

Testing Requirements

Operational Test

After installation of the equipment in the field and prior to integration of the equipment into the system, the Contractor shall perform an operational test in the field for each of the CCTV Video and PTZ Transceivers installed. The test shall demonstrate as a minimum the ability of the Transceiver to transmit and receive CCTV video and PTZ control signals between the hub and each of the field sites. As part of the operational test the optical transmit and receive levels shall be recorded for each transceiver.

If the Operational Test fails, the equipment shall be repaired and the test shall be rerun for that site. If a component has been modified as a result of a failure, that component shall be replaced in all like units and the test shall be rerun for each unit.
METHOD OF MEASUREMENT:

The CCTV Video and PTZ Fiber Optic Transceivers will be measured for payment as each unit of the type indicated in the contract documents furnished, installed, made fully operational and tested.

BASIS OF PAYMENT:

The unit price bid for each type of CCTV Video and PTZ Fiber Optic Transceivers shall include the cost of furnishing all labor, materials and tools and equipment necessary to complete the work. Power supplies needed with the shelf mounted transceivers at the camera end, racks for the rack mounted transceivers, and any miscellaneous hardware, including the fiber optic patch cable and the data cables required shall be included under this item and will not be paid for separately.
ITEM 683.1080bb10 - FIBER OPTIC VIDEO MULTIPLEXER PAIR- 8 CHANNEL

DESCRIPTION:

This work shall consist of furnishing and installing fiber optic video multiplexers in designated cabinets in the field and at central as shown in the contract documents and as directed by the Engineer. Each fiber optic video multiplexer pair consists of a transmitter and a receiver. The transmitter provides for the multiplexing and simultaneous transmission of multiple baseband video signals onto a single fiber of the type provided as part of this project and the receiver provides for the detection and demultiplexing of the video into separate baseband video signals.

MATERIALS:

All materials furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with all of the details shown in the Contract Documents and in the Special Specifications.

General Requirements

The transmitters and receivers shall be fully compatible with each other and shall be from the same manufacturer. The transmitters and receivers shall not require any electrical or optical adjustments.

To insure compliance and interchangeability with equipment installed as part of previous projects, the Video Fiber Optic Multiplexer Pair shall be the following:

| VT7830-26dB-R3  |
| VR7830-R3       |
| manufactured by International Fiber Systems, Inc. |
| 16 Commerce Road |
| Newtown CT 06470 |
| 203 426-1180    |

or equal as approved by the Engineer.

Specific Requirements

Optical

a. Wave length: 1310/1550 nm

b. Optical transmitter: laser

c. Link loss budget: 26 dB minimum

d. Dynamic range: 23 dB minimum

e. Connector: Type ST

Video (parameters measured in accordance with EIA/TIA-250-C)
ITEM 683.1080bb10 - FIBER OPTIC VIDEO MULTIPLEXER PAIR- 8 CHANNEL

a. Number of channels: 8
b. Video format: NTSC
c. Video modulation and multiplexing: FM or digital
d. Input/output impedance: 75 ± 1 ohm
e. Return loss: 30 dB minimum
f. Differential Gain: 5 % maximum
g. Differential Phase: 3° maximum
h. Signal to noise ratio: 56 dB minimum
i. Connector: Type BNC

Power Requirements
The transmitters and receivers shall be powered from a power supply contained in the chassis in which it is housed. The power supply shall operate from 115 ± 20 VAC. The transmitters and receivers shall be hot swappable.

Mechanical Requirements
The transmitter and receiver shall be configured for mounting in chassis which shall be provided as part of this item. In addition to the power supply the chassis shall hold four transmitters, receivers or a combination. Blank filler plates shall be used to cover all unused slots.
The chassis shall be designed for mounting in a standard 19 inch EIA rack. The maximum dimensions of the chassis shall be as follows: 19 inch L x 11 inch D x 5-3/8 inch H

Environmental Design Requirements
The equipment shall meet all of its specified requirements during and after being subjected to any combination of the following conditions:

- Ambient temperature range of -4°F to +149°F.
- Relative humidity from 0% to 95%, non-condensing.

CONSTRUCTION DETAILS:
The Contractor shall install the Fiber Optic Video Multiplexer transmitter or receiver in the designated cabinets as shown on the plans. At the transmitter, the Contractor shall terminate all unassigned video ports in accordance with the manufacture’s recommendation.

Documentation Requirements
Ten (10) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

- Equipment operation
- Complete installation procedures
- Complete performance specifications (functional, electrical, mechanical and environmental)
- Complete and accurate troubleshooting, diagnostic and maintenance procedures

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ITEM 683.1080bb10 - FIBER OPTIC VIDEO MULTIPLEXER PAIR- 8 CHANNEL

Testing Requirements

The Fiber Optic Video Multiplexer Pair shall be subjected to the following operational tests in addition to complying with the testing described in the Special Notes.

Operational Tests

- Measurement and recording of optical transmit and receive signal levels,
- For each Fiber Optic Video Multiplexer Pair the capability to transmit and receive video from each camera shall be demonstrated. This test shall not be performed until the video from all of the cameras reporting to a hub are operational. With video simultaneously on each input into the transmitter monitor each of the video outputs at the receiver to which the transmitter is connected. Where assigned the video from the cameras reporting to a hub shall be used and simulated video shall be used for inputs not currently assigned video. The Contractor shall propose a method, subject to approval of the Engineer, to simulate the video for inputs which do not have a video input assigned.

**METHOD OF MEASUREMENT:**

The Fiber Optic Video Multiplexer Pair will be measured for payment as each pair of units furnished, installed, made fully operational and tested.

**BASIS OF PAYMENT:**

The unit price bid for each Fiber Optic Video Multiplexer Pair shall include the cost of furnishing all labor, materials and tools and equipment necessary to complete the work. Chassis and power supplies needed to house the video and power the transmitters and receivers, hardware, including the fiber optic patch cable, optical pads, unused port terminations and the coaxial cable between the video sources and inputs into transmitters and coaxial cable between the video output of the receiver and the video destination shall be included under this item and will not be paid for separately.

Payment for all documentation and testing specified herein shall be included under this item.

Progress payments will be made as follows:

- Fifty percent of the bid price will be paid when the unit is installed; twenty percent will be paid upon satisfactory completion of the Operational Tests described in this section of the Special Specifications
- Twenty percent of the bid price will be paid upon satisfactory completion of the Video Communications Subsystem Integration Test as described in the Special Notes
- Ten percent of the bid price will be paid upon system acceptance
ITEM 683.93510010 - WIRELESS BROADBAND RADIO ASSEMBLY - SINGLE RADIO
ITEM 683.93520010 - WIRELESS BROADBAND RADIO ASSEMBLY - DUAL RADIO
ITEM 683.93530010 - WIRELESS BROADBAND RADIO ASSEMBLY - INTEGRATED UNIT

DESCRIPTION

The Contractor shall furnish and install a Wireless Broadband Radio Assembly - Single Radio, Dual Radio or Integrated Unit designated in the Contract Documents and as ordered by the Engineer. Wireless Broadband Radio Assemblies are used to transmit and receive 10/100 Mbps Ethernet data between field cabinets as designated on the plans.

MATERIALS

Wireless Broadband Radio Assembly - Single Radio

The Wireless Broadband Radio Assembly - Single Radio includes the radio transceiver, single antenna, and all cables and mounting hardware required. The single radio unit will typically be utilized in point to point and end of the line type configurations. It will also serve as the slave in a master/slave configuration.

Wireless Broadband Radio Assembly - Dual Radio

The Wireless Broadband Radio Assembly - Dual Radio includes two independent radio transceivers, two antennas and all cables and mounting hardware required. Both radio transceivers and associated antennas shall be housed in the same enclosure. The dual radio unit will typically be utilized in drop/insert or signal interconnect repeater type configurations.

Wireless Broadband Radio Assembly - Integrated Unit

The Wireless Broadband Radio Assembly - Integrated Unit includes the radio transceiver, single antenna, and all cables and mounting hardware required. The mounting of the antenna shall be integral to the radio transceiver housing requiring no external antenna input. The integrated unit will typically be utilized in point to point and end of the line type configurations.

All material furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with all the details shown in the Contract Documents and in these Special Specifications.

General Requirements

All equipment furnished under these items shall:

1. Be from the same manufacturer
2. Not require manual adjustment

Network Requirements

Data Rate

Minimum of 54 Mbps, Auto-Sensing
Bit Error Rate

< $10^{-9}$ (for any link loss between 0 and 15 dB)

Ethernet Port

10/100BaseTX

IEEE Compliance

- 802.1s/802.1w - STP/RSTP
- 802.3-10BaseT
- 802.3u-100BaseTX
- 802.3d-MAC Bridges
- 802.1d-Spanning Tree Protocol - Ethernet Bridging
- 802.1p/802.11e-Class of Service
- 802.1q-VLAN Tagging
- 802.11h - DFS and TPC
- 802.3af - Power over Ethernet
- VPN Compatible

Wireless Requirements

- Broadband 5.8 GHz (Unlicensed)
- 802.11 a/b/g/n Compliant
- Modulation - Orthogonal Frequency-Division Multiplexing (OFDM)
- Transmit Power - at least 28 dBm
- Range - up to 60 miles based on antenna selection
- Dynamic Frequency Selection

Security Features

- 802.11i with AES-CCM Encryption
- 802.1x Authentication
128 Bit WEP

MAC Authentication

**Network Management**

- Telnet
- SNMP

**Antenna**

The radio assemblies shall be furnished with a high gain, flat panel type, Yagi, sector or omni antenna suitable for the application or as specified on the plans. Antenna use will be determined by distance between radios, line of sight conditions and network architecture. Prior to installation, the Contractor shall submit his proposed antenna layout to the Engineer for approval. Typical antenna arrangements shall include:

- Single Radio - one flat panel or one yagi or one sector antenna
- Dual Radio - two yagi or two sector antenna
- Integrated Unit - one integrated high gain, flat panel antenna

The panel antenna shall be weatherproof and have the same ingress protection rating as the radio enclosure.

**Radio Enclosure**

The radio shall be mounted within a cast aluminum or similar enclosure that meets the following requirements:

- Maximum Dimensions: 10" L x 10" W x 3" D
- Maximum Weight: 3 lbs
- Ingress Protection (IP) 67 weatherproof rating
- Operating Temperature Range: -30°C to + 60°C
- Humidity (non-condensing): 5% to 95%
- Industrial, weatherproof 10/100 BaseT Ethernet connector
- Female Type N antenna connectors for external antenna connections as required. The single radio shall have one Type N connector; The dual radio shall have two Type N connector and the integrated unit shall have one Type N connector
Power Requirements

Power Over Ethernet

The radio units shall support Power over Ethernet (POE). A POE supply injector shall be provided with each radio. Typically this injector will be located in the local equipment/controller cabinet and shall meet the following requirements:

- Input Voltage: 100 to 240 VAC
- Output Voltage: 1A @ 18 VDC
- The injector shall have suitable lightning and surge protection integral to the unit

Power Consumption

- Single Radio - 0.5A, 9W max @ 18 VDC
- Dual Radio - 0.8A max, 15W max @ 18 VDC

Antenna Feed-line and Connectors

- All antenna feed-lines less than 15 meters long shall be low loss, nominal 50 ohm, weather resistant, flexible, semi-rigid coaxial cable such as Andrew FSJ4-50B Heliax or equivalent. Braided coax such as RG8U shall not be acceptable. Antenna feed-lines over 15 meters long shall utilize 7/8 hardline such as Andrew LDF5-50A or equivalent. Short flexible jumper cables made of Andrew FSJ4-50B Heliax or equivalent shall be utilized to connect the antenna to the 7/8 hardline and inside the equipment cabinet
- All coaxial cable connectors shall be EIA compliant UG1168 Utilizing captive pin technology
- All external antenna connections shall be made utilizing cold shrink tubing or butyl weatherproof tape sealed with 2” electrical tape in order to provide a weathertight seal at the N connector.

Lightning/Surge Protector

- Frequency range: DC - 1.5 GHZ..
- VSWR: 1.2:1 max. (to 1 GHZ.)
- Power Capacity: 100 W
- Insertion Loss (maximum): 0.5dB
- DC breakdown voltage (slow rising): 500 VDC
- Breakdown voltage at KV/use: 2,000 V
• Maximum impulse current for 8 x 10 us 500 A waveform: 5,000 A
• Impulse life for 10 x 1000 us 500 A waveform: 500 occurrences minimum
• Insulation resistance at 100 VDC: 100 Mohms
• Connectors: Female "N-Type"

Ethernet Cable

As part of this item. The Contractor shall furnish and install industrial, outdoor rated Cat 6e cable with weatherproof connector. The Contractor shall supply a minimum length as required to connect the local control equipment to the radio transceiver enclosure.

CONSTRUCTION DETAILS

The Contractor shall install the broadband radio assemblies at field locations as shown on the plans. The typical installation will require the Contractor to install the radio enclosure at the top of a traffic signal span pole or a CCTV pole and install the Cat 6e cable vertically down the pole to the local equipment cabinet. Specific details shall be as shown on the plans. As part of this item, the Contractor shall furnish and install all necessary mounting and attachment hardware for the radio enclosure and any external antennas required. If a pole installation requires external conduit connections between the radio enclosure and the local equipment cabinet, they will be paid under separate conduit items as shown on the plans.

The Contractor shall prepare a shop drawing which details the complete wireless broadband radio assemblies and all components to be supplied. Prior to submittal of the shop drawing, the Contractor shall conduct a site survey, including frequency scans, which shall identify any problems and/or pinpoint setup procedures for the radio system. The results of this survey shall determine the type of antenna required for the wireless link in accordance with the manufacturer's recommendations and shall be documented in the shop drawing. Particular care shall be given to the interconnection of all of the components and the cabling. The Engineer reserves the right to inspect and/or factory test any completed assemblies prior to delivery of the material to the project site. Any deviations from these specifications that are identified during such testing shall be corrected prior to shipment of the assembly to the project site.

The Contractor shall install the broadband radio transceiver at the location as designated in the plans or as directed by the Engineer. The radio shall be mounted on the structure as indicated in the standard details. The antenna lead-in shall be installed and connected to the transceiver and the antenna. The contractor shall program the broadband radio to operate at the designated address and channel. The antenna shall be positioned to insure a maximum strength signal at both ends of the transmission path.

The following tests shall be performed for each completed broadband radio transceiver assembly:

• After all antenna feed-line connections have been made, and before sealant has been applied to antenna connections, the Contractor shall perform an "Antenna /Feed-line test". The first part of this procedure shall be a "Standing Wave Ratio " (SWR) test of the antenna, feed-line, and
coaxial cable protector. For this test, a calibrated watt meter and reflectometer shall be used for measurements. The Contractor shall keep a record of the results of each antenna feed-line SWR test and provide the Engineer with a written report documenting the results. A SWR reading of 1.2:1 or better shall be obtained. Adjustments and corrections shall be implemented by the contractor until an acceptable SWR reading is obtained. After that point, all antenna connectors shall be sealed with cold shrink tubing or butyl weatherproof tape sealed with 2" electrical tape secured with an epoxy sealant, such as 3M brand CCT tubing.

- After the antenna feed-line test has been successfully completed, all directional antennas shall be properly aligned for maximum signal strength. The Contractor shall determine from the plan set the general direction that each broadband radio antenna shall be aimed to.

After the initial directional setup is made, the procedure outlined below shall be implemented to maximize the signal strength for each radio link. The Contractor shall adjust the output power to optimize the receive signal level at the slaves in compliance with FCC regulations. The master radio shall then be setup to transmit a continuous signal. The radio technician shall then adjust the beam heading at each slave location by measuring the radio signal level monitor output while adjusting the antenna beam heading for maximum signal. The contractor shall make a record of the channel settings and power levels to which each radio is set and the measured signal level measurement received at each radio. These test results shall be submitted to the Engineer in a written report.

Once the Antenna/feed-line and Antenna alignment tests have been completed, an Operational Stand-Alone test shall be initiated. For this test, the broadband radios to be tested shall be connected to the designated Ethernet port at each field equipment location as indicated in the plan set. The Contractor shall program the radios and adjust for proper operation. The Contractor shall then connect a portable computer to the master radio. Utilizing basic communications software to be provided by the contractor, each slave unit shall be addressed and successful two-way communications shall be demonstrated. Message throughput shall exceed 99% over at least a fifteen minute period. The contractor shall keep an accurate record of each Operational Subsystem Test and shall provide a written report to the Engineer.

**Warranty**

All components to be supplied under this specification shall be warrantied for a minimum of three years from the conclusion of the system acceptance test. This warranty shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more than two weeks from date of receipt and the provider of the warranty shall be responsible for all return shipping costs.

The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service. A warranty certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The certificate shall be supplied at the conclusion of the system acceptance test and shall be for a minimum of two years after that point. The
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certificate shall name NYSDOT as the recipient of the service. NYSDOT shall have the right to transfer this service to other private parties who may be contracted to perform overall maintenance of the facility.

Documentation

One copy of all operations and maintenance manuals for each spread spectrum radio transceiver components shall be delivered for each assembly installed.

METHOD OF MEASUREMENT

The unit price bid for each Wireless Broadband Radio Assembly will be measured by the number of wireless broadband radio assemblies furnished, installed, activated, tested, and accepted.

The unit price bid for each wireless broadband radio assembly shall include the cost of all equipment, material, testing, documentation, and labor detailed in the contract documents.

BASIS OF PAYMENT

The unit price bid for each Wireless Broadband Radio Assembly shall include the cost of furnishing all labor, materials and tools and equipment necessary to complete the work. The radio transceiver, weatherproof radio enclosure, antenna, antenna cable, POE injector, Cat 6e cable as required and all miscellaneous cabling and hardware required shall be included under this item. Payment for all documentation and testing specified herein shall be included under this item.
ITEM 685.0720XX18 - EPOXY REFLECTORIZED PAVEMENT MARKINGS – 20 MILS (WET NIGHT VISIBILITY SPHERES)
ITEM 685.0815XX18 - EPOXY REFLECTORIZED PAVEMENT MARKINGS - 15 MILS (WET NIGHT VISIBILITY SPHERES)

DESCRIPTION

Under this work the contractor shall furnish and apply epoxy reflectorized pavement markings in accordance with these specifications, the Contract Documents, the NYSMUTCD, or as ordered by the Engineer.

The epoxy marking material shall 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 a simultaneous application of Type I and Type II glass beads, the cured epoxy marking shall be an adherent reflectorized stripe that will provide wet night reflectivity.

MATERIALS REQUIREMENTS

A. Epoxy Material

1.0 Composition

The epoxy resin composition shall be specifically formulated for use as a pavement marking material and for hot-spray application at elevated temperatures. The type and amounts of epoxy resins and curing agents shall be at the option of the manufacturer, providing the other composition and physical requirements of this specification are met.

The epoxy marking material shall be a two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g. two volumes of Part A to one volume of Part B).

The epoxy marking material shall be supplied as either a regular-dry or a slow-dry material. Regular-dry may be used for all marking patterns. Slow-dry material is intended for marking hatchlines, edgelines, and other marking patterns located out of the general path of traffic.

Part A of both white and yellow shall conform to the following requirements:

PERCENT BY WEIGHT OF PART A

WHITE
*Pigment - 18 Minimum, Titanium Dioxide (ASTM D476, Type II)
Epoxy Resin - 75 to 82

YELLOW
*Pigment - 23 Minimum, Medium Chrome Yellow (ASTM D211, Type III)
Epoxy Resin - 70 to 77

*The entire pigment composition shall consist of either titanium dioxide or medium chrome yellow. No extender pigments are permitted. The white pigment, upon analysis, shall contain a minimum of 16.5% TiO₂ (100% purity). Yellow paints shall use organic yellow pigments, Color Index Pigment Yellow 65 (C.I. 11740) and or 74 (C.I. 11741).
The epoxy content of the epoxy resin in Part A will be tested in accordance with ASTM D1652 and calculated as the weight per epoxy equivalent (WPE) for both white and yellow. The epoxy content will be determined on a pigment free basis. The epoxy content (WPE) shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

The amine value of Part B shall be tested in accordance with ASTM D2074* to determine its total amine value. The total amine value shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

*The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Director, Materials Bureau.

2.0 Physical Properties of Mixed Components (Part A & Part B)

Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of 73±3°F

a. **Color.** The white epoxy composition, when applied at a wet film thickness of 15±1 mils and allowed to cure, shall be a reasonable visual match to Munsell Book Notation N9.5/0 (ASTM D1535).

The yellow epoxy composition, when applied at a wet film thickness of 15±1 mils and allowed to cure, shall be a reasonable visual match to Munsell Book Notation 10YR 8/14 (ASTM D1535).

b. **Directional Reflectance.** The white epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 84% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

The yellow epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 55% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

c. **Drying Time (Laboratory).** When tested in accordance with ASTM D711 as modified below, regular-dry epoxy marking material shall reach a no-pick-up time in 30 minutes or less. Under these same test conditions, slow-dry epoxy marking material shall reach a no-pick-up time in 60 minutes or less. A Bird Applicator or other suitable instrument shall be used to spread a uniform 15±1 mils thick wet film.

Type I reflective glass spheres shall be immediately dropped onto the epoxy
composition, followed by application of Type II glass spheres. Each type shall be applied at the rate of 10 lbs/gal of epoxy (total 20 lbs/gal).

d. **Drying Time (Field).** When installed at 77°F at the specified wet film thickness and reflectorized with Type I and Type II glass spheres, regular-dry and slow-dry epoxy markings shall reach a no-track condition in approximately 30 minutes, and 60 minutes, respectively.

Dry to "no-tracking" shall be considered as the condition where no visual deposition of the epoxy marking to the pavement surface is observed when viewed from a distance of 50 ft, after a passenger car is passed over the line.

e. **Abrasion Resistance.** The wear index of the composition shall not exceed 82 when tested in accordance with ASTM C501 using a CS-17 wheel and under a load of 2 pounds for 1000 cycles. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

f. **Hardness.** The epoxy composition when tested in accordance with ASTM D2240 shall have a Shore D hardness of between 75 and 100. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

g. **Infrared Spectrophotometer Analysis (ASTM D2621).** Samples of both Part A and Part B shall be analyzed by infrared spectrography to verify that the materials submitted for use are of an identical formulation as originally accepted by the Materials Bureau for the Department's "Approved List" of materials. Significant deviations, as determined by comparison with acceptable formulations, shall not be allowed.

**B. Reflective Glass Spheres**

Type I and Type II reflective glass spheres for drop-on application shall conform to the following requirements.

The glass spheres shall be colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres. Type I spheres shall be tested for roundness according to the procedural directives of the Materials Bureau. Type II spheres shall be tested in accordance with ASTM D1155, Procedure A.

The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 77°F.

The silica content of the glass spheres shall not be less than 60%.
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The glass spheres, Type I and II, shall be coated with a silane-type adherence coating designed to interact with and adhere to epoxy pavement markings.

The glass spheres shall have the following gradation when tested in accordance with ASTM D1214.

<table>
<thead>
<tr>
<th>TYPE I</th>
<th></th>
<th>TYPE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Standard</td>
<td>Total %</td>
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<tr>
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<td>Passing</td>
<td>Sieve No.</td>
</tr>
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<td>100</td>
<td>Passing # 20</td>
</tr>
<tr>
<td>Passing # 12</td>
<td>95-100</td>
<td>Passing # 30</td>
</tr>
<tr>
<td>Passing # 14</td>
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<td>Passing # 16</td>
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<td>Passing # 18</td>
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<td></td>
</tr>
<tr>
<td>Passing # 20</td>
<td>0-2</td>
<td></td>
</tr>
</tbody>
</table>

C. Packaging and Shipment

Epoxy pavement marking materials shall be shipped to the job site in strong, substantial containers.

Individual containers shall be plainly marked with the following information:

1. Name of Product
2. Item Number
3. Lot Number
4. Batch Number
5. Test Number
6. Date of Manufacture
7. Date of Expiration of Acceptance (6 months from date of manufacture)
8. The Statement (as appropriate)
   Part A - Contains Pigment & Epoxy Resin
   Part B - Contains Catalyst
9. Quantity
Reflective glass spheres shall be shipped in moisture resistant bags. Each bag shall be marked with the name and address of the manufacturer, the type (I or II) of glass sphere, and net weight of the material.

D. Basis of Acceptance

Only epoxy pavement marking materials from manufacturers appearing on the Department's Approved List shall be considered for acceptance. Details for obtaining Approved List status are available from the Materials Bureau.

Epoxy pavement marking materials will be sampled and tested in accordance with the procedural directives of the Materials Bureau. Samples will be taken at the manufacturing location and considered for acceptance in stock lot quantities.

Department red and green metal security seals will be placed on containers of pavement marking materials that meet specifications. The colored metal security seals serve as the evidence of acceptance for epoxy material delivered to the job site.

All acceptances of uninstalled epoxy marking material shall expire six (6) months after the date of manufacture.

Type I and Type II reflective glass spheres shall be accepted on the basis of the manufacturer's brand name or product code appearing on the Department's Approved list. Details for obtaining approved list status are available from the Materials Bureau.

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 a 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.
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Mobile applicating equipment shall be capable of installing up to 98,400 ft 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.

2. Individual tanks for the storage of Type I and Type II glass spheres. Each tank shall have a minimum capacity of 3000 lbs.

3. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.

4. Individual dispensers for the simultaneous application of Type I and Type II glass spheres. Each dispenser shall be capable of applying spheres at a minimum rate of 10 lbs/gal of epoxy resin composition.

5. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.

6. 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 Construction Details, D. Application of Epoxy Reflectorized Pavement Markings.

CONSTRUCTION DETAILS

A. General

All pavement markings and patterns shall be placed as shown on the Contract Documents and in accordance with the New York State, Manual of Uniform Traffic Control Devices (MUTCD).

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer.

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 thirty (30) ft intervals throughout the length of the pavement or as directed by the Engineer.

B. 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 a 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.

C. 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.

D. Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated in the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions 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. Type I and Type II reflective glass spheres are injected into or dropped onto the liquid epoxy marking. Type I beads shall be applied first immediately followed by the application of Type II beads. Each type shall be applied at a minimum rate of 10 lbs/gal of epoxy resin (minimum total application = 20 lbs/gal).

E. Defective Epoxy Pavement Markings

Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer as follows:

1. Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention.

   Repair Method. Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains.

   Immediately after surface preparation remove loose particles and foreign debris by brooming or blasting with compressed air.

   Repair shall be made by restriping over the cleaned surface in accordance with the requirements of this specification and at the full thickness indicated on the Contract Documents.

2. Uncured or discolored epoxy*; insufficient bond (to pavement surface or existing durable marking).

   Repair Method. The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense.

   The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending one meter in any direction.

   After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of this specification: MATERIALS, 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.

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 width greater than the basic 4 inches, as shown on the plans or directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (inches) } \times \text{ Feet} \div 4 \text{ inches}
\]

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.

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.

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

No payment will be made for the number of linear feet of skips in the dashed line.
ITEM 685.0720XX18 - EPOXY REFLECTORIZED PAVEMENT MARKINGS – 20 MILS (WET NIGHT VISIBILITY SPHERES)
ITEM 685.0815XX18 - EPOXY REFLECTORIZED PAVEMENT MARKINGS - 15 MILS (WET NIGHT VISIBILITY SPHERES)

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ITEM 685.0815XX08 - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)

DESCRIPTION:

Under this work the contractor shall furnish and apply epoxy reflectorized pavement markings (cross hatching) in accordance with these specifications, the Contract Documents, the NYSMUTCD, or as ordered by the Engineer.

The epoxy marking material shall 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 a simultaneous application of Type I and Type II glass beads, the cured epoxy marking shall be an adherent reflectorized stripe that will provide wet night reflectivity.

MATERIALS REQUIREMENTS:

A. Epoxy Material

1.0 Composition

The epoxy resin composition shall be specifically formulated for use as a pavement marking material and for hot-spray application at elevated temperatures. The type and amounts of epoxy resins and curing agents shall be at the option of the manufacturer, providing the other composition and physical requirements of this specification are met.

The epoxy marking material shall be a two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g. two volumes of Part A to one volume of Part B).

The epoxy marking material shall be supplied as either a regular-dry or a slow-dry material. Regular-dry may be used for all marking patterns. Slow-dry material is intended for marking hatch lines, edge lines, and other marking patterns located out of the general path of traffic.

Part A of both white and yellow shall conform to the following requirements:

PERCENT BY WEIGHT OF PART A

WHITE
  *Pigment - 18 Minimum, Titanium Dioxide (ASTM D476, Type II)
  Epoxy Resin - 75 to 82

YELLOW
  *Pigment - 23 Minimum, Medium Chrome Yellow (ASTM D211, Type III)
  Epoxy Resin - 70 to 77

*The entire pigment composition shall consist of either titanium dioxide or medium chrome yellow. No extender pigments are permitted. The white pigment, upon analysis, shall contain a minimum of 16.5% TiO₂ (100% purity). The yellow
pigment, upon analysis, shall contain a minimum of 20% PbCrO$_4$ (100% purity).

The epoxy content of the epoxy resin in Part A will be tested in accordance with ASTM D1652 and calculated as the weight per epoxy equivalent (WPE) for both white and yellow. The epoxy content will be determined on a pigment free basis. The epoxy content (WPE) shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

The amine value of Part B shall be tested in accordance with ASTM D2074* to determine its total amine value. The total amine value shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

*The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Director, Materials Bureau.

2.0 Physical Properties of Mixed Components (Part A & Part B)

Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of 73 ± 3°F

a. **Color.** The white epoxy composition, when applied at a wet film thickness of 15 ± 1mils and allowed to cure, shall be a reasonable visual match to Munsell Book Notation N9.5/0 (ASTM D1535).

   The yellow epoxy composition, when applied at a wet film thickness of 15 ± 1 mils and allowed to cure, shall be a reasonable visual match to Munsell Book Notation 10YR 8/14 (ASTM D1535).

b. **Directional Reflectance.** The white epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 84% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

   The yellow epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 55% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

c. **Drying Time (Laboratory).** When tested in accordance with ASTM D711 as modified below, regular-dry epoxy marking material shall reach a no-pick-up time in 30 minutes or less. Under these same test conditions, slow-dry epoxy marking material shall reach a no-pick-up time in 60 minutes or less. A Bird Applicator or other suitable instrument shall be used to spread a uniform 15 ± 1 mils thick wet film.
Type I reflective glass spheres shall be immediately dropped onto the epoxy composition, followed by application of Type II glass spheres. Each type shall be applied at the rate of 10lbs/gal of epoxy (total 20 lbs/gal).

d. Drying Time (Field). When installed at 77°F at the specified wet film thickness and reflectorized with Type I and Type II glass spheres, regular-dry and slow-dry epoxy markings shall reach a no-track condition in approximately 30 minutes, and 60 minutes, respectively.

Dry to "no-tracking" shall be considered as the condition where no visual deposition of the epoxy marking to the pavement surface is observed when viewed from a distance of 50 feet, after a passenger car is passed over the line.

e. Abrasion Resistance. The wear index of the composition shall not exceed 82 when tested in accordance with ASTM C501 using a CS-17 wheel and under a load of 2 pounds for 1000 cycles. Samples shall be allowed to cure for not less than 72 hours or more than 96 hours prior to testing.

f. Hardness. The epoxy composition when tested in accordance with ASTM D2240 shall have a Shore D hardness of between 75 and 100. Samples shall be allowed to cure for not less than 72 hours or more than 96 hours prior to testing.

g. Infrared Spectrophotometer Analysis (ASTM D2621). Samples of both Part A and Part B shall be analyzed by infrared spectrography to verify that the materials submitted for use are of an identical formulation as originally accepted by the Materials Bureau for the Department's "Approved List" of materials. Significant deviations, as determined by comparison with acceptable formulations, shall not be allowed.

B. Reflective Glass Spheres

Type I and Type II reflective glass spheres for drop-on application shall conform to the following requirements.

The glass spheres shall be colorless, clean, and transparent, free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres. Type I spheres shall be tested for roundness according to the procedural directives of the Materials Bureau. Type II spheres shall be tested in accordance with ASTM D1155, Procedure A. The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 77°F.

The silica content of the glass spheres shall not be less than 60%.
ITEM 685.0815XX08 - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)

The glass spheres, Type I and II, shall be coated with a silane-type adherence coating designed to interact with and adhere to epoxy pavement markings.

The glass spheres shall have the following gradation when tested in accordance with ASTM D1214.

<table>
<thead>
<tr>
<th>TYPE I</th>
<th>TYPE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Standard</td>
<td>Total %</td>
</tr>
<tr>
<td>Sieve No.</td>
<td>Passing</td>
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<tr>
<td>Passing #10</td>
<td>100</td>
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<tr>
<td>Passing #12</td>
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<td>Passing #18</td>
<td>0-7</td>
</tr>
<tr>
<td>Passing #20</td>
<td>0-2</td>
</tr>
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</table>

C. Packaging and Shipment

Epoxy pavement marking materials shall be shipped to the job site in strong, substantial containers.

Individual containers shall be plainly marked with the following information:

1. Name of Product
2. Item Number
3. Lot Number
4. Batch Number
5. Test Number
6. Date of Manufacture
7. Date of Expiration of Acceptance (6 months from date of manufacture)
8. The Statement (as appropriate)
   - Part A - Contains Pigment & Epoxy Resin
   - Part B - Contains Catalyst
9. Quantity
10. Mixing proportions, Application Temperature and Instructions
11. Safety Information
12. Manufacturer's Name and Address
Reflective glass spheres shall be shipped in moisture resistant bags. Each bag shall be marked with the name and address of the manufacturer, the type (I or II) of glass sphere, and net weight of the material.

D. Basis of Acceptance

Only epoxy pavement marking materials from manufacturers appearing on the Department's Approved List shall be considered for acceptance. Details for obtaining Approved List status are available from the Materials Bureau.

Epoxy pavement marking materials will be sampled and tested in accordance with the procedural directives of the Materials Bureau. Samples will be taken at the manufacturing location and considered for acceptance in stock lot quantities.

Department red and green metal security seals will be placed on containers of pavement marking materials that meet specifications. The colored metal security seals serve as the evidence of acceptance for epoxy material delivered to the job site.

All acceptances of uninstalled epoxy marking material shall expire six (6) months after the date of manufacture.

Type I and Type II reflective glass spheres shall be accepted on the basis of the manufacturer's brand name or product code appearing on the Department's Approved list. Details for obtaining approved list status are available from the Materials Bureau.

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 line patterns. The applicating equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of cross hatching and other special patterns as directed by the Engineer.

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.

Mobile applicating equipment shall be capable of installing up to 18.64 miles of epoxy reflectorized
ITEM 685.0815XX08 - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)

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.

2. Individual tanks for the storage of Type I and Type II glass spheres. Each tank shall have a minimum capacity of 3000 lbs.

3. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.

4. Individual dispensers for the simultaneous application of Type I and Type II glass spheres. Each dispenser shall be capable of applying spheres at a minimum rate of 10 lbs/gal of epoxy resin composition.

5. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.

6. 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 Construction Details, D. Application of Epoxy Reflectorized Pavement Markings.

CONSTRUCTION DETAILS

A. General

All pavement markings shall be placed as shown on the Contract Documents and in accordance with the New York State, Manual of Uniform Traffic Control Devices (MUTCD).

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer.

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.
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When necessary the Contractor shall establish marking line points at 30 foot intervals throughout the length of the pavement or as directed by the Engineer.

B. 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 a 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.

C. 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.

D. Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated in the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions 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. Type I and Type II reflective glass spheres are injected into or dropped onto the liquid epoxy marking. Type I beads shall be applied first immediately followed by
the application of Type II beads. Each type shall be applied at a minimum rate of 10 lbs/gal of epoxy resin (minimum total application = 20 lbs/gal).

E. 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 the requirements of this specification: MATERIALS, 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.
ITEM 685.0815XX08 - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 15 mils (WET NIGHT VISIBILITY SPHERES)

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.

METHOD OF MEASUREMENT

Pavement striping (cross hatching) 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 width greater than the basic 4 inches, as shown on the plans or directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (inches)} \times \text{Feet} \div 4 \text{ inches}
\]

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.

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

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