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
The following Special Specifications are attached herein:

<table>
<thead>
<tr>
<th>NYSDOT ITEM #</th>
<th>ITEM DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>555.02XXXX01</td>
<td>CONCRETE FOR STRUCTURES CLASS MP (MASS PLACEMENT)</td>
</tr>
<tr>
<td>645.03010011</td>
<td>HIGH VISIBILITY OVERHEAD-MOUNTED SIGN PANELS</td>
</tr>
<tr>
<td>645.03020011</td>
<td>HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS WITHOUT Z-BARS</td>
</tr>
<tr>
<td>645.03030011</td>
<td>HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS GREATER THAN 30 SF WITH Z-BARS</td>
</tr>
<tr>
<td>645.03040011</td>
<td>HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS LESS THAN OR EQUAL TO 30 SF WITH Z-BARS</td>
</tr>
<tr>
<td>680.51050010</td>
<td>CONCRETE FIBER OPTIC PULLBOX</td>
</tr>
<tr>
<td>680.51400010</td>
<td>INSTALL MICROCOMPUTER CABINET</td>
</tr>
<tr>
<td>680.81500010</td>
<td>PEDESTRIAN COUNT-DOWN TIMER MODULE</td>
</tr>
<tr>
<td>680.84430110</td>
<td>VMS 334 CABINET</td>
</tr>
<tr>
<td>680.94997008</td>
<td>FURNISH AND INSTALL ELECTRICAL DISCONNECT / GENERATOR TRANSFER SWITCH</td>
</tr>
<tr>
<td>680.95020615</td>
<td>SERVICE CABLE 2 CONDUCTOR, NO. 06 AWG</td>
</tr>
<tr>
<td>683.03100010</td>
<td>INSTALL NYSDOT FURNISHED IP CCTV ASSEMBLY</td>
</tr>
<tr>
<td>683.07010010</td>
<td>FIBER OPTIC INNERDUCT, 2 CHANNEL</td>
</tr>
<tr>
<td>683.07021210</td>
<td>FIBER OPTIC ARTERIAL DROP CABLE, 12 FIBERS</td>
</tr>
<tr>
<td>683.07101210</td>
<td>FIBER OPTIC CABLE PATCH PANEL - 12 PORT</td>
</tr>
<tr>
<td>683.07207210</td>
<td>SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS</td>
</tr>
<tr>
<td>683.84029110</td>
<td>LED VARIABLE MESSAGE SIGN, TYPE 3</td>
</tr>
<tr>
<td>685.0715XX10</td>
<td>EPOXY REFLECTORIZED PAVEMENT MARKINGS 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)</td>
</tr>
<tr>
<td>685.0720XX10</td>
<td>EPOXY REFLECTORIZED PAVEMENT MARKINGS 20 MILS THICK (WET NIGHT VISIBILITY SPHERES)</td>
</tr>
<tr>
<td>800.01000015</td>
<td>DESIGN BUILD – DESIGN SERVICES</td>
</tr>
<tr>
<td>800.02000015</td>
<td>DESIGN BUILD – CONSTRUCTION INSPECTION SERVICES</td>
</tr>
<tr>
<td>800.03000015</td>
<td>DESIGN BUILD – QUALITY CONTROL SERVICES</td>
</tr>
<tr>
<td>800.04000015</td>
<td>DESIGN BUILD – FORCE ACCOUNT WORK</td>
</tr>
<tr>
<td>800.05000015</td>
<td>DESIGN BUILD – SITE MOBILIZATION</td>
</tr>
<tr>
<td>800.06000115</td>
<td>DESIGN BUILD – CONSTRUCTION WORK</td>
</tr>
<tr>
<td>800.1000NN15</td>
<td>DESIGN BUILD - UTILITY RELATED WORK</td>
</tr>
</tbody>
</table>

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 555.02 01 - CONCRETE FOR STRUCTURES CLASS MP (MASS PLACEMENT)

DESCRIPTION:

Furnish and place portland cement concrete with a minimum compressive strength of 21 MPa where specified on the Plans for mass concrete placements of structural elements. Follow §555, except as noted below.

MATERIALS:

§555-2, except as modified herein.

Using materials meeting the requirements of §501-2.02 and as indicated below, design a concrete mixture(s) based on the following criteria.

- Strength - 56 day minimum compressive strength of 21 MPa.
- Slump - 80 mm +/- 25 mm. A high range water reducing admixture may be used upon prior written approval from the Director, Materials Bureau. If adding a high range water reducing admixture, slump will be limited to 80 mm maximum before the addition.
- Entrained Air - 5 to 8%.
- Water/Total Cementitious Material Ratio - 0.40 maximum.
- Class F Fly Ash - 20% to 50% by weight of cementitious materials.
- Cement, Type II only.
- Total cementitious content - 300 kg/m³ maximum

After the addition, slump will be limited to 200 mm maximum.

Perform mix development testing in accordance with ASTM C143, C231, C192 and C39, to assure all performance criteria can be achieved during production and placement.

An equal mix design may be submitted for evaluation to the Director, Material Bureau for approval.

At least 1 month prior to the start of any concrete placement, provide a copy of the proposed mixture design(s) and trial batch test results to the Director, Materials Bureau, submitted through the Engineer, for evaluation. Submit sufficient data to permit the Director to offer an informed evaluation. Include at least the following:

- Concrete mix proportions.
- Material sources. Also include fineness modulus and specific gravity for all aggregates.
- Air content of plastic concrete.
- Slump of plastic concrete.
- Compressive strength at 7, 14, 28, and 56 days, and at any other age tested or deemed necessary.
ITEM 555.0200  01 - CONCRETE FOR STRUCTURES CLASS MP (MASS PLACEMENT)

- Temperature/time relation (Interior of concrete with autogenous curing boxes) for 7 days measuring at hourly intervals.

Do not interpret having a valid mixture design as approval of the mixture. Resubmit any proposed mixture design change to the Director, Materials Bureau, for evaluation. Multiple mixture designs may be used to address performance and placement issues as deemed necessary by the Contractor. Submit each mixture for evaluation, as indicated above, prior to use.

CONSTRUCTION DETAILS:

Follow §555-3, except as modified herein:

Replace §555-3.01 - Concrete Manufacturing and Transporting with:
§501-2.03 Concrete Batching Facility Requirements,
§501-2.04 Concrete Mixer and Delivery Unit Requirements,
§501-3.02 Handling, Measuring, and Batching Materials, and
§501-3.03 Concrete Mixing, Transporting, and Discharging except that the maximum concrete temperature at the point of discharge shall be as specified in the Thermal Control Plan.

The Contractor shall prepare a Thermal Control Plan prior to placement of the mass concrete.

Thermal Control Plan:

The Thermal Control Plan shall at a minimum include a Heat Dissipation Study (Reference ACI 207 or thermal modeling software) as well as to describe the measures and procedures the Contractor intends to use to satisfy the following Temperature Control Requirements for each mass concrete element:

i. The Maximum Temperature Differential shall be limited to 20 degrees C (differential of 35 degrees F). The temperature differential between the interior and exterior portions of the designated mass concrete elements during curing will be maintained to be less than or equal to this Maximum Temperature Differential, and

ii. The Maximum Allowable Concrete Temperature shall be limited to that shown in the approved thermal control plan.

A change to the Temperature Control Requirements specified above can be addressed in the Thermal Control Plan through Heat Dissipation Studies to demonstration that deleterious effects to the concrete can be avoided through adherence to the Thermal Control Plan. Such a change requires approval by the D.C.E.S.
As a minimum, the Thermal Control Plan shall include the following:

A. Mix design. If the mix will be cooled, the Contractor shall define the methodology and necessary equipment to achieve these mix temperatures.

B. Duration and method of curing.

C. Methods of controlling temperature differentials, inclusive of active coolant systems not previously defined within the Engineering Drawings.

D. An analysis of the anticipated thermal developments in the mass concrete elements for all expected project temperature ranges using the proposed mix design, casting procedures, and materials. It shall show complete details and determine the maximum temperature differentials within the concrete mass.

E. Temperature sensor types and locations including installation details.

F. Temperature Monitoring System including system description, operating plan, recording and reporting plan, and remedial action plan.

G. Field measures and documentation procedures to ensure conformance with the maximum concrete temperature and temperature differential requirements.

H. Field methods of applying immediate corrective action should the temperature differential approach the Maximum Temperature Differential and Maximum Allowable Concrete Temperature.

The Contractor shall submit the Thermal Control Plan to the Engineer for approval a minimum of thirty working days prior to concrete placement. Mass concrete placement shall not begin until the D.C.E.S. has approved the Thermal Control Plan.


Modify §555-3.06 - Concrete Joints: Structural elements may be constructed in stages using construction joints if permission is granted by the Deputy Chief Engineer for Structures Design and Construction.

Modify §555-3.10 - Loading Limitations: After the minimum curing period, concrete may receive construction loads after reaching a compressive strength of 15 MPa. Testing will be in accordance with note 3 of Table 555-4.

All concrete for this item shall achieve 21 MPa prior to opening the structure to traffic.
ITEM 555.0200 01 - CONCRETE FOR STRUCTURES CLASS MP (MASS PLACEMENT)

Compressive strengths shall be determined from cylinders stored and cured in the same manner as the concrete it represents. The average compressive strength of each cylinder set shall be greater than the desired compressive strength, with no individual cylinder less than 90% of the desired compressive strength.

**Temperature Monitoring System:**

The temperature monitoring and recording system for mass concrete shall consist of temperature sensors connected to a data acquisition system capable of printing, storing, and downloading data to a computer. Temperature sensors shall be located such that the maximum temperature difference within a mass concrete element can be monitored. As a minimum, concrete temperatures shall be monitored from the center of the concrete mass, the base of the mass, the surface of the mass, and the center of an exterior outer face that is the shortest distance from the center of the concrete mass.

Temperature readings shall be automatically recorded on an hourly basis or as required by the Engineer. A redundant set of sensors shall be installed near the primary set. Provision shall be made for recording the redundant set, but records of the redundant sensors need not be made if the primary set is operational.

Methods of concrete consolidation shall prevent damage to the temperature monitoring and recording system. Wiring from temperature sensors cast into the concrete shall be protected to prevent movement. Wire runs shall be kept as short as possible. The ends of the temperature sensors shall not come into contact with either a support or concrete form, or reinforcing steel.

When any equipment used in the temperature control and monitoring and recording system fails during the mass concrete construction operation, the Contractor shall take immediate remedial measures to correct the situation as specified in the Thermal Control Plan.

Temperature reading will begin when mass concrete placement is complete. Temperature readings will continue until the maximum temperature differential (not maximum temperature) is reached and a decreasing temperature differential is confirmed as defined in the Thermal Control Plan. Furnish a copy of all temperature readings daily.

If monitoring indicates that the temperature differential is approaching the maximum temperature differential of 20°C the Contractor shall take immediate corrective action as defined in the Thermal Control Plan to retard further increase of the temperature differential. The Contractor will make the necessary revisions to the approved Thermal Control Plan to satisfy the temperature control requirements on future placements. Revisions to the plans must be approved by the Engineer prior to implementation.

§555-3.13 - Damaged or defective concrete, applies with the following additions:
ITEM 555.0200  01 - CONCRETE FOR STRUCTURES CLASS MP (MASS PLACEMENT)

If mass concrete temperature differentials are exceeded, provide all analyses and test results deemed necessary by the D.C.E.S. for determining the structural integrity and durability of the mass concrete element, to the satisfaction of the D.C.E.S.. The Department will make no compensation, either monetary or time, for the analyses, tests or any impacts upon the project.

Any cracks in the structural element greater than 0.40 mm resulting from the contractor’s inability to properly maintain concrete temperature differentials, shall be repaired using epoxy injection at no additional cost to the Department. The effectiveness of repairs shall be demonstrated by the contractor using evaluation methods acceptable to the Department. The Engineer-In-Charge will be responsible for accepting or rejecting the repairs after the field evaluation.

METHOD OF MEASUREMENT:

Cubic meter as per §555-4.

BASIS OF PAYMENT:

§555-5, including the cost of the mix design and Thermal Control Plan in the unit bid price per cubic meter.
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>
<thead>
<tr>
<th></th>
<th>0.2°/-4°</th>
<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>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>380</td>
<td>215</td>
<td>275</td>
<td>135</td>
<td>80</td>
<td>45</td>
</tr>
<tr>
<td>Yellow</td>
<td>300</td>
<td>162</td>
<td>220</td>
<td>100</td>
<td>60</td>
<td>34</td>
</tr>
<tr>
<td>Green</td>
<td>45</td>
<td>22</td>
<td>31</td>
<td>14</td>
<td>8.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Red</td>
<td>95</td>
<td>43</td>
<td>56</td>
<td>27</td>
<td>16</td>
<td>9.0</td>
</tr>
<tr>
<td>Blue</td>
<td>22</td>
<td>10</td>
<td>17</td>
<td>6.0</td>
<td>3.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Fl. Yellow</td>
<td>240</td>
<td>130</td>
<td>165</td>
<td>81</td>
<td>48</td>
<td>27</td>
</tr>
<tr>
<td>Fl. Yellow/Green</td>
<td>325</td>
<td>170</td>
<td>236</td>
<td>110</td>
<td>64</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 1
Minimum Coefficient of Retroreflection (R') cd/ft²
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

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

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAND NAME</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>3M Diamond Grade - DG³</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>3M Diamond Grade™ - VIP</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Avery Dennison Omni-View™</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
ITEM 645.03010011 HIGH VISIBILITY OVERHEAD-MOUNTED SIGN PANELS
ITEM 645.03020011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
ITEM 645.03030011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS
ITEM 645.03040011 HIGH VISIBILITY GROUND-MOUNTED SIGN PANELS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>T-9507</td>
</tr>
<tr>
<td>Red</td>
<td>T-9508</td>
</tr>
<tr>
<td>White</td>
<td>T-9500</td>
</tr>
<tr>
<td>Yellow</td>
<td>T-9501</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
680.51050010—RECTANGULAR REINFORCED CONCRETE PULLBOX
(26 inches X 18 inches)

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 “SIGNS” on the second line in place of the text “TRAFFIC SIGNS” 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 680.80324515 - 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.
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

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.
ITEM 680.81500010 – PEDESTRIAN COUNT-DOWN TIMER MODULE

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 60Hz 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 120 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.
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 680.84430010 - FIELD MULDEM CABINET
ITEM 680.84430110 - VMS 334 CABINET
ITEM 680.84430210 - CCTV 334 CABINET
ITEM 680.84430310 - VIDEO HUB 334 CABINET
ITEM 680.84470010 - FTMS RAMP METER CONTROLLER CABINET
ITEM 680.84480010 - FTMS SURVEILLANCE CABINET

DESCRIPTION:
Under these items, the Contractor shall furnish and install equipment cabinets at the locations shown by the Contract Documents and as ordered by the Engineer. These cabinets shall house control and communications equipment furnished and installed under other contract items.

MATERIALS:
All materials furnished, assembled, fabricated, or installed shall be new, corrosion resistant, and in strict accordance with New York State and industry standards. The cabinet and all related equipment required under these items shall meet the requirements of the Model 334 System as specified in the most current version of the FHWA Type 170 Traffic Signal Control System - Hardware Specification.

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 in the Contract Documents.

All cabinets 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.

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.

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.

The Contractor shall submit a cabinet layout of each type of cabinet specified for review by the Engineer. Only cabinets with approved layouts will be accepted under this Contract.

Specific Cabinet Configuration Requirements
The various types of cabinets required under these items shall be configured as follows:
Field Muldem Cabinet

This cabinet will be installed at fiber optic node locations and shall be configured to accept the following peripheral equipment at a minimum:

- Field Muldem and Power Supplies
- Fiber Optic Data Transceiver-Multidrop, Rack mounted
ITEM 680.84430010 - FIELD MULDEM CABINET
ITEM 680.84430110 - VMS 334 CABINET
ITEM 680.84430210 - CCTV 334 CABINET
ITEM 680.84430310 - VIDEO HUB 334 CABINET
ITEM 680.84470010 - FTMS RAMP METER CONTROLLER CABINET
ITEM 680.84480010 - FTMS SURVEILLANCE CABINET

12/29/08E-Page16 2/16/96 3/4/97M
Rev 11/04/02

• Fiber Optic Transmitter and Receiver Pair
• Fiber Optic Distribution Panel
• EIA-232 Port Expander
• Fiber Optic Distribution Panel
• Spare shelf

FTMS Ramp Meter Controller Cabinet
This cabinet will be installed at ramp metering locations and shall be configured to accept the following peripheral equipment at a minimum:
• Model 2070 Lite Microprocessor Controller Unit
• Standard Type 170 detector Input file
• Model 200 solid-state switch pack
• Model 204 flasher/flash transfer relays
• Model 222 loop detector amplifier
• Model 242 DC isolation module
• Standard cabinet power distribution assembly/power supply
• Fiber Optic Data Transceiver-Multidrop, Standalone
• Fiber optic distribution panel
• Spare shelf

FTMS Surveillance Cabinet
This cabinet will be installed at mainline surveillance locations and shall be configured to accept the following peripheral equipment at a minimum:
• Model 2070 Lite Microprocessor Controller Unit
• Standard Type 170 detector Input file
• Model 222 loop detector amplifier
• Model 242 DC isolation module
• Standard cabinet power distribution assembly/power supply
ITEM 680.84430010 - FIELD MULDEM CABINET
ITEM 680.84430110 - VMS 334 CABINET
ITEM 680.84430210 - CCTV 334 CABINET
ITEM 680.84430310 - VIDEO HUB 334 CABINET
ITEM 680.84470010 - FTMS RAMP METER CONTROLLER CABINET
ITEM 680.84480010 - FTMS SURVEILLANCE CABINET

- Fiber Optic Data Transceiver-Multidrop, Standalone
- Fiber optic distribution panel
- Spare shelf

Variable Message Sign 334 Cabinet
This cabinet will be installed at Variable Message Sign (VMS) locations and shall be configured to accept the following peripheral equipment at a minimum:
- VMS Controller Unit and surge suppressor boards
- Standard cabinet power distribution assembly/power supply
- Fiber Optic Data Transceiver-Multidrop, Standalone
- Fiber optic distribution panel
- Spare shelf

CCTV 334 Cabinet
This cabinet will be installed at mainline surveillance locations and shall be configured to accept the following peripheral equipment at a minimum:
- All ground mounted cabinet items specified in the Field Closed Circuit TV Equipment item including the RDU and other miscellaneous CCTV control and interface equipment
- Standard cabinet power distribution assembly/power supply
- Communication terminal panel for all cables from the cabinet to the pole mounted equipment
- CCTV Video PTZ Fiber Optic Transceiver, Shelf Mount and any other equipment specified elsewhere which is designated on the plans to be installed in the cabinet
- Fiber optic distribution panel
- Spare shelf

Video Hub 334 Cabinet
This cabinet will be installed at video hub locations and shall be configured to accept the following peripheral equipment at a minimum:

- Fiber Optic Video Multiplexers
- CCTV Video PTZ Fiber Optic Transceiver, Rack Mount and any other equipment specified
elsewhere which is designated on the plans to be installed in the

- Fiber Optic Distribution Panel
- Spare shelf

The Type 170 support equipment specified above under the two FTMS cabinet configurations shall be the standard equipment as specified in the FHWA Type 170 Traffic Control System - Hardware Specification.

The State will supply the following equipment in the required quantities for installation by the Contractor:

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>220</td>
<td>Solid State Switch Pack</td>
</tr>
<tr>
<td>204</td>
<td>Solid State Flasher Relay</td>
</tr>
<tr>
<td>222</td>
<td>Dual Loop Vehicle Detector Module</td>
</tr>
<tr>
<td>242</td>
<td>Dual DC Isolation Modules</td>
</tr>
</tbody>
</table>

The Contractor shall accept delivery and store the State supplied equipment before installation in the cabinets.

All peripheral electronic equipment will be furnished and installed under separate contract items as required except for the fiber optic distribution panel and Type 170 Input file assemblies which shall be furnished as appropriate as part of these these cabinets bid items.

The Type 2070 Lite controllers, VMS Controllers, Field Closed Circuit field equipment, Video Multiplexors, Field MULDEMS, CCTV Video PTZ Fiber Optic Transceivers, Fiber optic data transceiver - multidrop, EIA-232 Port Expanders and RS232/RS485 Interface Converters will be furnished and installed under separate contract bid items.

All equipment listed shall be rack mounted unless otherwise approved by the Engineer. Rack mounted shelves shall be provided to mount shelf mounted equipment specified.
General Requirements
All cabinets furnished under these items shall be physically identical to the Model 334 cabinet as specified in the FHWA Type 170 Signal Control System - Hardware Specification, or as modified herein. Each field cabinet shall, as a minimum, meet the following requirements:

Dimensions
The minimum cabinet dimensions shall be 66 inch H x 24 inch W x 30 inch D.

Material
The cabinet shall be constructed of 1/8 inch aluminum, in accordance with ASTM Designation B 209 for 5052-H32 aluminum sheet.

External Finish
The cabinet exterior shall be bare, unpainted aluminum per federal specification QQA-250/8. Cabinets shall be painted where designated on and in accordance with the plans.

Access
The cabinet shall have single, full-size front and rear doors. The doors shall be securely gasketed to prevent the entrance of dust and moisture. The gasket shall meet the physical properties as found in UL508 table 21.1 and shall form a weather tight seal between the door and cabinet. The doors shall include substantially the full area of the front and rear of the cabinet, and shall be flush with the sides of the cabinet when closed. The door opening shall be double flanged on all four sides.

The doors shall be provided with a catch to hold the door open at 135 degrees, ± 25 degrees. The catch shall hold the door securely open until released.

Doors shall be hinged on the right-hand side by means of a continuous hinge bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts. The hinge shall be 3/32 inch thick aluminum and shall have a ¼ inch minimum diameter stainless steel hinge pin. The hinge pin shall be capped top and bottom by weld. Hinge leaves shall not be exposed externally when the door is closed.

Ventilation
The cabinet shall contain a 200 cubic feet per minute fan with thermostatic control. The lower portion of the front door shall have a louver area of sufficient size to permit the free flow of air corresponding to the rated capacity of the associated cabinet fan. The louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Filters shall be provided on all louvers, and
shall be securely bracketed to the door. 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 110 degrees Fahrenheit.

Sun Shields
All painted cabinets shall be provided with sun shields. In addition, the Field Muldem and Video Hub cabinets shall be provided with sun shields even if specified as unpainted (bare aluminum).

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

Heating
All cabinets shall be provided with a cabinet heater located near the bottom of the cabinet. A thermostat shall be provided to turn the heater on and off and shall be set to turn on at 36 ± 5 degrees F and turn off at 52 ± 5 degrees F. The heater shall be rated at 250 Watts.

The switched output of the thermostat shall have a metal oxide varistor (MOV) or an approved equivalent surge suppressor of appropriate rating. The surge suppressor shall be connected to the cabinet ground bus.

Locking System
The cabinet shall be furnished with 3 point draw roller positive locking doors. The doors shall be equipped with a self-locking, heavy duty, pin tumbler, rim cylinder type lock. 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. Two keys shall be provided for each cabinet. A stainless steel lock protector plate shall be installed over the rear of the lock.

Door Handles
The cabinet shall have stainless steel door handles with padlock feature on both front and back doors.
Galvanized Steel Hasps
Two heavy duty galvanized steel safety hasps shall be furnished and installed on each equipment cabinet as shown on the plans. Padlocks will be furnished and installed by the State.

Light
A fluorescent lamp shall be provided at the front and back of each cabinet. The lights shall be configured to turn on upon door opening.

Rack Assembly
The cabinet shall have a standard EIA 19 in removable, self-standing rack assembly. The rack shall be capable of housing all equipment specified.

Fiber Optic Distribution Panel
Fiber optic distribution panels shall be provided in each cabinet specified for the termination and optical continuation of the fiber optic cables as required. The unit shall act as an interface between the fiber optic drop cable and the fiber optic patch cables located within the cabinet. In addition, the distribution panel shall facilitate the reassignment of the fibers within and testing of the optical fiber cable plant. The rack shall be configured in connector fields consisting of rack mounted bulkhead connectors. The fields shall contain a sufficient quantity of connectors to accommodate the maximum number of fibers entering the equipment cabinet. Each connector field shall consist of up to 12 type ST single mode connectors per row, with the connector fields clearly identified by function. The distribution panel shall be capable of mounting in the standard 19 inch rack assembly of the cabinet.
The distribution panel shall have sufficient room for slack fiber and shall have multiple entrances. All connections to active optical transmission equipment within the cabinet shall be via this panel.

Fiber Optic Cable Slack
Cabinets that are required to store slack fiber cable per the Contract documents shall be laid out and furnished with sufficient room to neatly coil the cable in the base of the cabinet. Cable rack hardware shall be furnished and installed to hold the cable up and off of the concrete base.

Fiber Optic Patch Cables
The cabinets shall be equipped with fiber optic patch cables to provide internal distribution to all opto-electronic equipment as shown on the plans. The patch cables shall be factory terminated with connectors compatible with the specified equipment complement. The optical characteristics shall be compatible with the fiber optic drop cable specified under a separate contract item. Each patch cable shall conform to industry published connector and cable specifications. The Contractor shall submit a record of test performances from the factory for each individual cable assembly installed.

Coaxial Jumper Cable
The cabinet shall be equipped with coaxial jumper cables to provide internal distribution of the video signals between the specified video equipment complement. The coaxial jumper cables shall be factory terminated with connectors compatible with the equipment to which it connects. The cable shall be type RG-59U. The cable assembly shall pass a frequency sweep test at the factory. The Contractor shall submit a record of test performance from the factory for each individual cable assembly installed.

Input/Output Terminals
The cabinet shall be furnished with field terminals for all input/output files in accordance with the FHWA Type 170 Traffic Signal Control System - Hardware Specification. In addition, one or more appropriately sized quick connect telephone type terminal facilities with a minimum of four (4) common terminals across shall be provided with each cabinet. 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.

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, it does not press against the cables or force the cables against the various components inside the cabinets.

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 10 MILS. 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 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

Surge Protection

Protector and Cabinet Configuration
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 protector shall have a minimum continuous current rating that is adequate for the protected equipment load (and any associated start up current surges) in the cabinet. 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 lb) of surge energy without damage to itself. The unit shall have a 15 watt power dissipation rating.

Signal Wire Protection
All signal 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 Conductor (Twisted Pair) Protection
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.
(c) Energy Rating
The unit shall be capable of dissipating 100 joules (74 ft-lb) 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 lb) of energy without being damaged.

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.

**Electrical**

**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. Properly rated equipment
ITEM 680.84430010 - FIELD MULDEM CABINET  
ITEM 680.84430110 - VMS 334 CABINET  
ITEM 680.84430210 - CCTV 334 CABINET  
ITEM 680.84430310 - VIDEO HUB 334 CABINET  
ITEM 680.84470010 - FTMS RAMP METER CONTROLLER CABINET  
ITEM 680.84480010 - FTMS SURVEILLANCE CABINET  

Circuit breaker(s) shall be provided for the equipment complement shown on the plans. 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.

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 internal
wiring 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 internal wiring 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.

**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.

**Cabinet Thermostat**

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 and cabinet heater. The varistor shall have characteristics equal to or better than the following:

- GE Model Number VI5OLAIOA
- Stetron 250NRO7-1
- Siemens SIOK150

12/29/08E-Page16
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 Subsection 680-3.12 of the New York State Standard Specifications.

CONSTRUCTION DETAILS:
All cabinets shall be installed on concrete foundations as shown on the plans. The work required to modify the existing anchor bolt pattern, and identify existing cabling, will be included under separate contract items.
Prior to cabinet installation, the Contractor shall submit an approved cabinet wiring schematic for each cabinet specified to the Engineer. The schematic shall depict the wiring required for the equipment complement of that specific cabinet. No cabinet shall be installed without an Engineer approved schematic.

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 4 twists per ft.
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.

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.

Documentation

Each field cabinet shall be supplied with three (3) hard copies of the Final Cabinet Wiring Diagram and one electronic copy on CD in Microstation version SE or later with the approval of the Engineer. One (1) hard copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) hard copies shall be delivered to the Engineer. The electronic copy of the cabinet wiring diagrams shall be delivered to the Engineer.

Quality Assurance Provisions

All environmental and design approval tests specified in the FHWA Type 170 Traffic Signal Control System - Hardware Specification shall be performed. The test results shall be submitted to the Engineer for approval.

Water Spray Tests

One of each type of cabinet shall be subjected to a water spray test as follows:

Water shall be sprayed from a point directly overhead at an angle of 60 degrees 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 0.1 gal
per minute per square ft of surface area. The cabinet shall then be inspected for leakage. Evidence of water leakage shall be cause for rejection.

Stand-alone Tests

Stand-alone Tests as described in the Special Note found elsewhere in the Contract Documents shall be conducted on each cabinet after installation.

METHOD OF MEASUREMENT:

Each Field Muldem Cabinet, FTMS Ramp Meter Controller Cabinet, FTMS Surveillance Cabinet, VMS 334 Cabinet, CCTV 334 Cabinet, and Video Hub 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 Field Muldem Cabinet, FTMS Ramp Meter Controller Cabinet, FTMS Surveillance Cabinet, VMS 334 Cabinet, CCTV 334 Cabinet, and Video Hub 334 Cabinet shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Payment for cabinet grounding, interconnect cables and wires, fiber optic patch cables, coaxial jumper cables, fiber optic distribution panels, surge protectors, fiber optic cable rack hardware, installation of 2070 Lite Controller, electronic peripherals and interface equipment, documentation and services, and the testing referenced herein shall be included under the price bid for these items.

Progress payment will be made as follows:

Fifty percent of the bid price of each item will be paid when it is installed; fifteen percent will be paid upon satisfactory completion of the Stand-alone Test requirements described in the Special Note of these Special Specifications; twenty-five percent of the bid price will be paid upon satisfactory completion of the subsystem integration test of which it is a part, as described in the Special Notes; and ten percent of the bid price will be paid upon satisfactory completion of Final System Acceptance.
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.
ITEM 680.95010415 - SERVICE CABLE 1 CONDUCTOR, NO. 04 AWG
ITEM 680.95010615 - SERVICE CABLE 1 CONDUCTOR, NO. 06 AWG
ITEM 680.95010815 - SERVICE CABLE 1 CONDUCTOR, NO. 08 AWG
ITEM 680.95011015 - SERVICE CABLE 1 CONDUCTOR, NO. 10 AWG
ITEM 680.95020415 - SERVICE CABLE 2 CONDUCTOR, NO. 04 AWG
ITEM 680.95020615 - SERVICE CABLE 2 CONDUCTOR, NO. 06 AWG
ITEM 680.95020815 - SERVICE CABLE 2 CONDUCTOR, NO. 08 AWG
ITEM 680.95021015 - SERVICE CABLE 2 CONDUCTOR, NO. 10 AWG

**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 683.03100010 - INSTALL NYSDOT FURNISHED IP CCTV ASSEMBLY

DESCRIPTION

Under this item the Contractor shall install NYSDOT furnished IP CCTV assemblies at the locations indicated on the plans. Three types of IP CCTV assemblies are covered under this item as follows:

- Integrated pole top style
- Dome
- Low powered IP CCTV

MATERIALS

The NYSDOT will supply the following equipment for the Contractor to install:

- IP CCTV
- Standard wall or pole mounting brackets
- POE++ power supply
-Unterminated pole harness cable
- Pole harness surge suppression
- Ethernet Switch (site specific)
- CDMA modem (site specific)
- Fiber optic cable media converter (site specific)

The NYS furnished equipment to be installed under this item will be located at a NYSDOT storage facility in Hauppauge, NY. The Contractor shall transport the equipment from the storage facility to the field site and install the item as shown in the drawings or as required by the Engineer. The cost of transporting the equipment from the storage facility to the field site shall be included in the cost of the item.

The Contractor's shall request in writing delivery of the equipment that is supplied by the NYSDOT under this item. The delivery request shall be made five weeks in advance to the Engineer. The equipment will be delivered to the Contractor at the NYSDOT’s storage facility in Hauppauge, NY.

The Contractor shall provide all miscellaneous material that includes but is not limited to mounting hardware, camera pole adapter plates and fasteners, miscellaneous local electronic harnesses, fiber patch cables, and Ethernet patch cables required for the installation of the above equipment. All miscellaneous cables furnished by the Contractor under this Contract shall be UL approved, where applicable.

CONSTRUCTION DETAILS
ITEM 683.03100010 - INSTALL NYSDOT FURNISHED IP CCTV ASSEMBLY

The Contractor shall install the NYSDOT furnished IP CCTV on the pole or wall shown in the plans and as ordered by the Engineer.

The contractor shall install the site specific NYSDOT furnished communication, network, power supply, and surge suppression equipment in the local cabinet designated on the plans. The contractor shall install and terminate the NYSDOT furnished pole harness from the IP CCTV to the surge protection in the designated local cabinet. The Contractor shall terminate the NYSDOT furnished pole harness cable using approved waterproof connectors and connector installation methods. The Contractor shall connect the equipment to the power and communication cables indicated on the plans. The camera assembly shall be electrically bonded to ground

NYSDOT will provide the site specific camera, network, and communication equipment configuration settings for the Contractor to program into the NYSDOT furnished equipment prior to installation in the field.

All incidental materials necessary to complete the installation but not specified herein or on the plans and not provided by NYSDOT as described herein shall be provided by the Contractor as necessary to provide a complete and properly operating system.

The NYSDOT furnished IP CCTV installations shall be tested as described in the special note for this contract.

METHOD OF MEASUREMENT:

This work will be measured as the number of NYSDOT furnished IP CCTV assemblies installed in accordance with the plans, specifications and directions of the Engineer. The installation shall not be considered completed until successful completion all required testing specified in the special note for this project.

BASIS OF PAYMENT:

The unit price bid for each Install NYSDOT furnished IP CCTV assembly shall include the cost of furnishing all labor, miscellaneous materials and tools and equipment necessary to complete the work including testing. All miscellaneous materials required for the installation of the unit, including but not limited to mounting hardware, connectors, and miscellaneous cables shall be included in this price.
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:
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:**
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.
ITEM 683.07021210 - FIBER OPTIC ARTERIAL DROP CABLE, 12 FIBERS
ITEM 683.07033610 - FIBER OPTIC ARTERIAL DROP CABLE, 36 FIBERS
ITEM 683.07047210 - FIBER OPTIC ARTERIAL DROP CABLE, 72 FIBERS

DESCRIPTION:

This work shall consist of the furnishing and installation of fiber optic drop cables in accordance with the contract documents and as directed by the Engineer. Splicing of the fiber optic arterial drop cable to the fiber optic arterial trunk cable is included under separate items.

MATERIALS

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

1. Single Mode Fiber Optic Drop Cable
2. Fiber Optic Cable Connectors

1. Single-mode Fiber Optic Drop Cable

Fiber optic arterial drop cables shall be installed in conduit, risers or in traffic span poles between the fiber optic arterial trunk cable and equipment cabinets patch panels as shown on the plans. Under separate contract items, they shall be spliced to the appropriate fiber within approved splice cases on messenger wire or in pullboxes adjacent to equipment cabinets as specified. Fiber optic arterial drop cables furnished and installed under these items shall be continuous from end to end and shall not contain any splices.

Material Requirements

The fiber optic arterial drop cable shall have the identical physical configuration as the fiber optic arterial trunk cable specified under separate contract items. The fiber optic drop cable shall contain the number of fibers as specified.

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. Under a separate contract item, the unterminated end shall be fusion spliced to the appropriate trunk 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 feet of slack provided on either end.

The Contractor shall follow the drop cable manufacturer’s recommendation in the installation of the drop cables, including the individual breakout fibers.

The single-mode fiber optic drop 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
ITEM 683.07021210 - FIBER OPTIC ARTERIAL DROP CABLE, 12 FIBERS  
ITEM 683.07033610 - FIBER OPTIC ARTERIAL DROP CABLE, 36 FIBERS  
ITEM 683.07047210 - FIBER OPTIC ARTERIAL DROP CABLE, 72 FIBERS

(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-492CAAA Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers.

**Attenuation**: The nominal attenuation shall not exceed 0.4dB/km at a wavelength of 1310 nm and 0.3dB/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 2.1dB/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 0.05dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15dB/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 x km).

**Polarization Mode Dispersion**: Not to exceed 0.5 ps/(km)¹/₂

**Dispersion**: Less than 3.5 ps/(nm x km) for 1285 nm through 1330 nm and less than 18 ps/(nm x 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
- Cladding Diameter: 25.0±1.0 μm
- Core-to-Cladding Offset: Not to exceed 0.5 μm
- 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 \( \mu m \) (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 \( \mu m \) (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.

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 oscillation (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.
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 foot 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 three foot 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/inch. The 63 lb/inch load shall be maintained for a period of 10 minutes. Attenuation
measurements shall be performed before release of the 63 lb/inch 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 inches, 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 \( \leq 20\% \) 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 3.24 lb·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.

**Temperature Cycling:** When tested in accordance with EIA/TIA Standard FOTP-3, the change in attenuation at extreme temperatures \((-40^\circ F \text{ to } +158^\circ F)\) 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 \( \leq 20 \) times the cable diameter for four hours at test temperatures of \(-22^\circ F \text{ and } +140^\circ F\). Neither the inner our 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 6.5 feet 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 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: \(-4^\circ F \text{ to } +158^\circ F\)
- Insertion loss: 0.5 dB maximum
- Return loss: 55 dB minimum
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:

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 arterial drop cable will be lashed to messenger cable, overlashed to existing aerial cables, installed in innerduct placed in steel conduit or installed within traffic span poles as indicated in these contract documents or otherwise directed by the Engineer.

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, 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 manufacture’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 pulling from the cable’s conductors and for pulling from the cable’s outer jacket.
  - Minimum bend radii, which shall specify a radius both loaded and unloaded.
  - Method to install multiple cables.
The cable plant design shall be submitted prior to the installation of any fiber optic cable.

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.

Installation
Fiber optic drop 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 feet 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 six feet 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 drop fiber cable shall be installed in continuous lengths without intermediate splices throughout the project.

i. 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.

j. Prior to any installation of cable, the Contractor shall clean existing conduit in accordance with the requirements of these special provisions.

k. 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 determine, what, if any, action should be taken.

l. Slack cable and innerduct where pulled through a pullbox shall be racked to the pullbox wall.

**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.
ITEM 683.07021210 - FIBER OPTIC ARTERIAL DROP CABLE, 12 FIBERS
ITEM 683.07033610 - FIBER OPTIC ARTERIAL DROP CABLE, 36 FIBERS
ITEM 683.07047210 - FIBER OPTIC ARTERIAL DROP CABLE, 72 FIBERS

- 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 be 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.

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
After installation 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.
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.

METHOD OF MEASUREMENT:
The fiber optic arterial drop 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 683.07021210 - FIBER OPTIC ARTERIAL DROP CABLE, 12 FIBERS
ITEM 683.07033610 - FIBER OPTIC ARTERIAL DROP CABLE, 36 FIBERS
ITEM 683.07047210 - FIBER OPTIC ARTERIAL DROP CABLE, 72 FIBERS

BASIS OF PAYMENT:
The unit price bid per foot for Fiber Optic Arterial Drop Cable shall include the cost of furnishing all labor, material, tools and equipment and testing of the fiber optic drop cable to complete the work. The cost of splicing the fiber optic arterial drop cable to the fiber optic arterial trunk cable, including splice cases, trays and all necessary passive components shall be included in separate contract items.
ITEM 683.07100610 – FIBER OPTIC CABLE PATCH PANEL – 6 PORT
ITEM 683.07101210 – FIBER OPTIC CABLE PATCH PANEL – 12 PORT
ITEM 683.07103610 – FIBER OPTIC CABLE PATCH PANEL – 36 PORT
ITEM 683.07107210 – FIBER OPTIC CABLE PATCH PANEL – 72 PORT

DESCRIPTION
Under this item, the Contractor shall furnish and install Fiber Optic Cable Patch Panels and terminate fiber optic cables installed under this Contract to these patch panels at the equipment cabinet locations on the plans and in accordance with the contract documents and as directed by the Engineer.

MATERIALS
Each fiber optic patch panel shall be designed for the termination of 6, 12, 36 or 72 single mode optical fibers with ST type connectors in field equipment cabinets. The size of the panel shall be as shown on the plans.

All fiber optic patch panels shall include the following accessories:

- Mounting bolts
- ST type receptacle, interconnect sleeve or bulkhead adapter
- Jumper cables
- Fiber drawers (36, 72 and 144 fiber patch panel)
- Storage for fiber (6 and 12 fiber patch panel)
- Cable clamps and strain relief
- Patch cords
- Attenuators

Fiber Optic Patch Panels – 6 and 12 Fibers
Fiber optic patch panels that provide for the termination of 6 or 12 single mode optical fibers shall be shelf or wall mounted in field equipments as specified in the Contract Documents. The nominal size of the panel shall be 8.5” H x 7.25” W x 2.5” D. The storage compartment for excess fiber or pigtails shall be lockable.

Fiber Optic Patch Panels – 36, 72 and 144 Fibers
Fiber optic patch panels that provide for the termination of 36, 72 or 144 single mode optical fibers shall be designed for installation in standard EIA – 483mm equipment racks and shall be installed in field equipment cabinets as specified in the Contract Documents.

The panels shall have a clear front cover that shall be easily removed or opened by the use of a hinge and/or fastened with thumbscrews to provide easy access for cable installation. The bottom and/or back shall provide openings for cable entrance and provide for strain relief at each entrance point. The patch panel shall provide drawers and other fixtures as required to maintain the cable fibers at or greater than the minimum bending radius without strain placed on the cable.

ST Type Connectors
ST connectors shall be for single mode applications, pre-radiused, zirconia ceramic ferrule, metallic or composition body with strain relief boot. The ST connector shall meet the following requirements:
ITEM 683.07100610 – FIBER OPTIC CABLE PATCH PANEL – 6 PORT
ITEM 683.07101210 – FIBER OPTIC CABLE PATCH PANEL – 12 PORT
ITEM 683.07103610 – FIBER OPTIC CABLE PATCH PANEL – 36 PORT
ITEM 683.07107210 – FIBER OPTIC CABLE PATCH PANEL – 72 PORT

- Operating Temperature -- -40°F to 158°F
- Insertion Loss -- < 0.35dB
- Reflectance -- < -40dB
- Durability -- < 0.3 dB change for > 200 matings

ST type receptacles interconnect sleeve or bulkhead adapters shall have a zirconia sleeve.

Attenuators
Attenuators shall be for single mode operation with wavelength matched to the mating equipment attached. The attenuator shall be either a fixed or variable in-line type as approved by the Engineer. The attenuator shall meet the following requirements:
- Operating Temperature -- -40°F to 158°F
- Attenuation Accuracy -- ±1.5 dB

Fiber Optic Patch Cords
Fiber optic patch cords shall be compatible with single mode optical fiber and provided with factory installed ST type single mode connectors. The patch cords shall have a maximum insertion loss of 0.3 dB with a return loss > 55dB. The length of the patch cords shall be 9’. The following number of patch cords shall be furnished with each type of panel specified:
- 6 and 12 fiber patch panels -- 6, 12 patch cords respectively
- 36, 72 and 144 fiber patch panels -- 36, 72, 144 patch cords respectively

CONSTRUCTION DETAILS
The Contractor shall install fiber optic patch panels and terminate fiber optic cables at locations as shown on the Contract Documents.
Fiber optic patch panels shall be installed in accordance with manufacturer’s recommended instructions.
ST connectors shall be installed on all fiber which terminates in patch panels. ST connectors with pigtails shall not be allowed for termination.
All required cross connecting and connections to equipment shall be in accordance with the Contract Documents or as directed by the Engineer.
All unused ST receptacles on the patch panels and plug ends on patch cords shall capped with an approved cap.
If attenuation is required for proper operation of the attached equipment, the value of the attenuator used shall be recorded on the patch panel and in the as-built documentation.

METHOD OF MEASUREMENT
The fiber optic cable patch panel will be measure for payment as the number of units furnished, installed and made fully operational.

BASIS OF PAYMENT
The unit price bid for Fiber Optic Drop Cable Patch Panel shall include the cost of furnishing all labor, material, tools and equipment as necessary to complete the work.
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

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-492CAAA “Detail Specification for Class Iva

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)²

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.
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

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.
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

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 885lb/in.

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.

12/29/08E
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

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 our 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.
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

- Nominal dimensions of the basic case shall be 22 inch long by 9 inch wide by 9 inch high. The basic case shall weigh 20 lbs maximum.
- The splice case shall have a termination block to terminate the central strength members of the fiber optic cables.

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:

12/29/08E
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

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.
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

- 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

12/29/08E
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.
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
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 be 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
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

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.
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.
DESCRIPTION:

Under these items, the Contractor shall furnish and install light emitting diode (LED) variable message sign (VMS) field equipment for use along the roadways at locations specified on the plans or as ordered by the Engineer. The purpose of the VMS is to provide motorists with advance information of traffic conditions at a location where there will be sufficient time for motorists to decide upon the possible use of alternate routes in order to avoid traffic congestion.

All VMS shall meet the requirements specified in Section 730-27 “PERMANENT VARIABLE MESSAGE SIGNS” in Addendum No. 2 of the New York State Department of Transportation Standard Specifications, unless amended herein.

Six types of signs are covered in these specifications. All signs shall be of the full matrix type and shall be capable of displaying the number of lines and the nominal characters sizes as described below. A nominal character shall be a 5 X 7 matrix. Two pixels shall be used for character and line spacing, respectively. In addition all signs shall be capable of displaying double-stroke characters.

Type 1 -- 1 line, 11-12” characters per line.

Type 2 -- 1 line, 12-12” characters per line.

Type 3 -- 2 line, 16-12” characters per line.

Type 4 -- 3 line, 16-12” characters per line.

Type 5 -- 3 line, 16-18” characters per line.

Type 6 -- 4 line, 20-18” characters per line.

In order to insure commonality of equipment and compatibility with existing Regional Transportation Management / Operations Center VMS system equipment, certain VMS equipment provided under these items shall be identical to existing equipment as specified herein.

The VMS equipment shall include, but not be limited to, the following:

- Variable Message Signs
- Sign Controllers at the VMS Sites
- Sign and Conduit Attachment Hardware
- All required conduit, cabling, surge protection devices

The VMS shall be a light-emitting diode (LED) continuous full matrix sign.
The sign controller shall be microprocessor based, capable of monitoring and controlling the VMS functions specified herein. The controller shall be addressable and shall interface with an RS-232 type serial port of a voice grade, radio frequency (RF) or fiberoptic modem and shall decode the address before each transmission. It shall ignore any transmission that does not contain its identifying address. The controller shall have the capability of displaying either a message from central, transmitted via the communications link, or a message stored in controller memory. Each controller shall continuously perform diagnostics on the sign electronics and shall format status messages for transmission to central. The RF and fiberoptic modems and all central communications and control equipment exist or are included under separate contract items.

**MATERIALS:**

**Variable Message Sign**

Each sign shall be single-faced with the message face arranged in the number of lines and characters as shown on the plans. Each line shall contain display characters with number and height as shown on the plans.

Each display message shall be capable of being written at a minimum rate of 60 characters per second.

**Display Module**

The display module shall be composed of 45 pixels in a matrix of 9 rows by 5 columns each. Each pixel shall be a cluster of LEDs.

**LED Characteristics**

The LED used in the VMS shall meet the following requirements:

- LEDs shall be untinted, non-diffused, high-output solid state lamps utilizing aluminum indium gallium phosphide (AlInGaP) LED technology.

- Display Color -- The light emitted by the LEDs shall be amber, with a peak wavelength centered at 592±4 nanometers.

- LED Selection -- The LEDs shall be obtained from batches sorted for luminous output, where the highest luminosity LED shall not be more than two times more luminous than the lowest luminosity LED.
Size of the LED shall be T-1.75 (0.2”)

• Light Output -- The luminous output of each LED shall be 2.5 candela, minimum, at the forward current specified by the manufacturer.

• Viewing Angle -- The viewing angle of the discrete LEDs shall be a minimum of 15 degrees (50% of the normalized intensity) from the normal, generating a cone of vision of 30 degrees

• Reliability -- The LEDs shall be rated a minimum of 100,000 hours of continuous duty and with less than 20 % degradation at 140° F. The rating shall be based on the forward drive current specified by the VMS manufacturer.

• LEDs shall be soldered to circuit boards with through-hole type of circuit board mounting. Surface mounting of LEDs will not be allowed.

**Pixel Characteristics**

All pixels shall meet the following requirements:

• Pixels shall be attached to the display panel with a secured fastening system.

• Pixels shall be mounted perpendicular to the display panel.

• Materials shall contain UV light inhibitor and shall be designed for direct exposure to sunlight.

• LED clusters shall be constructed with string(s) of seven (7) LEDs.

• Display modules shall be identical in all signs of a given type.

• Replaceable printed circuit boards shall form the display, with each board containing no fewer than 45 pixels.

• To minimize the chance of LEDs being pushed out of alignment with the sign’s optical axis, LEDs must be mounted no more than 1/100 inch from the front side of the printed circuit board. The LEDs must be mechanically protected, so that there is no contact with them when the module is gripped or dropped.
The center-to-center distance between pixels shall be the same horizontally as vertically.

For each sign, the range of brightness shall be such that the brightest pixel is no more than twice as bright as the dimmest pixel.

**Photosensor Control**

To prevent blooming and to maintain readability under varying ambient light conditions, a minimum of three (3) levels of LED dimming shall be provided. Dimming shall be controlled automatically at the sign by means of an array of photocells. An override shall be possible via central control.

The field LED intensity controller shall be mounted in the equipment cabinet at grade. All necessary cabling required to interconnect the lamp controller with the power supplies located in the VMS enclosure shall be furnished and installed under this item.

It shall be possible to vary the LED intensity to overcome unfavorable ambient conditions such as fog or intense back-lighting. The ambient light conditions shall be sensed via an array of three photovoltaic cells oriented in the following manner:

a. Cell 1 -- northern sky
b. Cell 2 -- facing oncoming traffic (upstream)
c. Cell 3 -- facing passed traffic (downstream)

The ambient illumination conditions determined by the photosensor array shall initiate the controller to request an optimum brightness levels categorized into the following three groups:

- Daylight (default setting)
- Nighttime - under low ambient light conditions
- Overbright - when light level differential towards the sign from the perpendicular directions is significant.

The LED intensity threshold parameters shall be submitted to the Engineer for approval. Final settings will be determined in the field by the Engineer.

**Enclosure Design**

The enclosure design and the design load shall be in accordance with the NYSDOT
The sign enclosure shall be designed and constructed so as to present a clean, neat appearance. The equipment housed within shall be protected from moisture, dust, dirt and corrosion. Type 5 (3 Line, 16-18” Characters) and Type 6 (4 Line, 20-18” characters) VMS shall have walk-in type enclosures.

Materials - The enclosure housing shall be constructed of aluminum alloy 3003-H14 or an approved equivalent which shall not be less than 0.125 inches thick. Framing structural members shall be made of aluminum alloy 6061-T6 or an approved equivalent. Seams shall be continuously welded by an inert gas process. The housing shall be completely sealed to prevent the entry of water and dust. Neoprene gaskets shall be utilized as necessary. The housing shall be thoroughly cleaned and then neutralized for priming. The housing shall then be treated with a phosphate coating solution per U.S. Government Spec. MIL-C-5541, followed by a sealing neutralizing solution. The finish shall be two coats of the best quality flat matte black paint.

The front of the sign shall be enclosed by a protective, weathertight face. The protective face material shall be LEXAN SG-100 Solar Grade facing or approved equal. Nominal thickness shall be 1/4”.

All hardware shall be corrosion-resistant steel or protected from corrosion by suitable plating.

Access - Front access shall be provided to the display modules by means of a top-hinged window(s). The windows shall be fastened closed by means of captive fasteners. The windows must be fitted with adequate hold-open devices for safety and ease of maintenance, and they shall not be released accidentally or by the action of the wind on the open window. They shall not interfere with the operation of the display when the windows are held open or when the windows are closed.

Module Mounting - The modules shall be mounted in such a way that easy access to all user serviceable components is provided through the front access windows in the open position. The modules shall be easily removable through the open window. In addition, on the signs equipped with a walk-in type enclosure, easy access shall be provided to all user serviceable parts from the rear of the sign, and each individual module shall be easily removable from within the enclosure. The positioning of the modules shall allow for a free flow of air vertically between the front of the module and the window.

Design Load - The sign enclosure and mounting hardware shall be designed to meet the
loading and fatigue requirements specified in the NYSDOT Overhead Sign Structures Design Manual updated March 2007. Shop drawings certified by licensed NYS Engineer shall be submitted for approval before the fabrication of the sign enclosure.

Ventilation - The Contractor shall install a positive pressure ventilation system. The ventilation system shall be sufficient to circulate three (3) times the volume of air inside the enclosure per minute. Multiple fans or blowers shall be used to provide the specified venting and shall be located within the enclosure to minimize heat stratification.

The louvered or vent areas shall be of sufficient size to permit the free flow of air corresponding to the specified ventilation requirements. Changeable filtration devices shall be provided at drain holes and at all points where forced air enters the enclosure. The fans and louvers shall be located with respect to each other so as to direct the bulk of the air flow throughout the entire enclosure and in particular over the lamp assemblies and power supplies. The fans shall be thermostatically controlled and adjustable to turn on between 90 degrees and 120 degrees F. The local field controller shall monitor the internal temperature of the enclosure and provide status reports to Central upon request in order to avoid overheating upon fan failures.

Mounting - The signs shall be mounted by means of a minimum of two horizontal Z members on the rear running the full length of the enclosure. All nuts or bolts securing the Z-member bracket to the rear of the housing shall be securely locked to resist loosening under vibration. Removable lifting eyes or the equivalent shall be provided to facilitate the handling and mounting of the sign.

At locations where VMS will be installed in conjunction with fixed signing, the signs shall be mounted so that the front sign faces are flush as shown on the plans. Under these items, the Contractor shall furnish and install all structural members in order to extend the fixed sign in order to accomplish this requirement.

Conduit Provisions - Separate power and sign control conduit connections shall be provided. VMS control and power cables shall be isolated from each other in all locations. The size of the conduits shall be as shown on the plans. The Contractor shall provide all conduit attachment hardware as required.

**VMS Field Controller**

The Contractor shall furnish and install one (1) field controller at each VMS site as shown on the plans. This controller shall be an integral unit containing its own power supplies. The Contractor shall coordinate with the modem wiring requirements to provide the correct
wiring and interface equipment for interconnecting the controllers to the modems (existing or furnished under separate contract items).

Each sign shall be operated by a microprocessor based controller located at the VMS site and connected to the central control system via a communications channel.

The sign controller shall incorporate, as an integral part, a watchdog timer to detect an out-of-program condition and reset the microprocessor.

A unique address shall be assigned to each field controller. All commands from central shall be prefaced with this address. The field controller shall compare this address with its assigned address and shall accept the command only if the addresses match. The controller address shall be readily changed by the use of external jumpers or switches. Disassembly of the controller shall not be required to change the address.

The controller shall be compatible with the existing Regional Transportation Management / Operations Center central VMS controller and communication scheme.

All data transmitted between central and the sign controller shall be encoded in the ASCII representation, using one start bit, seven data bits, one parity bit and one stop bit. Parity shall be even. The controller shall be capable of communicating with central at individually selectable data rates of 300, 1200 and 9600 bits per second.

Upon request from central, the sign controller shall return a status indicating current operating conditions. Minimum information to be supplied includes the following:

- Sign Address
- Message Display (slot number of message being displayed)
- Controlling Device (central/local)
- Power fail indication (notifies central of a power fail/restore occurrence since the last status transmission from the controller)
- Sign driver board failure
- Communications failure/recovery indication
- Light Source Outage Indication
- Current Light Source Level
- Cabinet Door opened or closed.

The sign controller shall acknowledge all transmissions from central. A negative acknowledgment shall be sent if a parity, check sum or data content error is detected. A positive acknowledgement shall be sent if no error is detected.
Each sign in the system shall be provided with a sign controller that is capable of 10,000 characters of RAM message storage, and 6,000 characters of EPROM message storage. The EPROM messages shall be pre-specified and be capable of being displayed on the sign upon command from the central or the manual input unit. The text of the messages can also be viewed by central. The RAM messages shall be downloaded from central. The contents of these messages can be altered or complete messages replaced from central. These messages shall be displayed on the sign upon command from central or from the manual input unit.

It shall be possible to display all alphanumeric characters and special shapes included in the character set of the sign. They shall be capable of being displayed in any active area on the sign face.

The controller shall be capable of the following at a minimum:

- Accepting a message for display or storage in RAM.
- Transmitting the content of any message back to central.
- All sequencing operations without any intervention from central.
- Local sign control by means of a manual input unit.
- Writing any message at a minimum effective rate of 60 characters per second.

Each sign controller shall be provided with error detection and reporting features, which shall be utilized to guard against incomplete or incorrect information transmission, message generation and display on each sign face. These features are required to prevent misinformation being displayed to the motorist user to preclude the possibility of a hazardous roadway condition developing. The following information security features shall be provided at a minimum:

- Check sum and parity error checking of all data received from Central, with positive or negative acknowledgement for all transmissions.
- A syntax and compatibility check shall be automatically performed by the sign controller on each message and sequence prior to display or storage in the sign's RAM. Any error shall prevent display or storing of the message or sequence. The compatibility check shall ensure that the message will physically fit on the sign.
- The sign controller shall be designed for fail-safe prevention of improper information display in the case of system malfunction. An automatic blanking feature shall clear the message on a sign experiencing any of the following:
ITEM 683.84028910 – LED VARIABLE MESSAGE SIGN, TYPE 1
ITEM 683.84029010 – LED VARIABLE MESSAGE SIGN, TYPE 2
ITEM 683.84029110 – LED VARIABLE MESSAGE SIGN, TYPE 3
ITEM 683.84029210 – LED VARIABLE MESSAGE SIGN, TYPE 4
ITEM 683.84029310 – LED VARIABLE MESSAGE SIGN, TYPE 5
ITEM 683.84029410 – LED VARIABLE MESSAGE SIGN, TYPE 6

- Communication failure, or invalid transmission from central.

- Main AC line failure, and

In addition, central shall be capable of directing any sign to go to all blanks by transmitting an appropriate control command.

Each controller shall have the capability of remotely testing and exercising each pixel. An RS-232, 9 or 25 pin D type connector shall be provided for plugging in a portable terminal for local test purposes.

The controller and the sign shall be NTCIP compatible by changing some hardware and/or firmware. The Contractor shall furnish a set of such hardware/firmware, which shall have the necessary objects to provide all the sign functions describe in these Special Specifications.

**Electrical Interface**

**Controller-Modem**

The data interface between the controller and the modem shall conform to EIA RS-232 Standard, or other standard interfaces as directed by the Engineer. The Contractor shall modify the interface wiring if required to conform with the field modem supplied by others or under a separate bid item.

**Controller-Sign**

All ungrounded control lines required between the at-grade equipment cabinet and the overhead VMS enclosure shall be surge protected with protectors meeting the following requirements:

- Less than 1 ns (nanosecond or $10^{-9}$ second) response time
- Line to line protection
- Line to ground protection
- Clamping voltage compatible with the signal voltage
- Series impedance compatible with the driver circuitry
- Peak pulse current shunting capacity (10x1000 $\mu$s waveform, $\mu$s = microsecond, or $10^{-6}$ second) of 36 A
- Plug-in modules with 2 lines per module
- 66M/M1-50 standard telephone connecting blocks with terminal screws as
base plates for the modules, capable of terminating solid or stranded wire.

- Capacitance not to interfere with the driver operations.

**Manual Input Unit**

The manual input unit shall be located in the controller cabinet. It shall be designed to operate the sign locally. EPROM and RAM messages and sequences resident within the sign controller may be selected and displayed by means of this unit. A message displayed from the manual unit shall remain on the sign after returning the switch to central control. While under manual switch control, central shall have the capability of monitoring sign status.

The VMS controller with manual input unit shall be packaged in a corrosion proof, 1/16 inch thick aluminum enclosure (or equal as approved by the Engineer) suitable for mounting in a standard 19 inch EIA rack in an equipment cabinet as shown on the plans. All cable connection points including the EIA-232 port shall be accessible through the cabinet front door. All sign driver boards shall also be rack mounted within the controller cabinet.

**Power Requirements**

The VMS field controller and its associated sign shall operate from 120 VAC and 240 VAC, respectively, ± 15%, 60 Hz.

All power inputs shall be adequately protected by either fuses or circuit breakers. All power cables shall be isolated from control cables at all times. The Contractor shall be required to install continuous flexible, steel conduit, as required to provide a suitable shield of the power cables. Payment for the flexible conduit will be included under this contract item.

A power line surge protector shall be installed, in or external to each unit, between input power circuit and ground. The protector shall have the following characteristics:

- Dual stage protection.
- Protection for both line and neutral to ground.
- Response time of 10 ns or less.
- Working Voltage - The unit shall be rated for operation on AC power lines with a voltage rating of 115 ± 20 Volts RMS and continuous current of 10 Amp.
- Surge Voltage - The unit shall limit the surge voltage to the equipment to 350 Volts at a peak surge current of 20 KA. The surge current shall be an unsymmetrical triangular wave (designated 8 X 20 μs) that requires 8
microseconds to reach peak value and at 20 microseconds will have half the peak value.

- **Rating** - The unit shall be capable of dissipating the energy at 20 KA with a surge of 8 X 20 µs waveshape for 20 times.

The VMS equipment shall conform with all applicable requirements of good engineering practices for construction and workmanship. Construction shall be such that performance will not be impaired after the equipment has been subjected to shock and vibration caused by normal installation, transportation and maintenance handling. The equipment, including all parts and accessories, shall be constructed in a thoroughly workmanlike manner and in accordance with best commercial practice. Particular attention shall be given to neatness and thoroughness of soldering, wiring, welding, plating, riveting, finishes and machine operations. All parts shall be free from burrs and sharp edges or any other defect that could make the part or equipment unsatisfactory for the operation or function intended in this specification.

**Electrical**

- **Design Life** - All components in their normal circuit applications shall be designed to operate continuously for at least 16 years.

- **Wire Size** - All wiring shall be of such size to satisfy good engineering practices and meet the requirements of the National Electric Code.

- **Sleeving** - All wiring connected to terminal strips shall be identified by the use of insulated pre-printed sleeving slipped over the wire before final attachment, or other suitable identification.

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

- **Transient Suppression** - All DC relays, solenoids and holding coils shall have diodes across the coils for transient suppression.

- **Protection** - The equipment shall contain readily accessible, normally resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

- **Fail Safe** - The equipment shall be designed such that the failure of the equipment shall not cause the failure of any other.
Primary Power Interruption - In the event of a power failure of 500 milliseconds or less, proper operation of the equipment shall commence after restoration of power without creating false information.

High Frequency Interference - The equipment operation shall be unaffected by line voltage spikes of up to ±300 volts amplitude at 2500 watts peak power and 1 microsecond pulse rise time, 10 microsecond pulse rise time and 10 microsecond pulse width at a repetition rate of one pulse every other cycle moving uniformly over the full wave once every 3 seconds for 10 minutes.

Line Voltage Transients - The equipment shall be unaffected by voltage transients of ±600 volts amplitude from a 10 microfarad capacitor once every 10 seconds for a maximum of 10 applications of each polarity.

**Mechanical**

Modular Design - The VMS shall be of modular design such that major portions may easily be replaced.

Walk-in Enclosure - Types 5 and 6 shall have walk-in enclosures.

Size - The nominal size and weight of the signs shall be as shown on the plans. The maximum size and weight dimensions for each VMS configurations is as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Sign Configuration</th>
<th>Length</th>
<th>Height</th>
<th>Depth</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 Line, 11-12” Characters</td>
<td>12.5 ft</td>
<td>2.5 ft</td>
<td>1.5 ft</td>
<td>610 lb</td>
</tr>
<tr>
<td>2</td>
<td>1 Line, 12-12” Characters</td>
<td>13.5 ft</td>
<td>2.5 ft</td>
<td>1.5 ft</td>
<td>720 lb</td>
</tr>
<tr>
<td>3</td>
<td>2 Line, 16-12” Characters</td>
<td>17.5 ft</td>
<td>4.5 ft</td>
<td>1.5 ft</td>
<td>1420 lb</td>
</tr>
<tr>
<td>4</td>
<td>3 Line, 16-18” Characters</td>
<td>17.5 ft</td>
<td>6.5 ft</td>
<td>1.5 ft</td>
<td>2000 lb</td>
</tr>
<tr>
<td>5</td>
<td>3 Line, 16-18” Characters</td>
<td>26 ft</td>
<td>8 ft</td>
<td>3.5 ft</td>
<td>3800 lb</td>
</tr>
<tr>
<td>6</td>
<td>4 Line, 20-18” Characters</td>
<td>32 ft</td>
<td>10.5 ft</td>
<td>3.5 ft</td>
<td>6025 lb</td>
</tr>
</tbody>
</table>

Keying - Modules of unlike functions shall be mechanically keyed to prevent insertion into the wrong socket or connector.
Identification - All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

Maintenance Provisions - 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 equipment required for maintenance by Maintenance personnel shall be simple hand held tools and various meters.

Switches - Switch contacts shall be derated 50% from their maximum current ratings.

Terminal Blocks - Terminal blocks shall be molded screw type terminal blocks adequate for a specified number of external connections, including spares as follows:

A.C. terminal blocks shall be U.L. approved for 600 volts A.C. minimum and shall be suitable for equipment located outdoors.

D.C. terminal blocks shall be barrier type rate for at least 250 volts.

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.

Design and Layout Review

The Contractor shall furnish cut sheets, shop drawings and block and schematic diagrams which show in detail all proposed materials, dimensions, electronic layouts, part numbers, part values and operation parameters prior to construction of the VMS for the approval of the Engineer.

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 schematic diagrams.
- Complete installation procedures.
- Complete performance specifications (Functional, electrical, mechanical and environmental) on the equipment.
ITEM 683.84028910 – LED VARIABLE MESSAGE SIGN, TYPE 1
ITEM 683.84029010 – LED VARIABLE MESSAGE SIGN, TYPE 2
ITEM 683.84029110 – LED VARIABLE MESSAGE SIGN, TYPE 3
ITEM 683.84029210 – LED VARIABLE MESSAGE SIGN, TYPE 4
ITEM 683.84029310 – LED VARIABLE MESSAGE SIGN, TYPE 5
ITEM 683.84029410 – LED VARIABLE MESSAGE SIGN, TYPE 6

- Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
- Pictorial of component layout on circuit board.
- Complete maintenance and trouble-shooting procedures.
- Complete stage-by-stage explanation of circuit theory and operation.

Environmental Requirements

The equipment shall meet all of its specified requirements during and after subjection to any combination of the following requirements:

Ambient Temperature - Range of -30 degree F to +165 degree F.

Temperature Shock - Not to exceed 30 degree per hour, during which the relative humidity shall not exceed 95%.

Relative Humidity Range - Not to exceed 95% over the temperature range of 40 degree F to +110 degree F.

Moisture Condensation - On all surfaces caused by temperature changes.

CONSTRUCTION DETAILS:

The sign shall be built and installed in accordance with the details shown on the plans.

All material shall be transported and handled in a manner that will cause no permanent deformation, injury or damage. Material to be stored shall be stored above the ground in a manner and at a location approved by the Engineer. Any part of the entire sign or structure damaged during transportation, handling or erection shall be repaired, or if determined by the Engineer as unfit for use in the finished work, shall be removed from the site and replaced by the Contractor at his own expense.

Quality Assurance Provisions

Three (3) types of tests shall be required for each unit of equipment furnished: Design Approval Tests, Stand-Alone Tests, and System Acceptance Tests. Each of these tests are described in the following sections.

The Contractor shall be responsible for developing detailed test procedures for each type of equipment and for conducting the specified tests to verify satisfactory operation of the
equipment. The test procedures shall be submitted to the Engineer for approval prior to the tests. Only approved test procedures shall be used during the tests. A minimum of ten (10) work days shall be allowed for the Engineer's review and approval of the test procedures.

The Engineer shall be notified in writing a minimum of ten (10) work days in advance of the time when these tests are to be conducted.

The results of each test shall be compared with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect, and equipment shall be subject to rejection by the Engineer.

Rejected equipment may be offered again for retest provided all non-compliances have been corrected and retested by the Contractor and evidence thereof submitted to the Engineer.

Final inspection and acceptance of equipment shall be made after installation at the locations specified on the plans unless otherwise specified herein.

**Design Approval Test**

Design approval tests shall be conducted by the Contractor on one or more sample equipment of each type, as approved by the Engineer, to determine if the design of the equipment meets the requirements of this specification. The tests shall be conducted in accordance with the test procedures prepared by the Contractor and approved by the Engineer as described in the above section.

In the case of standard product line equipment, the Engineer may waive the design approval tests if the manufacturer's written specifications (functional and environmental) are equal to or better than those specified herein and he so states in writing or if the Contractor provides certification by an independent testing laboratory that these design approval tests have been previously satisfactorily completed. The design approval test shall cover the following at a minimum:

- **Temperature** - All functional operations of the equipment shall be successfully performed under the following conditions and in the order specified below:

  The equipment shall be stabilized at 32 degrees F. After stabilization at this temperature, the equipment shall be operated without degradation for 2 hours.
The equipment shall be stabilized at 122 degrees F. After stabilization, the equipment shall be operated without degradation for 2 hours.

Relative Humidity - All equipment shall meet its performance requirements when subjected to a temperature and relative humidity of 122 degrees F and 70% respectively. The equipment shall be maintained at the above condition for 48 hours. At the conclusion of the soak, within 30 minutes the equipment shall meet all of its operation requirements.

Power Variation - The equipment shall meet all of the specified performance requirements when the input voltage is plus or minus 10 volts from the nominal value of 115 volts. The equipment shall be operated at the extreme limits for at least 15 minutes during which it shall meet all of its operations requirements.

Vibration - The equipment shall show no degradation of mechanical structure, soldered components, plug-in components or satisfactory operation in accordance with the manufacturer's specification after being subjected to the following vibration test:

The equipment shall be secured to the (shaker) head of suitable electromechanical shaker in the vertical, lateral and longitudinal planes respectively. The object of the test is to vibrate the equipment in each of the three mutually perpendicular axes, in accordance with the following parameters:

- Amplitude - 0.06 "Double Amplitude" (peak-to-peak).
- Linear Acceleration (g's) - 5 maximum.
- Linear Velocity - approximately 7.4 inches per second.
- Frequency - 40 Hz.
- Duration - 5 minute dwell in each axis.

If the equipment fails the design approval tests, the design fault shall be corrected and the entire design approval test shall be repeated. All deliverable equipment shall be modified, without additional cost to the State, to include design changes required to pass the design approval tests.

**Stand-Alone Test**

The Contractor shall conduct an approved stand-alone test of the equipment after installation at each field site shown on the plans. This test shall not be performed unless a representative of the Regional Transportation Management / Operations Center
Maintenance Contractor is present. The test shall, as a minimum, exercise all stand-alone (non-network) functional operations of the equipment with all of the equipment installed per the plans as directed by the Engineer. Approved data forms shall be completed and turned over to the Engineer as the basis for review and rejection or acceptance.

The sign shall be left in the diagnostics mode for thirty (30) days after the above tests are successfully completed. The stand-alone tests conclude at the end of this thirty day period if the sign operates continuously without failures.

If the equipment fails the stand-alone test, it shall be corrected or another substituted in its place and the test successfully repeated. If a unit has been modified as a result of a stand-alone test failure, a report shall be prepared and delivered to the Engineer prior to retesting of the equipment. The report shall describe the nature of the failure and the corrective action taken. If a failure pattern, as defined by the Engineer, develops, then he may direct that design and construction modifications be made to all equipment without additional cost to the State or extension of the contract period.

**Final Acceptance Test**

Following satisfactory completion of the stand-alone test, the equipment will be connected to the Regional Transportation Management / Operations Center system by the Maintenance Contractor and a final acceptance test shall be conducted.

The final acceptance test shall, as a minimum, exercise all functional operations of the equipment as an integrated system. The test shall demonstrate all remotely controlled features (from central) and all local controlled features specified herein.

In the event of a failure of any Contractor supplied equipment, the test shall be restarted. In the event of a failure of equipment installed by others, such as the RF Modem or the central control equipment, the test shall be suspended until the problems have been corrected, and then the test shall be resumed from the point of suspension.

**Experience**

The Variable Message Sign proposed for meeting the requirements described in the preceding sections shall be manufactured by a firm established in the production and installation of such equipment. The manufacturer shall meet the following requirements at a minimum:
1. Five (5) years experience in the successful manufacture and installation of computer-controlled outdoor LED matrix signs.

2. One (1) installed LED sign system in continuous satisfactory operation for at least one (1) year. This sign may include VMS that have been retrofitted with LED technology. The Contractor shall submit, as proof, photographs of the signs and names, addresses and telephone numbers of the operating personnel who can be contacted regarding the sign systems. The Contractor shall arrange for a demonstration of the sign, to the Engineer upon request. Unless otherwise determined by the Engineer, the LED sign submitted for experience shall meet all of the requirements specified herein.

**Operational Support Equipment**

The Contractor shall supply the following support equipment to the State for each VMS which is furnished and installed under the various items:

- Four (4) complete display modules (5 X 9 pixels each, sized in accordance with the specific pay item).
- One (1) set of LED power supplies sufficient to power all sign modules.

These modules shall be delivered to the Engineer upon request. Payment for these modules shall be included under the price bid for this item.

**Warranties and Guarantees**

The Contractor shall provide warranties and guarantees for the equipment’s operations for a period of 12 months starting from the passing of the Stand-Alone Tests, covering both parts and labor for the sign, the controller and all accessory equipment.

**Training**

The Contractor shall provide training for NYSDOT engineering, maintenance and operations staff at a facility provided by the Department and in the field. The training shall include all material and manuals required for each participant. The training shall be as follows:

Engineering and Maintenance Training – Training shall be provided for a minimum of sixteen (16) hours for up to ten (10) engineers and technicians. The training shall include operation instructions, theory of operations, circuit descriptions, preventive maintenance procedures, troubleshooting and repair of all controller and sign equipment. Hands-on use of central workstation and field computer to communicate with the signs shall be included in
Operations Training – Training shall be provided for a minimum of eight (8) hours for up to fifteen (15) control center operators. The training shall include a complete demonstration of the system operations and the control of all the VMS.

METHOD OF MEASUREMENT:

The LED Variable Message Sign will be measured as the number of complete units furnished, installed and tested in accordance with the Contract Documents or as ordered by the Engineer.

BASIS OF PAYMENT:

The unit price bid for each Variable Message Sign shall include the cost of furnishing all labor, materials, tools and equipment necessary to complete the work. Payment for all brackets and hardware required for sign support and attachment, all cabling, conduits and surge protection per the plans, documentation, testing referenced herein, operational support equipment and all other necessary material shall be included under this bid item. Payment for all support brackets required to mount the VMS flush with corresponding fixed sign shall be included under these items.

The total amount of the bid price of each item will be paid when it is installed and successfully completed the design approval, stand-alone and final acceptance tests described above.
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. Items for Special Markings include stop bars and crosswalks.

Yield line symbols are isosceles triangles with height equaling 1.5 times the base dimension:
A small yield line symbol shall have a base dimension of one foot.
A large yield line symbol shall have a base dimension of two feet.
Yield line symbols are to be installed with the Apex of the triangle oriented towards oncoming traffic.

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 Standard Glass Beads (Type 2) and Wet/Night Visibility Beads (Type 1), the cured epoxy marking shall be an adherent reflectorized stripe that will provide wet night retro-reflectivity.

MATERIALS REQUIREMENTS:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy Paint</td>
<td>727-03</td>
</tr>
<tr>
<td>Glass Beads for Pavement Markings</td>
<td>727-05</td>
</tr>
</tbody>
</table>

Reflective Glass Spheres

Retro-reflective beads shall be a double drop system of glass spheres consisting of Standard Beads (Type 2) and Wet/Night Visibility Beads (Type 1) as defined in §727-05 Glass Beads for Pavement Markings.

EPOXY APPLICATING EQUIPMENT

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.
ITEM 685.0715XX10 - EPOXY REFLECTORIZED PAVEMENT MARKINGS 15 MILS THICK (WET NIGHT VISIBILITY SPHERES)

ITEM 685.0720XX10 - EPOXY REFLECTORIZED PAVEMENT MARKINGS 20 MILS THICK (WET NIGHT VISIBILITY SPHERES)

Mobile applicating equipment shall be capable of installing up to 19 miles 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 Standard (Type 2) and Wet/Night Visibility (Type 1) 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 Standard (Type 2) and Wet/Night Visibility (Type 1) 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.

Page 2 of 7

November 2015
The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

When necessary the Contractor shall establish marking line points at 30 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 §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. Standard (Type 2) and Wet/Night Visibility (Type 1) reflective glass spheres are injected into or dropped onto the liquid epoxy marking. Standard beads (Type 2) shall be applied first immediately followed by the application of Wet/Night Visibility beads (Type 1). 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.
ITEM 685.0715XX10 - EPOXY REFLECTORIZED PAVEMENT MARKINGS 15 MILS THICK  
(WET NIGHT VISIBILITY SPHERES)  
ITEM 685.0720XX10 - EPOXY REFLECTORIZED PAVEMENT MARKINGS 20 MILS THICK  
(WET NIGHT VISIBILITY SPHERES)  

*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of §727-03 Epoxy Paint; 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 (regular lines, cross hatching and special markings) 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:

\[ \text{Plan Width of Striping (inches)} \times \text{Feet} \]  
\[ 4 \text{ inches} \]

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.

<table>
<thead>
<tr>
<th>PAY ITEM NO.</th>
<th>DESCRIPTION</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>685.07150110</td>
<td>White Epoxy Reflectorized Pavement Stripes – 15 mils</td>
<td>Foot</td>
</tr>
</tbody>
</table>

Page 5 of 7  
November 2015
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>685.07150210</td>
<td>White Epoxy ReflectORIZED Pavement Letters - 15 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07150310</td>
<td>White Epoxy ReflectORIZED Pavement Symbols – 15 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07150410</td>
<td>White Epoxy ReflectORIZED Cross Hatching - 15 mils Thick (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07150510</td>
<td>White Epoxy ReflectORIZED Pavement Stripes (Special Markings) 15 mils Thick (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07150610</td>
<td>Yellow Epoxy ReflectORIZED Pavement Stripes – 15 mils (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07150710</td>
<td>Yellow Epoxy ReflectORIZED Pavement Stripes (Cross Hatching) 15 mils Thick (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07150810</td>
<td>White Epoxy ReflectORIZED Pavement Yield Line Symbols - Small - 15 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07150910</td>
<td>White Epoxy ReflectORIZED Pavement Yield Line Symbols - Large - 15 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07200110</td>
<td>White Epoxy ReflectORIZED Pavement Stripes – 20 mils (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07200210</td>
<td>White Epoxy ReflectORIZED Pavement Letters – 20 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07200310</td>
<td>White Epoxy ReflectORIZED Pavement Symbols – 20 mils (Wet Night Visibility Spheres)</td>
<td>Each</td>
</tr>
<tr>
<td>685.07200410</td>
<td>White Epoxy ReflectORIZED Pavement Stripes (Cross Hatching) 20 mils Thick (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>685.07200510</td>
<td>White Epoxy ReflectORIZED Pavement Stripes (Special Markings) 20 mils Thick (Wet Night Visibility Spheres)</td>
<td>Foot</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>685.07200610</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes – 20 mils (Wet Night Visibility Spheres)</td>
<td></td>
</tr>
<tr>
<td>685.07200710</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes (Cross Hatching) 20 mils Thick (Wet Night Visibility Spheres)</td>
<td></td>
</tr>
<tr>
<td>685.07200810</td>
<td>White Epoxy Reflectorized Pavement Yield Line Symbols - Small - 20 mils (Wet Night Visibility Spheres)</td>
<td></td>
</tr>
<tr>
<td>685.07200910</td>
<td>White Epoxy Reflectorized Pavement Yield Line Symbols - Large - 20 mils (Wet Night Visibility Spheres)</td>
<td></td>
</tr>
</tbody>
</table>
ITEM 800.01000015 – DESIGN BUILD – DESIGN SERVICES

DESCRIPTION. This work shall consist of providing design services in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide Design Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build - Design Services will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build - Design Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.
DESCRIPTION. This work shall consist of providing Construction Inspection Services in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide Construction Inspection Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build - Construction Inspection Services will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build - Construction Inspection Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.
ITEM 800.03000015 – DESIGN BUILD – QUALITY CONTROL SERVICES

**DESCRIPTION.** This work shall consist of providing Quality Control Services in accordance with the contract documents.

**MATERIALS.** None Specified.

**CONSTRUCTION DETAILS.** The Design Builder shall provide Quality Control Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

**METHOD OF MEASUREMENT.** Design Build - Quality Control Services will be measured for payment on a lump sum basis.

**BASIS OF PAYMENT.** The lump sum price bid for Design Build - Quality Control Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.
ITEM 800.04000015 – DESIGN BUILD – FORCE ACCOUNT WORK

DESCRIPTION. This work shall consist of performing construction work in accordance with the contract documents and as directed by the Engineer.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall perform construction work in accordance with the contract documents as directed by the Engineer. The Design Builder will maintain and provide agreed price or force account records to document the costs in accordance with DB section 109-9.

METHOD OF MEASUREMENT. Design Build – Force Account Work will be measured for payment on a Dollar Cents basis.

BASIS OF PAYMENT. The price shown for Design Build - Force Account Work shall include the cost of furnishing all labor, materials, equipment and incidentals to satisfactorily complete the work. The total cost shown in the itemized proposal will be considered the price bid even though payment will be made only for actual work performed. The unit price amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid for the contract.

Progress payments will be made in accordance with the contract documents.
DESCRIPTION. This work shall consist of providing necessary bonds, insurance, prefinancing and set up of necessary general plant, including shops, storage areas, office and such sanitary and other facilities as are required by local or state law or regulation.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide the above facilities and service for mobilization in a safe and workmanlike manner in conformance with any pertinent local or State Law, regulation or code to the extent and at the time the Contractor deems them necessary for its operations. Good housekeeping shall be maintained.

METHOD OF MEASUREMENT. Design Build – Site Mobilization will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build – Site Mobilization shall not exceed four percent (4%) of the total contract bid price for all Construction Work items. Should the bidder exceed the foregoing four percent (4%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

Progress payments in the amount of 4% of the construction work items will be made to the Contractor with the first contract payment made for other contract work at the individual itemized work site.
ITEM 800.0600NN15 – DESIGN BUILD – CONSTRUCTION WORK

DESCRIPTION. This work shall consist of construction work in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall perform all construction work in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build – Construction Work will be measured for payment on a lump sum basis for each location. The individual locations are identified in the contract documents.

BASIS OF PAYMENT. The lump sum price bid for Design Build – Construction Work shall include the cost of furnishing all labor, materials, equipment, management and supervision to satisfactorily complete the work. Progress payments will be made for each construction work location in accordance with the contract documents.

Note: NN in pay item number denotes serialization by location.
ITEM 800.1000NN15 – DESIGN BUILD – UTILITY RELATED WORK

DESCRIPTION. This work shall consist of utility related work in accordance with the contract documents or owner requirements. The “owner” of each utility is identified in the contract documents.

MATERIALS. Materials shall be as specified in the contract documents or owner requirements. If none specified, then the proposed material shall be approved by the Engineer of Record before any purchase is made.

CONSTRUCTION DETAILS. The Design Builder shall perform all utility related work in accordance with the requirements in the contract documents or owner requirements. In case of a conflict with owner requirements, the owner requirements shall take precedence.

METHOD OF MEASUREMENT. Design Build – Utility Related Work as defined in the contract documents will be measured for payment on a fixed price lump sum basis for each utility. The individual utilities will be identified in the contract documents.

BASIS OF PAYMENT. The fixed price lump sum for Design Build – Utility Related Work shall include the cost of furnishing all labor, materials, equipment, design, construction inspection, testing, and supervision to satisfactorily complete the work. Progress payments will be made for each utility work in accordance with the contract documents.

FIXED PRICE ITEM
The fixed price shown in the proposal for this pay item is not to be altered in any manner by the Proposer. Should the amount be altered, the new figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

Note: NN in pay item number denotes serialization by each utility.