

DOCUMENT A00801

**SPECIAL PROVISIONS****BOLTON TO LITTLETON****Federal Aid Project No. NHP(IM)-495S(295)X  
Pavement Preservation and Related Work (Including 5 Bridges)  
along a Section of Interstate 495**

Labor participation goals for this Project shall be 15.3% for minorities and 6.9% for women for each job category. The goals are applicable to both Contractor's and Subcontractor's on-site construction workforce. Refer to Document 00820 for details.

**SCOPE OF WORK**

All work under this Contract shall be done in conformance with the *2021 Standard Specifications for Highways and Bridges*, the *2017 Construction Standard Details*, the *Traffic Management Plans and Detail Drawings*, *MassDOT Work Zone Safety Temporary Traffic Control*, the *1990 Standard Drawings for Signs and Supports*; the *2015 Overhead Signal Structure and Foundation Standard Drawings*, the *2009 Manual on Uniform Traffic Control Devices (MUTCD)* with Massachusetts Amendments; the *1968 Standard Drawings for Traffic Signals and Highway Lighting*; *The American Standard for Nursery Stock*; the Plans and these Special Provisions.

This Contract consists of milling and placing a Ultra Thin Bonded Overlay on Interstate 495 in the towns of Berlin, Bolton, Boxborough, and Harvard. Additional work includes adjusting drainage structures, repairing guardrail, and new pavement markings. The Contract begins at the Berlin/Bolton town line (mm 67.6±). The Contract ends at the Boxborough/Littleton town line (mm 77.0±). The total length of this Project is approximately 9.4 miles.

The bridge work consists of full depth pavement removal, joint rehabilitation, full depth and/or partial depth deck repairs, and railing/parapet repairs. Joint rehabilitation work will be required for all bridge joints, and, in general, consists of slab-over backwall construction at all abutments and a pre-compressed seal joint at all piers. The locations of full and partial depth deck repairs will be as required by the Engineer. There are also several locations where the existing bridge railing is either damaged, or missing, and requires replacement in-kind.

Even though this project is proposed to occur within the buffer zones of natural watercourses and bordering vegetated wetlands, there are no major soil disturbances anticipated. However, prior to construction, erosion control barriers shall be installed to protect and prevent any encroachment into environmentally sensitive areas.

All work is to be performed within the existing State, City, or Town roadway layouts. No right to enter on or occupy private property have been acquired for this project.

---

## **SUBSECTION 7.05 INSURANCE REQUIREMENTS**

### **B. Public Liability Insurance**

The insurance requirements set forth in this section are in addition to the requirements of the Standard Specifications and supersede all other requirements.

#### **Paragraphs 1 and 2**

The Massachusetts Department of Transportation and applicable railroads shall be named as additional insureds.

## **CONTRACTOR QUESTIONS AND ADDENDUM ACKNOWLEDGEMENTS**

Prospective bidders are required to submit all questions to the Construction Contracts Engineer by 1:00 P.M. on the Thursday before the scheduled bid opening date. Any questions received after this time will not be considered for review by the Department.

Contractors should email questions and addendum acknowledgements to the following email address [massdot specifications@dot.state.ma.us](mailto:massdot specifications@dot.state.ma.us). The MassDOT project file number and municipality is to be placed in the subject line.

## **PROPRIETARY PRODUCTS**

A letter discussing TE Connectivity Roadtrax BL piezo sensor; PAT/IRD TRS solar harness; Morningstar SunSaver SS-MPPT-15L regulator; Morningstar Ethernet MeterBus Converter EMC-1 ethernet connectivity; Sierra Wireless AirLink RV50X modem listed under Item 819.907 as a proprietary specification pursuant to M.G.L. c. 30, § 39M(b) has been filed with MassDOT

## **CONTRACTOR/SUBCONTRACTOR CERTIFICATION – CONTRACT COMPLIANCE**

(Revision 03-23-10)

Pursuant to 23 C.F.R. § 633.101 *et seq.*, the Federal Highway Administration requires each contractor to “insert in each subcontract, except as excluded by law or regulation, the required contract provisions contained in Form FHWA–1273 and further requires their inclusion in any lower tier subcontract that may in turn be made. The required contract provisions of Form FHWA–1273 shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the requirements contained in the provisions of Form FHWA–1273.” The prime contractor shall therefore comply with the reporting and certification requirements provided in MassDOT’s CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form (DOT-DIST-192) certifying compliance with 23 C.F.R. § 633.101 for each subcontract agreement entered into by the contractor. The contractor shall provide a fully executed original copy of said CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form to MassDOT upon execution of any subcontract agreement. Failure to comply with the reporting and certification requirement of the CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form may result in action against the prequalification status of the prime contractor with MassDOT.

---

## **COVID 19 GUIDELINES AND PROCEDURES**

Commonwealth of Massachusetts COVID-19 GUIDELINES AND PROCEDURES FOR ALL CONSTRUCTION SITES AND WORKERS AT ALL PUBLIC WORK dated March 2020 as amended shall be adhered to.

It is the Contractor's responsibility to stay current with any changes or addendums issued to these guidelines. For copies of the guidelines go to:

<https://www.mass.gov/covid-19-guidelines-and-procedures-for-all-construction-sites-and-workers-at-all-public-work>

These Guidelines and Procedures will remain in effect until further notice. At the start of the Work the Contractor is required to submit a letter to the Engineer certifying that the Contractor is in compliance with CDC, OSHA and the Commonwealth's COVID-19 guidelines. The certification applies to the general contractor as well as all subcontractors engaged with the Work covered under this contract. No Work will be allowed to begin until the letter is submitted and approved by the Engineer. In addition, on a daily basis, the Contractor is required to submit a copy of the MassDOT Contractor COVID-19 Guidelines Compliance Checklist to the Engineer. If the Contractor fails to submit the daily checklist no work will be allowed until one is submitted. Any items checked with a NO will require immediate corrective action by the Contractor before any Work can begin.

Per Subsection 5.09 – Inspection of the Work - the Contractor is required to provide assistance to the Engineer to make a complete and detailed inspection of the work. That assistance includes furnishing equipment to perform the inspection, therefore the Contractor will be required to provide CDC compliant Personal Protective Equipment (PPE) to Department personnel field staff. The CDC compliant PPE shall consist of face masks, gloves and eye protection.

All costs associated with compliance with this provision are considered to be incidental to the contract cost and therefore the contractor will not be entitled to any additional compensation.

## **ACCESS MASSDOT HIGHWAY INFORMATION ON WEBSITE**

Access MassDOT Highway Information related to Construction, Design/Engineering, Contractor/Vendor Information, Approved Materials and Fabricators, Manuals, Publications and Forms at:

<http://www.mass.gov/massdot/highway>

## **EQUIVALENT SINGLE AXLE LOADS (ESALS)**

The estimated traffic level to be used for SUPERPAVE HMA mixture designs for this contract, expressed in Equivalent Single Axle Loads (ESALs) for the design travel lane over a 20-year period, is a traffic Level 3 ( $\geq 10$ ) Million 18-kip (80-kN) ESALs.

---

## **PROVISIONS FOR TRAVEL AND PROSECUTION OF WORK**

Attention is directed to the fact that this is a high volume roadway and as such the Contractor's personnel and equipment shall be well off of the traveled way and shoulders by the times specified in the contract. Under no circumstance should a Contractor close a travel lane or in any way affect traffic outside the specified work hours. All travel lanes of the roadway must be fully open to traffic prior to the start and after the end of the approved work schedule. In no case will operations commence prior to the specified work hours. This includes traffic setups that restrict the flow of traffic.

The number of simultaneous work locations that the Contractor will be permitted to work is subject to the approval of the Engineer. If more than two (2) work locations are proposed at any time, a request must be submitted for approval which must include the proposed daily work activities and locations, along with the proposed limits of the work zone setups.

The Contractor shall not perform both nighttime and daytime operations in the same period. The Contractor shall notify the Engineer in writing, at least two weeks prior to the commencement of nighttime operations and prior to changing from nighttime to daytime work.

The Contractor shall notify the Engineer in writing two (2) weeks in advance of any proposed temporary roadway closures necessary to complete the work. Before starting any work under the Contract, the Contractor shall submit a Schedule of Operations. Work on roadways shall proceed only on such sections and widths thereof as will be approved by the Engineer.

The Contractor will be required to maintain a minimum of two (2) unobstructed 11 foot wide travel lanes in each direction with acceptable alignment within the roadway throughout all sections until 10:00 pm when a second lane may be closed, at which one (1) unobstructed travel lane must be maintained at all times.

The micromilling operations shall be scheduled to minimize the duration and placement of traffic on the micromilled surface. The limits of micromilling production are subject to the approval of the Engineer.

Temporary pavement markings shall be applied to the cold planed and newly paved areas at the end of each work shift or as required by the Engineer. Pavement markings no longer applicable, which may create confusion, shall be obliterated. During milling and paving operations all stop lines and cross walks affected by those operations are to be restored during the same work shift of the approved hours.

Signs having messages that are irrelevant to normal traffic conditions shall be removed or properly covered at the end of each work period. Signs are to be kept clean at all times and legends shall be distinctive and unmarred.

---

## **WORK SCHEDULE**

(Supplementing Section 8.00)

All milling and UTBO placement on the mainline roadway shall be done before October 15, 2021.

Milling and paving of the mainline, including all bridge related work, will be done between the hours of 8:00 pm and 5:00 am Sunday night through Friday morning excluding holidays. Prior to the 5:00 am reopening of the traffic, the milled pavement area shall be swept clean of all milled material, temporary lines striped, all equipment including traffic control devices shall be removed from the work area. Any modifications to these proposed work hours are subject to the written approval of the District Highway Director. **No work involving pavement repairs, pavement removal, resurfacing, drainage, or any other work requiring lane closures shall be performed during the hours of 5:00 am and 8:00 pm except as directed by the Engineer.**

The Contractor shall schedule their operations so that at the end of each work week, prior to the weekend, the limits of milling and resurfacing has been squared off across the entire width of the roadway, including shoulders.

## **PAVEMENT MARKINGS**

The Engineer will not provide a line of reference for establishing the pavement markings. It shall be the responsibility of the Contactor to survey and record all existing pavement markings, their locations and dimensions for reproduction after final paving. The proposed pavement markings in accordance with the Standard Specifications and Construction and Traffic Standard Details shall be placed in the same location as referenced existing pavement markings unless otherwise directed. The recording shall be done prior to any other work on the project and copies given to the Engineer for approval prior to the commencement of any operations that will remove existing pavement markings. Payment for this work will be included in the bid price for the applicable pavement marking items with no additional compensation.

Pavement marking's line width shall be upgraded as follows:

- Existing 4" pavement markings locations shall be increased to a width of 6".

All permanent pavement markings must be applied within two weeks of paving the course. Upon completing the paving of the top course within any section of roadway, the permanent pavement markings must be applied. The Contactor shall not wait until all paving has been completed prior to applying the permanent pavement markings.

## **PAVEMENT MARKERS**

No separate payment will be made for removal and disposal of existing pavement markers, but all costs in connection therewith shall be included in the respective Contract price bid.

## **HOOKLOCK GRATE INSTALLATION**

The Contractor shall install all necessary hooklock grates before traffic shifts and milling/paving operations begin. Traffic shall not be shifted over any drainage castings unless hooklock grates are in place.

## **PUBLIC SAFETY AND CONVENIENCE**

(Supplementing Subsection 7.09)

All Contractors' vehicles involved with setting traffic control signs and equipment shall have installed an arrow board and shall be equipped with two 8 inch diameter amber rotating beacons and a safety approved walkway on back of vehicle when performing traffic control work.

The closing of travel lanes carrying traffic will be permitted for the construction, subject to the conditions contained herein. Lane closings will be permitted if, in the opinion of the Engineer, the conditions of the road, weather and traffic are favorable.

## **PIGEON WASTE**

The Contractor shall remove and dispose of the pigeon waste and any other debris accumulated on the steel members and bridge seats in areas where work is being performed. Pigeon waste and debris material contaminants will require special handling and disposal in accordance with all Federal, state, and local requirements. No separate payment will be made for removal and disposal of pigeon waste. Cost shall be incidental to the contract pay items.

---

## **HOLIDAY WORK RESTRICTION**

(Supplementing Subsection 7.09)

The District Highway Director (DHD) may authorize work to continue during these specified time periods if it is determined by the District that the work will not negatively impact the traveling public. DHD may allow work in those areas on a case by case basis and where work is behind barrier and will not impact traffic

Below are the holiday work restrictions:

### New Years Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

### Martin Luther King's Birthday (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

### President's Day (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

### Evacuation Day (Suffolk County State Holiday)

No work restrictions due to traffic concerns.

### Patriot's Day (State Holiday)

Work restrictions will be in place for Districts 3 and 6 along the entire Boston Marathon route and any other locations that the DHD in those districts determine are warranted so as to not to impact the marathon. All other districts work restrictions will be as per DHD.

### Mother's Day

No work on Western Turnpike and Metropolitan Highway System from 5:00 AM on the Friday before, until the normal start of business on the following day.

### Memorial Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

### Bunker Hill Day (Suffolk County State Holiday)

No work restrictions due to traffic concerns.

### Independence Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

## **HOLIDAY WORK RESTRICTIONS (Continued)**

### Labor Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

### Columbus Day (Federal Holiday)

No work on major arterials from 5:00 AM on the Friday before, until the normal start of business on the following day

### Veterans' Day (Federal Holiday)

No work restrictions due to traffic concerns.

### Thanksgiving Day (Federal Holiday)

No work on major arterials from 5:00 AM two days before until the normal start of business on the following Monday.

### Christmas Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day.

## **NATIONAL GRID EMERGENCY TELEPHONE NUMBERS**

### GAS:

Emergency: 1-800-233-5325

New Service: 1- 877-696-4743

Customer Support: 1-800-732-3400

### ELECTRIC:

Outage/ Emergency: 1-800-465-1212

New Service: 1-800-375-4730

Customer Support: 1-800-322-3223

## **EVERSOURCE EMERGENCY TELEPHONE NUMBERS**

### GAS:

Outage/ Emergency: 800-592-2000

New Service: 866-678-2744

Customer Support: 800-592-2000

### ELECTRIC:

Outage/ Emergency: 800-592-2000 or 844-726-7562

New Service: 1-888-633-3797 (1-888-need pwr)

Customer Support: 1-800-340-9822



**NOTICE TO OWNERS OF UTILITIES**

(Supplementing Subsection 7.13)

Written notice shall be given by the Contractor to all public service corporations or Municipal and State officials owning or having charge of publicly or privately owned utilities of his intention to commence operations affecting such utilities at least one week in advance of the commencement of such operations. The Contractor shall, at the same time, file a copy of such notice with the Engineer.

Before beginning any work or operations, which might damage any subsurface structures, the Contractor shall carefully locate all such structures and conduct his operations so as to avoid any damage to them.

The following website lists the names and addresses of the utilities may be affected, but the completeness of the list is not guaranteed:

<https://www.mass.gov/info-details/utility-contacts-by-district-and-municipality>

Town officials are shown at website <https://www.mass.gov/lists/massachusetts-cities-and-towns> and select the required City/Town website.

The Contractor shall be responsible for informing the following officials in each area that he is assigned to work in:

Superintendent, Department of Public Works or Town Engineer.

Superintendent, Water Department, Superintendent, Sewer Departments.

Police Department, Fire Department, Electric Company, Railroads.

State Police are shown at website <https://www.mass.gov/info-details/massachusetts-state-police-troop-boundaries>. Select the area of jurisdiction to find the local station.

**NOTICE TO OWNERS OF UTILITIES** (Continued)**BOLTON****BOLTON - Pole Data**

<u>Municipality</u>	<u>Pole Set Responsibility</u>	<u>Updated</u>
BOLTON	National Grid	2/21/2008

**District Utility/Constructability Engineer**

<u>County</u>	<u>District</u>	<u>Contact</u>	<u>Phone</u>	<u>Email</u>
Worcester	3	Ross Goodale	508-929-3938	Ross.A.Goodale@dot.state.ma.us

**Utility Data**

<b>Electric</b>						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
National Grid Electric	548 Haydenville Road	Leeds	MA	01053	12/4/2018	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Sandra Annis	413-582-7424		sandra.annis@nationalgrid.com12/21/2018

<b>Gas</b>						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Tennessee Gas Pipeline Company	8 Anngina Drive	Enfield	CT	06082	8/17/2010	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
David Wood	860-763-6005		KMEncroachmentsNorth@kindermorgan.com5/20/2020

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Eversource Gas	157 Cordaville Road, 3113	Southborough	MA	017725	31/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>	<u>Updated</u>
Jeffrey Evans-Mongeon	508-305-6970		Jeffrey.Evans-Mongeon@eversource.com	6/4/2018

**Telephone**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Verizon	385 Myles Standish Blvd.	Taunton	MA	02780	11/8/2013

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>	<u>Updated</u>
Karen Mealey	774-409-3160		karen.m.mealey@verizon.com	8/29/2012

**Water**

no information

**Sewer**

no information

**Railroad**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
No Railroad					

**Cable**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Comcast Cable Corporation	PO Box 6505, 5 Omni Way	Chelmsford	MA	018248	8/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Wendy Brown	978-848-5163		Wendy_Brown@comcast.com4/8/2019

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
AT&T / Teleport Communications America, c/o Siena Engineering Group	50 Mall Road - Suite 203	Burlington	MA	01803	4/15/2014

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Hayleigh Walker	781-221-8400 x7023		Hayleigh.Walker@sienaengineeringgroup.com1/3/2018

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
CenturyLink	1025 Eldorado Blvd.	Broomfield	CO	80021	6/26/2019

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Renoy Thomas	516-712-3041		CenturyLinkNationalOspRelocations@centurylink.com8/6/2019

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Crown Castle	80 Central Street	Boxborough	MA	01719	1/18/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Mark Bonanno	508 616 7818		mark.bonanno@crowncastle.com7/17/2018

**BOXBOROUGH**

**BOXBOROUGH - Pole Data**

<u>Municipality</u>	<u>Pole Set Responsibility</u>	<u>Updated</u>
BOXBOROUGH	Littleton Electric Light	2/21/2008

**District Utility/Constructability Engineer**

<u>County</u>	<u>District</u>	<u>Contact</u>	<u>Phone</u>	<u>Email</u>
Middlesex	3	Ross Goodale	508-929-3938	Ross.A.Goodale@dot.state.ma.us

**Utility Data**

**Electric**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Littleton Municipal Electric Light Co.	39 Ayer Road	Littleton	MA	01460	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Scott Edwards			

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
National Grid Electric	548 Haydenville Road	Leeds	MA	01053	12/4/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Sandra Annis	413-582-7424		sandra.annis@nationalgrid.com12/21/2018

**Gas**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
National Grid Gas	40 Sylvan Road	Waltham	MA	02451	9/20/2019

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Melissa Owens	781-907-2845		Melissa.Owens@nationalgrid.com9/4/2012

**Telephone**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Verizon	385 Myles Standish Blvd.	Taunton	MA	02780	11/8/2013

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Karen Mealey	774-409-3160		karen.m.mealey@verizon.com

**Water**

no information

**Sewer**

no information

**Railroad**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
MBTA Document Control Group	500 Arborway	Boston	MA	02130	4/16/2020

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Tyler Scott			tscott@mbta.com

**Cable**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
CenturyLink	1025 Eldorado Blvd.	Broomfield	CO	80021	6/26/2019

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Renoy Thomas	516-712-3041		CenturyLinkNationalOspRelocations@centurylink.com

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Comcast Cable Corporation	PO Box 6505, 5 Omni Way	Chelmsford	MA	018248	8/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Wendy Brown	978-848-5163		Wendy_Brown@comcast.com

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Crown Castle	80 Central Street	Boxborough	MA	01719	1/18/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Mark Bonanno	508 616 7818		mark.bonanno@crowncastle.com

**Fire Alarm**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Boxborough Fire Department	29 Middle Road	Boxborough	MA	01719	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
William Clayton, Chief			

**DPW**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Boxborough DPW	29 Middle Road	Boxborough	MA	01719	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Warren W. Morse			

<b>Other</b>						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
MCI-Verizon Business	P.O. Box 600	Charlton	MA	01507	2/22/2017	

  

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Stephen Parretti	508-248-1305		stephen.parretti@verizon.com

HARVARD

**HARVARD - Pole Data**

<u>Municipality</u>	<u>Pole Set Responsibility</u>	<u>Updated</u>
HARVARD	National Grid	2/21/2008

**District Utility/Constructability Engineer**

<u>County</u>	<u>District</u>	<u>Contact</u>	<u>Phone</u>	<u>Email</u>
Worcester	3	Ross Goodale	508-929-3938	Ross.A.Goodale@dot.state.ma.us

**Utility Data**

<b>Electric</b>						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
National Grid Electric	548 Haydenville Road	Leeds	MA	01053	12/4/2018	

  

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Sandra Annis	413-582-7424		sandra.annis@nationalgrid.com



**Gas**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
National Grid Gas	40 Sylvan Road	Waltham	MA	02451	9/20/2019

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Melissa Owens	781-907-2845		Melissa.Owens@nationalgrid.com

**Telephone**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Verizon	385 Myles Standish Blvd.	Taunton	MA	02780	11/8/2013

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Karen Mealey	774-409-3160		karen.m.mealey@verizon.com

**Water**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Harvard DPW	47 Depot Rd.	Harvard	MA	01451	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
James Smith	978-456-4130		

**Sewer**

no information

**Railroad**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
PanAm Railways	Iron Horse Park	North Billerica	MA	01862	4/15/2009

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Ted Krug	978-663-1077		tkrug@panam.com4/5/2017

**Cable**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Charter Communications	301 Barber Avenue	Worcester	MA	01606	11/12/2014

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Rick Molnar	774-243-9789		Rick.Molnar@charter.com4/22/2019

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
AT&T / Teleport Communications America, c/o Siena Engineering Group	50 Mall Road - Suite 203	Burlington	MA	01803	4/15/2014

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Hayleigh Walker	781-221-8400 x7023		Hayleigh.Walker@sienaengineeringgroup.com1/3/2018

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
CenturyLink	1025 Eldorado Blvd.	Broomfield	CO	80021	6/26/2019

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Renoy Thomas	516-712- 3041		CenturyLinkNationalOspRelocations@centurylink.com8/6/2019

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Crown Castle	80 Central Street	Boxborough	MA	01719	1/18/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Mark Bonanno	508 616 7818		mark.bonanno@crowncastle.com7/17/2018

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
MCI-Verizon Business	P.O. Box 600	Charlton	MA	01507	2/22/2017

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Stephen Parretti	508-248-1305		stephen.parretti@verizon.com7/24/2017

**Fire Alarm**

no information

**DPW**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Harvard DPW	47 Depot Rd.	Harvard	MA	01451	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
James Smith	978-456-4130		

**Other**

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Axia KCST	30 Elmview Circle	Dover	NH	03820	11/6/2018

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Jason Wing	403-538-4545		jason.wing@axia.com10/19/2018

## **ENVIRONMENTAL PERMITTING**

Environmental permits have not been obtained, as no work (either temporary or permanent) is proposed to occur in water or wetland resource areas. If Contractor erection, demolition, storage, or other procedures require work to occur in or otherwise impact water, wetland resource areas, buffer zones, or Natural Heritage & Endangered Species Program (NHESP) mapped Priority or Estimated Habitat, the Contractor is advised that no associated work can occur until all required environmental permits have been obtained. Environmental Permits will be required for any physical work or encroachment into resource areas and associated buffer zones that goes beyond specific exemptions of the Wetlands Protection Act, including Sections 10.02 and 10.58. The Contractor must notify the District 3 Highway Director and the Engineer in writing at least 60 days prior to desired commencement of the proposed activity. All environmental submittals, including any contact with Local, State, or Federal environmental agencies, must be coordinated through the District 3 Environmental Engineer. The Contractor is expected to fully cooperate with requests for information and provide same in a timely manner. The Contractor is further advised that the Department will not entertain a delay claim due to the time required to obtain the environmental permits. As a supplement to Section 7.00 of the Standard Specifications, the Contractor is reminded that no debris of any type shall be allowed to enter water or wetland resource areas, either temporarily or permanently.

## **EMERALD ASH BORER ADVISORY**

To the extent possible, all trees and brush shall be disposed on site, typically chipped and spread in place. When trees or brush must be removed, such as in urban, or otherwise populated areas, Contractor shall identify proposed location for disposal, and provide written notification to the Engineer for approval. Disposal shall be in city or town of project, or at minimum, within county, of construction operations.

## **NORTHERN LONG-EARED BAT PROTECTION**

The U.S. Fish and Wildlife Service (USFWS) has listed the northern long-eared bat as threatened under the Endangered Species Act (ESA) and the following requirements exist to protect the bat and its habitat.

This project has been consulted with the USFWS through the Optional Framework to Streamline Section 7 Consultation and is consistent with the Programmatic Biological Opinion under the authority of section 4(d) of the Endangered Species Act and the Final 4(d) Rule published in the Federal Register on January 14, 2016. No conservation measures or time of year restrictions on tree cutting are required. If additional cutting is proposed by the Contractor that is outside the scope of this contract, additional review is required by the MassDOT Highway Division's Environmental Services Section, additional review may be required by the USFWS, and time of year restrictions could apply to such tree cutting.

---

## **BIDDERS LIST**

Pursuant to the provisions of 49 CFR Part 26.11 all official bidders will be required to report the names, addresses and telephone numbers of all firms that submitted bids or quotes in connection with this project. Failure to comply with a written request for this information within 15 business days may result in a recommendation to the Prequalification Committee that prequalification status be suspended until the information is received.

The Department will survey all firms that have submitted bids or quotes during the previous year prior to setting the annual goal and shall request that each firm report its age and gross receipts for the year.

## **COMPLIANCE WITH THE NATIONAL DEFENSE AUTHORIZATION ACT**

(Supplementing Subsection 7.01)

On all projects, the “Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment” Regulation (2 CFR 200.216) prohibits the Contractor from using or furnishing the following telecommunications equipment or services:

- Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
- For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
- Telecommunications or video surveillance services provided by such entities or using such equipment.
- Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

This prohibition applies to all products manufactured by the aforementioned companies, including any individual components or parts.

By submitting a bid on a project, the Contractor certifies that all work will be in compliance with the terms of 2 CFR 200.216. The Contractor shall submit a COC indicating compliance with the above provisions for all telecommunications equipment or services included in the Contract.

Payment for the item in which the materials are incorporated may be withheld until these COCs are received. Any cost involved in furnishing the certificate(s) shall be borne by the Contractor.

---

## **SUBSECTION 8.14 UTILITY COORDINATION, DOCUMENTATION, AND MONITORING RESPONSIBILITIES**

### **A. GENERAL**

In accordance with the provisions of Section 8.00 Prosecution and Progress, utility coordination is a critical aspect to this Contract. This section defines the responsibility of the Contractor and MassDOT, with regard to the initial utility relocation plan and changes that occur as the prosecution of the Work progresses. The Engineer, with assistance from the Contractor shall coordinate with Utility companies that are impacted by the Contractor's operations. To support this effort, the Contractor shall provide routine and accurate schedule updates, provide notification of delays, and provide documentation of the steps taken to resolve any conflicts for the temporary and/or permanent relocations of the impacted utilities. The Contractor shall provide copies to the Engineer of the Contractor communication with the Utility companies, including but not limited to:

- Providing advanced notice, for all utility-related meetings initiated by the Contractor.
- Providing meeting minutes for all utility-related meetings that the Contractor attends.
- Providing all test pit records.
- Request for Early Utility work requirements of this section (see below).
- Notification letters for any proposed changes to Utility start dates and/or sequencing.
- Written notification to the Engineer of all apparent utility delays within seven (7) Calendar Days after a recognized delay to actual work in the field – either caused by a Utility or the Contractor.
- Any communication, initiated by the Contractor, associated with additional Right-of-Way needs in support of utility work.
- Submission of completed Utility Completion Forms.

### **B. PROJECT UTILITY COORDINATION (PUC) FORM**

The utility schedule and sequence information provided in the Project Utility Coordination Form (if applicable) is the best available information at the time of the bid and has been considered in setting the contract duration. The Contractor shall use all of this information in developing the bid price and the Baseline Schedule Submission, inclusive of the individual utility durations sequencing requirements, and any work that has been noted as potentially concurrent utility installations.

### **C. INITIATION OF UTILITY WORK**

The Engineer will issue all initial notice-to-proceed dates to each Utility company based on either the:

- 1) Contractor's accepted Baseline Schedule
- 2) An approved Early Utility Request in the form of an Early Utility sub-net schedule (in accordance with the requirements of this Subsection)
- 3) An approved Proposal Schedule

#### **C.1 - BASELINE SCHEDULE – UTILITY BASIS**

The Contractor shall provide a Baseline Schedule submission in accordance with the requirements of Subsection 8.02 and inclusive of all of the information provided in the PUC Form that has been issued in the Contract documents. This is to include the utility durations, sequencing of work, allowable concurrent work, and all applicable considerations that have been depicted on the PUC Form.

---

**SUBSECTION 8.14** (Continued)**C.2 – EARLY UTILITY REQUEST – (aka SUBNET SCHEDULE) PRIOR TO THE BASELINE**

All early utility work is defined as any anticipated/required utility relocations that need to occur prior to the Baseline Schedule acceptance. In all cases of proposed early utility relocation, the Contractor shall present all known information at the pre-construction conference in the form of a ‘sub-net’ schedule showing when each early utility activity needs to be issued a notice-to-proceed. The Contractor shall provide advance notification of this intent to request early utility work in writing at or prior to the Pre-Construction meeting. Prior to officially requesting approval for early utility work, the Contractor shall also coordinate with MassDOT and all utility companies (private, state or municipal) which may be impacted by the Contract. If this request is acceptable to the Utilities and to MassDOT, the Engineer will issue a notice-to-proceed to the affected Utilities, based on these accepted dates.

**C.3 – PROPOSAL SCHEDULE - CHANGES TO THE PUC FORM**

If the Contractor intends to submit a schedule (in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02) that contains durations or sequencing that vary from those provided in the Project Utility Coordination (PUC) Form, the Contractor must submit this as an intended change, in the form of a Proposal Schedule and in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02. These proposed changes are subject to the approval of the Engineer and the impacted utilities, in the form of this Proposal Schedule and a proposed revision to the PUC form. The Contractor shall not proceed with any changes of this type without written authorization from the Engineer, that references the approved Proposal Schedule and PUC form changes. The submission of the Baseline Schedule should not include any of these types of proposed utility changes and should not delay the submission of the Baseline Schedule. As a prerequisite to the Proposal Schedule submission, and in advance of the utility notification(s) period, the Contractor shall coordinate the proposed utility changes with the Engineer and the utility companies, to develop a mutually agreed upon schedule, prior to the start of construction.

**D. UTILITY DELAYS**

The Contractor shall notify the Engineer upon becoming aware that a Utility owner is not advancing the work in accordance with the approved utility schedule. Such notice shall be provided to the Engineer no later than seven (7) calendar days after the occurrence of the event that the Contractor believes to be a utility delay. After such notice, the Engineer and the Contractor shall continue to diligently seek the Utility Owner’s cooperation in performing their scope of Work.

In order to demonstrate that a critical path delay has been caused by a third-party Utility, the Contractor must demonstrate, through the requirements of the monthly Progress Schedule submissions and the supporting contract records associated with Subsection 8.02, 8.10 and 8.14, that the delays were beyond the control of the Contractor.

---

**SUBSECTION 8.14** (Continued)

All documentation provided in this section is subject to the review and verification of the Engineer and, if required, the Utility Owner. In accordance with MassDOT Specifications, Division I, Subsection 8.10, a Time Extension will be granted for a delay caused by a Utility, only if the actual duration of the utility work is in excess of that shown on the Project Utility Coordination Form, and only if;

- 1) proper Notification of Delay was provided to MassDOT in accordance with the time requirements that are specified in this Section
- 2) the utility delay is a critical path impact to the Baseline Schedule (or most recently approved Progress Schedule)

**E. LOCATION OF UTILITIES**

The locations of existing utilities are shown on the Contract drawings as an approximation only. The Contractor shall perform a pre-construction utility survey, including any required test pits, to determine the location of all known utilities no later than thirty (30) calendar days before commencing physical site work in the affected area.

**F. POST UTILITY SURVEY – NOTIFICATION**

Following completion of a utility survey of existing locations, the Contractor will be responsible to notify the Engineer of any known conflicts associated with the actual location of utilities prior to the start of the work. The Engineer and the Contractor will coordinate with any utility whose assets are to be affected by the Work of this Contract. A partial list of utility contact information is provided in the Project Utility Coordination Form.

**G. MEETINGS AND COOPERATION WITH UTILITY OWNERS**

The Contractor shall notify the Engineer in advance of any meeting they initiate with a Utility Owner's representative to allow MassDOT to participate in the meeting if needed.

Prior to the Pre-Construction Meeting, the Contractor should meet with all Utility Owners who will be required to perform utility relocations within the first 6 months of the project, to update the affected utilities of the Project Utility Coordination Form and all other applicable Contract requirements that impact the Utilities. The Contractor shall copy the Engineer on any correspondence between the Utility Owner and the Contractor.

**H. FORCE ACCOUNT / UTILITY MONITORING REQUIREMENTS**

The Engineer will be responsible for recording daily Utility work force reports. The start, suspension, re-start, and completion dates of each of the Utilities, within each phase of the utility relocation work, will be monitored and agreed to by the Engineer and the Contractor as the work progresses.

**I. ACCESS AND INSPECTION**

The Contractor shall be responsible for allowing Utility owners access to their own utilities to perform the relocations and/or inspections. The Contractor shall schedule their work accordingly so as not to delay or prevent each utility from maintaining their relocation schedule.



**SUBSECTION 8.02 SCHEDULE OF OPERATIONS**

Replace this subsection with the following:

An integrated cost and schedule controls program shall be implemented by the Contractor to track and document the progress of the Work from Notice to Proceed (NTP) through the Contractor Field Completion (CFC) Milestone. The Contractor's schedules will be used by the Engineer to monitor project progress, plan the level-of-effort required by the Department's work force and consultants and as a critical decision-making tool. Accordingly, the Contractor shall ensure that it complies fully with the requirements specified herein and that its schedules are both accurate and updated as required by the specification throughout the life of the project. Detailed requirements are provided in Division II, Section 772 Construction Scheduling.

---

## SECTION 722 CONSTRUCTION SCHEDULING

### DESCRIPTION

#### 722.20 General

The Contractor's approach to prosecution of the Work shall be disclosed to the Department by submission of a Critical Path Method (CPM) schedule and a cost/resource loaded Construction Schedule when required in this Subsection. These requirements are in addition to, and not in limitation of, requirements imposed in other sections.

The requirements for scheduling submissions are established based on the Project Value at the time of the bid and are designated as Type A, B, C or D. The definitions of these Schedule Requirement Types are summarized below. Complete descriptions of all detailed requirements are established elsewhere in this specification.

**Type A** – for all Site-Specific Contracts with a Project Value over \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Resource-Loading
- Resources Graphic Reporting
- Cash Flow Projections from the CPM
- Cash Flow Charts
- Cost-loaded CPM
- Contractor-furnished CPM software, computer and training

**Type B** – for all Site-Specific Contracts with a Project Value between \$10 Million and \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Cost-loaded CPM
- Resource-Loading
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

**SECTION 722 (Continued)**

**Type C** – for all Site-Specific Contracts with a Project Value between \$3 Million and \$10 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

**Type D** - for all contracts with a Project Value less than \$3 Million; various locations contracts of any dollar amount; contracts with durations less than one-hundred and eighty (180) Calendar Days; and other contracts as determined by the Engineer.

- Bar chart schedule updated monthly or at the request of the Engineer (See Section 722.62.B - Bar Charts.)
- Monthly Projected Spending Report (PSR) (See Section 722.62.F - Projected Spending Reports.)

**MATERIALS, EQUIPMENT, PERSONNEL****722.40 General****A. Software Requirements (Types A, B and C)**

The Contractor shall use Primavera P6 computer scheduling software.

In addition to the requirements of Section 740 – Engineer’s Field Office and Equipment, the Contractor shall provide to the Department one (1) copy of the scheduling software, one (1) software license and one (1) computer capable of running the scheduling software for the duration of the Contract. This computer and software shall be installed in the Engineer’s Field Office within twenty-eight (28) Calendar Days after Notice to Proceed. The computer and software shall be maintained and serviced as recommended by the computer manufacturer and/or as required by the Engineer during the duration of the Contract at no additional cost to the Department. The Contractor shall provide professional training in the basic use of the software for up to eight (8) Department employees. The trainer shall be approved by the Engineer. This training shall be provided within twenty-eight (28) Calendar Days after Notice to Proceed.

**B. Scheduler Requirements**

For all schedule types, if the Contractor plans to use outside scheduling services, the scheduler shall be approved as a subcontractor by the Engineer.

For Type A, B and C Schedules the name of the Contractor’s Project Scheduler together with his/her qualifications shall be submitted to the Department for approval by the Engineer within seven (7) Calendar Days after NTP. The Project Scheduler shall have a minimum of five [5] years of project CPM scheduling experience, three [3] years of which shall be on projects of similar scope and value as the project for which the Project Scheduler is being proposed. References shall be provided from past projects that can attest to the capabilities of the Project Scheduler.

**SECTION 722 (Continued)****CONSTRUCTION METHODS****722.60 General****A. Schedule Planning Session**  
(Types A, B and C)

The Contractor shall conduct a schedule planning session within seven (7) Calendar Days after the Contractor receives the NTP and prior to submission of the Baseline Schedule. This session will be attended by the Department and its consultants. During this session, the Contractor shall present its planned approach to the project including, but not limited to:

1. the Work to be performed by the Contractor and its subcontractors;
2. the planned construction sequence and phasing; planned crew sizes;
3. summary of equipment types, sizes, and numbers to be used for each work activity;
4. all early work related to third party utilities;
5. identification of the most critical submittals and projected submission timelines;
6. estimated durations of major work activities;
7. the anticipated Critical Path of the project and a summary of the activities on that Critical Path;
8. a summary of the most difficult schedule challenges the Contractor is anticipating and how it plans to manage and control those challenges;
9. a summary of the anticipated quarterly cash flow over the life of the project.

This will be an interactive session and the Contractor shall answer all questions that the Department and its consultants may have. The Contractor shall provide a minimum of five (5) copies of a written summary of the information presented and discussed during the session to the Engineer. The Contractor's Baseline Schedule and accompanying Schedule Narrative shall incorporate the information discussed at this Schedule Planning Session.

**B. Schedule Reviews by the Department (All Types)****1. Baseline Schedule Reviews**

The Engineer will respond to the Baseline Schedule Submission within thirty (30) Calendar Days of receipt providing comments, questions and/or disposition that either accepts the schedule or requires revision and resubmittal. Baseline Schedules shall be resubmitted within fifteen (15) Calendar Days after receipt of the Engineer's comments.

**2. Contract Progress Schedule / Monthly Update Reviews**

The Engineer will respond to each submittal within twenty one (21) Calendar Days. Schedules shall be resubmitted by the Contractor within five (5) Calendar Days after receipt of the Engineer's comments.

Failure to submit schedules as and when required could result in the withholding of full or partial pay estimate payments by the Engineer.

**SECTION 722 (Continued)****722.61 Schedule Content and Preparation Requirements**  
(Types A, B and C unless otherwise noted)

Each Contract Progress Schedule shall fully conform to these requirements.

**A. LOGIC**

The schedules shall divide the Work into activities with appropriate logic ties to show:

1. conformance with the requirements of this Section and Division I, Subsection 8.02 - Schedule of Operations
2. the Contractor's overall approach to the planning, scheduling and execution of the Work
3. conformance with any additional sequences of Work required by the Contract Documents, including, but not limited to, Subsection 8.03 - Prosecution of Work and Subsection 8.06 – Limitations of Operations.

**B. ACTIVITIES**

The schedules shall clearly define the progression of the Work from NTP to Contractor Field Completion (CFC) by using separate activities for each of the following items:

1. NTP
2. Each component of the Work defined by specific activities
3. Detailed activities to satisfy permit requirements
4. Procurement of fabricated materials and equipment with long lead times, including time for review and approval of submittals required before purchasing
5. The preparation and submission of shop drawings, procedures and other required submittals, with a planned duration that is to be demonstrated to the Engineer as reasonable
6. The review and return of shop drawings, procedures and other required submittals, approved or with comments, the duration of which shall be thirty (30) Calendar Days, unless otherwise specified or as approved by the Engineer
7. Interfaces with adjacent work, utility companies, other public agencies, sensitive abutters, and/or any other third party work affecting the Contract
8. The Critical Path, clearly defined and organized
9. Float shall be clearly identified
10. Access Restraints – restrictions on access to areas of the Work that are defined by the Department in the bid package, in Subsection 8.06 – Limitations of Operations or elsewhere in the Contract
11. Milestones listed in Subsection 8.03 - Prosecution of Work or elsewhere in the Contract Documents
12. Subcontractor approvals at fifteen (15) Calendar Days from submittal to response
13. Full Beneficial Use (FBU) Contract Milestone per the requirements of Subsection 8.03 - Prosecution of Work
14. Contractor's request for validation of FBU (ready to open to traffic)
15. The Department's confirmation of completed work to allow for FBU

**SECTION 722 (Continued)**

16. Substantial Completion Contract Milestone per the requirements of Subsections 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
17. Contractor's request for validation of Substantial Completion
18. Punchlist Completion Period of at least thirty (30) Calendar Days per the requirements of Subsections 5.11 - Final Acceptance, 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
19. Contractor confirmation that all punchlist work and documentation has been completed
20. Physical Completion of the Work Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
21. Documentation Completion per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
22. Contractor Field Completion Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
23. Utility work to be performed in accordance with the Project Utility Coordination (PUC) Form as provided in Section 8.14 - Utilities Coordination, Documentation and Monitoring Responsibilities
24. Traffic work zone set-up and removal, night work and phasing
25. Early Utility Relocation (by others) that has been identified in the Contract
26. Right-of-Way (ROW) takings that have been identified in the Contract
27. Material Certifications
28. Work Breakdown Structure in accordance with the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:  
<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>
29. For Type A and B Contracts only: All items to be paid, including all Unit Price and Lump Sum pay items, shall be identified by activity. This shall include all non-construction activities such as engineering work; purchase of permanent materials and equipment, purchase of structural steel stock, equipment procurement, equipment delivery to the site or storage location and the representative amount of overhead/indirect costs that was included in the Contractor's Bid Prices.

**C. EARLY AND LATE DATES**

Early Dates shall be based on proceeding with the Work or a designated part of the Work exactly on the date when the corresponding Contract Time commences. Late Dates shall be based on completing the Work or a designated part of the Work exactly on the corresponding Contract Time, even if the Contractor anticipates early completion.

---

**SECTION 722 (Continued)****D. DURATIONS**

Activity durations shall be in Work Days. Planned Original Durations shall be established with consideration to resources and production rates that correspond to the Contractor's Bid Price. Within all of the Department-required schedules, the Contractor shall plan the Work using durations for all physical construction activities of no less than one (1) Work Day and no greater than fourteen (14) Work Days, unless approved by the Engineer as part of the Baseline Schedule Review.

Should there be an activity with a duration that is determined by the Engineer to be unreasonable, the Contractor will be asked to provide a basis of the duration using bid documents, historic production rates for similar work, or other form of validation that is acceptable to the Engineer. Should the Contractor and the Engineer be unable to agree on reasonable activity durations, the Engineer will, at a minimum, note the disagreement in the Baseline Schedule Review along with a duration the Engineer considers reasonable and the basis for that duration. A schedule that contains a substantial number of activities with durations that are deemed unreasonable by the Engineer will not be accepted.

**E. MATERIALS ON HAND (for Types A and B only)**

The Contractor shall identify in the Baseline Schedule all items of permanent materials (Materials On Hand) for which the Contractor intends to request payment prior to the incorporation of such items into the Work.

**F. ACTIVITY DESCRIPTIONS**

The Contractor shall use activity descriptions in all schedules that clearly describe the work to be performed using a combination of words, structure numbers, station numbers, bid item numbers, work breakdown structure (WBS) and/or elevations in a concise and compact label as specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

**G. ACTIVITY IDENTIFICATION NUMBERS**

The Contractor shall use the activity identification numbering system specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

**H. ACTIVITY CODES**

The Contractor shall use the activity codes specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

**I. CALENDARS**

Different calendars may be created and assigned to all activities or to individual activities. Calendars define the available hours of work in each Calendar Day, holidays and general or project-specific non-Work Days such as Fish Migration Periods, time of year (TOY) restrictions and/or area roadway restrictions.

**SECTION 722 (Continued)**

Examples of special calendars include, but are not limited to:

- Winter Shutdown Period, specific work is required by separate special provision to be performed during the winter. See Special Provision 8.03 (if applicable)
- Peak traffic hours on heavily traveled roadways. This shall be from 6:30 am to 9:30 am and from 3:30 pm to 7:00 pm, unless specified differently elsewhere in the Contract.
- Special requirements by sensitive abutters, railroads, utilities and/or other state agencies as defined in the Contract.
- Cape Cod and the Islands Summer Roadway Work Restrictions: A general restriction against highway and bridge construction is enforced between Memorial Day and Labor Day, unless otherwise directed by the Engineer. Refer to the Project Special Provisions for specific restrictions.
- Cape Ann Summer Roadway Work Restrictions: While there are no general restrictions for Cape Ann as there are for Cape Cod and the Islands, project-specific restrictions may be enforced. Refer to the Project Special Provisions for specific restrictions.
- Turtle and/or Fish Migration Periods and/or other in-water work restrictions: Refer to the Project Special Provisions for specific restrictions.
- Working over Waterways Restricted Periods: Refer to the Project Special Provisions for specific restrictions.
- Night-time paving and striping operations, traffic and temperature restrictions: Refer to the Project Special Provisions for specific restrictions.
- Utility Restrictions shall be as specified within the Contract.

**J. FLOAT**

For the calculation of float in the CPM schedule, the setting for *Retained Logic* is required for all schedule submissions, starting with the Baseline Schedule Submission. Should the Contractor have a reason to propose that an alternative calculation setting such as *Progress Override* be used, the Contractor shall obtain the Engineer's approval prior to modifying to this setting.

**K. COST AND RESOURCE LOADING (Types A and B only)**

For all Type A and B Schedules, the Contractor shall provide a cost and resource-loaded schedule with an accurate allocation of the costs and resources necessary to complete the Work. The costs and resources shall be assigned to all schedule activities in order to enable the Contractor to efficiently execute the Contract requirements and the Engineer to validate the original plan, monitor progress, provide cash flow projections and analyze delays.

1. Each schedule activity shall have an assigned cost that accurately represents the value of the Work. Each schedule activity shall have its resources assigned to it by craft and the anticipated hours to accomplish the work. Each schedule activity's equipment resources shall be assigned to it by equipment type and hours operated. Front-loading or other unbalancing of the cost distribution will not be permitted.
2. The sum of the cost of all schedule activities shall be equal to the Contractor's Bid Price.
3. Indicating the labor hours per individual, per day, by craft and equipment hours/day will be acceptable.



**SECTION 722 (Continued)**

4. The Engineer reserves the right to use the cost-loading as a means to resolve changes, disputes, time entitlement evaluations, increases or decreases in the scope of Work, unit price renegotiations and/or claims.
5. For all Type A and B Schedules, all subnets, fragnets, Proposal Schedules, and Recovery Schedules shall be cost and resource- loaded to help to quickly validate and monitor the duration of the Work to be performed.
6. For Type A Schedules, cost-loading of the schedule will also be used for cash flow projection purposes.
7. The cost-loading of each activity shall indicate the portion of the cost for that activity that is applicable to a specific bid item (cost account.) The total cost for each cost account must equal the bid item price.
8. For Type A Schedules, each month, the Contractor will be paid using the Cost-loaded CPM activities for Lump Sum payment items. This requirement supersedes any requirements elsewhere in this Contract regarding partial payments of schedule-of-values for all Lump Sum items.

**L. NOT TO BE USED IN THE CONTRACTOR'S CPM SCHEDULE**

1. Milestones or constraint dates not specified in the Contract
2. Scheduled work not required for the accomplishment of a Contract Milestone
3. Use of activity durations, logic ties and/or sequences deemed unreasonable by the Engineer
4. Delayed starts of follow-on trades
5. Float suppression techniques

**722.62 Submittal Requirements**

All schedules shall be prepared and submitted in accordance with the requirements listed below.

Each monthly Contract Progress Schedule submittal shall be uniquely identified.

Except as stated elsewhere in this subsection, schedule submittals shall include each of the documents listed below, prepared in two formats, for distribution as follows:

- a. four (4) compact discs (CD); one (1) each for the Office of Project Controls and Performance Oversight (O-PC&PO), the Boston Construction Section Office, the District Construction Office and the Resident Engineer's Office. Additional copies shall be required if the work is performed in more than one district.
- b. two (2) hard copies plotted in color on 24" X 36" paper; one (1) copy each for the District Construction Office and the Resident Engineer's Office. No copies for the O-PC&PO and the Boston Construction Section Office. Additional copies shall be required if the work is performed in more than one district.

**SECTION 722 (Continued)****A. Narratives**

A written narrative shall be submitted with every schedule submittal. The narrative shall:

1. itemize and describe the flow of work for all activities on the Critical Path in a format that includes any changes made to the schedule since the previous Contract Progress Schedule / Monthly Update or the Baseline Schedule, whichever is most recent;
2. provide a description of any specification requirements that are not being followed. Identify those that are improvements and those that are not considered to be meeting the requirements;
3. provide all references to any Notice of Delay that has been issued, within the time period of the Contract Progress Schedule Update, by letter to the Engineer. Note that any Notice of Delay that is not issued by letter will not be recognized by the Engineer. See Subsection 722.64.A - Notice of Delay;
4. provide a description of each third-party utility's planned vs. actual progress and note any that are trending late or are late per the durations and commitments as provided in the PUC Form; provide a description of the five (5) most important responses needed from the Department and the need date for the responses in order to maintain the current Schedule of Record;
5. provide a description of all critical issues that are not within the control of the Contractor or the Department (third party) and any impact they had or may have on the Critical Path;
6. provide a description of any possible considerations to improve the probability of completing the project early or on-time;
7. compare Early and Late Dates for activities on the Critical Path and describe reasons for changes in the top three (3) most critical paths ;
8. describe the Contractor's plan, approach, methodologies and resources to be employed for completing the various operations and elements of the Work for the top three (3) most critical paths. For update schedules, describe and propose changes to those plans and verify that a Proposal Schedule is not required;
9. describe, in general, the need for shifts that are not 5 days/week, 8 hours/day, the holidays that are inserted into each calendar and a tabulation of each calendar that has been used in the schedule;
10. describe any out-of-sequence logic and provide an explanation of why each out-of-sequence activity does not require a correction, if one has not been provided, and an adequate demonstration that these changes represent the basis of how these activities will be built, including considerations for resources, dependencies and previously-approved production rates;
11. identify any possible duration increases resulting from actual or anticipated unit price item quantity overruns as compared to the baseline duration, with a corresponding suggestion to mitigate any possible delays to the Critical Path. If the delay is anticipated to impact the Critical Path, refer to Subsections 4.06 - Increased or Decreased Contract Quantities and 8.10 - Determination and Extension of Contract Time for Completion and submit a letter to the Engineer notifying of a potential delay;
12. include a schedule log consisting of the name of the schedule, the data date and the date submitted.

**SECTION 722 (Continued)****B. Bar Charts (Types A, B, C and D)**

One (1) time-scaled bar chart containing all activities shall be prepared and submitted using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Critical Paths shall be highlighted and Total Float shall be shown for all activities.

A second time-scaled bar chart shall also be prepared containing only the Critical Path or, if the Critical Path is not the longest path, the Longest Path using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Total Float shall be shown for all activities.

Bar Charts shall be printed in color and submitted on 11" X 17" paper or, if approved by the Engineer, as a .pdf file.

**C. Detailed Activity Schedule Comparisons**

A Detailed Activity Schedule Comparison (DASC) is a simple reporting tool in the format of a graphical report that will provide Resident Engineers with immediate, timely and up-to-date information. The DASC consists of an updated bar chart that overlays the current time period's bar chart onto the previous time period's bar chart for an easily-read comparison of progress during the present and previous reporting periods. The DASC shall be prepared and submitted in accordance with the instructions contained in the Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

The reports described in Subsections D, E and F below shall be submitted with all of the schedules listed in Subsection 722.20 - General:

**D. Activity Cost Report and Monthly Cash Flow Projections (Type A only)**

With each Contractor Quantity Estimate (CQE), the Contractor shall submit an Activity Cost Report and Cash Flow Projection that includes all activities grouped by Contract Bid Item.

The Activity Cost Report shall be generated from the Schedule of Record and shall be the basis of the Monthly Cash Flow Projection. Within each contract Bid Item, activities shall be sequenced by ascending activity identification number and shall show:

1. activity ID and description,
2. forecast start and finish dates for each activity and,
3. when submitted as a revised schedule, actual start and finish dates for each completed activity.

For Unit Price pay items, in addition to the above, estimates to complete and any variance to the estimated Contract quantity shall be shown.

**E. Resource Graphs (Type A only)**

Monthly and cumulative resource graphs for the remaining Contract period using the Early Dates and Late Dates in the Contract Progress Schedule shall be included as part of each schedule submittal.

---

**SECTION 722 (Continued)****F. Projected Spending Reports (Types B, C and D)**

A Projected Spending Report (PSR) shall be prepared and submitted in accordance with the instructions listed at the end of this section. The PSR shall indicate the monthly spending (cash flow) projection for each month from NTP to Contractor Field Completion (CFC). Each month's actual spending shall be calculated using all CQEs paid during that month. If the difference between the Contractor's monthly projections vs. the actual spending is greater than 10%, the Contractor's monthly spending projection shall be revised and resubmitted within fifteen (15) Calendar Days.

The Projected Spending Report (PSR) shall be depicted in a tabular format and printed in color on 11 x 17-sized paper or larger as approved by the Engineer. For additional instructions and a template for preparing the Projected Spending Report (PSR), refer to the Contractor's Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit> or consult with the District Construction Scheduler.

**722.63. Progress Schedule Requirements****A. Baseline Schedule**

The Baseline Schedule shall be due thirty (30) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule shall only reflect the Work awarded to the Contractor and shall not include any additional work involving Extra Work Orders or any other type of alleged delay. The Baseline Schedule shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements. Once the Baseline Schedule has been accepted by the Engineer, with or without comments, it shall represent the as-planned schedule for the Work and become the Contract Progress Schedule of Record until such time as the schedule is updated or revised under Subsections 722.63.C - Contract Progress Schedules / Monthly Updates, 722.64.C - Recovery Schedules and 722.64.D - Proposal Schedules.

The Cost and Resource-Loading information (Types A and B only) shall be provided by the Contractor within forty-five (45) Calendar Days after NTP.

The Engineer's review comments on the Baseline Schedule and the Contractor's responses to them will be maintained for the duration of the Contract and will be used by the Engineer to monitor the Contractor's work progress by comparing it to the Contract Progress Schedule / Monthly Update.

**B. Interim Progress-Only Schedule Submissions**

The first monthly update of the Contract Progress Schedule/Monthly Update is due within seventy (70) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule review period ends at sixty (60) Calendar Days after NTP, see Subsection 722.60.B - Schedule Reviews by the Department. If the Baseline Schedule has not been accepted within sixty (60) Calendar Days after NTP, an Interim Progress-Only Schedule shall be due within seventy (70) Calendar Days after NTP. The purpose of the Interim Progress-Only Schedule is to document the actual progress of all activities, including non-construction activities, from NTP until the Baseline Schedule is accepted.

**SECTION 722 (Continued)****C. Contract Progress Schedules / Monthly Updates (Types A, B, C and D)**

The first Contract Progress Schedule shall be submitted by the Contractor no later than seventy (70) Calendar Days after NTP. The data date for this first Progress Schedule shall be sixty (60) Calendar Days after NTP. Subsequent Progress Schedules shall be submitted monthly.

Each Contract Progress Schedule shall reflect progress up to the data date. Updated progress shall be limited to as-built sequencing and as-built dates for completed and in-progress activities. As-built data shall include actual start dates, remaining Work Days and actual finish dates for each activity, but shall not change any activity descriptions, the Original Durations, or the Original Resources (as planned at the time of bid), without the acceptance of the Engineer. If any activities have been completed out-of-sequence, the Contractor shall propose new logic ties for affected in-progress and future activities that accurately reflect the previously-approved sequencing. Alternatively, the Contractor may submit to the Engineer for approval an explanation of why an out-of-sequence activity does not require a correction and an adequate demonstration that the changes accurately represent how the activities will be built, including considerations for resources, dependencies and previously approved production rates. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

No revisions to logic ties; sequence, description or duration of future activities; or planned resource costs shall be made without prior approval by the Engineer.

Any proposed logic changes for in-progress or future activities shall be submitted to the Engineer for approval before being incorporated into a Contract Progress Schedule. The logic changes must be submitted using a Proposal Schedule or a schedule fragnet submission. Once approved by the Engineer, the Contractor may incorporate the logic in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

For any proposed changes to the original sequence, description or duration of future activities, the Contractor shall submit to the Engineer for approval an explanation of how the proposed description or duration change reflects how the activity will be progressed, including considerations for resources and previously approved production rates. Any description or duration change that does not accurately reflect how the activity will be progressed will not be approved by the Engineer. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule if any Contract Progress Schedule/Monthly Update indicates a failure to meet the Contract Dates.

**D. Short-Term Construction Schedule**

The Contractor shall provide a Short-Term Construction Schedule that details daily work activities, including any multiple shift work that the Contractor intends to conduct, in a bar chart format. The daily activities shall directly correspond to the Contract Progress Schedule activities, with a matching reference to the activity identification number in the Contract Progress Schedule, and may be at a greater level of detail.

**SECTION 722 (Continued)**

The Short-Term Construction Schedule shall be submitted every two weeks. It shall display all work for a thirty-five (35) Calendar Day period consisting of completed work for the two (2) week period prior and all planned work for the following three (3) week period. The initial submission shall be provided no later than thirty (30) Calendar Days after NTP or as required by the Engineer.

The Contractor shall be prepared to discuss the Short-Term Construction Schedule, in detail, with the Engineer in order to coordinate field inspection staff requirements, the schedule of work affecting abutters and any corresponding work with affected utilities. Short-Term Construction Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements.

Failure to submit Short-Term Construction Schedules every two (2) weeks may result in withholding of full or partial payments by the Engineer.

**722.64 Impacted Schedule Requirements****A. Notice of Delay**

The Contractor shall notify the Engineer in writing, with copies to the District and State Construction Engineers, within three (3) Calendar Days of the start of any delays to the Critical Path that are caused by actions or inactions that were not within the control of the Contractor. Delay notifications that are not provided in a letter to the Engineer, such as a delay notification in the schedule narrative, will not be recognized as contractual notice in the determination of any Time Extension related to the impacts to the work associated with this specific alleged delay. Should such delay continue for more than one (1) week, the Contractor shall note it in the Schedule Narrative until the delay is no longer impacting the Critical Path for the completion of the Contract Milestones. The Engineer will evaluate the alleged delay and its impact and will respond to the Contractor within ten (10) Calendar Days after receipt of a notice of delay.

**B. Time Entitlement Analysis**

A Time Entitlement Analysis (TEA) shall consist of a descriptive narrative, prepared in accordance with Subsection 722.62.A - Narratives, and an as-built CPM schedule, which may be in the form of a schedule fragnet ( that has been developed from the project's Contract Progress Schedule of Record, and illustrates the impact of a delay to the Critical Path, Contract Milestones and/or Contract Completion Date as required in Subsection 8.10 - Determination and Extension of Contract Time for Completion. TEAs shall also be used to determine the schedule impact of proposed Extra Work Orders (EWO) as also required in Subsection 8.10.

TEAs shall be prepared and submitted in accordance with the requirements of Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements and shall be based on the Contract Progress Schedule of Record applicable at the start of the delay or impact from an EWO. A TEA fragnet must start with a specific new activity describing the work contained in either a Notice of Delay previously submitted to the Department per Subsection 722.64.A - Notice of Delay or an EWO.

**SECTION 722 (Continued)**

TEAs shall be submitted:

1. as part of any Extra Work Order that may impact Contract Time,
2. with a request for a Time Extension,
3. within fourteen (14) Calendar Days after a request for a TEA by the Engineer for any other reason.

A TEA shall be submitted to the Engineer before any Time Extension is granted to the Contractor. Time Extensions will not be granted unless the TEA accurately reflects an evaluation of all past delays and the actual events that occurred that impacted the Critical Path. The TEA must also demonstrate a plan for the efficient completion of all of the remaining work through an optimized CPM Schedule. The analysis shall include all delays, including Contractor-caused delays, and shall be subdivided into timeframes and causes of delays.

TEAs shall incorporate any proposed activities, logic ties, resource considerations, and activity costs required to most efficiently demonstrate the schedule impacts in addition to detailing all impacts to existing activities, logic ties, the Critical Path, Contract Milestones and the Contract Completion Date. In addition, TEAs shall accurately reflect any changes made to activities, logic ties, restraints and activity costs, necessitated by an Extra Work Order or other schedule impact, for the completion of the remaining work. The Contractor shall provide TEAs that demonstrate that all delays have been mitigated to the fullest extent possible without requiring an Equitable Adjustment to the original bid basis.

All TEAs shall clearly indicate any overtime hours, additional shifts and the resource that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts. The Engineer shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions if it is determined to be in the best interest of the Department to do so.

When accepted, the changes included in a TEA shall be incorporated into the next Contract Progress Schedule per the requirements of Subsection 722.63.C - Contract Progress Schedules / Monthly Updates.

During the review of any TEA, all Contract Progress Schedules shall continue to be submitted as required.

The Engineer may request that the Contractor prepare a Proposal Schedule or a Recovery Schedule to further mitigate any delays that are shown in the accepted TEA/Contract Progress Schedule.

**C. Recovery Schedules**

The Contractor shall promptly report to the Engineer all schedule delays during the prosecution of the Work. Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule within fourteen (14) Calendar Days of a Contract Progress Schedule submission that shows failure to meet the Contract Dates. This requirement is critical to the Department's ability to make informed decisions regarding Contract Time and costs.

**SECTION 722 (Continued)**

During the prosecution of the Work, should the Contractor's progress on a critical operation clearly not meet anticipated production, without cause by fault of the Department, or should a critical activity or series of activities not be staffed in accordance with the Contractor's approved Baseline Schedule resource planning, the Contractor shall be obligated to recover such delay. Recovery Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements within fourteen (14) Calendar Days of any of the cases listed above.

Recovery Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in to the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts and shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions, without additional compensation for any Contractor delays, if it is determined to be in the best interest of the Department to do so.

During the review of any Recovery Schedule, all Contract Progress Schedules shall continue to be required every month.

The Engineer may request that the Contractor prepare a Recovery Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

Changes represented in accepted Recovery Schedules shall be incorporated into the next Contract Progress Schedule.

**D. Proposal Schedules**

A Proposal Schedule is an alternative schedule used to evaluate proposed changes to the Contract scope or significant alternatives to previously approved approaches to complete the Work, which may include changes to activity durations, logic and sequence. For Types A and B Schedules, the Proposal Schedule shall be cost and resource-loaded.

A Proposal Schedule may be requested by the Department at any time or may be offered by the Contractor. The Engineer may request that the Contractor prepare a Proposal Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

The Contractor shall submit the Proposal Schedule within thirty (30) Calendar Days of a request from the Department.

The Proposal Schedule shall not be considered a Schedule of Record until the logic, durations, narrative and basis of the Proposal Schedule have been accepted by the Engineer. If the Proposal Schedule took the form of a fragnet, it must be incorporated into the Contract Progress Schedule of Record showing the current progress of all other activities and the impacts/results of the changes made by the Proposal Schedule before the Proposal Schedule is accepted by the Department.

Proposal Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts.

Changes represented in accepted Proposal Schedules shall be incorporated into the next Contract Progress Schedule. During the review of any Proposal Schedule, all Contract Progress Schedules shall continue to be required every month.



**SECTION 722 (Continued)****E. Disputes (Types A, B, C and D)**

All schedules shall be submitted, reviewed, dispositioned and accepted in the timely manner specified herein so as to provide the greatest possible benefit to the execution of this Contract.

Any dispute concerning the acceptance of a schedule or any other question of fact arising under this subsection shall be determined by the Engineer. Pending resolution of any dispute, the last schedule accepted by the Engineer will remain the Contract Schedule of Record.

**COMPENSATION****722.80 Method of Measurement and Basis of Payment (Types A, B, C and D)**

The Special Provisions will specify the fixed-price amount to be paid to the Contractor for the Project Schedule requirements contained herein. Each bidder shall include this lump-sum, fixed-price bid item amount in his/her bid. Failure to do so may be grounds for the rejection of the bid.

All required schedule-related work, including, but not limited to computers, computer software, the planning and coordination with utilities, training, schedule preparation and schedule submittals will be paid for under the fixed price amount.

This fixed price amount is for payment purposes only and is separate from what the Department considers to be the Contractor's General Condition costs. If the Contractor deems it necessary to include additional costs to provide all of the requirements of this section, these additional costs shall be included in the Contractor's overall bid price.

Twenty percent (20%) of this pay item will be paid upon the Engineer's acceptance of the Contractor's Baseline Schedule, prepared and submitted in accordance with Subsection 722.63.A.

The remaining eighty percent (80%) of this pay item will be paid in equal monthly installments distributed across the Contract Duration from Notice to Proceed (NTP) to Contractor Field Completion (CFC), less the 2 months required for the submittal and review of the Baseline Schedule in accordance with the following formula:

$$\text{Monthly Payment} = \frac{\text{Remaining Fixed Price amount (80\% of Item 100.)}}{\text{Contract Duration in whole months} - 2 \text{ months}}$$

The timely and accurate submission of the Baseline Schedule is critical to the Contract and the Department's ability to make informed decisions. Only payments under Item 740 - Engineer's Field Office and Item 748 - Mobilization will be made until the Baseline Schedule is accepted by the Engineer.

**SECTION 722 (Continued)**

No payment for any other pay item will be processed beyond seventy-five (75) Calendar Days from Notice to Proceed (NTP) until the Baseline Schedule is accepted by the Engineer. Until the Engineer's acceptance of the Baseline Schedule, the combined total of all payments made to the Contractor will be limited to an amount no greater than the total price for Item 748 - Mobilization or 3% of the contract price, whichever is less.

All Contract Progress Schedule Updates submitted later than ten (10) Calendar Days after the CQE (Contract Quantity Estimate) completion date, or greater than forty (40) Calendar Days from the Data Date of the previous submission, will be deemed to be no longer useful and will not qualify for payment. Late submittal of missed Contract Progress Monthly Updates will not result in recovery of the previously forfeited portion of the Schedule of Operations Fixed Price Payment Item.

Failure to submit schedules as and when required may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

Failure to submit schedules that are acceptable to the Engineer may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

The Schedule of Operations pay item will be adjusted to pay for only the actual quantity of schedules that have been submitted in accordance with this section.

The Contractor's failure or refusal to comply with the requirements of this Section shall be reasonable evidence that the Contractor is not prosecuting the Work with due diligence and may result in the withholding of full or partial payments by the Engineer.

Should there be a Time Extension granted to the Contractor, the Engineer may provide an Equitable Adjustment for additional Contract Progress Schedule Updates at intervals directed by the Engineer. Item 100. will be the basis for this Equitable Adjustment.

**722.82 Payment Items**

100. SCHEDULE OF OPERATIONS - FIXED PRICE \$ \_\_\_\_\_ LUMP SUM

**ITEM 120.1**

**UNCLASSIFIED EXCAVATION**

**CUBIC YARD**

The work under this Item shall conform to the relevant provisions of Subsection 120 of the Standard Specifications and the following: The work shall consist of removal and satisfactory disposal of excavated material at the bridge approaches. This work includes excavation required during reconstruction of backwalls and joints and, if required, the removal of the existing abutment joint protective course, which could be made up of HMA or concrete.

Prior to excavation, the Contractor shall cover all drainage structures that may be affected by the work. The structures shall remain covered until the new concrete has set and the area has been cleaned.

The edges of the limit of the excavation shall be cut to neat lines by saw cutting or by methods approved by the Engineer, to a minimum depth of 2 inch, and all costs in connection with such work shall be considered as incidental under this Item.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 120.1 will be measured and paid per Subsections 120.80 and 120.81, respectively.

No separate payment will be made for sawcutting, but all costs in connection therewith shall be included in the Contract unit price bid.

Pavement removed within the excavated area shall be measured for payment under this Item. The Contractor will not be compensated for removing the paved surface of the excavated area under Item 129.6.

---

<b><u>ITEM 127.1</u></b>	<b><u>REINFORCED CONCRETE EXCAVATION</u></b>	<b><u>CUBIC YARD</u></b>
<b><u>ITEM 127.4</u></b>	<b><u>REINFORCED CONCRETE DECK EXCAVATION (FULL DEPTH)</u></b>	<b><u>SQUARE YARD</u></b>
<b><u>ITEM 127.41</u></b>	<b><u>REINFORCED CONCRETE DECK EXCAVATION (PARTIAL DEPTH)</u></b>	<b><u>CUBIC YARD</u></b>

The Work under these Items shall conform to the relevant Provisions of Subsection 120 of the Standard Specifications and shall consist of full and/or partial depth removal and satisfactory disposal of all disintegrated or otherwise unsatisfactory reinforced concrete from the bridge deck, parapet, coping, diaphragms, etc. where and as directed by the Engineer.

Prior to excavation, the Contractor shall cover all drainage structures that may be affected by the work. The structures shall remain covered until the new concrete has set and the area has been cleaned.

The edges of all areas where concrete is removed under Items 127.1, 127.4 and 127.41 shall be cut to neat lines by saw cutting or by methods approved by the Engineer, to a minimum depth of 1 inch, and all costs in connection with such work shall be considered as incidental under these Items. Patch areas shall be made rectangular in shape, if possible, with horizontal and vertical edges and square corners.

Minimum depth of all cement concrete areas to be excavated shall be one (1) inch below the bottom of the top layer of longitudinal reinforcing steel throughout the entire excavated area. No concrete shall be placed until approval of the Engineer is given.

The cost for the removal of hot mix asphalt and any membrane waterproofing above the area of reinforced concrete excavation shall be incidental to Items 127.4 and 127.41.

Surface preparation and concrete removal equipment shall be of the following types:

- (1) Pneumatic and Power Driven Chipping Hammers: In no event shall any pneumatic or power hammer weighing in excess of thirty-five (35) pounds be used for the removal of concrete. The Contractor will be restricted to a fifteen (15) pounds Chipping Hammers when work involves repairs to slabs of prestressed concrete adjacent deck or box beams.
- (2) Abrasive Blasting Equipment: Abrasive Blasting equipment shall be capable of removing rust and old concrete from exposed reinforcing steel when deemed necessary by the Engineer.

During the prosecution of this work, the Engineer may reject the use of any method or equipment which causes undue vibration or possible damage to the structure or any part thereof.

**ITEMS 127.1, 127.4, AND 127.41** (Continued)

Bobcats/Skid Steers will be allowed only to collect debris from the deck surface and will not be allowed to remove concrete from the patch area. All concrete debris shall be removed by hand or by using hand tools. The smaller pieces may be blown out using an oil free air compressor after first being wetted with water to control airborne particulates.

The Contractor shall take all precautions necessary so as not to damage that portion of the deck including reinforcing steel which is to remain. This includes determining the concrete cover to the steel bars at the edge of each patch prior to excavating concrete. Also included under these Items are all costs in connection with the cleaning, cutting, and bending of the existing reinforcing steel designated to be retained in the proposed construction. Any existing reinforcing steel damaged or otherwise made unsatisfactory for continued use as a result of the Contractor's operations shall be replaced at the Contractor's expense. Any reinforcing steel that is unsuitable for further use through no fault of the Contractor shall be replaced under Item 910.1, Steel Reinforcement for Structures – Epoxy Coated. All reinforcing steel that is loose shall be tied tightly together using wire ties. Ties are required at every other intersection of transverse and longitudinal reinforcing.

Temporary Protective Shielding must be used on bridges over the roadway during full depth excavation and when, in the opinion of the Engineer, there is the possibility of dislodging concrete from the bottom of the deck.

No debris, tools or incidental equipment of any kind will be permitted to fall into areas where vehicular or pedestrian traffic exists. Any material that accidentally falls into such areas shall be removed immediately.

**METHOD OF MEASUREMENT**

Items 127.1 and 127.41 will be measured for payment by the Cubic Yard.

Item 127.4 will be measured for payment by the Square Yard.

**BASIS OF PAYMENT**

Items 127.1 and 127.41 will be paid at the at the respective Contract unit price per Cubic Yard. Item 127.4 will be paid at the Contract unit price per Square Yard.

The price shall include all labor, materials, equipment, sawcutting, removal of any bituminous concrete and waterproof membrane, and all incidental costs required to complete the work.

The Contractor will be compensated under either Item 127.1, 127.4 or 127.41 for excavated concrete. In no case will the Contractor be compensated under more than one Item for the same excavated material.

Payment for temporary protective shielding will be made under Item 994.1, "Temporary Protective Shielding" and Item 994.12 "Temporary Protective Shielding Removed and Reset".

**ITEM 129.6****BRIDGE PAVEMENT EXCAVATION****SQUARE YARD**

The work to be done under this item shall conform to the relevant provisions of Subsections 120 and 415 of the Standard Specifications and the following:

The work to be done under this item consists of the excavation of the entire bridge deck pavement from the riding surface down to and including the waterproofing membrane. The existing pavement may be HMA, cement concrete patches, or a combination of both. The contractor is responsible for examining the condition of each bridge deck to determine the effort required.

It is expected that a combination of milling and mechanical methods will be required. All excavation methods are subject to the pre-approval of the Engineer. In order to minimize the dynamic loading on the bridge deck, the milling machinery shall not travel more than 30 feet per minute when removing the existing bridge pavement.

The Contractor shall submit for the Engineer's approval the cut sheet of the milling machine for removing pavement from the bridge decks. At minimum, the cut sheet shall have operation weight, track width and length, and the distance between the center of the front and rear tracks. The contractor may be required to provide additional measures to reduce the weight of the milling machine and the loading on the bridge during milling operation.

The thickness of the existing bridge pavement may vary and the Contractor is responsible for examining the condition of each bridge deck to determine the effort required.

Regardless of the milling and/or mechanical methods used, the ridge to valley depth shall not exceed 3/16 inch. The surface shall be trimmed free of rough spots, projections, and defects. Any areas that exceed the 3/16 inch ridge to valley measurement shall be repaired with a method approved by the Engineer at no additional cost.

**Method of Measurement and Basis of Payment**

Item 129.6 will be measured and paid per Subsections 415.80 and 415.81, respectively.

**ITEM 221.1**

**FRAME AND COVER - SECURED**

**EACH**

The work under this Item shall conform to the relevant provisions of Subsection 201, 220 and the following:

The work to be done under this Item consists of the furnishing and delivering Frame and Cover – Secured to the site as shown on the Plans, and as directed by the Engineer.

Frame and Cover - Secured assemblies shall consist of covers and frames that conform to the nominal size, weight, material and load-carrying requirements in MassDOT Construction Standard Details E 202.6.0, E 202.7.0 and E 202.8.0, and are on the relevant MassDOT Qualified Construction Materials list. Some dimensions of secured manhole covers and frames may vary slightly from those shown on the standard details to account for necessary fastening components. The Contractor shall submit shop drawings of all drainage castings for approval prior to ordering.

Covers and frames shall be held securely together by bolting to threaded holes in the frame or to nuts or tumbler devices secured by the frame, by use of hooks attached to the cover or by any other means approved by MassDOT, to prevent being dislodged under traffic loading. Gaskets and other sealing devices will not be allowed.

**Method of Measurement**

Item 221.1 will be measured per EACH Frame and Cover – Secured furnished and delivered to the site.

**Basis of Payment**

Item 221.1 will be paid for at the contract unit price EACH Frame and Cover – Secured furnished and delivered.

**ITEM 450.16****ULTRATHIN BONDED OVERLAY -  
POLYMER (UTBO - P)****SQUARE YARD****General**

Work under this item shall be subject to the provisions of Subsection 450 Hot Mix Asphalt Pavement, as modified below. The asphalt binder content of the HMA-UTBO-P and emulsion tack coat shall be subject to the period price adjustments. Period prices for liquid asphalt are located on the MassDOT- Highway Division website referenced in the “Notice to Contractors” document.

The UTBO-P will use a polymer modified binder (PG64E-28).

The UTBO-P pavement will utilize a warm polymer modified asphalt emulsion tack coat followed immediately with placement of the UTBO-P mixture. The tack coat is spray applied immediately prior to the application of the UTBO-P mixture to produce a durable pavement surface that can be opened to traffic. This contract shall require a minimum thickness of 3/4”.

The Contractor will receive no additional compensation for the actual quantity of HMA (UTBO-P) produced and placed other than the contract unit price per square yard of in-place mixture. The Contractor shall be responsible for submitting the yield and tack coat usage on a daily basis.

The existing pavement will be crack sealed prior to placement of the HMA-UTBO-P to prevent emulsion from entering open cracks.

**Materials**

The contractor shall develop and submit to the Engineer, a Laboratory Trial Mix Formula (LTMF) for each UTBO-P Mixture meeting the requirements below. The use of recycled asphalt pavement materials, including RAP, MAS, and RAS shall not be permitted in the UTBO mixtures under this demonstration project.

\*Note: All aggregate percentages are based on the total weight of the aggregate.



**ITEM 450.16** (Continued)**Mixture Requirements - Item 450.16 UTBO- P**

The Item 450.16 UTBO –P mixture shall meet the following requirements:

**Table 1C–UTBO-P Mixture Requirements:**

AASHTO Sieve Size	Total % Passing by Weight
¾"	100
½"	92-100
3/8"	55-90
#4	24-41
#8	21-33
#16	15-26
#30	11-20
#50	8-16
#100	5-10
#200	4-7
% PGAB	4.8 – 5.2
Binder	PG 64E-28

\*Note: All aggregate percentages are based on the total weight of the aggregate.

**Binder Requirements - Item 450.16 UTBO – P**

A PGAB binder grade of PG64E-28 shall be used for this Item. The PG64E-28 shall be graded in accordance with AASHTO MP19. The binder shall be modified using a Warm-Mix Asphalt (WMA) additive. The WMA additive shall be a product listed on the Northeast Asphalt User Producer Group (NEAUPG) website or the WMA additive must be an approved equal. However, no WMA foaming technology will be permitted which requires the mechanical injection of steam or water into the liquid asphalt. The WMA additive must be compatible with polyphosphoric acid modified and polymer modified asphalts and the HMA producer's HMA anti-stripping agents. The WMA additive shall be introduced in accordance with the Manufacturer's dosing rates and approved blending methods. No warm-mix technologies which involve the mechanical injection of water directly into the asphalt will be considered for this project. The WMA Manufacturer shall have an on-site representative at the beginning of paving operations. The WMA Manufacturer's representative shall be available for additional consultation during the remaining WMA production.

**ITEM 450.16** (Continued)**Coarse Aggregate**

Coarse aggregates used shall be from approved sources and shall meet one of the following requirements.

1. Coarse aggregates shall be crushed limestone having an acid insoluble residue content of not less than 20%, excluding particles of chert and similar siliceous rocks.
2. Coarse aggregates shall be crushed dolomite having an acid insoluble residue content of not less than 17%, excluding particles of chert and similar siliceous rocks.
3. Coarse aggregates shall be crushed gravel or blends of two or more of the following types of materials: crushed gravel, limestone, dolomite, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials. These aggregates must meet the following requirements: not less than 20% (by weight with adjustments to equivalent volume for materials of different specific gravities) of the total coarse aggregate particles, (plus 3.2 mm, (1/8”), material), shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

Where coarse aggregates for these mixes are from more than one source or of more than one type of material, they shall be proportioned and blended to provide a uniform mixture.

**Table 2– Coarse Aggregate Properties**

	<b>Test Method Value</b>	<b>Value</b>
LA Abrasion, % loss	AASHTO T96-94	30 max
Soundness, % loss Magnesium Sulfate or Sodium Sulfate	AASHTO T104-94	18 max 12 max
Flat and Elongated Ratio, % @ 5:1	ASTM D-4791	10 max
% Crushed, single face	ASTM D-5821	95 min
% Crushed, two or more crushed faces	ASTM D-5821	85 min
Cleanliness (% passing 0.60 mm, (#30))	ASTM D-142	2 max
Resistance to stripping*	ASTM D-3625	80 min **

\* Where “G” is the smallest square opening through which the particle can pass and “E” is the smallest slot through which the particle can pass.

\*\* Anti-Stripping agents may be required to provide resistance to stripping.

**Fine Aggregate**

The fine aggregate shall have a minimum sand equivalent of 60, (ASTM D2419). The fine aggregate shall be 100% crushed.

**ITEM 450.16** (Continued)**Mineral Filler**

Hydrated lime, fly ash, baghouse fines and cement are acceptable as mineral filler.

Typical acceptable gradation:           100% passing #30  
   75-100% passing #200

**Tack Coat**

Use grade CRS-2 asphalt emulsion meeting the requirements of Table 3 below.

**Table 3 – Tack Coat Material Properties**

Property	Method	Minimum	Maximum
Elastic Recovery, % at 25 degrees C	AASHTO T301	65	
Penetration of Residue at 25 degrees C, 100g., 5 sec.	AASHTO T49	60	150
Residue by Distillation, %	AASHTO T59	63	

**Paver Equipment**

The equipment used for this placement shall be a self-priming paver manufactured for said purpose. The tack coat application system shall have a metering system with integrated ground-speed controls that adjust application rates based on paving speed and screed width. The self-priming paver must be capable of spraying the tack coat, applying the UTBO-P mixture, and smoothing the surface of the mat in one pass. The self-priming paver must incorporate a receiving hopper, feed conveyor, insulated storage tank for emulsion, metered tack coat spray bar and a variable width, heated, ironing type screed. The metered tack coat spray bar must adjust automatically to the full-width of the screed. The screed must have the ability to be crowned at the center both positively and negatively and have vertically adjustable extensions to accommodate the desired pavement profile.

**Compaction Equipment**

Use steel wheeled double drum rollers weighing at 10 tons that are equipped with functioning water systems and scrapers to prevent the fresh mix from adhering to the roller drums.

**Surface Preparation**

All surface preparations shall be completed prior to applying the UTBO-P mixture.

Cover all manhole covers, water boxes, catch basins and other such utility structures with plastic or building felt. Reference each for location and adjustment after paving

Remove all thermoplastic traffic markings.

**ITEM 450.16** (Continued)

Clean and flush fill all cracks and joints greater than 1/4", wide with rubberized asphalt crack sealant meeting the requirements of ASTM 3405. Equipment used for blowing cleaning, drying and heating sidewalls of cracks and joints shall be a hot compressed air (H.C.A.) lance capable of producing a flame retarded air stream at a minimum temperature of 2500°F.

Thoroughly clean the entire area to be overlaid. Pressurized water and/or vacuum may be required.

Remove all standing water. A damp surface is acceptable if favorable weather conditions are expected during paving operations.

**Tack Coat Application**

The minimum pavement surface temperature for application of the tack coat and placement of the UTBO mixture is 50° F.

Apply the tack coat at a temperature of 140° - 160° F. Provide a uniform application across the entire width to be overlaid, at a rate of 0.18 - 0.22 gallons per square yard. Continuously monitor the rate of spray.

No equipment shall come in contact with the tack coat before the UTBO mixture is applied.

Immediately after applying the tack coat, apply the UTBO mixture across the full width of the tack coat at a temperature of 300° - 325° F.

**Compaction**

Begin compaction immediately after the application of UTBO mixture. Use a minimum of two passes. The roller(s) will not be allowed to stop on the freshly placed UTBO mixture. Use an adequate number of rollers to complete compaction before the pavement temperature falls below 185° F. Protect the UTBO mixture from traffic until the rolling operation is complete and the material has cooled sufficiently to resist damage.

**Contractor Quality Control**

The Contractor shall provide a Quality Control (QC) system in accordance with the provisions of Subsection 450 Hot Mix Asphalt, as modified below. All UTBO mixtures shall be evaluated as Category A Lots as defined in Subsection 450.30.

**Contractor Quality Control Plan**

The QC system shall be detailed in a Quality Control Plan (QC Plan) for "Pavement Preservation Treatments" that addresses QC personnel, QC laboratory facilities, QC inspection, QC testing, data analysis, corrective action (when necessary), and documentation. The QC Plan shall conform to the requirements in Subsection 450.61 for submittal, format, contents, and approval. The scope of the QC Plan shall include the following items: Micromilling, HMA Patching, Hot Applied Asphaltic Crack Sealer, HMA Leveling Course, HMA UTBO Mixtures

**ITEM 450.16** (Continued)

**Quality Control Personnel Requirements**

The Contractor shall provide the QC personnel required by Subsection 450.62.

**Quality Control Laboratory Facility Requirements**

The Contractor shall provide the QC laboratory facilities required by Subsection 450.63.

**Quality Control Inspection**

The Contractor shall perform Quality Control inspection of the HMA-UTBO-P mixtures in accordance with the requirements of Subsection 450.64, as amended herein.

Quality Control inspection of HMA for Patching shall be performed in accordance with the requirements of Subsection 450.53 and Table 450.6.

Quality Control inspection of the tack coat for HMA-UTBO-P mixtures shall be performed in accordance with the requirements of Table 450.25 below.

**Table 450.25 - Minimum QC Inspection of Tack Coat for HMA-UTBO-P Mixtures**

Inspection Component	Attributes Inspected	Minimum Inspection Frequency	Point of Inspection	Inspection Method
Equipment	As specified in QC Plan	Per QC Plan	Per QC Plan	Per QC Plan
Environmental Conditions	Underlying Surface Cleanliness & Moisture	Per QC Plan	Underlying Surface	Visual Check
	Temperature of Air & Underlying Surface	1 per Day <sup>(2)</sup>	At Paving Site	Check Measurement
Materials	Asphalt Emulsion (Correct Type)	Per QC Plan	Per QC Plan	Check Manufacturer COC
	Asphalt Emulsion Temperature	(See Note 1)	From Tack Distributor System	Check Measurement
Workmanship	Asphalt Emulsion Application Rate	(See Note 1)	From Tack Distributor System	Check Measurement

1. The Asphalt Emulsion Temperature and Application Rate shall be checked as follows:
  - Upon delivery of a new load of Asphalt Emulsion to the paver.
  - After application of the first 1,000 lane-feet (300 lane-meters) of HMA-UTBO-P mixture.
  - After application of the next 1,500 lane-feet (450 lane-meters) of HMA-UTBO-P mixture.
  - After application of the next 2,500 lane-feet (750 lane-meters) of HMA-UTBO-P mixture.
  - Thereafter, a minimum of once per 5,000 lane-feet (1500 lane-meters) each day.
2. As a minimum, the temperature measurements of the air and underlying surface shall be obtained prior to starting the tack coat placement.

**ITEM 450.16** (Continued)

The Contractor's QC personnel will perform Quality Control inspection at both the HMA-UTBO-P production facility and at the site of HMA-UTBO-P field placement to ensure that the production and placement processes are providing work conforming to the contract requirements.

The minimum items to be inspected for each HMA-UTBO-P Lot shall be in accordance with the requirements of Subsection 450.54 thru Subsection 450.59 and as outlined in Table 450.26 and Table 450.27 below.

**Table 450.26 - Minimum QC Inspection at HMA-UTBO-P Production Facility**

<b>Inspection Component</b>	<b>Attributes Inspected</b>	<b>Minimum Inspection Frequency</b>	<b>Point of Inspection</b>	<b>Inspection Method</b>
Equipment	As specified in QC Plan	Per QC Plan	Per QC Plan	Per QC Plan
Environmental Conditions	Stockpile Moisture	Per QC Plan	HMA Production Facility	Visual Check
	Air Temperature & Precipitation Forecast	1 per Day <sup>(2)</sup>	HMA Production Facility	Check Measurement
Materials	PG Binder (Correct Type)	Per QC Plan	HMA Production Facility	Visual Check + Manufacturer COC
	Aggregates (Correct Type)	Per QC Plan	HMA Production Facility	Visual Check
	Release Agent	Per QC Plan	Haul Vehicle Bed at Plant	Check QPL + Visual Check + Manufacturer COC
	Temperature of HMA Mix at Plant	4 per Day <sup>(1)</sup>	From Haul Vehicle at Plant	Check Measurement
Workmanship	Uncoated Mixture	Per QC Plan	HMA Production Facility	Visual Check
	Excess Blue Smoke or Moisture	Per QC Plan	HMA Production Facility	Visual Check
	Burnt Mix	Per QC Plan	HMA Production Facility	Visual Check
	Physical Segregation	Per QC Plan	HMA Production Facility	Visual Check

(1) The initial temperature measurements shall be taken from the first or second load.

(2) As a minimum, the air temperature measurements and precipitation forecast shall be obtained prior to starting the HMA Plant operation.

**ITEM 450.16** (Continued)**Table 450.27 - Minimum QC Inspection at HMA-UTBO-P Placement Location**

<b>Inspection Component</b>	<b>Attributes Inspected</b>	<b>Minimum Inspection Frequency</b>	<b>Point of Inspection</b>	<b>Inspection Method</b>
Equipment	As specified in QC Plan	Per QC Plan	Per QC Plan	Per QC Plan
Environmental Conditions	Underlying Surface Soundness & Moisture	Per QC Plan	Underlying Surface	Visual Check
	Temperature of Air & Underlying Surface	1 per Day <sup>(2)</sup>	At Paving Site Check	Check Measurement
Materials	Temperature of Delivered HMA Mix	4 per Day <sup>(1)</sup>	From Haul Vehicle or Paver Hopper	Check Measurement
Workmanship	Joint Location & Alignment	Per QC Plan	Per QC Plan	Visual Check
	Sawcut Joint Vertical Face	Per QC Plan	Joint Vertical Face	Visual Check
	Temperature Differential in HMA Mat	Once per 500 feet (150 meters) per pavement course	HMA Mat Behind Paver	Per Subsection 450.55C
	Physical Segregation	Per QC Plan	HMA Mat Behind Paver & Compacted HMA	Visual Check
	HMA Lift Thickness	Per QC Plan	HMA Lift	Check Measurement
	Joint Tightness	Per QC Plan	Compacted HMA	Visual Check
	Joint Surface Deviations	Once per 500 feet (150 meters) per joint	At Finished Joint	10 foot (3 meter) standard straightedge
	Wheel Path Deviations	Once per 2,000 ft (600 meters) per Wheel Path	Wheel Path	10 foot (3 meter) standard straightedge

(1) The initial temperature measurements will be taken from the first or second load.

(2) As a minimum, the temperature measurements of the air and underlying surface shall be obtained prior to starting the HMA placement.

**ITEM 450.16** (Continued)**Quality Control Sampling and Testing Requirements**

The Contractor shall perform Quality Control sampling and testing of the HMA-UTBO-P mixtures in accordance with the requirements of Subsection 450.65, as amended herein.

Quality Control sampling and testing of HMA for Patching shall be performed in accordance with the requirements of Table 450.9.

The Contractor's QC personnel will perform Quality Control sampling and testing at both the HMA-UTBO-P production facility and at the site of HMA-UTBO-P field placement to ensure that the production and placement processes are providing work conforming to the contract requirements. All QC sampling and testing shall be in accordance with the AASHTO, ASTM, NETTCP, or Department procedures specified in Table 450.28 below. The Contractor shall furnish approved containers for all material samples. The Engineer shall be provided the opportunity to monitor and witness all QC sampling and testing.

**Table 450.28 - Minimum Quality Control Sampling & Testing of HMA Lots**

<b>Quality Characteristic</b>	<b>Test Method(s)</b>	<b>Sublot Size</b>	<b>Minimum Test Frequency</b>	<b>Point of Sampling</b>	<b>Sampling Method</b>
PG Asphalt Binder Grading	AASHTO M320	Per Supplier QC Plan or 12,000 tons (11,000 Mg) of HMA-UTBO-P per Subsection 450.65F(1)	See Subsection 450.65F(1)	See Subsection 450.65F(1)	Random AASHTO T40
Aggregate Gradation	AASHTO T27	Per QC Plan	Per QC Plan	At HMA Plant Per QC Plan	Random AASHTO T2
PG Asphalt Binder Content	AASHTO T164 or AASHTO T308	300 tons (275 Mg)	1 per Sublot <sup>(1)</sup>	From Haul Vehicle at Plant	Random AASHTO T168
Combined Aggregate Gradation	AASHTO T30	300 tons (275 Mg)	1 per Sublot <sup>(1)</sup>	From Haul Vehicle at Plant	Random AASHTO T168
Ride Quality (IRI)	AASHTO PP52 Per Subsection 450.65F(11)	0.1 miles (160 meters) per each Wheel Path	3 Runs per Sublot	Each Pavement Course Per Subsection 450.65F(11)	Random Per Subsection 450.65F(11)

(1) In the event that the total daily HMA production is less than one Sublot, a minimum of one random QC sample shall be obtained for the day's production.



**ITEM 450.16** (Continued)**HMA Mix Design Verification and Control Strip Requirements**

For each HMA-UTBO-P mixture, the HMA mix design Verification and Control Strip procedures outlined in Subsection 450.66, as amended herein, shall apply.

**A. Laboratory Verification of HMA-UTBO-P Mix Design**

The Contractor shall develop and submit a Laboratory Trial Mix Formula (LTMF) for each HMA-UTBO-P mixture type a minimum of forty-five (45) days prior to the start of HMA-UTBO-P production. The Contractor shall not proceed to HMA-UTBO-P production for the Control Strip as outlined below until the LTMF is verified by the Department.

**B. HMA Control Strip**

The Contractor shall produce and place a Control Strip Lot for each HMA-UTBO-P mixture type on the first day of HMA-UTBO-P production. The Control Strip will be used to verify that the HMA-UTBO-P can be produced per the LTMF, to establish rolling patterns, and to verify that the equipment and processes for lay-down are capable of providing the HMA-UTBO-P pavement course in conformance with these specifications. The Control Strip Lot shall consist of the first day's production of each HMA-UTBO-P mixture a minimum of 600 tons (550 Mg) of HMA-UTBO-P, but not more than 1,200 tons (1,100 Mg). Each Control Strip will be divided into three (3) equal Sublots. The Contractor and the Department will both perform inspection, sampling, and testing on the Control Strip and evaluate the corresponding data as outlined in Subsection 450.66B, as amended below.

**(1) Control Strip Inspection.**

The Contractor's QC personnel shall perform inspection of each Control Strip Sublot at both the HMA production facility and at the site of HMA field placement. The specific attributes to be inspected for the Control Strip shall include the four primary inspection components (Equipment, Environmental Conditions, Materials, Workmanship) in accordance with the requirements of Table 450.26, Table 450.27 and as specified in the Contractor's approved QC Plan. The Department will also inspect each Control Strip Sublot for the inspection components of Materials and Workmanship.

**(2) Control Strip Sampling and Testing.**

The Contractor and the Department shall independently sample and test the Control Strip Lot for the Quality Characteristics identified in Table 450.29. The Contractor and the Department shall each sample and test each Sublot produced and placed. Each Contractor QC sample and each Agency Acceptance sample shall be randomly obtained from each Sublot in accordance with ASTM D3665 and the prescribed sampling protocols for each Quality Characteristic as outlined in Subsection 450.65F. Split samples shall be retained for each Sublot by both the Contractor and the Department in accordance with Subsection 450.65D.

**(3) Evaluation of Control Strip Inspection Data.**

The Contractor and the Department shall each evaluate their respective Control Strip inspection data against the requirements for Materials and Workmanship specified in Subsection 450.53 thru Subsection 450.58.

**ITEM 450.16** (Continued)

**(4) Evaluation of Control Strip Sampling and Testing Data.**

The Contractor and the Department shall each evaluate their respective individual Sublot test results against the Control Strip Quality Limits in Table 450.29. The Contractor and the Department shall also evaluate the Control Strip Lot Quality Level (PWL) using the Specification Limits in Table 450.29 for those Quality Characteristics subject to Quality Level Analysis. The Contractor’s QC test data shall be combined with the Agency’s Acceptance test data to determine the Lot Quality Level, provided that the QC data is Validated against the Acceptance data in accordance with Subsection 450.77. The Control Strip Lot Quality Level must be 70 PWL or greater.

**Table 450.29 – HMA-UTBO-P Control Strip Quality Limits**

Quality Characteristic	Target	Specification Limits		Engineering Limits		Acceptance Limit
		LSL	USL	LEL	UEL	
PG Asphalt Binder Grading	Per Binder Grade specified	N/A	N/A	Per AASHTO M320	Per AASHTO M320	N/A
PG Asphalt Binder Content	Per LTMF	Target -0.3 %	Target + 0.3 %	Target - 0.4 %	Target + 0.4%	≥ 70 PWL
PG Asphalt Binder Content (UTBO-AR Mix)	Per LTMF	Target - 0.4 %	Target + 0.4 %	Target - 0.6 %	Target + 0.6 %	≥ 70 PWL
Combined Gradation: Passing #4 (4.75mm) and Larger Sieves	Per LTMF	N/A	N/A	Target - 7%	Target + 7%	N/A
Combined Gradation: Passing #8 (2.36mm) Sieve	Per LTMF	N/A	N/A	Target - 5%	Target + 5%	N/A
Combined Gradation: Passing #16 (1.18mm) to #50 (300um) Sieve	Per LTMF	N/A	N/A	Target - 4%	Target + 4%	N/A
Combined Gradation: Passing #100 (150um) Sieve	Per LTMF	N/A	N/A	Target - 3%	Target + 3%	N/A
Combined Gradation: Passing #200 (75um) Sieve	Per LTMF	N/A	N/A	Target - 1.5%	Target + 1.5%	N/A
Ride Quality: Greater than or equal to 55 mph (90 km/hr)	65 in/mile	N/A	85 in/mile	N/A	100 in/mile	≥ 70 PWL

**ITEM 450.16** (Continued)**(5) Verification of Control Strip Lot and LTMF**

In order for a Control Strip Lot and corresponding LTMF to be Verified, the criteria in Subsection 450.66B(5) must be met.

**(6) Acceptance and Payment of Control Strips**

For each Control Strip Lot that has been Verified, payment shall be determined for each individual Quality Characteristic in accordance with the pay adjustment provisions of Subsection 450.66B(6) and Subsection 450.92.

**Quality Control Documentation and Data Evaluation**

The Contractor shall document all QC inspection, sampling and testing and perform evaluation of QC data in accordance with Subsection 450.67.

**Corrective Action**

As part of the Contractor's Quality Control system, the Contractor shall implement corrective action for any part of a Lot that is determined by inspection or testing to not be in conformance with the quality requirements in accordance with Subsection 450.68.

**Quality Control Records System.**

The Contractor shall maintain a QC records system in accordance with Subsection 450.69.

**DEPARTMENT ACCEPTANCE****Acceptance System Approach**

The Engineer's acceptance determination for each HMA-UTBO-P Lot will be based on an evaluation of the Department's Acceptance inspection information and Acceptance testing data in accordance with Subsection 450.71.

Department Monitoring of Contractor Quality Control. The Department will monitor the Contractor's Quality Control system in accordance with Subsection 450.72

**Acceptance Inspection**

The Engineer will perform Acceptance inspection of all work items addressed under Subsection 450 in accordance with Subsection 450.73 to ensure that all materials and completed work are in conformance with the contract requirements.

The Department will perform Acceptance inspection of the prepared underlying surface prior to placement of HMA-UTBO-P. The items to be inspected and minimum frequency of inspection will be in accordance with Subsection 450.73A.

The Department will perform Acceptance inspection at both the HMA production facility and at the site of HMA field placement. For purposes of Acceptance inspection, the total quantity of each HMA-UTBO-P mixture produced and placed during the same construction season will constitute a Lot. Each in-place HMA Lot will be divided into 500 lane-feet (150 lane-meters) Sublots. The items to be inspected and minimum frequency of inspection will be in accordance with the requirements of Subsection 450.73B, Table 450.26 and Table 450.27.

**ITEM 450.16** (Continued)

**Acceptance Sampling and Testing**

The Department will perform sampling and testing of the HMA-UTBO-P mixtures in accordance with the requirements of Subsection 450.74, as amended herein.

Acceptance sampling and testing of HMA for Patching shall be performed in accordance with the requirements of Table 450.9.

The Department will perform Acceptance testing using the random samples obtained in accordance with Subsection 450.74A from the HMA-UTBO-P production facility and at the site of HMA-UTBO-P field placement. The specific Quality Characteristics subject to Department Acceptance testing are identified in Table 450.28. All Acceptance testing of HMA-UTBO-P Lots will be performed by the Engineer in accordance with the AASHTO, ASTM, NETTCP, or Department test methods specified in Subsection 450.74F and Table 450.28.

**Split Sample Correlation**

The Department will perform Split Sample Correlation with the Contractor on samples of the HMA-UTBO-P in accordance with Subsection 450.75.

**Lot Acceptance Determination Based on Inspection Results**

The Department's Acceptance Inspection results will be used in the final acceptance determination for all HMA- UTBO in accordance with Subsection 450.76.

**Lot Acceptance Determination Based on Testing Data.**

The Department's Acceptance testing data will be evaluated for the final acceptance determination for each HMA- UTBO Lot in accordance with Subsection 450.77 and Table 450.30.

**ITEM 450.16** (Continued)**Table 450.30 - Quality Limits for Acceptance of HMA Lots**

Quality Characteristic	Target	Specification Limits		Engineering Limits		Acceptance Limit
		LSL	USL	LEL	UEL	
PG Asphalt Binder Grading	Per Binder Grade specified	N/A	N/A	Per AASHTO M320	Per AASHTO M320	N/A
PG Asphalt Binder Content	Per LTMF	Target - 0.3 %	Target + 0.3 %	Target - 0.4 %	Target + 0.4 %	≥ 60 PWL
PG Asphalt Binder Content (UTBO-AR Mix)	Per LTMF	Target - 0.4 %	Target + 0.4 %	Target - 0.6 %	Target + 0.6 %	≥ 60 PWL
Combined Gradation: Passing #4 (4.75mm) and Larger Sieves	Per LTMF	N/A	N/A	Target - 7%	Target + 7%	N/A
Combined Gradation: Passing #8 (2.36mm) Sieve	Per LTMF	N/A	N/A	Target - 5%	Target + 5%	N/A
Combined Gradation: Passing #16 (1.18mm) to #50 (300um) Sieve	Per LTMF	N/A	N/A	Target - 4%	Target + 4%	N/A
Combined Gradation: Passing #100 (150um) Sieve	Per LTMF	N/A	N/A	Target - 3%	Target + 3%	N/A
Combined Gradation: Passing #200 (75um) Sieve	Per LTMF	N/A	N/A	Target - 1.5%	Target + 1.5%	N/A
Ride Quality: Greater than or equal to 55 mph (90 km/hr)	65 in/mile	N/A	85 in/mile	N/A	100 in/mile	≥ 60 PWL

**ITEM 450.16** (Continued)**450.78 Quality Level Analysis Procedures**

For each HMA-UTBO-P Lot, the Engineer will determine the Lot Quality Level, for the applicable Quality Characteristics in Table 450.30, using the Quality Level Analysis (QLA) procedures outlined in Subsection 450.78.

**Procedures for Dispute Resolution**

The Contractor or the Department may dispute any of the test values that are utilized in the acceptance determination for a given HMA-UTBO-P Lot in accordance with the procedures contained in Subsection 450.80 through Subsection 450.84.

**COMPENSATION**

The asphalt binder content of the HMA-UTBO-P and emulsion tack coat shall be subject to the period price adjustments. Period prices for liquid asphalt are located on the MassDOT- Highway Division website referenced in the “Notice to Contractors” document.

**Method of Measurement**

Item 450.16 will be measured per Square Yard and shall be the actual pavement course quantity complete in place and accepted by the Engineer.

**Basis of Payment**

Item 450.16 will be paid for at the contract unit price per Square Yard of in-place mixture. Payment shall include protection of all utility structures as described above, cleaning the underlying surface via pressurized water and/or vacuum, transportation, delivery, placement, and compaction of each HMA-UTBO-P pavement course in accordance with Subsection 450.54 through Subsection 450.58, as amended herein. All sawcutting required for joints in accordance with Subsection 450.57 shall also be included in the contract unit price for each HMA-UTBO-P pavement course.

**ITEM 450.16** (Continued)**450.92 Pay Adjustment (PA)**

Payment adjustments for each HMA-UTBO-P Lot will be made in accordance with Subsection 450.92, as amended herein. The relative pay adjustment weight assigned to each of the HMA-UTBO-P.

Quality Characteristics is indicated in Table 450.31 below.

**Table 450.31 - Pay Adjustment Weight Assigned to HMA-UTBO-P Quality Characteristics**

HMA Quality Characteristics	Pay Adjustment Weight
PG Asphalt Binder Content	35 percent
Ride Quality (IRI)	65 percent

**Pay Adjustment for PG Asphalt Binder Content**

Pay adjustment for PG Asphalt Binder Content shall be applied to Pay Item 999.490 at the completion of the HMA Lot. The total Lot pay adjustment for PG Asphalt Binder Content will be determined as follows:

$$PA_{PGAB} = \sum(PF_i - 1) (Q_i) (P_i) (0.35)$$

Where:  $PA_{PGAB}$  = Pay adjustment in dollars for PG Asphalt Binder Content.

$PF_i$  = Pay factor based on Quality Level (PWL) of PG Asphalt Binder Content for individual Lot (i).

$Q_i$  = Quantity represented by individual Lot (i) in square yards.

$P_i$  = Contract unit price per square yard for individual Lot (i).

0.35 = Weight given to PG Asphalt Binder Content pay adjustment

**Pay Adjustment for Ride Quality**

Pay adjustment for Ride Quality shall be applied to Pay Item 999.494 at the completion of each HMA-UTBO-P mixture Lot. The pay adjustment will be applied to the total quantity of each HMA-UTBO-P mixture placed. Each wheel path of the final HMA-UTBO-P mixture pavement course represents a Lot for Ride Quality. The total Lot pay adjustment for Ride Quality will be determined as follows:

$$PA_{Ride\ Quality} = \sum (PF_i - 1) (\sum (Q_{pc})(P_{pc}))/N_{wp} (0.65)$$

Where:  $PA_{Ride\ Quality}$  = Pay adjustment in dollars for Ride Quality.

$PF_i$  = Pay factor based on Quality Level (PWL) of Ride Quality for individual Lot (i).

$Q_{pc}$  = Quantity represented by individual pavement course (pc) in square yards.

$P_{pc}$  = Contract unit price per square yard for individual pavement course (pc).

$N_{wp}$  = Total number of wheel paths for all lanes tested.

0.65 = Weight given to Ride Quality pay adjustment.

**ITEM 457.1**

**SUPERPAVE WATERPROOFING SURFACE  
COURSE – 9.5 (SSC-W-9.5)**

**TON**

Work under this Item shall conform to the relevant provisions of SUBSECTION 457 SUPERPAVE WATERPROOFING SURFACE COURSE provided in Document 00714.



**ITEM 482.31****SAWING & SEALING JOINTS IN ASPHALT  
PAVEMENT AT BRIDGES****FOOT**

The work under this Item consists of saw cutting the existing pavement at the bridge to the depth, width and shape shown on the Plans.

Prior to the start of the asphalt pavement operation, the Contractor shall place a mark on each curb or barrier on either side of the paved roadway. These marks shall be aligned with the actual end of the bridge deck and shall be placed so that they will not be covered or otherwise obscured by the asphalt pavement.

After the completion of the paving operation, the Contractor shall snap a straight chalk line on the pavement between these two marks. The Contractor shall then saw cut the pavement along this line to the depth, width and shape shown on the Plans. The equipment shall be approved by the Engineer prior to commencing work.

After completing the saw cutting, the Contractor shall clean the saw groove of any dust and debris with an oil free air blast. If the groove was wet sawn, the groove shall be cleaned with a water blast to remove any remaining slurry and debris, vacuumed with a Wet-or-Dry vacuum to remove any standing water, and then dried with an air blast from a Hot-Air-Lance.

Once the groove is clean and dry, the Contractor shall fill it completely with a hot-applied bituminous crack sealer meeting the requirements of M3.05.4 in accordance with the manufacturer's application instructions and restrictions regarding ambient and material temperatures. The crack sealer shall be thoroughly cured prior to opening the road to traffic. To reduce tackiness, only boiler slag aggregate (black beauty) shall be scattered over the sealer when deemed necessary by the Engineer. Conventional sand shall not be used for this purpose.

**METHOD OF MEASUREMENT**

Item 482.31 will be measured by the foot along the center line of the joint, complete in place.

**BASIS OF PAYMENT**

Item 482.31 will be paid at the contract unit price per foot which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

**ITEM 740. ENGINEERING FIELD OFFICE AND EQUIPMENT – TYPE A MONTH**

The work under this Item shall conform to the relevant provisions of Subsection 740 of the Standard Specifications and the following:

Three computer systems and printer system meeting minimum requirements set forth below including installation, maintenance, power, paper, disks, and other supplies shall be provided at the Resident Engineer's Office:

All equipment shall be UL approved and Energy Star compliant.

The Computer System shall meet the following minimum criteria or better:

Processor:	Intel, 3.5 GHz
System Memory (RAM):	12 GB
Hard Drive:	500 GB
Optical Drive:	DVD-RW/DVD+RW/CD-RW/CD+RW
Graphics Card:	8 GB
Network Adapter:	10/100 Mbit/s
USB Ports:	6 USB 3.0 ports
Keyboard:	Generic
Mouse:	Optical mouse with scroll, MS-Mouse compliant
Video/Audio	the computer system shall be capable of allow video calling and recording:
Video camera	shall be High Definition 1080p widescreen capable video calling and recording with built in microphone. The microphone system shall capture natural audio while filtering out background noise.
Audio	shall be stereo multimedia speaker system delivering premium sound.
OS:	Latest Windows Professional with all security updates
Web Browser:	Latest Internet Explorer with all security updates
Applications:	Latest MS Office Professional with all security updates Latest Adobe Acrobat Professional with all security updates Latest Autodesk AutoCAD LT Antivirus software with all current security updates maintained through the life of the contract.
Monitors:	Two 27" LED with Full HD resolution. Max. resolution 1920 x 1080
Flash drives:	2 (two) - 128GB USB 3.0
Internet access:	High Speed (min. 24 mbps) internet access with wireless router.

**ITEM 740.** (Continued)

The Multifunction Printer System shall meet the following minimum criteria or better:

Color laser printer, fax, scanner, email and copier all in one with the following minimum capabilities:

- Estimated volume 8,000 pages per month
- LCD touch panel display
- 50 page reversing automatic document feeder
- Reduction/enlargement capability
- Ability to copy and print 11" x 17" paper size
- email and network pc connectivity
- Microsoft and Apple compatibility
- ability to overwrite latent images on hard drive
- 600 x 600 dpi capability
- 30 pages per minute print speed (color),
- 4 Paper Trays Standard (RADF) (not including the bypass tray)
- Automatic duplexing
- Finisher with staple functions
- Standard Ethernet. Print Controller
- Scan documents to PDF, PC and USB
- ability to print with authenticated access protection

The Contractor shall supply a maintenance contract for next day service, and all supplies (toner, staples, paper) necessary to meet estimated monthly usage.

The Engineer's Field Office and the equipment included herein including the computer system, and printer shall remain the property of the Contractor at the completion of the project. Disks, flash drives, and card readers with cards shall become the property of the Department.

Compensation for this work will be made at the contract unit price per month which price includes full compensation for all services and equipment, and incidentals necessary to provide equipment, maintenance, insurance as specified and as directed by the Engineer.

**ITEM 767.121****SEDIMENT CONTROL BARRIER****FOOT**

The work under this item shall conform to the relevant provisions of Subsections 670, 751 and 767 of the Standard Specifications and shall include the furnishing and placement of a sediment control barrier. Sediment control barrier shall be installed prior to disturbing upslope soil.

The purpose of the sediment control barrier is to slow runoff velocity and filter suspended sediments from storm water flow. Sediment barrier may be used to contain stockpile sediments, to break slope length, and to slow or prevent upgradient water or water off road surfaces from flowing into a work zone. Contractor shall be responsible for ensuring that barriers fulfill the intent of adequately controlling siltation and runoff.

Twelve-inch diameter (after installation) compost filter tubes with biodegradable natural fabric (i.e., cotton, jute, burlap) are intended to be the primary sedimentation control barrier.

For small areas of disturbance with minimal slope and slope length, the Engineer may approve the following sediment control methods:

- 9-inch compost filter tubes
- Straw bales which shall be trenched

No straw wattles may be used. Additional compost filter tubes (adding depth or height) shall be used at specific locations of concentrated flow such as at gully points, steep slopes, or identified failure points in the sediment capture line.

When required by permits, additional sediment barrier shall be stored on-site for emergency use and replacement for the duration of the contract.

Where shown on the plans or when required by permits, silt fence shall be used in addition to compost filter tubes and straw bales and shall be incidental to the item.

Sediment control barriers shall be installed in the approximate location as shown on the plans and as required so that no excavated or disturbed soil can enter mitigation areas or adjacent wetlands or waterways. Barriers shall be in place prior to excavation work. No work shall take place outside the barriers.

**MATERIALS AND CONSTRUCTION**

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans and adjust placement to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched, and/or wedged as specified herein and according to the Manufacturer's instructions. Barriers shall be securely in contact with existing soil such that there is no flow beneath the barrier.

---

**ITEM 767.121** (Continued)**Compost Filter Tube**

Compost material inside the filter tube shall meet M1.06.0, except for the following: no peat, manure or bio-solids shall be used; no kiln-dried wood or construction debris shall be allowed; material shall pass through a 2-inch sieve; and the C:N ratio shall be disregarded.

Outer tube fabric shall be made of 100% biodegradable materials (i.e., cotton, hemp or jute) and shall have a knitted mesh with openings that allow for sufficient water flow and effective sediment capture.

Tubes shall be tamped, but not trenched, to ensure good contact with soil. When reinforcement is necessary, tubes shall be stacked as shown on the detail plans.

**Straw Bales**

Straw bales shall be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

Bales should be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. All bales should be either wire-bound or string-tied. Straw bales should be installed so that bindings are oriented around the sides (rather than along the tops and bottoms) of the bales in order to prevent deterioration of the bindings.

The barrier should be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material which might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil should be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.

Each bale should be securely anchored by at least 2 stakes or re-bars driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together. Stakes or re-bars should be driven deep enough into the ground to securely anchor the bales. For safety reasons, stakes should not extend above the bales but should be driven in flush with the top of the bale.

The gaps between the bales should be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

When used in a swale, the barrier should be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it.

---

**ITEM 767.121** (Continued)**Silt Fence**

Materials and Installation shall be per Section 670.40 and 670.60 of the Standard Specifications and the following:

Silt fence shall only be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

When used with compost filter tubes, the tube shall be placed on a minimum of 8 inches of folded fabric on the upslope side of the fence. Fabric does not need to be trenched.

When used with straw bales, an 8-inch deep and 4-inch wide trench or V-trench shall be dug on the upslope side of the fence line. One foot of fabric shall be placed in the bottom of the trench followed by backfilling with compacted earth or gravel. Stakes shall be on the down slope side of the trench and shall be spaced such that the fence remains vertical and effective.

Width of fabric shall be sufficient to provide a 36-inch high barrier after fabric is folded or trenched. Sagging fabric will require additional staking or other anchoring.

**MAINTENANCE**

Maintenance of the sediment control barrier shall be per Section 670.60 of the Standard Specifications or per the Stormwater Pollution Prevention Plan (SWPPP), whichever is more restrictive.

The contractor shall inspect the sediment barrier in accordance with relevant permits. At a minimum, barriers shall be inspected at least once every 7 calendar days and after a rain event resulting in 0.25 inches or more of rainfall. Contractor shall be responsible for ensuring that an effective barrier is in place and working effectively for all phases of the Contract.

Barriers that decompose such that they no longer provide the function required shall be repaired or replaced as directed. If the resulting berm of compost within the fabric tube is sufficiently intact and continues to provide effective water and sediment control, barrier does not necessarily require replacement.

**DISMANTLING & REMOVING**

Barriers shall be dismantled and/or removed, as required, when construction work is complete and upslope areas have been permanently stabilized and after receiving permission to do so from the Engineer.

Regardless of site context, nonbiodegradable material and components of the sediment barriers, including photo-biodegradable fabric, plastic netting, nylon twine, and silt fence, shall be removed and disposed off-site by the Contractor.

**ITEM 767.121** (Continued)

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. In urban, residential, or other locations where aesthetics is a concern, the following shall apply:

- Compost filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (as would be done with a soil amendment or mulch). No more than a 2-inch depth shall be left on soil substrate.
- Straw bales shall be removed and disposed off-site by the Contractor. Areas of trenching shall be raked smooth and disturbed soils stabilized with a seed mix matching adjacent seeding or existing grasses (i.e., lawn or native grass mix).
- Silt fence, stakes, and other debris shall be removed and disposed off-site. Site shall be restored to a neat and clean condition.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 767.121 will be measured and paid for at the contract unit price per foot of sediment control barrier which price shall include all labor, equipment, materials, maintenance, dismantling, removal, restoration of soil, and all incidental costs required to complete the work.

Silt fence, when used in conjunction with compost filter tubes or straw bales, will be incidental to this item.

Additional barrier, such as double or triple stacking of compost filter tubes, will be paid for per foot of tube installed.

Barriers that have been driven over or otherwise damaged by construction activities shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

**ITEM 819.907****3 LANE CLASSIFICATION  
TRAFFIC DATA COLLECTION STATION****EACH**

The work under this item shall conform to the relevant provisions of Subsection 800 of the Standard Specifications, Document A00803, and the following:

Work consists of furnishing and installing one (1) new cabinet with one (1) new post mounted **60 Watt** solar panel on a foundation at the specified locations. The existing foundation and pull box may be used in the new installations if deemed to be in acceptable condition by the MassDOT Resident Engineer. Count stations 9 NB, 4010 NB, & 4090 SB are to be moved to the new location for better solar panel sun exposure. Work includes removal and disposal of the foundation at the existing location of count stations 9 NB, 4010 NB, & 4090 SB. The six (6) existing Traffic Data Collection cabinets and associated equipment being removed shall be delivered to the Traffic Counting Section of the Massachusetts Department of Transportation. A dated receipt indicating the MassDOT contract number, the number of cabinets, and the count station numbers shall be supplied at delivery. The contractor and MassDOT Resident Engineer shall ensure that Steven O'Neill is contacted at (857) 368-8919 or at [Steven.D.ONeill@dot.state.ma.us](mailto:Steven.D.ONeill@dot.state.ma.us) two weeks prior to start of any work in the vicinity of the traffic count station, including but not limited to roadway resurfacing or cabinet removal so that the existing cabinet internal data collection equipment can be safely removed and for cabinet delivery arrangements. Steven O'Neill shall be notified of the work schedule of all work associated with the traffic count station so that the MassDOT Traffic Data Collection section has the opportunity to witness any work as deemed necessary including the road sensor installation.

Work at each location includes installing six (6) 6' x 6' loop detectors, six (6) 11 foot class II piezo sensors, lead-in cables, pull box, conduit, and electrical connections as shown on enclosed drawings "Traffic Data Collection Stations", "Typical Loop Wire Installation", and "Loop Detector Construction Details" provided in Document A00803. Piezo installation procedures established by the manufacturer shall be adhered to ensure proper operation. A manufacturer factory representative shall be present to monitor and assist with the piezo installation process. The contractor has full installation responsibility and may install without the manufacturer present if they were previously trained during the current construction season by a manufacturer's representative.

The loop and piezo leads shall go from the pavement edge underground in conduit through the pullbox and end on the terminal strip in the cabinet. There shall be no splices allowed in the piezo sensor leads and no splices in the loop sensor leads. Each sensor shall have a separate flex conduit from the roadway to the pullbox.

The flex conduit shall be a minimum of six (6) inches below ground level including at the road edge. The roadway sensor lead-in wires shall enter the flex conduit via a drilled hole in the pavement. Roadway loop wires and piezos shall be installed in the pavement course below the top wearing surface installation. The timing of the road sensor installation shall be coordinated with the general contractor to occur just prior to the wearing surface installation. If the road sensors are to be installed in the milled surface, the milling should be around 60 feet per minute and the milling adjusted to cut a smooth surface in the sensor area. The road sensors shall not be exposed during the winter months. The loop and piezo lead terminations in the cabinet shall be done promptly after the road sensor installation. Any loop and piezo leads not terminated right away shall have the ends sealed in a watertight enclosure and put on the cabinet shelf (not in the pullbox or on the concrete cabinet base) to ensure that water corrosion does not occur.



**ITEM 819.907** (Continued)

The road sensors are to be installed in a relatively straight and flat roadway section away from any lane changing ramp traffic. The contractor shall verify the top surface lane marking locations with the MassDOT Resident Engineer to ensure that the loop and piezo subsurface roadway sensors will be centered in each lane. The contractor shall carefully measure and record the actual distances between all installed sensors in each lane on the cabinet layout drawing. Each loop and piezo shall be given the number shown on the “Traffic Data Collection Stations” drawing and that number shall be clearly designated on both the terminal board and the cabinet drawing. All loop and piezo testing shall be done both before and after the sensors are covered by the pavement wearing surface. Work shall also include all other items (whether or not specified) necessary to make the installations operate as a classification, volume, and speed data collection station. Traffic recorders are not required for this item as they will be provided and installed by the Traffic Data Collection (TDC) Section of the Massachusetts Department of Transportation. One (1) Backup battery is required for each cabinet per specifications. This work applies to the following six (6) count stations.

CABINET LOCATION: Route I-495 NB in Bolton (Traffic Count Station # 9 NB)

The existing northbound cabinet and foundation being removed is located approximately 13 feet behind the guardrail, 40 feet south of the guardrail end, and 25 feet north of the overhead sign denoting ½ mile to exit 27 for Route 117. GPS coordinates of this location: Latitude – N42.42550947 degrees, Longitude - W071.59670357 degrees.

CABINET LOCATION: Route I-495 NB in Bolton (Traffic Count Station # 9 NB)

The new northbound cabinet and foundation shall be installed approximately 5 feet behind the guardrail, at the guardrail end, and 65 feet north of the overhead sign denoting ½ mile to exit 27 for Route 117. GPS coordinates of this location: Latitude – N42.42561303 degrees, Longitude - W071.59666062 degrees.

CABINET LOCATION: Route I-495 SB in Bolton (Traffic Count Station # 9 SB)

The existing southbound cabinet being replaced is located approximately 15 feet behind the guardrail, 58 feet north of the guardrail end (north of MM 67.6), and 77 feet south of the overhead sign denoting ½ mile to exit 26 for Route 62. GPS coordinates of this location: Latitude – N42.40113443 degrees, Longitude - W071.60853668 degrees.

CABINET LOCATION: Route I-495 NB in Boxborough (Traffic Count Station # 4010 NB)

The existing northbound cabinet and foundation being removed is located approximately 13 feet behind the guardrail, 102 feet south of the guardrail end, and 50 feet north of the overhead sign denoting 1 mile to exit 28 for Route 111. GPS coordinates of this location: Latitude – N42.47554360 degrees, Longitude - W071.55268298 degrees.

CABINET LOCATION: Route I-495 SB in Bolton (Traffic Count Station # 4010 NB)

The new northbound cabinet and foundation shall be installed approximately 5 feet behind the guardrail, and 57 feet south of the overhead sign denoting ½ mile to exit 28 for Route 111. GPS coordinates of this location: Latitude – N42.48146933 degrees, Longitude - W071.54821770 degrees.

**ITEM 819.907** (Continued)**CABINET LOCATION:** Route I-495 SB in Bolton (Traffic Count Station # **4010 SB**)

The existing southbound cabinet being replaced is located approximately 15 feet behind the guardrail, 70 feet north of the guardrail end, and 70 feet south of the overhead sign denoting ½ mile to exit 27 for Route 117. GPS coordinates of this location: Latitude – N42.43708203 degrees, Longitude - W071.59056972 degrees.

**CABINET LOCATION:** Route I-495 NB in Boxborough (Traffic Count Station # **4090 NB**)

The existing northbound cabinet being replaced is located approximately 8 feet behind the guardrail and 121 feet south of the overhead sign denoting the Devins Mohawk Trail – Exit 29B. GPS coordinates of this location: Latitude – N42.50988515 degrees, Longitude - W071.52028858 degrees.

**CABINET LOCATION:** Route I-495 SB in Boxborough (Traffic Count Station # **4090 SB**)

The existing southbound cabinet and foundation being removed is located approximately 5 feet behind the guardrail, 17 feet north of the guardrail end, 5 feet south of MM 76.6, and 6 feet south of the sign denoting Boxboro-5, Worcester-27, Cape Cod-89. (Approx. 0.4 miles south of Littleton town line) GPS coordinates of this location: Latitude – N42.50954570 degrees, Longitude - W071.52206695 degrees.

**CABINET LOCATION:** Route I-495 SB in Boxborough (Traffic Count Station # **4090 SB**)

The new southbound cabinet and foundation shall be installed approximately 5 feet behind the guardrail, 98 feet south of the guardrail start, and 250 feet north of the blue info (gas/food exit 28) sign located approximately 0.1 miles south of MM 75.0. GPS coordinates of this location: Latitude – N42.49017038 degrees, Longitude - W071.54310708 degrees.

**MATERIALS**

The MassDOT Resident Engineer shall consult with the Traffic Data Collection section regarding all count station material (catalog cut) submittal approvals. Disposal of existing equipment if necessary shall be in accordance with Subsection 815.65 of the Standard Specifications.

**PIEZO SENSORS**

The thirty six (36) classification sensors for Item 819.907 (2 per lane) shall be **11-foot length Class II** polymer piezo sensors designed for permanent roadway installation with the system capable of gathering classification, speed, and volume traffic data. The sensor shall be installed directly into the road without an aluminum channel or epoxy encapsulation on the sensor. The Piezo sensor shall be TE Connectivity (formally Measurement Specialties Incorporated - MSI) Roadtrax BL or approved equal. The piezo shall be supplied with 100 feet of transmission cable unless otherwise specified and shall have lightning surge protection. The epoxy grout used to seal the piezo in the road surface slot shall be per piezo manufacturer requirements for the installed roadway surface and for the area climate conditions. The piezo epoxy has a limited shelf life and storage temperature requirements. Expired or improperly stored epoxy does not set properly and will not be allowed on any piezo installations. The sawcut must be clean and dry prior to the piezo and epoxy installation. No splices shall be allowed in the piezo cable. **The Contractor shall adhere to the Piezo installation procedures established by the manufacturer to ensure proper operation. The only allowed deviations from the manufacturer's procedures is installation in the pavement course**

**ITEM 819.907** (Continued)

**below the wearing surface (binder) and being very liberal in spreading the epoxy on each side of the saw cuts in order to prevent water intrusion and to seal the aggregate.** A manufacturer factory representative shall be present to monitor and assist with the piezo installation process. The Contractor has full installation responsibility and may install without the manufacturer present if they were previously trained during the current construction season by a manufacturer representative. Steven O'Neill of the MassDOT Traffic Data Collection section shall be notified at (857) 368-8919 a minimum of two weeks prior to the proposed piezo installation date. TE Connectivity (formally MSI) and two additional piezo vendors can be contacted at the following addresses:

TE Connectivity (MSI) Inc.	Diamond Traffic Products	International Road Dynamics
Sensor Solutions 1050 Westlakes Drive Berwyn, Pa 19312 Phone: (610) 893-9800	76433 Alder Street P.O. Box 1455 Oakridge, OR 97463 Phone: (541) 782-3903 Fax: (541) 782-2053	2402 Spring Ridge Drive Suite E Spring Grove, IL 60081 Phone: (815) 675-1430 Fax (815) 675-1530

**TYPE CB CABINET**

The six (6) furnished new and installed cabinets for item and 819.907 (1 per location/direction) shall be a weatherproof aluminum cabinet identified as type "CB". The cabinet shall be base mounted and bolted to a standard (not core type) cement concrete foundation equipped with a ground rod, all in accordance with the applicable requirements of Subsection 800 of the Standard Specifications. The new cabinet installations shall be secured to the foundation with 4 anchor bolts (3/4" x 15 3/4") instead of the standard 2 bolts to minimize potential damage due to snow being pushed into the cabinet by snowplows. The Contractor shall ensure that the foundation anchor bolts, washers, and nuts are completely installed within the cabinet base slot/hole, fully engaged with the cabinet base, and securely tightened. The cabinet bases and entry conduit shall be sealed against dust and moisture penetration and shall have a weather-stripped door. A clear silicone sealer shall be used at the base of the cabinet to form a water-tight seal with the foundation. The cabinet shall not have a door switch compartment (police door).

Guardrail shall be installed for cabinet protection if required. Any required guardrail work in the vicinity of the count station shall be scheduled prior to the road sensor installation to avoid potential damage to the road edge leads/conduit. If this is not possible, the road edge leads/conduit shall be unearthed and clearly identified, the guardrail work closely monitored, and the road sensor leads tested before and after the guardrail work in the presence of the MassDOT Resident Engineer. The Type CB Cabinet and foundation shall be set back a minimum of 5 feet from the back of the Guard Rail, unless otherwise directed by the Mass DOT Engineer. Cabinets shall not be installed close to the guardrail due to the potential damage of snow being pushed into the cabinet by snowplows. The cabinet shall be installed with the door opening positioned in order to allow observation of the flow of traffic and the inside of the cabinet at the same time. (You should be facing the roadway traffic when looking into the opened cabinet). This will also keep the door away from the plowed snow. Grading in the foundation area shall be in accordance with Standards Specifications Subsection 170. Grading in the area of the pullbox and foundation shall include a minimum 3 foot wide (in all directions) and 1 inch thick top layer of material (i.e. stone, pavement millings, etc.) to deter soil erosion and vegetation growth. A 3 feet x 3 feet by 4 inches concrete pad over an 8 inch gravel base shall be provided in front of the cabinet door.

**ITEM 819.907** (Continued)

Each cabinet furnished shall be equipped with the following:

1. Two (2) height adjustable shelves. The lower shelf shall be used for the backup battery and shall have insulated material under the battery to inhibit power drainage. The other shelf shall be spaced to allow wiring access to the terminal boards, regulator, and convertor.
2. Vents with installed washable metal replaceable air filters.
3. A thirty- (30) position double row barrier strip for the spade tongue type lugs shall be installed above each of the shelves. A gas-tube surge arrester (Type TII-317-A) shall be installed on the barrier strip for each terminated loop.
4. A standard traffic lock with 2 keys.
5. The exterior finish of all housings shall have two (2) coats of green enamel paint over a corrosive resistant primer coat. All paint shall conform to Standard Specification Subsection 815.61.
6. The concrete foundation (4000 psi  $\frac{3}{4}$ " Class D) shall conform to the MassDOT latest editions of "Standard Drawings for Traffic Signals and Highway Lighting" and "Standard Specifications for Highways and Bridges", or as directed by the Engineer. Foundations shall have a total of three 3" diameter conduit sweeps installed. Sweeps not used shall be capped and sealed.

The Type CB cabinet will require the installation of a post mounted solar panel to power the Traffic Data Collection instruments. The standard hook up to the traffic data collector is shown in Document A00803 typical drawing "Standard Solar Panel Connection to Traffic Data Collectors".

**SOLAR PANELS AND SUPPORT POSTS**

The six (6) furnished new and installed post mounted **60 Watt** solar panels for Item 819.907 (1 per cabinet) shall include all necessary mounting hardware, sealer, voltage regulator, terminal boards, and recorder battery connections including the solar charging harness cable. The solar harness shall be a PAT/IRD TRS harness for classification and volume stations. The solar charging harness shall connect to the regulator/terminal board voltage source with 2 spade lug connectors and shall connect on the other end to the recorder with an AMP connector. The solar harness must fit the PAT/IRD recorder version 4.07 or newer. The solar charging harness can be purchased or manufactured by the Contractor. Information on the PAT/IRD dual communication TRS recorder connection and solar charging harness can be obtained by calling PAT/IRD at (815) 675-1430. The solar panel with tilting capabilities shall be **post mounted** per Document A00803 "Solar Panel Mounting Detail" drawing. The Photovoltaic panels shall be 60 Watt crystalline silicon photovoltaic arrays modules with anodized aluminum frame and adjustable mounting brackets with nominal dimensions of approximately 21" x 33" as manufactured by Ameresco Solar or approved equal. The solar panel shall be mounted to maximize the solar capabilities of the site (orientated toward the south and tilted at an angle of approximately 30-40 degrees) as well as minimize vandalism. All holes made in the cabinet during installation shall be sealed.

**ITEM 819.907** (Continued)

Photovoltaic panel support posts shall be fabricated from galvanized 2 ¼"x 2 ¼" square steel tube meeting the requirements of ASTM A1011, Grade 50 from an approved manufacturer and conforming to the requirements of Section M8.18.3, Sign Supports, for Type P5 Sign Post of the Standard Specification. Posts shall be galvanized in accordance with ASTM A653, Coating Designation G140 with a minimum coating of 1.4 ounces per square foot total of zinc on all sides under triple spot tests; or a minimum coating of 1.15 ounces per square foot total on all sides under triple spot tests. All bolts, nuts washers and miscellaneous hardware shall conform to the requirements of ASTM A307 and shall be galvanized unless otherwise specified. Galvanizing shall conform to AASHTO M232, Zinc Coating (Hot Dip) on Iron and Steel Hardware, and as further specified in Subsection M7.10.0 Galvanized Coatings of the Standard Specifications. Work shall conform to the relevant provisions of Subsection 828, Traffic Signs, and Subsection 840, Sign Supports of the Standard Specifications and these Special Provisions.

The Contractor shall verify existing or proposed cabinets are installed on concrete foundations and anchorage is as specified in Subsection 815 of the Standard Specifications, consisting of ¾" x 16" anchor bolts. Post shall be mounted on the equipment or signal cabinets as shown on the Typical Installation Details. Fasteners spacing may be adjusted within the parameters defined on the Typical Installation Detail Drawings. Fastener location and spacing shall be such as to avoid interference with existing or future control or switching devices located within the cabinet, and shall not exceed the allowable parameters shown on the Typical Installation Detail Drawing. Galvanized washers shall be used beneath the nut at the interior side of the traffic cabinet for all bolted connections. For installations where access constraints require the head of the bolt be located at the interior side of the cabinet, a galvanized washer shall be used under the head of the bolt at the interior of the cabinet and a galvanized washer shall still be used beneath the nut at the exterior side of the connection. Solar panels shall be mounted to the support post using a minimum of 2 bolts per connection. Mounting bolts shall be of the size shown on the drawings and shall be galvanized.

**CHARGE CONTROLLER WITH ETHERNET CONNECTIVITY**

The six (6) furnished new and installed regulators for Item 819.907 (1 per cabinet) shall be capable of supplying charges to a 6 volt traffic data recorder internal battery or a 12 volt deep cell, marine backup type battery application. The regulator shall be Morningstar Sunsaver SS-MPPT-15L or approved equal equipped with battery status indicator lights, a low voltage disconnect (LVD), and a low voltage reconnect (LVR). Regulator fuse protection (30 amp spade) is required for the solar input in addition to the Morningstar fuse requirements for the load and battery circuits. A spare fuse of each type shall be supplied and left in a clear plastic bag in the cabinet. IP-based Ethernet connectivity to the charge controller shall be included and installed (one per cabinet) to allow remote interfacing and status tracking of the charge controller. The Ethernet connectivity shall be Morningstar Ethernet MeterBus Converter EMC-1 or approved equal with status indicator lights, a standard RJ-45 port for Ethernet connection to a cellular modem, and a MeterBus port (RJ-11) to allow connection to the charge controller. Morningstar and two additional vendors can be contacted at the following addresses for the charge controller with Ethernet connectivity:

**ITEM 819.907** (Continued)

Morningstar Corporation 8 Pheasant Run Newtown PA, 18940 Phone: 215-321-4457 Fax: 215-321-4458 <a href="mailto:info@morningstarcorp.com">info@morningstarcorp.com</a>	Go Green Solar 330 E. Orangethorpe Ave Placentia CA 866-798-4435 <a href="mailto:info@gogreensolar.com">info@gogreensolar.com</a>	Northern Arizona Wind and Sun 4091 E. Huntington Drive Flagstaff AZ 86004 800-383-0195 928-527-0729 <a href="mailto:windsun@wind-sun.com">windsun@wind-sun.com</a>
--	---	---

**BACKUP BATTERIES**

The six (6) new rechargeable **12 Volt 110 AMP HR minimum AGM** backup batteries for Item 819.907 (1 per cabinet) shall be furnished new and installed in the cabinet in order to sufficiently power the traffic recorder and telecommunication equipment. These batteries shall be equipped with any necessary adapters, connectors, and include a 30 amp spade fuse between it and the specified solar panel regulator. All wires shall be color coded as red for positive and black for negative. Back-up batteries shall be installed in the cabinet in order to avoid blocking access to ALL terminal boards in the cabinet (loops, piezos, solar, regulator, etc.). The backup batteries shall be placed on insulated material to inhibit power drainage.

**WIRELESS MODEM & ANTENNA**

The six (6) furnished new and installed wireless modems for Item 819.907 (1 per cabinet) shall be industrial grade, LTE advanced performance, low power consumption with simplified deployment and remote management capabilities. The wireless modem shall be provided with an approved antenna (1 per cabinet) with a standard SMA connector. The modem (Sierra Wireless AirLink RV50X or approved equal) shall meet the following requirements.

**Cellular Wide Area Network (WAN):** The modem shall be approved to operate on the Verizon Wireless network and shall support frequency bands associated with 4G/LTE, and 3G/EV-DO/CDMA. The modem shall have all necessary industry and FCC approvals. The modem shall incorporate a software-defined radio with automatic network operator switching and dual SIM interfaces.

**Interfaces:** The modem shall provide the following interfaces: 10/100/1000 Ethernet through a standard RJ-45 port, RS-232 serial through a standard 9-pin (DB-9) port, USB 2.0 through a Micro-B connector. The modem shall have SMA interfaces for an approved cellular antenna with support for both primary and diversity connections, and an approved GPS antenna.

**Input/Output:** The modem shall provide a digital input/output (I/O) pin that can be configured as well as an analog input that is capable of accepting 0.5-36 VDC.

**Network Interfaces:** The modem shall provide the following IP features including but not limited to Network Address Translation (NAT), port forwarding, host port reporting, and dynamic DNS. The modem shall support secure Virtual Private Network (VPN) through IPsec, GRE and Open VPN client. Up to 5 concurrent VPN tunnels shall be supported. The modem shall have Dead Peer Detection (DPD) and support multiple subnets. The modem shall support inbound and outbound port filtering, inbound and outbound trusted IP, MAC address filtering, DMZ and support remote authentication using LDAP, RADIUS, TACACS+.

**ITEM 819.907** (Continued)

Event Reporting: The modem shall have the capability to trigger event reports based on digital input, network parameters, data usage, timer, power, device temperature and voltage.

Custom Software: The modem shall be provided with an application framework to allow development, testing and execution of custom software written in a web scripting language (Lua or approved equal) using an Eclipse-based Integrated Development Environment (IDE).

Power: The model shall accept 7 to 36 VDC input voltage. When idle, the modem power consumption shall be no more than 900 mW (75 mA @ 12 VDC). In addition, the modem shall have the capability to be placed in standby power mode with a power consumption of no more than 53 mW (4.4 mA @ 12 VDC) triggered by a periodic timer or the I/O pin.

Environmental: The modem shall have an operating temperature range of -30 deg C to +70 deg C; 90% relative humidity; IP64 rated ingress protection; and conform to military specifications for shock, vibration, thermal shock and humidity.

Warranty: The modem shall have no less than a three (3) year standard warranty.

Contact information for Sierra Wireless and two additional vendors are listed below:

Sierra Wireless, Inc.  
13811 Wireless Way Richmond,  
British Columbia V6V 3A4 Canada  
+1 (604) 231-1100

Digi International  
11001 Bren Road East  
Minnetonka, MN 55343  
(877) 912-3444

Red Lion Controls, Inc.  
20 Willow Springs Circle  
York PA 17406 USA  
+1 (717) 767-6511

**ROADWAY LOOP DETECTORS**

The thirty six (36) wire loop detectors for Item 819.907 (2 per lane) will conform to the following:

**1. LOOP WIRE**

Shall be single conductor, No. 12 AWG, stranded copper wire, cross-linked polyethylene insulated, rated 600 volts, type XLP-USE. The loop wire shall be encased in a 1/4" OD flexible plastic tubing formed by continually extruding the tube over the wire assembly, allowing the wire to slip freely within the tubing. Loop wire shall conform to IMSA specification 51-5.

---

**ITEM 819.907** (Continued)**2. SHIELDED LEAD-IN CABLE**

Shall be No. 12 AWG, stranded copper twisted pair wire, 100% shield jacketed or a manufacturer's recommended lead-in cable to allow multiple independent channel operation in a single cable.

**3. CONNECTIONS**

Shall be made with approved terminals or connectors applied with a crimping tool (Per Standard Specification Subsections 813.60, 815.64).

**4. SOLDERING**

All wire loop sensor/shielded lead-in splices and connections shall be soldered using 60% tin/40% lead rosin-core electronic solder meeting the requirements of Federal Specification QQ-571D (MHD-815.64). Flame shall not be used for soldering. An electrical pencil soldering iron not exceeding 35 watts shall be used.

**5. SPLICING INSULATOR**

Shall be heat-shrinkable, black homogeneous tubing made of thermally stabilized polyolefin to be used in conjunction with electrical insulation putty. The tubing shall have factory-applied sealant on the entire surface of the tubing. The electrical insulation putty shall be capable of sealing out moisture in multi-conductor cable connections. Splices are only allowed in pull boxes and shall conform to Standard Specification Subsection 813.60.

**6. SAWCUT SEALANT**

The saw-cuts shall be filled with an approved roadway loop embedding sealer to protect the wire. (Standard Specification Subsection 815.64)

**7. FLEXIBLE METALLIC CONDUIT LIQUID TIGHT**

Shall be in accordance with Material Subsection M5.07.2B or an approved equal.

**8. PULL BOXES**

Pre-cast or cast-in-place boxes shall conform to typical details. The pull boxes specified will be 12"x 12" or 12"x 24" as shown in MHD Standard Drawings for Traffic Signals and Highway Lighting, latest edition. The size specified for each application is shown on the construction sketches provided in Document A00803.



**ITEM 819.907** (Continued)

Before the contractor can occupy the public way the following materials and equipment must be **on-site**.

- a. Power Saw:  
Self propelled of at least 35 HP equipped with a diamond blade capable of cutting a 5/16" slot, water valve, depth gauge and horizontal guide.
- b. Water Supply:  
Adequate to cool diamond saw blade and clean saw slots.
- c. Air Compressor:  
To clean and dry saw cuts.
- d. Drill:  
Capable of drilling a 1 1/4" diameter hole at the corners of the loop prior to sawing. The drill shall also be equipped with a paddle mixer attachment for mixing epoxy.
- e. Blunt Tool:  
Such as a wooden paint stirring stick for seating the wire in the slot; no screwdrivers or any other pointed tools shall be allowed.
- f. Twister:  
To provide symmetrical twists of the lead-in wire.
- g. Template/Straight Edge:  
For marking the outlines of the loops on the pavement.
- h. Trenching Machine:  
For burying cable in soil.
- i. Meter:  
To test continuity, capacitance, resistance and inductance of the loops as specified.
- j. Electric Soldering Iron:  
An electrical pencil soldering iron not exceeding 35 watts for soldering connections.
- k. Measuring Tape:  
Minimum 100' tape for exact measurements for placement of loops.
- l. Traffic Control Devices:  
All traffic control devices required by the traffic control plan must be available and in place on the roadway prior to occupation of the roadway for purposes of work.
- m. Traffic Police:  
If a police detail is authorized, for the site, the officer must be present prior to entering the highway. Under no circumstances shall a limited access highway be occupied without a traffic officer present.

**ITEM 819.907** (Continued)**ROAD SENSOR INSTALLATION**

The location of each loop/piezo sensor and loop/piezo leads shall be marked on the pavement, using the typical layout shown on the plans, and approved by the Engineer before cutting the slots. **The sensors shall be located in the pavement coarse below the wearing surface** so that they are centered in the lanes after the wearing surface is applied. Piezo installation is preferred in a straight, level section of the roadway. Sensors shall not be installed near expansion joints in a concrete roadway installation. A power saw of at least 35 HP equipped with a diamond blade shall be used to cut a slot in the pavement. The saw can be wet or dry at the discretion of the Contractor and MassDOT Resident Engineer. The saw must be equipped with a depth gauge and horizontal guide to assure proper depth and alignment of the slot. The diamond blades to be utilized for the saw cut shall provide a clean, well-defined saw cut without damage to adjacent areas.

The saw cut for loops shall be 5/16" wide and 2" deep, or as directed by the Engineer. The saw cut for piezos shall be 3/4" wide and 3/4" deep, or as directed by the Engineer. A 1 1/4" diameter hole shall be drilled at each intersecting sawcut or lead in angle point to prevent sharp bends in the loop/piezo cable. All loop cuts and drilled holes shall be to the full 2" depth. It is critical that the saw cuts be as straight as possible; parallel each other, and perpendicular to the axis of the lane. All saw cuts connecting the loops/piezoes with the edge of pavement must be separated by at least 1 foot. This separation is necessary to preclude the premature breaking up of pavement.

It is strongly recommended that a single 3/4" wide saw cut be used for the piezo slots. The loop/piezo slots and pavement shall be flushed with clean water to remove the saw slurry. Filtered compressed air shall be used to remove all dust and moisture from the sawcut slots. Sand or other moisture absorbing materials shall not be used in the slot. The installation of the loop/piezo in the slots will not take place until the slot is clean and absolutely dry. The piezo manufacturer's installation instructions shall be adhered to as closely as possible to ensure correct operation.

A flexible metallic PVC jacketed conduit shall be installed between the pavement and pull box in accordance with Document A00803 "Loop Detector Construction Details". The flex conduit shall be a minimum of six (6) inches below ground level including at the road edge. The roadway sensor lead-in wires shall enter the flex conduit via a drilled hole in the pavement.

The loop wire shall be installed without damage to the wire or its insulation, starting at the pull box and around the loop for the specified four (4) turns and then back to the pull box as shown on attached "Typical Loop Wire Installation". The sensor wire shall be laid in the slot so there are no kinks or curls and no stretching of the insulation and shall be installed as far down in the slot as possible. A blunt object, similar to a wooden paint stirrer should be used to seat the loop sensor wire. In no case shall a screwdriver or other sharp tool be used for this purpose.

The loop wires between the edge of loop and the splice to the shielded lead-in cable in the pull box shall be twisted together to provide three (3) turns per foot.

**SPLICE AND CONNECTION**

Each sensor lead shall run from the roadway edge in flex conduit through the pullbox and into the cabinet without any splices. Each sensor lead shall have a separate flex conduit.

**ITEM 819.907** (Continued)

No splices shall be allowed except in the pull box. In the 12"x 24" pull box nearest the roadway each loop sensor lead and lead-in conductor shall be stripped back and spliced using a pressure type wire connector applied with a crimping tool. No splices shall be allowed in the piezo lead cable.

Multiple loop sensors and piezos shall be identified (colored tape or fiber tags) at each location.

Loop splices, when necessary in the pullbox nearest the detector shall be soldered and made completely watertight using an approved rigid body re-enterable closure.

The loop splices will be suspended by hangers inside the pull box to prevent them from resting on the bottom of the pull box.

The lead-in conductors shall be connected to appropriate terminals in the Type CB cabinet using crimped and soldered terminal ends (Type A only).

Do not leave excess sensor wire slack or wiring for old milled sensors in the cabinet or the pullbox. Excess wire or coiled wire may create another loop or create crosstalk between the loops thus reducing roadway sensitivity.

Each loop and piezo shall be given a number and that number shall be clearly designated at the terminal board. Document A00803 drawings "Traffic Data Collection Stations" for each site shall be used for the loop and piezo numbering system. The drawings shall be protected by a clear plastic cover and attached to the inside of the cabinet door.

**TESTING OF LOOPS AND PIEZOS**

The following test procedure shall be performed in the presence of the Engineer before and after the loop sensor is sealed in the pavement as detailed below. Document A00803 "Loop Detector Test Data Sheet" shall be used to record the test results. The cost of equipment, labor, and materials to perform such testing and similar re-testing following repairs, replacement, or adjustment of any detector within the project area shall be included in the price bid for the Traffic Data Collection Station for that location.

After installation of loop wire in the roadway and installation of shielded lead-in connecting the loops to the cabinet or pull box, each loop sensor and/or lead-in combination shall be tested for proper installation. The resistance (R) from lead to lead of the same loop shall not exceed three (3) ohms per one thousand (1,000) feet as measured by a high quality meter suitable for measurements of low resistance. The quality of each loop tested (Q value) shall be no less than 5. The measured inductance of each loop (L) shall conform to calculated inductance values after accounting for the size of the loop, the number of turns, and the inductance of the loop lead-in length.

A megohm meter test at 500 volts D.C. shall be made between the two leads of a loop/lead-in combination temporarily spliced together, but otherwise disconnected from all terminals, and the shielded drain wire and then the earth ground connection. The resistance for both of these tests shall be at least one hundred (100) megohms.

A megohm meter test at 500 volts D.C. shall be made between lead-in shield and the earth ground rod. This resistance shall be at least one hundred (100) megohms.

---

**ITEM 819.907** (Continued)

The piezo sensor shall be tested in accordance with the manufacturer specifications before and after the piezo sensor is sealed in the pavement. A copy of the manufacturer factory test data and the contractor completed piezo test results (capacitance, dissipation, resistance, etc.) shall be forwarded to the MassDOT Traffic Data Collection Section.

If any loop sensor/piezo and lead-in combination fails to pass any of the above tests, it shall be repaired and then re-tested on two occasions at least two (2) weeks apart, and then shall pass on each re-test occasion. If the loop sensor/piezo lead-in combination does not pass all these re-tests, a new loop sensor and/or lead-in shall be installed, and shall pass these tests, at no additional cost. This shall be repeated until the required tests are all satisfactory.

After the above tests have been satisfactorily completed, all loop wire and shielded lead-in inductances shall be measured and a written report of the results shall be filed with the MassDOT Resident Engineer along with a copy of the ground electrode, resistance tests required by Standard Specification Subsection 813.62B. An original signed copy of the completed "Loop Detector Test Data Sheet" provided in Document A00803 shall be forwarded to the MassDOT Traffic Data Collection Section. Attention is directed to Subsection 815.66 of the Standard Specifications, portions of which apply to these Special Provisions.

**GUARANTEE**

For a period of one (1) year after date of acceptance, the successful bidder shall replace or repair at no charge, any part or component that fails or does not function properly and if necessary will provide technical assistance on site to aid in repair or replacement of faulty components.

**TESTING OF FIELD STATIONS**

The field stations shall be thoroughly tested by the Contractor in the presence of the MassDOT Resident Engineer in all functions required by these specifications or included in the normal design or function of the equipment as normally provided.

**ACCEPTANCE**

The system will be tested and evaluated for acceptance upon completion of installation of the field station. *Contact Steven O'Neill at (857) 368-8919 or at Steven.D.ONeill@dot.state.ma.us upon completion of the field station installation.* Acceptance will be given after a 30-day period of trouble-free operation and after MassDOT reviews the collected data to ensure that the station is functioning properly. The 30-day period will begin after testing has been completed and after the installed recorders start collecting valid traffic data.

**METHOD OF MEASUREMENT**

Item 819.907 will be measured for payment by the Each 3 Lane Classification Traffic Data Station installed, complete in place.

**BASIS OF PAYMENT**

Item 819.907 will be paid for at the Contract unit bid price per Each accepted location, complete in place. Such payment shall be full compensation for all labor, materials, and equipment, and includes foundation, cabinet, solar panel, mounting bracket, mounting post, regulator, modem, antenna, solar charging harness, backup batteries, roadway loop detectors, roadway class II piezo sensors, lead-in cables, pull boxes, conduit, fasteners, and electrical connections including testing and all incidental expenses necessary to complete the installation as specified and shown.

**ITEM 853.8**

**TEMPORARY ILLUMINATION FOR WORK ZONE**

**DAY**

The work under this Item shall conform to the relevant provisions of Subsection 850 of the Standard Specification and the following:

The work under this Item shall include the deployment and maintaining in proper operating condition a LED balloon diffuser lighting system. These portable light towers shall be used throughout the project area for temporary work zone lighting. The use of unshielded high wattage flood lights shall not be permitted.

These towers shall be used, relocated and adjusted to meet the criteria in Subsection 850 of the Standard Specifications and the following:

The Contractor shall illuminate the following work zone areas:

- Change in direction (i.e., work zone entrances and exits, crossovers, etc.)
- Tapered areas
- Actual area where the construction is being performed

Light measurement shall be based on the illuminance method and the lighting levels shall be based on the classification of construction activity that is taking place. At no time shall the light level be below 5 fc and the uniformity shall not exceed 6:1. Task Classifications and recommended illumination levels is shown in Table 1.

**ITEM 853.8** (Continued)

Task Classifications	Illumination Level	Average Minimum Maintained Illuminance
All work operations areas, setup of lane or road closures, lane closure tapers, and flagging stations, such as: Excavation (all types), Embankment Fill and Compaction, Reworking Shoulders, Asphalt Pavement Rolling, Subgrade, Stabilization and Construction, Base Course Rolling, Sweeping, Cleaning and Landscaping.	Level I	5 foot-candles
Areas on or around construction equipment; asphalt paving, milling, and concrete placement and/or removal, such as, Milling, Removal of Pavement, Asphalt Paving and Resurfacing, Concrete Pavement, Waterproofing and Sealing, Sidewalk Construction, Base Course Grading and Shaping, Surface Treatment, Bridge Decks, Drainage Structures and Drainage Piping, Other Concrete Structures, Barrier Wall and Traffic Separators, Guardrails and Fencing, Striping and Pavement Markings, Repair of Concrete Pavement, Highway Signs, Hole Filling and Repair of Guardrails and Fencing.	Level II	10 foot-candles
Pavement or structural crack/ pothole filling; joint repair, pavement patching and/or repairs, installation of signal/electrical/mechanical equipment, such as, Traffic Signals, Highway Lighting Systems and Crack Filling	Level III	20 foot-candles

TABLE 1  
TASK CLASSIFICATIONS AND ILLUMINATION LEVELS

A detailed work zone lighting plan shall be submitted to MassDOT for approval before any work has commenced. Said plan shall include photometrics that detail the light levels that are to be provided. Photometrics shall include the following: calculated illuminance, uniformity, and glare avoidance verification throughout the work zone as well as the active travel lanes. The lighting plan shall be submitted with all supporting calculations, catalog cut sheets and supporting documentation.

Any potential glare from the lighting system should be considered from each direction and on all approaching roadways and opposing lanes of traffic. Glare from the illumination system should be minimized as much as possible for both workers and motorists in adjacent active travel lanes. If necessary, the Contractor shall provide supplemental hardware, such as, visors, louvers, shields, glare screen and barrier to reduce glare in adjacent active travel lanes.

**ITEM 853.8** (Continued)

The plan shall show the layout for each work area including the number, location, spacing of all fixed and/or mobile structures, description of illumination equipment that is proposed to be used on this project, and mounting details for mobile lights attached to construction equipment. Plan shall be designed by a professional engineer that is registered and licensed by the Commonwealth of Massachusetts and shall be submitted to the Engineer for approval prior to any nighttime work operations within the State Highway Right of Way.

The Contractor shall allow MassDOT up to 30 calendar days for review and comment.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 853.8 will be measured in accordance with Subsection 850.80.

Item 853.8 will be paid for at the contract unit price per DAY in accordance with Subsection 850.81 which Contract unit bid price shall also include all labor, materials, equipment, tools and all incidentals required for the design and installation of the work zone lighting system. This shall include, but not be limited to lighting plan preparation, wiring connections, equipment relocations, and include all material and labor incidental for a complete, functional and operational work zone illumination system.

The price of this item shall include the material and labor necessary to install any supplemental hardware required to reduce glare on all adjacent active travel lanes.

Installation and modifying the existing set-up shall be incidental to Item 853.8.

**ITEM 854.016    TEMPORARY PAVING MARKINGS – 6 INCH (PAINTED)    FOOT**

The work to be done under this item shall conform to the relevant provisions of Subsection 850 of the Standard Specifications, and the following:

**Construction Methods**

The Contractor shall provide all necessary temporary pavement markings following the completion of each day's operation or prior to opening the roadway to traffic.

Any existing pavement markings in conflict with temporary pavement markings shall be removed in accordance with Subsections 850.48 and 850.69 and shall be considered incidental to this item with no additional compensation allowed. The Contractor's attention is directed to the fact that all markings must be removed by grinding or other approved methods. Blacking out markings by use of asphaltic liquids, paint, or any other material is unacceptable.

If the temporary pavement markings are not painted following the completion of the workday, the Contractor shall place temporary pavement markings (non-removable tape) as required by the Engineer. The road shall be painted the next day or construction may be suspended until the painted lines are installed.

Non-removable temporary pavement markings shall not be used on the final wearing surface.



**ITEM 854.6****TEMPORARY PORTABLE RUMBLE STRIPS****DAY**

The work under this Item shall conform to the relevant provisions of Subsection 850 of the Standard Specification and the following:

Work under this item consists of furnishing, deploying, maintaining in proper operating conditions, and removing temporary portable rumble strips (TPRS) for temporary lane closures of 24 hours or less.

**MATERIALS**

The TPRS shall be 10' to 11' wide, measured perpendicular to the path of travel, 12" to 16" long, measured parallel to the path of travel, and 0.5" to 0.75" tall. All edges shall be beveled. The surfaces shall be grooved to limit potential hydroplaning.

The TPRS shall lay flat on the road surface without the use of nails, anchors, or adhesives, and shall be flexible so as to conform to the surface profile.

The TPRS shall be able to withstand vehicle weights of up to 80,000 lbs. and operate in temperatures between 0° to 120° F.

The manufacturer shall certify the TPRS to be safe for use on roads with speed limits of at least 70 mph.

TPRS that appear damaged or functioning in an unsafe manner may be order removed by the Engineer and replaced at no additional cost.

**CONSTRUCTION METHODS**

The TPRS shall be installed per the plans or at the discretion of the Engineer.

The Contractor shall conform to the manufacturer's specifications for installation and the following:

- A. The road surface shall be cleared of all gravel, sand, and debris.
- B. If RoadQuake 2™ model is used, the modular pieces shall be assembled into 11-foot strips per the manufacturer's instructions in advance of deployment. The interconnected segments shall form a smooth and flat, continuous section.
- C. A Truck-Mounted Attenuator, conforming to Section 850, shall be used as shadow vehicle protection during the deployment and removal of TPRS on any roadway with speeds of 45 mph or greater.
- D. TPRS shall be deployed in conjunction with all other temporary traffic control devices. MA-W28-1 (Rumble Strips Ahead) sign(s) shall be installed per the Temporary Traffic Control Plan.

**ITEM 854.6** (Continued)

E. TPRS deployment:

1. TPRS shall be placed perpendicular to the direction of travel, centered in the lane.
2. Three (3) individual strips are required for a single array.
3. Refer to the Temporary Traffic Control Plan for the location of the array respective to the lane closure.
4. The spacing of the individual strips within the array shall conform to the following table:

<b>Speed Limit</b>	<b>Distance Between Rumble Strips (measured center-to-center)</b>
>55 mph	20 feet
40 mph to 55 mph	15 feet
<40 mph	10 feet

5. The TPRS shall be placed without the use of nails, adhesives, or other methods of affixing them to the road surface.

F. All TPRS shall be maintained in proper condition, alignment, spacing, and location throughout the duration of the lane closure, at no additional cost.

G. The TPRS shall be removed prior to the removal of the traffic control devices used to close the travel lane.

H. TPRS shall not be used during snow events.

METHOD OF MEASUREMENT

An array of three (3) temporary portable rumble strips is considered one (1) unit and will be measured by the day. Each period of up to 24 hours during which this unit is in use will be measured as one day regardless of the number of times the array is deployed, repositioned, or removed.

BASIS OF PAYMENT

Temporary Portable Rumble Strips will be paid for at the Contract unit bid price per Day, which shall include full compensation for furnishing, deploying, repositioning, and removing the array of three (3) individual strips as directed by the Engineer.

---

**ITEM 859.1**      **REFLECTORIZED DRUMS WITH SEQUENTIAL**      **DAY**  
**FLASHING WARNING LIGHTS**

**DESCRIPTION**

The work under this item shall conform to the relevant provisions of Subsection 850 of the Standard Specifications and the following:

Work under this Item consists of furnishing, installing, maintaining in proper operating conditions, and removing reflectorized drums, and any necessary ballast, equipped with sequential flashing warning lights.

**MATERIALS**

Reflectorized drums shall be listed on the MassDOT Qualified Traffic Control Equipment List. Reflective sheeting on drums shall meet or exceed ASTM D4956 Type VIII. All drums shall be maintained in a satisfactory manner including the removal of oils, dirt, and debris that may cause reduced retroreflectivity.

The Contractor shall use one of the following sequential flashing warning light systems unless otherwise approved by the Engineer:

1. Empco-Lite LWCSO.
2. pi-Lit® Sequential Barricade-Style Lamp; or
3. Unipart Dorman SynchroGUIDE.

Sequential flashing warning lights shall be secured to reflectorized drums per the light manufacturer's specifications.

**CONSTRUCTION METHODS**

The first ten drums in any merging or shifting taper as designated in the Temporary Traffic Control Plan shall be equipped with sequential flashing warning lights. These lights shall be operating, at a minimum, between dusk and dawn when the taper is deployed.

The successive flashing of the sequential warning lights shall occur from the upstream end of the merging or shifting taper to the downstream end of the taper in order to identify the desired vehicle path. Each warning light in the sequence shall be flashed at a rate of not less than 55, nor more than 75 times per minute.

Warning lights shall be powered off when drums are not deployed in a taper.

**METHOD OF MEASUREMENT**

A group of ten (10) reflectorized drums with sequential flashing warning lights is considered one (1) unit and will be measured by the day. Each period of up to 24 hours during which this unit is in use will be measured as one day regardless of the number of times that the drums are positioned, repositioned, removed, or returned to service.

**BASIS OF PAYMENT**

Reflectorized Drums with Sequential Flashing Warning Lights will be paid for at the contract unit price per day, which shall include full compensation for furnishing, positioning, repositioning, and removing the group of ten (10) drums as directed by the Engineer.

---

<b><u>ITEM 868.206</u></b>	<b><u>6 INCH WET REFLECTIVE RECESSED WHITE LINE (POLYUREA)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 868.212</u></b>	<b><u>12 INCH WET REFLECTIVE RECESSED WHITE LINE (POLYUREA)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 869.206</u></b>	<b><u>6 INCH WET REFLECTIVE RECESSED YELLOW LINE (POLYUREA)</u></b>	<b><u>FOOT</u></b>

The work to be done under these items shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

Work shall consist of grooving a slot in the pavement surface and the furnishing and installation of wet reflective polyurea pavement markings.

### **Materials**

Wet reflective polyurea pavement markings shall consists of a liquid binder, first drop beads or elements to provide dry and wet retroreflectivity, and second drop glass beads to improve the durability of the pavement marking, reduce track-free times, and provide supplementary dry retroreflectivity.

The Contractor shall use one of the following binders and first drop beads or elements, or approved equivalents:

1. 3M™ Liquid Pavement Marking Series 5000 with 3M™ All Weather Series 90 elements;
2. Epoplex GLOMARC® 90 with Potters VISIMAX® Glass Bead System; or
3. SWARCO MFUA-12 with SWARCO MEGALUX-BEADS®.

Combination of other binder and first drop bead or element series may only be used at the approval of the Engineer.

Second drop beads shall be manufactured from glass of a composition that is highly resistant to traffic wear and to the effects of weathering. If coating is required to meet the performance requirements, the second drop beads shall be coated to ensure satisfactory embedment and adhesion. Second drop beads retained on a No. 40 U.S. Standard Mesh Sieve shall have a minimum crush strength of 30 lbs. when tested in accordance with ASTM D1213.

Second drop beads shall have a minimum refractive index of 1.51 when tested in accordance with AASHTO M247.

Second drop beads passing the No. 30 sieve shall have a minimum of 75 percent true spheres when tested in accordance with ASTM D1155. All second drop beads retained on the No. 20 and No. 30 sieves shall have a minimum of 80 percent true spheres as determined by ASTM D1155.

**ITEMS 868.206, 868.212 AND 869.206** (Continued)

Second drop beads shall meet the following gradation requirements when tested in accordance with ASTM D1214:

U.S. Standard Sieve No.	Percent Retained
20	3-10
30	15-35
50	45-75
70	0-10
Pan	0-5

**Construction Methods****Installation of Groove**

Prior to cutting out the grooves for all recessed lines, the Contractor shall use a chalk line or other suitable method to layout the proposed pavement markings on the surface course so that the Engineer can inspect the locations. Once the Engineer has inspected and approved the proposed striping layout, the grooves for the proposed pavement markings may be cut. No pavement grooving shall be done without the prior approval of the Engineer.

Groove position shall be a minimum of 4 inches from the edge of the pavement marking to any longitudinal pavement joints. The groove shall not be installed on bridge joints, on drainage structures, or in other areas identified by the Engineer. The groove shall not be installed continuously for intermittent pavement markings, but only where markings are to be applied.

The use of gang stacked diamond cutting blades to grind a smooth square slot is required for producing all grooves. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades. The acceptability of the surface texture will be determined by the Engineer.

The diamond grinder shall have an articulating head so that the slots are installed correctly on grades and super elevated sections.

Grooves that are ground deeper or wider than the specified allowable limits shall be repaired per the direction of the Engineer at no additional cost. Grooves that are ground too shallow, too narrow, or with unacceptable rises between blade cuts shall be reground to the correct size, depth, and surface finish at no additional cost. Slots ground out of alignment shall be patched using an approved method and materials.

Grooves shall be 1 inch  $\pm$  ¼ inch wider than the pavement marking material. Groove depth shall be 100 mils  $\pm$  5 mils, unless otherwise approved by the Engineer. Depth shall be consistent across the full width of the groove. Depth plates shall be provided by the Contractor to the Engineer to assure that desired groove depth is achieved.

**ITEMS 868.206, 868.212 AND 869.206** (Continued)

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. Shrouds and a vacuum apparatus shall be included as part of the grinder to remove larger pieces of pavement that are ground out. If water is used to clean the groove or the grooving process takes place during rainfall, a minimum of 24 hours of dry time is required prior to the placement of pavement markings.

After the depth, width, length, and surface condition has been approved by the Engineer, an air lance shall be used to remove fine particles from the groove. Air compressors shall initially be blown out away from the application area to prevent compressor condensation build-up from entering the groove. The Contractor shall prevent traffic from traversing the grooves and re-clean grooves, as necessary, prior to application of pavement markings at no additional cost to the Department.

All grooves must be given final approval by the Engineer prior to the placement of pavement markings.

**Installation of Wet Reflective Polyurea**

Installation of wet reflective polyurea pavement markings shall conform to the Manufacturer's specifications and the following:

Application rate for binder and all beads and elements shall consider final pavement surface composition and smoothness in advance of application to ensure proper wet film thickness and embedment of all beads and elements. The Contractor shall provide the Engineer with documentation from the Manufacturer with all recommended application rates in advance of any pavement marking installation.

The minimum uniform wet thickness for the polyurea binder shall be 25-30 mils. The line thickness shall be met across at least the middle  $\frac{2}{3}$  of the pavement marking width. Depth plates shall be provided by the Contractor to the Engineer to assure that desired thickness is achieved.

The finished white color shall be free from tint, with good opacity and visibility under both daylight and artificial light. The finished yellow color shall be defined by Federal Test Standard 595 - Color Chip Number 13538, using Federal Test Standard 141 (Method 4252). The finished lines shall be uniform in color and have clean, well-defined edges.

First and second drop beads and/or elements shall be applied in a manner that does not induce rolling or bouncing, to ensure that exposed portions of beads are free of binder material. Beads and elements should be embedded in the binder to a depth of approximately 50% of their diameter.

Drop rate for first drop bead or element shall be per the Manufacturer's specifications.

Drop rate for second drop glass bead shall be 6.4-10.2 lbs. per gallon.

Newly installed pavement markings shall be protected from tracking during the setting period per Subsection 860.63.

### **ITEMS 868.206, 868.212 AND 869.206** (Continued)

Once the installed pavement markings have been open for traffic for a minimum of 48 hours, the Contractor shall perform retroreflectance readings per the measurement and sampling procedures contained in ASTM D7585 (Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments) using the Referee Evaluation Protocol found in section 6.4. The following tests shall be performed during the measurement and sampling process:

1. ASTM E1710 (*Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer*); and
2. ASTM E2177 (*Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness*).

The average initial retroreflectance readings shall exceed the following minimum values:

	*White Markings	*Yellow Markings
ASTM E1710 (Dry)	475 mcd/lux/m <sup>2</sup>	375 mcd/lux/m <sup>2</sup>
ASTM E2177 (Wet Recovery)	375 mcd/lux/m <sup>2</sup>	300 mcd/lux/m <sup>2</sup>

\*Observation Angle = 1.05°, Entrance Angle = 88.8°

Pavement markings with measured average initial retroreflectance readings that do not meet the specified minimum values using the procedures outlined in subsection 6.4.5 of ASTM D7585 shall be removed by a method approved by the Engineer and reapplied at no additional cost.

#### **Pavement Marking Asset Management**

Upon completion of the pavement marking installation, the following data shall be tabulated by the Contractor:

1. Retroreflectance readings, including date(s), time(s), and location(s) where readings took place;
2. Liquid binder type(s) and application rate;
3. Reflective element type and drop rate;
4. Date of groove installation;
5. Lot, batch number, or any other material identifiers and manufacturing information;
6. Date and time of final liquid marking installation;
7. Highway location (including direction) of installation;
8. Air and pavement temperature during application;
9. Measured material application thickness, depth of groove; and
10. Any other pertinent information that may assist MassDOT with Quality Control.

**ITEMS 868.206, 868.212 AND 869.206** (Continued)

Results for all readings shall be provided within 10 business days of testing to the Engineer, with a second copy sent to:

State Traffic Engineer  
Attention: Pavement Marking Installation & Testing  
10 Park Plaza, Room 7210  
Boston, MA 02116

The cost to prepare and submit this data shall be considered incidental to the cost of the items.

**Method Of Measurement**

Wet reflective recessed polyurea pavement markings will be measured per FOOT, complete in place, as specified under Section 860.80.

**Basis Of Payment**

Wet reflective recessed polyurea pavement markings will be paid at the respective contract unit price per FOOT.

The contract prices shall include all material, labor, and equipment required or incidental to the satisfactory completion of the work.



**ITEM 868.306****6 INCH WET REFLECTIVE RECESSED  
WHITE LINE (PREFORMED)****FOOT**

Work to be completed under this item shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

Work shall consist of grooving a slot in the pavement surface and the furnishing and installation of preformed wet reflective pavement markings.

**MATERIALS**

Preformed pavement markings shall be certified by the manufacturer as capable of meeting the following minimum initial retroreflectivity levels:

	*White	*Yellow
ASTM E1710 (Dry)	500 mcd/lux/m <sup>2</sup>	300 mcd/lux/m <sup>2</sup>
ASTM E2177 (Wet Recovery)	250 mcd/lux/m <sup>2</sup>	200 mcd/lux/m <sup>2</sup>
ASTM E2832 (Wet Continuous)	200 mcd/lux/m <sup>2</sup>	175 mcd/lux/m <sup>2</sup>

\*Observation Angle = 1.05<sup>0</sup>, Entrance Angle = 88.8<sup>0</sup>

Material certifications shall be provided to the Engineer prior to installation. Certification shall include the date(s) the materials were manufactured and the NTPEP code number.

**CONSTRUCTION METHODS****Installation of Groove**

Contractor shall refer to 3M<sup>TM</sup> Information Folder 5.18 *Grooving Applications* and the following:

Prior to cutting out the grooves for all recessed lines, the Contractor shall use a chalk line or other suitable method to layout the proposed pavement markings on the surface course so that the Engineer can inspect the locations. Once the Engineer has inspected and approved the proposed striping layout, the grooves for the proposed pavement markings may be cut. No pavement grooving shall be done without the prior approval of the Engineer.

Groove position shall be a minimum of 4 inches from the edge of the pavement marking to any longitudinal pavement joints. The groove shall not be installed on bridge joints, on drainage structures, or in other areas identified by the Engineer. The groove shall not be installed continuously for intermittent pavement markings, but only where markings are to be applied.

The use of gang stacked diamond cutting blades to grind a smooth square slot is required for producing all grooves. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades. The acceptability of the surface texture will be determined by the Engineer.

The diamond grinder shall have an articulating head so that the slots are installed correctly on grades and super elevated sections.

**ITEMS 868.306** (Continued)

Grooves that are ground deeper or wider than the specified allowable limits shall be repaired per the direction of the Engineer at no additional cost. Grooves that are ground too shallow, too narrow, or with unacceptable rises between blade cuts shall be reground to the correct size, depth, and surface finish at no additional cost. Slots ground out of alignment shall be patched using an approved method and materials.

Grooves shall be 1 inch  $\pm$  ¼ inch wider than the pavement marking material. Groove depth shall be 150 mils  $\pm$  5 mils, unless otherwise approved by the Engineer. Depth shall be consistent across the full width of the groove. Depth plates shall be provided by the Contractor to the Engineer to assure that desired groove depth is achieved.

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. Shrouds and a vacuum apparatus shall be included as part of the grinder to remove larger pieces of pavement that are ground out. If water is used to clean the groove or the grooving process takes place during rainfall, a minimum of 24 hours of dry time is required prior to the placement of pavement markings.

After the depth, width, length, and surface condition has been approved by the Engineer, an air lance shall be used to remove fine particles from the groove. Air compressors shall initially be blown out away from the application area to prevent compressor condensation build-up from entering the groove. The Contractor shall prevent traffic from traversing the grooves and re-clean grooves, as necessary, prior to application of pavement markings at no additional cost to the Department.

All grooves must be given final approval by the Engineer prior to the placement of pavement markings.

**Installation of Preformed Pavement Markings**

A primer shall be applied in the groove prior to the installation of the preformed marking. The primer application shall conform to the primer manufacturer's specifications and shall be considered incidental to the cost of the item.

Installation of the preformed pavement markings shall conform to the Manufacturer's specifications.

Adhesion of each longitudinal line shall be tested at intervals no greater than 2,000 feet. A paint scraper shall be held near parallel to the pavement surface and the edges of the preformed material shall be lightly scraped. Any dislodging of material shall be considered a failure of application. The Contractor shall remove any failed applications to a point of a successful adhesion test both upstream and downstream from the failure and reapply the preformed material at no additional cost.

**ITEMS 868.306** (Continued)

**Pavement Marking Asset Management**

Upon completion of the pavement marking installation, the following data shall be tabulated by the Contractor:

1. Date of groove installation;
2. Depth of groove;
3. Lot, batch number, or any other preformed material identifier and manufacturing information;
4. Date and time of final preformed marking installation;
5. Highway location (including direction) of installation;
6. Air and pavement temperature during application;
7. Any other pertinent information that may assist MassDOT with Quality Control.

Results for all readings shall be provided within 10 business days of testing to the Engineer, with a second copy sent to:

State Traffic Engineer  
Attention: Pavement Marking Installation & Testing  
10 Park Plaza, Room 7210  
Boston, MA 02116

The cost to prepare and submit this data shall be considered incidental to the cost of the items.

**METHOD OF MEASUREMENT**

Wet reflective recessed preformed pavement markings will be measured per FOOT, complete in place, as specified under Subsection 860.80.

**BASIS OF PAYMENT**

Wet reflective recessed preformed pavement will be paid at the respective contract unit price per FOOT. The contract prices shall include all material, labor, and equipment required or incidental to the satisfactory completion of the work.

**ITEM 874.2**

**TRAFFIC SIGN REMOVED AND RESET**

**EACH**

The work under this Item shall conform to the relevant provisions of Subsections 828 and 840 of the Standard Specifications, the Standard Drawings for Signs and Supports and the following:

The work to be done under this item shall consist of dismantling, removing, transporting and resetting of existing traffic signs including regulatory and guide sign panels.

The sign panels shall be stored at an appropriate location to prevent damage until ready to be installed in the new locations.

The Contractor shall exercise particular care in the dismantling, removal, transporting and resetting of the existing signs designated to be reused. Any sign panel damaged during construction operations, shall be replaced immediately at the Contractor's expense.

Signs, attachment hardware and sign support posts lost, damaged or otherwise made unsuitable for reuse while being removed, transported, stored or reset shall be replaced with new material at no additional cost to the Department. New attachment hardware shall be furnished and installed as necessary to replace any missing or unusable existing hardware.

The Contractor shall backfill with compacted gravel all holes resulting from the removal of the existing signs and their foundations and restore the area to match existing conditions of adjacent areas.

The existing signs shall not be removed and reset without permission of the Engineer.

**METHOD OF MEASUREMENT**

Item 874.2 will be measured for payment by the Each traffic sign that are removed and reset.

**BASIS OF PAYMENT**

Item 874.2 will be paid for at the Contract unit price per Each, which price shall include all labor, materials, equipment, backfill, area restoration, and all incidental costs required to complete the work.

**ITEM 905.2**

**5000 PSI, 3/8 IN, 710 CEMENT CONCRETE**

**CUBIC YARD**

The work under this Item shall conform to the relevant Provisions of Subsection 901 of the Standard Specifications and the following: This item shall be used for repairs of parapets and other concrete repairs as directed by the Engineer.

Approval by the Engineer of all formwork shall be required prior to placement of any concrete.

**PREPARATION OF CONCRETE SURFACES:**

All concrete surfaces to be patched shall be roughened, cleaned of all laitance, dirt, grease, oil, other contaminants and all standing water. All reinforcing steel encountered in the excavation shall be thoroughly cleaned by abrasive blasting and painted with a zinc-rich primer conforming to M7.04, before being covered with new concrete. Deteriorated steel reinforcement shall be replaced as required by the Engineer.

Epoxy bonding compound shall be applied to all concrete repair surfaces.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 905.2 will be measured and paid per Subsections 901.80 and 901.81, respectively.

No separate payment will be made for coating of the steel reinforcing, and removing and reinstalling/installing existing and/or new guardrail connection, but all costs in connection therewith shall be included in the Contract unit price bid.

New epoxy coated reinforcing steel will be paid under Item 910.1.

Epoxy bonding compound will be paid under Item 964.1.

---

**ITEM 909.2                      CEMENTITIOUS MORTAR FOR PATCHING                      SQUARE FOOT**

The work under this item shall conform to the relevant Provisions of Subsection 901 of the Standard Specifications and shall also consists of furnishing and placing a polymer-modified, cementitious, fast setting, trowel grade patching mortar to patch vertical and horizontal surfaces on the existing structures where the repaired surface is less than 2 inches in depth.

This item does not include the repair of any vertical or horizontal patch that exceeds 2" in depth. The repairs to those patches shall be made using Item 905.2.

**MATERIAL**

The polymer modified cementitious patching mortar shall conform to the following requirements:

The mortar system shall not contain chlorides, nitrates, added lime, or high silica cements. The system shall be non-combustible, either before or after cure.

Finishing Time	20-60 minutes after combining components
Color	Concrete Gray

**TYPICAL PROPERTIES OF CURED MATERIALS**

Abrasion Resistance	6 times that of controlled concrete
Bond Strength	100% concrete substrate failure (Pull off method)
Modulus of Elasticity	4.5 x 10 <sup>6</sup> PSI
Surface Scaling (freeze/thaw)	No Deterioration after 120 cycles (deicing salt solution)
Compressive Strength (2 hours 50% RH)	150 PSI minimum
Compressive Strength (28 days 50% RH)	5,500 PSI minimum
Flexural Strength (28 days 50% RH)	1,300 PSI minimum

The system shall conform to the ECA/USPHS Standards for surface contact with potable water. The system shall not produce a vapor barrier. The system shall be thermally compatible with concrete.

**ITEM 909.2** (Continued)**CERTIFICATION**

The Contractor shall furnish notarized certification that all materials conform to the above requirements. In addition, samples of all materials proposed for use shall be submitted to the Department's Research and Materials Section. To allow sufficient time for testing, these samples must be submitted at least six weeks prior to scheduled use.

**SURFACE PREPARATION**

The contractor shall remove all deteriorated and spalled areas as designated by the Engineer. All costs to remove the deteriorated and spalled concrete shall be compensated for under Item 127.1.

Immediately before preparation for placement of new concrete, the exposed area to be patched shall be free of foreign materials. These materials shall be removed by abrasive blasting and by use of oil free compressed air. No grease, dust, rust, or laitance will be allowed to remain on reinforcing steel and exposed concrete surfaces.

The Contractor shall have the approval of the Engineer certifying that all spalled and deteriorated concrete has been removed prior to patching deteriorated areas. If the deterioration of the vertical surfaces is deeper than 1", then the repair will be made in maximum lifts of 1" deep. The preceding lift shall be allowed to reach final set before applying fresh material. The fresh mortar must be scrubbed into the preceding lift.

**APPLICATION METHODS**

Areas to be patched must be clean and sound. All loose and disintegrated concrete shall be removed by means of sandblasting, or an equivalent method, to a depth where sound concrete is exposed. Minimum patch depths at edges of patch shall be ½". Abrasively blast existing concrete to remove all contaminants prior to applying mortar. Chipping methods are to be approved in advance by the Engineer.

At the time of application, surfaces should be damp (saturated surface dry) with no glistening water. Mortar must be worked into the substrate filling all pores and voids. Force the material against the edge of the repair, working towards the center. After filling, consolidate, then screed.

The maximum thickness of application in one pass shall be 1". If the depth of patch exceeds 1", the mortar shall be placed in two passes of approximate equal thickness. Before the first pass has achieved an initial set, the surface shall be prepared for the second pass by scratching with a trowel to form a grid of deformation on the surface.

**CURING**

Use a fine mist spray of water, wet burlap, or a non-solvent approved curing compound if ambient conditions might cause premature surface drying (high temperature, low humidity, strong winds, etc.). If necessary, protect the newly applied mortar from rain. To prevent freezing, cover with insulating material.

**ITEM 909.2** (Continued)

**MANUFACTURER'S FIELD REPRESENTATIVE**

The Contractor shall arrange with the material's manufacturer or distributor to have the services of a competent field representative at the work site prior to any mixing of components to instruct the work crews in the proper mixing and application procedures.

The manufacturer's field representative must be fully qualified to instruct artisans or perform the work and shall be subject to the approval of the Engineer.

The Contractor shall be completely responsible for the expense and services of the required field representative and the bid contract price shall be full compensation for all cost in connection therewith.

**METHOD OF MEASUREMENT**

Item 909.2 will be measured by the Contract unit price per Square Foot of patch area, complete in place and accepted by the Engineer.

**BASIS OF PAYMENT**

Item 909.2 will be paid at the Contract unit bid price per Square Foot of cementitious mortar installed, which price shall include all labor, materials, equipment, manufacturer's representative, and all incidental costs required to complete the work.



**ITEM 909.3****RAPID SETTING LOW PERMEABILITY  
REPAIR CONCRETE****CUBIC YARD**

The Work to be done under this Item shall conform to the relevant provisions of section 901 of the Standard Specifications and the following:

The work under this Item shall consist of supplying, mixing, placing, and curing rapid setting concrete suitable for joint rehabilitation, including tops of backwalls where directed by Engineer, and full/partial depth deck repairs as directed by the Engineer.

**MATERIAL:**

Materials shall be delivered to jobsite in original, unopened, undamaged containers that clearly show the manufacturer's name, product name, and batch number. Material shall be stored in a dry area off the ground protected from rain, snow, and other sources of moisture. Material shall be protected from temperature extremes. Bulk sand and coarse aggregate shall be stored in a well-drained area on a clean, solid surface and materials shall be covered to prevent contamination with foreign matter.

An approved cement material shall be used to produce rapid setting repair concrete that is workable, durable and fast setting. The concrete mix shall be formulated to include the rapid set cement, fine aggregate, coarse aggregate, supplementary materials, water and admixtures proportioned to meet job work requirements. The approved rapid setting repair concrete shall be suitable for batching in Drum and Mobile Concrete (volumetric) mixing equipment. Other delivery and placement equipment and methods are subject to approval of the Engineer.

The rapid setting repair concrete shall be formulated to develop a minimum compressive strength of 2500 PSI within four (4) hours. It shall also meet the following performance criteria:

Initial Set/Final Set (AASHTO T197)	30 minutes/45 minutes
Air Content	3% - 7% at Slump of 7 to 9 inches
Shrinkage (ASTM C157)	28 days, 0.06% Maximum
Compressive Strength, at 7 Days	5000 PSI
Freeze-Thaw (ASTM C666)	300 Cycles, 80 Minimum
Chloride Penetration (ASTM C1202)	90 days, 1500 Coulomb Maximum

The rapid setting concrete mix design shall be mitigated per Subsection M4.02.00. Proposed mix design with data sheets and proposed procedure for trial batches shall be submitted to the Research and Materials Section for review and approval. The Engineer shall be notified at least 48 hours prior to the test batching.

The Contractor shall formulate a design mix, based upon performing trial mixes and testing witnessed by District Materials personnel, and submit it to the MassDOT Research and Materials Section for approval. The rapid setting repair concrete must satisfy all performance criteria and trial batch testing requirements to the satisfaction of the Engineer in order to be considered acceptable.

**ITEM 909.3** (Continued)

All tests necessary to demonstrate the adequacy of the concrete mix shall be performed by the Contractor, including, but not limited to: slump, air content, temperature, initial set and final set. Compressive strength tests shall be determined on standard and field cured 6" X 12" cylinders. A minimum of 9 sets of 2 cylinders (18 total) shall be field cured and tested at 3 hours, 4 hours, 5 hours, 6 hours, 24 hours, approximately 30 hours, 2 days, 3 days, and standard cured cylinders at 7 days, and additional cylinders as needed.

Compressive strength results of standard and field cured trial batch cylinders shall meet all of the following minimum overdesign strength requirements in order to be considered acceptable. Compressive strength results shall be the average of two (2) 6" x 12" cylinders:

4 hour cylinders:	2,750 psi
30 hour cylinders:	4,000 psi
7 day cylinders:	5,500 psi

This testing period shall be no longer than six (6) weeks and the testing period shall be included in the Contractor's schedule for operations. As part of the approval process, a minimum 3 cubic yard of a mock-up placement shall be performed within two (2) weeks of trial batch (or as approved by the Engineer) in order to assess workability of the concrete mix and efficiency of the delivery and placement methods. The location of this placement will be subject to approval of the Engineer.

Once the mix has been approved and production has started, the contractor shall be required to provide an ACI Certified field technician to obtain cylinders for verifying the concrete early strength. For each placement, the Contractor's field technician shall prepare three (3) cylinders under the direction of the Engineer. The samples shall be field cured in accordance with the requirements of AASHTO T-23 and transported to an AASHTO accredited testing laboratory approved by the department. Cylinders shall be tested after they have been field cured for at least four (4) hours. The average of the three-cylinder breaks shall be provided to the Engineer to assist with his decision to re-open the roadway.

Acceptance of the concrete compressive strength will be based on the field cured cylinders achieving a minimum of 5000 psi at 7 days or earlier as cast and tested by MassDOT. Compressive strength testing of field cured cylinders cast and tested by MassDOT should achieve a minimum compressive strength of 4000 psi at 30 hours as a verification that the mix is on target to achieve the 7-day acceptance requirement.

**SURFACE PREPARATION**

Existing concrete surfaces to be in contact with the proposed rapid setting repair concrete must be free of materials such as paint, oil, curing compound, bond breaker, etc. that will inhibit bonding. Existing concrete surfaces shall be hydroblasted with equipment that can remove asphaltic material, oils, dirt, rubber, curing compounds, paint carbonation, laitance, weak surface mortar and other potentially detrimental materials, which may interfere with the bonding or curing of the proposed rapid setting repair concrete. Retained reinforcing steel shall be cleaned by abrasive blasting or other mechanical means to achieve a white metal finish. Deteriorated reinforcement shall be replaced as directed by the Engineer.

**ITEM 909.3** (Continued)

Existing concrete surfaces must be saturated prior to concrete placement using potable water. Standing water shall be removed from surfaces to achieve a Saturated Surface Dry (SSD) condition.

**MIXING**

The use of Volumetric (Mobile) Concrete Mixers must follow procedures and requirements set in Engineering Directive No. E-10-004.

The concrete mixing and delivery equipment shall be capable of mixing and delivering concrete to the placement location at rates that are sufficient to comply with the project's restrictive time constraints. Cement concrete shall be proportioned and mixed using self-contained, mobile, and continuously mixing equipment that meets the following requirements:

1. Use a self-propelled mixer that is capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, and water to produce at least 6 cubic yards of concrete on site. Use a mixer that is capable of positive measurement of cement introduced into the mix as well as fine and coarse aggregate. Use a recording meter that is visible at all times and equipped with a ticket printout to indicate the quantity of cement and aggregate materials.
2. Calibrate the mixers to accurately proportion the specified mix. Prior to placing concrete, perform calibration and yield tests under the Engineer's supervision in accordance with the Department's written instructions. Copies of these written instructions are available from the Research & Materials Unit. Perform the calibration and yield tests using the material to be used on the project. Recalibrate the mixer after any major maintenance operation, on the mixer, anytime the source of materials changes, or as directed. Furnish all materials and equipment necessary to perform the calibrations and yield tests.
3. Use a mixer that controls the flow of water into the mix. Measure the flow rate of water with a calibrated flow meter coordinated with both the cement and aggregate feeding mechanisms and the mixer. Adjust the flow rate, as necessary, to control the slump and ensure that the water-cement ratios are met. In addition to flow meters, use mixers with accumulative water meters capable of indicating the number of gallons, to the nearest 0.1 gallon, introduced into the mixer. Filter water with a suitable mesh filter before it flows through the accumulative water meters.
4. Use a mixer that has a minimum of two liquid admixture dispensers and is capable of dispensing the admixtures through a controlled flow meter in accordance with ASTM C685.
5. Calibrate the mixer to automatically proportion and blend all components of the indicated composition on a continuous or intermittent basis as the finishing operation requires. Provide a mixer that discharges mixed material through a conventional chute and is capable of spraying water over the placement width as it moves ahead to ensure that the surface to be overlaid is wet prior to receiving the concrete.
6. Mount a tachometer on the unit to indicate the drive shaft speed.

**ITEM 909.3** (Continued)

For any project where a Mobile Concrete Mixer is proposed to be used, the Contractor must prepare and submit a project-specific construction Quality Control Plan (QC Plan.) The QC Plan shall conform to the format and content detailed in the Northeast Transportation Training and Certification Program (NETTCP) Model QC Plan (December 2009, or latest edition). Information contained in relevant sections of the approved QSM for the proposed Mobile Concrete Mixer may be referenced, rather than repeated, in applicable sections of the QC Plan (e.g. Materials Control, Production Facilities). The QC Plan shall be submitted to the Engineer within 30 days of the Notice to Proceed for the Contract. The District Construction Engineer and the Research & Materials Section will review the QC Plan. The Contractor shall not place any concrete by Mobile Concrete Mixer prior to approval by the Research & Materials Section.

A signed batch ticket printout from the printer mounted on the Mobile Concrete Mixer truck indicating that the mix batched is in conformance with the mix design previously approved shall also be provided to the Engineer prior to discharging concrete.

Quality Control inspection, sampling and testing, including but not limited to slump, air content, temperature and cylinders for compressive strength, shall be performed by the Contractor in accordance with the approved QC Plan. The Engineer will perform Acceptance sampling (every 50 cubic yards per day per approved truck) and testing for field cured cylinders as well as Acceptance inspection for materials and workmanship attributes.

The use of Item 909.3 is prohibited when the ambient temperature is expected to drop below 40° F within 7 days prior to the anticipated concrete placement. The Engineer may suspend or revoke approval of the Mobile Concrete Mixer at any time the unit fails to produce uniformly mixed concrete within the quality limits specified.

Material to be mixed should have a temperature of about 70°F. Warmer material will set faster than expected and cooler material will have slower strength gain. The temperature of the mixed concrete shall be controlled by protecting the bags of repair material from temperature extremes and by adjusting the temperature of the mixing water.

The coarse aggregate shall be placed in the mixer followed by the mixing water, then the cement. The components shall then be mixed for 2 to 3 minutes to achieve a uniform lump-free consistency. Admixtures not included as part of the approved mix design shall not be added without the approval of the Engineer. The repair concrete shall not be re-tempered. The concrete mixing and delivery equipment shall be capable of mixing and delivering concrete to the placement location at rates that are sufficient to avoid horizontal cold joints between successive placements.

The use of drum mixers is strictly limited to emergency situations as described in Item 748.1 Emergency Response in which the use of the Mobile Concrete Mixer may impede the progress of work. The use of drum mixers shall also be limited to concrete deck repairs that are less than two cubic yards per bridge deck.

---

**ITEM 909.3** (Continued)**PLACEMENT AND FINISHING**

The deck repair concrete shall be placed onto substrates that are Saturated, Surface Dry (SSD). The manufacturer's limitations on minimum surface and ambient temperatures shall be complied with.

Surfaces that are adjacent to the placement shall be protected with drop cloths, waterproof paper, or other means to maintain them free of material splashes, water and debris.

The deck repair concrete shall be placed immediately after mixing and shall be worked firmly into sides and bottom of repair area to achieve good bond. The concrete placement shall start at one edge of the excavation and shall continue full depth with temporary vertical bulkheads, if needed, to ensure that horizontal cold joints do not occur between successive concrete placements.

Final finishing shall be performed as soon as possible after placement as there will be little or no bleed water.

At the direction of the Engineer, in order to minimize the effects of vibrations from vehicular traffic passing in adjacent lanes next to each placement, traffic should be slowed along the adjacent travel lanes.

Approval by the Engineer of all formwork shall be required prior to placement of any concrete.

Water curing of the deck repair concrete shall start once the deck repair concrete begins to lose its moist sheen. Wet burlap shall be placed on the deck and joint repair concrete and the burlap shall be kept continuously wet for a 4-hour period after final set.

Placements shall be completed in accordance with the work schedule for acceptable lane closures so that the required compressive strength of 2500 PSI is attained **and** the minimum requirement for cure time (**5 hours**) is satisfied before the area is opened to traffic.

The mixer shall be cleaned immediately after use or add mix water and begin mixing immediately for the next batch. Buildup of hardened repair material in the mixer shall not be allowed since this creates inefficient mixing and the heat generated accelerates later batches.

**ITEM 909.3** (Continued)

**METHOD OF MEASUREMENT & BASIS OF PAYMENT**

Item 909.3 will be measured and paid at the Contract unit price per Cubic Yard, complete in place, which price shall be the full payment for all materials, equipment, tools, labor, clean-up and incidentals thereto; cost of high pressure washing/mechanical brushing of exposed concrete and steel surfaces, removal of rust and scale and laitance on existing steel reinforcing surfaces; replacement of deteriorated reinforcement, placement of proposed reinforcement and forming, placing, curing, stripping and finishing new concrete; and all other incidentals required to perform the work as specified and as required.

Proposed or any existing reinforcement that is unsuitable for further use through no fault of the contractor will be separately compensated under Item 910.1 “Steel Reinforcement for Structures – Epoxy Coated”.

The cost of Quality Control concrete cylinders and an AASHTO accredited testing laboratory providing test results for the determination of opening the bridge shall be considered incidental to Item 909.3. The preformed expansion joint filler, backer rods, tar paper, and joint sealer for the joint repairs shall also be considered incidental to the work to be performed under this item, if not already accounted for under other items.

**ITEM 910.1**                    **STEEL REINFORCEMENT FOR STRUCTURES -**                    **POUND**  
**EPOXY COATED**

All work under this Item shall conform to the relevant Provisions of Subsection 901 and the following:

All requirements of Subsection 901.61 Reinforcement shall be adhered to including but not limited to lapping at splices and ties at every other intersection.

The Contractor may be required to submit for approval, detail plans and schedule of bar reinforcement. The Contractor will replace reinforcing bars as directed by the Engineer. Any reinforcing steel damaged by the Contractor's operations will be replaced by the Contractor at his own expense.

**METHOD OF MEASUREMENT**

Item 910.1 will be measured for payment by the actual number of pounds of steel reinforcement bar in place as directed by the Engineer. Welding of steel reinforcement shall not be allowed.

**BASIS OF PAYMENT**

Item 910.1 will be paid at the Contract unit price per Pound, which price shall include all labor, materials, tools, equipment, and incidental costs required to complete the work.

**ITEM 912.****DRILLED AND GROUTED DOWELS****EACH**

The work under this Item shall conform to the relevant provisions of Subsection 901 of the Standard Specifications and the following:

The work shall consist of drilling holes, furnishing, installing, and grouting of steel dowel reinforcement at the locations shown on the drawings or as required by the Engineer.

The dowel embedment must be adequate to fully develop 125% of the yield strength of the bar. The embedment length, edge distance, and the core hole diameter shall conform to the minimum dimensions shown on the plans or the recommendations of the manufacturer. The method and equipment used to core the holes and the final embedment length and diameter of the core hole shall be submitted to the Engineer for approval.

**Materials**

The preferred epoxy adhesive anchor system for grouting rebar: “Hilti HIT-RE 500-SD” as manufactured by Hilti, Inc. of Tulsa, Oklahoma; “Simpson Strong-Tie SET-XP” as manufactured by Simpson Strong-Tie Company, Inc. of Pleasanton, California; “Chemofast C-RE 385” as manufactured by Chemofast Anchoring of Germany; or an approved equal. Any epoxy adhesive anchor systems listed for “*Adhesive Anchors*” on the most current MassDOT *Qualified Construction Materials List* will be acceptable.

The threaded anchor rod shall meet the requirement of ASTM F1554 Grade 55 requirement. All rods shall be hot dipped galvanized in accordance with AASHTO M 232 or mechanically galvanized in accordance with AASHTO M 298.

The contractor may submit an alternative anchoring method for the Engineer’s Approval. The Contractor shall confer with the Research & Materials Division regarding which products are approved for use on Massachusetts Department of Transportation bridge projects.

All materials shall be delivered in original, unopened containers with the manufacturer’s name, labels, product identification and batch numbers. Damaged material must be removed from the site immediately. All materials shall be stored off the ground and protected from rain, freezing or excessive heat until ready for use.

The Contractor shall submit copies of manufacturer’s literature for approval, including product data sheets and appropriate material safety data sheets.

Two test dowel bars of each dowel size shall be installed in the existing concrete and tested by the Contractor for pull-out. The pull-out force shall correspond to 90% of the yield strength of the bar. If any of the tested bars pull out or if the surrounding concrete shows signs of cracking, the Contractor must adjust the hole diameter, embedment, length and/or grouting material to meet this test requirement. All testing of the drilled and grouted dowels shall be performed by the Contractor and is incidental to the work under this item. The method of applying the tension test load to the dowels shall conform to ASTM E488.



**ITEM 912.** (Continued)

Details of the testing equipment used, and the locations and details of the test dowels shall be submitted to the Engineer for approval. The Contractor shall perform this test as soon as possible in order to eliminate delays in construction due to the approval process. Dowels shall not be ordered until the embedment lengths have been approved by the Engineer.

**Construction Methods**

All dowel holes shall be air drilled provided that the minimum edge distance of 6" is observed. Should, in the Engineer's opinion, air drilling be inappropriate due to questionable strength of the existing concrete or insufficient edge distance, the holes shall be diamond core drilled. The inner surfaces of diamond core drilled holes shall be scored to develop sufficient keying action. The method of scoring of the hole's inner surfaces shall be subject to the approval of the Engineer.

The diameter and embedment of the drilled dowel holes shall be in accordance with the recommendations of the grout manufacturer and the following minimum dimensions:

Diameter: minimum 1" larger than the diameter of the rebar, providing a minimum ½" annular spacing.

Embedment: as indicated on Plans and a minimum of fifteen times the rebar's diameter.

Drilled dowel hole diameters and embedments are based on the requirements specified under this item, the strength of the existing concrete, and the layout of dowels on the existing structure.

The holes shall be blown clear of any debris and shall have the approval of the Engineer prior to the placement of any grout material.

The drilling operation shall be performed without damage to any existing reinforcing or portion of the structure that is to remain in place. Any damage to the existing concrete that is to remain in place shall be repaired to a condition equal to or better than that existing prior to the beginning of the Contractor's operations and shall be repaired at the his/her expense.

The Contractor shall strictly follow the recommendations of the manufacturer for mixing and placing the grout material prior to the placement of the dowels. The Contractor shall adhere to the ACI code requirements regarding minimum and maximum temperatures while placing the grout. Any excessive grout around the hole after placement of the dowel shall be struck off smooth while the grout is still fresh.

**Field Representative**

The Contractor shall arrange with the materials manufacturer or distributor to have the services of a competent field representative at the work site prior to any drilling of the proposed holes to instruct the work crews in proper dowel installation procedures.

**ITEM 912.** (Continued)

The field representative shall remain at the job site after work commences and continue to instruct until the representative and the Contractor, Inspector and/or Engineer are satisfied that the crew has mastered the technique of installing the dowels successfully.

The representative shall make periodic visits to the project as the work progresses and shall confer on each visit with the Contractor, Inspector and/or Engineer. The manufacturer's field representative must be fully qualified to perform the work and shall be subject to the approval of the Engineer.

The Contractor shall be completely responsible for the expense of the services of the required field representative and the bid contract price shall be full compensation for all costs in connection therewith.

The Contractor shall have no claim for any variations in the diameter of the hole, the embedment length, the method of drilling the hole, or the type of grout used in anchoring the proposed dowels.

**Method of Measurement**

Item 912. will be measured for payment per Each dowel cored, grouted and installed complete in place and accepted by the Engineer.

**Basis of Payment**

Item 912. will be paid for at the Contract unit price bid per Each dowel installed in place, which price shall include all labor, materials, equipment, furnishing dowels, drilling holes and grouting the dowels regardless of the diameter or depth of the hole, manufacturer representative, and all incidental costs required to complete the work.

**ITEM 964.1****EPOXY BONDING COMPOUND****SQUARE FOOT**

The work under this Item shall conform to the relevant Provisions of Subsection 901 and the following:

This specification describes a 2-component, 100% solids; moisture insensitive, epoxy resin system which shall be used as a bonding adhesive to bond newly placed Cement Concrete to surfaces of sound, hardened concrete as required by the Engineer.

**MATERIAL**

Products to be used for this Item shall be approved by the Engineer before the Contractor begins his/her operations.

Epoxy Bonding Compound Materials shall meet requirements of Materials Specification Subsection M4.05.5 of the Standard Specifications for Highways and Bridges.

The Contractor shall furnish notarized certification that the epoxy bonding compound conforms to the above requirements.

**CONSTRUCTION METHODS****A. Preparation of Concrete Surfaces:**

All surfaces to be patched with cement concrete must be clean and sound. Surfaces shall be free of standing water. The entire surface to be bonded shall be blast cleaned to remove any laitance, dirt, grease, oil, or other contaminants.

**B. Mixing Epoxy Compound**

Components "A" and "B" of the epoxy-resin system shall be mixed in exact accordance with the manufacturer's instructions.

The area to be overlaid shall be covered with one coat of the epoxy compound, applied with long-nap paint rollers, brooms, brushes, or by spray.

The rate of application shall be 80 sq. ft/gallon maximum on smooth concrete (20 mils). As the concrete increases in roughness, the rate of coverage decreases proportionately.

While the epoxy compound is still tacky (4-5 1/2 hrs. at 73 degrees F.), place the concrete. If the bonding compound should harden before the concrete is placed, apply a fresh coat over the hardened coat and proceed.

**ITEM 964.1** (Continued)

## C. Weather Limitations

The epoxy bonding compound shall be applied according to manufacturer's recommendations and as directed.

## D. Epoxy Manufacturer's Field Representative

The Contractor shall arrange with the epoxy manufacturer to have the services of competent field representative present at the work site. The field representative shall be present at work site prior to any mixing of components to instruct the work crews, explain the inspection procedure and to inspect the condition of the prepared surfaces. He shall remain at the job site after work commences and continue to instruct until the Contractor has mastered the technique of installing the epoxy system successfully. At the discretion of the Engineer, the services of the manufacturer's representative may not be required when in the opinion of the Engineer, the Contractor has demonstrated a thorough understanding and successful execution of the work procedures. The Contractor shall be completely responsible for the expense of the services of the required field representative and the contract bid price shall be full compensation for all costs in connection therewith.

If the bonding compound prematurely hardens, additional bonding compound shall be applied, if allowed by the bonding compound manufacturer or the hardened bonding compound shall be addressed as per the bonding compound manufacturer's recommendations.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 964.1 will be measured for payment by the Square Foot, measuring the horizontal or vertical surfaces of the existing concrete area to which the bonding compound is applied, complete in place and accepted.

Item 964.1 will be paid at the Contract unit bid price per Square Foot of epoxy bonding compound applied, which price shall include all labor, materials, equipment and all incidental costs required to complete the work.

---

**ITEM 964.3      ELASTOMERIC PROTECTIVE COATING      SQUARE FOOT****DESCRIPTION**

The work to be done under this item shall consist of applying a minimum of two coats of an elastomeric acrylic protective coating to the above grade surfaces of concrete barriers, bridge parapets, and other locations as directed by the Engineer. A total dry film thickness (DFT) of 16 mils shall be required.

The acrylic protective coating shall be breathable, durable, flexible, and color retentive. It shall provide protection and be resistant to weathering, carbon dioxide, chlorides, UV light, wind driven rain, dirt pick up and mildew. It shall also bridge hairline cracks up to 1/32". The acrylic protective coating system shall be one of the following or an approved equal:

- SikaGard 550W Elastocolor by Sika Corp.
- Flexxide Elastomer by Carboline
- Colorlastic by ChemMasters

The proposed coating product shall be submitted to the Engineer for approval. The Contractor shall submit the proposed application procedures and Manufacturer's Product Data Sheet(s) that completely describe the product. The color of the coating shall be "DOVER SKY" for barriers. This color is from the SikaGard Color Chart and has been approved by the District Bridge Engineer. This color must be exactly reproduced as certified by the manufacturer in order to be allowed to use the Flexxide or Colorlastic coatings (at this time Flexxide has matching color samples that have been pre-approved).

**Preparation & Protection of Surfaces**

All vegetation growing adjacent to or within the limits of the concrete surfaces to be coated shall be removed and properly discarded. All debris adjacent to or within the limits of the concrete surfaces to be coated shall be removed and properly discarded

All surfaces to be coated must be dry, clean, sound and free of all contaminants that could interfere with adhesion of the coating. All loose material shall be removed. If directed by the Engineer, the contractor shall repair any holes and any spalled and damaged concrete prior to applying the coating. All concrete repair areas shall be cured for a minimum 28 days before coating.

The Contractor shall pressure wash all concrete surfaces to be coated. The pressure washer shall operate at a minimum of 3,000 psi. The protective coating shall not be applied until the surface is dry and the surface preparation has been approved by the Engineer. All concrete to be coated must be tested for the presence of moisture after the surface preparation has been completed and prior to application of coating. Testing shall be in accordance with ASTM D 4263.

**ITEM 964.3** (Continued)

APPLICATION

Application shall be done by airless sprayer or roller or a combination of both and in accordance with the manufacture's recommendations. The use of a primer shall not be required unless stipulated for that particular coating by the manufacturer. A minimum of two coats shall be applied to achieve a total DFT of 16 mils. The recommended minimum wet film thickness (WFT) must be maintained during each application. The manufacturer's specified temperature and weather limitations for the application shall be strictly adhered to.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 964.3 will be measured by the SQUARE FOOT for all concrete surfaces to which the coating is applied, complete in place, and accepted,

Item 964.3 will be paid at Contract unit bid price bid per SQUARE FOOT, which price shall be the full payment of all labor, materials, tools, equipment, all preparation & protection of surfaces, wet/dry film thickness gauge for the use of the Engineer, and all incidental costs required to complete the work. The Contractor will retain ownership of the gauge.

Any concrete repairs directed by the Engineer will be paid under the appropriate contract items.

**ITEM 966.****MEMBRANE WATERPROOFING  
FOR BRIDGE DECK REPAIRS****SQUARE FOOT****General**

The work under this item shall conform to the relevant provisions of Subsection 966 of the Standard Specifications and to the following:

The work under this Item consists of furnishing and applying an approved sheet membrane waterproofing system to the repaired deck surface as indicated on the plans and as directed by the Engineer.

**Material**

Only products pre-approved by the Research & Materials Section will be accepted for use.

Chemical composition, physical properties and dimensional requirements of the sheet membrane shall conform to the following specifications for the materials. The membrane waterproofing system shall consist of:

1. Primer: This material shall be suitable for priming concrete and masonry surfaces prior to the application of waterproofing and meets the requirements of ASTM D41.
2. Preformed reinforced rubberized asphalt sheet membrane shall meet the requirements specified in Table 1.
3. Mastic: The mastic for use with preformed rubberized sheets shall be a rubberized asphalt cold-applied joint sealant. The mastic for use with modified bitumen sheet shall be a blend of bituminous and synthetic resins. The mastic shall be approved for use by the manufacturer.

**Material Qualification**

A manufacturer requesting approval of a preformed sheet membrane shall furnish to the Research and Materials Section the following:

1. The membrane system material specifications including product performance data.
2. A sample (12" x 12") of the peel-off backing material shall be furnished for testing of tear resistant to prevent portions of it from remaining after the membrane is applied.
3. Certified independent test reports demonstrating conformance to Table 1.
  - a. The independent lab shall be recognized by the National Cooperation for Laboratory Accreditation (NACLA) in Construction Materials Engineering and Testing (CMET) or an equal program approved by Research and Materials. All testing shall be performed by one independent lab unless approved by the Engineer.

**ITEM 966.** (Continued)

- b. Independent test reports must be dated within five (5) years from the initial submission. Samples for all required testing shall be fabricated at the same time. Test reports shall denote the lot of material as well as the sample fabrication and testing dates.

**Table 1: Preformed Sheet Membrane Material Properties**

Property	Test	Requirements
Thickness	ASTM D3767	≥ 60 mils
Thickness at 350°F		≥ 55 mils
Thermal stability at 350°F		≤ 5% increase in area
Tensile Strength, Membrane	ASTM D412, Die C	≥ 250 psi
Tensile Strength, Film	ASTM D882*	≥ 3,000 psi
Elongation	ASTM D412	≥ 300%
Flexibility	ASTM D1970***	Unaffected
Adhesion to Concrete	ASTM D903**	≥ 6 lbs./in.
Permeance	ASTM E96 Water Method, Procedure B	≤ 0.1 perms
Water Absorption	ASTM D570	≤ 0.5%
Puncture Resistance	ASTM E154	≥ 40 lbs.
Notes: * Method A, 1-inch wide strip with 4-inch minimum initial separation and 4-inch gage length at 2 inches per minute at 73.4F ± 3.6F. Average 5 samples. ** Concrete is cast against the protective coating surface of the membrane and allowed to cure (7 days minimum). Peel adhesion of membrane to concrete is measured at a rate of 2 in. per minute at room temperature. *** ASTM D1970 shall be based on a 180° bend over 1 in. mandrel at -20°F.		

**Construction Method****Surface Preparation**

All concrete surfaces which are to be waterproofed shall be screeded to the true cross section. Depressions shall be filled to a smooth flush surface with rapid setting concrete. Other surfaces shall be trimmed free of rough spots, projections or other defects which might cause puncture of the membrane.

The membrane waterproofing for bridge joint repairs shall not be placed unless the Contractor is ready to follow within 24 hours with the first layer of hot mix asphalt pavement; a longer period of time will be allowed only with the approval of the Engineer. No vehicular traffic shall be permitted over the bare membrane waterproofing, and no waterproofing shall be done in wet, damp or foggy weather, nor when the ambient temperature is 40°F or below, without permission of the Engineer.



**ITEM 966.** (Continued)

Immediately prior to the membrane application, the concrete surface shall be thoroughly swept and blown clean with an oil free compressed air to remove any loose debris. If the concrete surface is damp it shall be dried by use of a propane gas torch or similar equipment.

**Priming**

The primer, suitable for priming concrete surfaces, shall be applied to all surfaces at a rate specified by the manufacturer. The primer shall be thoroughly mixed and continuously agitated during application. It shall be applied by spray or squeegee. It shall thoroughly dry before application of the preformed sheet membrane. Should the membrane not be placed over the primed surface within 8 hours, the surface shall be re-primed.

**Membrane Application**

Membrane application shall be in accordance with the manufacturer's instructions. The preformed membrane sheets shall be applied to the primed surfaces either by hand or by mechanical applicators. The membrane shall have tear resistant peel off backing material to prevent portions of it from remaining after the membrane is applied.

The membrane sheet shall be placed in such a manner that a shingling effect is achieved in the direction that water will drain and overlapped at least three (3) inches. Adhesive strips shall secure the overlapped sections. After being laid, the membrane sheets shall be rolled with hand rollers or other apparatus as necessary to develop a firm and uniform bond with the primed concrete surface. Procedures shall be used that minimize wrinkles and air bubbles.

Mastic shall be applied as a bead along the exposed edge of the membrane sheet that extends up the barrier railing or curb face and that terminates in the high-side gutter after the sheets have been installed. The mastic for use with preformed rubberized sheets shall be a rubberized asphalt cold-applied joint sealant. The mastic for use with modified bitumen sheet shall be a blend of bituminous and synthetic resins. The mastic shall be approved for use by the manufacturer.

Any tears, cuts, or narrow overlaps shall be patched, using a satisfactory adhesive and by placing sections of membrane sheet over the defective area in such a manner that the patch extends at least six (6) inches beyond the defect.

To eliminate any possible damage to the membrane and in accordance with Subsection 450.50, the hot mix asphalt overlayment shall be applied as soon as possible. Caution must be observed to assure that the paver does not cause damage to the membrane.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 966. will be measured and paid per Subsections 966.80 and 966.81, respectively.

**ITEM 968.3****BRIDGE DECK DRAIN****EACH****Description**

This work shall consist of furnishing and installing new deck drain pipes and/or replacing deteriorated/clogged existing drain pipes as shown on the Plans and/or as directed by the Engineer.

All deck drain work shall be completed prior to the paving operation of the bridge decks.

The Polyvinyl Chloride (PVC) pipes for the deck drains and their fitting shall conform to ASTM D1785, Schedule 40. Rubber gaskets shall be provided at all PVC flange-to-concrete connections. Solvent Cement Fittings shall conform to ASTM D2468, Schedule 40. All support straps and hardware shall be hot dip galvanized and be of the same type as used with steel pipe. Support spacing shall be based on the pipe manufacturer's recommendations for the service conditions. Jointing the pipe shall be done by solvent welding process and be in accordance with Manufacturer's recommendations. All joints to be set with P.V.C. primer and P.V.C. cement.

The drain pipes shall be installed in the new concrete pour for the joint repair. If the proposed deck drains are located in area beyond the joint or deck concrete repair limits, the contractor shall install the drain pipes in core drilled holes (1½ inch diameter minimum) in the bridge deck. The portion of the pipe that extends through the proposed concrete deck and the cored hole shall be scored. All pipes shall be adequately fastened and secured to the deck and the deck beam. The drain pipes shall be bonded to the surrounding concrete with an approved epoxy resin grout. All coring shall be done with an approved coring machine.

The drain pipes shall be installed through the waterproof membrane (if applicable), extended 12 inches below the bottom of the adjacent girder, and attached to the bottom flange with a clamp and mechanical fastening system appropriate for attaching to concrete and submitted to the Engineer for approval. After completing the membrane waterproofing and before laying the asphalt protective course, the top end of the pipes shall be covered with galvanized wire screen.

The removal and backfill of existing deck drain pipes shall be considered incidental to this Item. Where new drains are not installed the same locations as the existing, the holes of the existing deck pipes shall be filled with epoxy resin grout or non-shrink cementitious grout.

**Method of Measurement and Basis of Payment**

Payment under this item will be measured by Each set of three deck drain pipes installed in place. The Contract Unit Price per Each set of three deck drain pipes shall include the cost of furnishing all labor, materials, equipment necessary to complete this work, and all incidental costs required to complete the work. Payment shall be the same for installing the deck drain pipes in cored holes and for placing them in a new concrete pour.

---

**ITEM 973.      PRE-COMPRESSED SEAL BRIDGE JOINT SYSTEM      FOOT****DESCRIPTION**

The work under this Item shall conform to the relevant provisions of Subsections 971 and 972 of the Standard Specifications and the following:

The work shall consist of furnishing and installing pre-compressed bridge seals meeting the requirement stated in these provisions as replacements for failed or damaged hot poured joint bridge seals. This work shall be completed after bridge joints are repaired as provided in the attached sketches and as directed by the Engineer.

The pre-compressed seal joint system assembly shall consist of a preformed (pre-compressed) seal, epoxy adhesive, and injected silicone sealant bands all combined in a manner required so that a fully operational, waterproof system will seal the joint.

All joint sealing material shall be capable of accommodating movements of +50%, -50% (100% Total) of nominal material size.

The pre-compressed sealant shall be as manufactured by Emseal Joint Systems LTD (BEJS), Sealtite 50N, Watson Bowman Acme (H-Seal), or approved equivalent.

The sealant system shall be comprised of three components: 1) cellular polyurethane foam impregnated with hydrophobic 100% acrylic (to be certified in writing by independent laboratory tested FTIR and DSC analysis to be free in composition of any waxes or wax compounds), water-based emulsion, factory coated with highway-grade, fuel resistant silicone; 2) field-applied epoxy adhesive primer; 3) field-injected silicone sealant bands. Impregnation agent is to have proven non-migratory characteristics. Silicone coating to be highway-grade, low-modulus, fuel resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellow. Depth of seal shall be as recommended by the manufacturer. The foam seal shall be installed into manufacturer's standard field-applied epoxy adhesive. The sealant system is to be installed recessed from the surface such that when the field applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellow, the highest part of the silicone bellow will be flush with the concrete deck surface.

Changes in plane and direction (such as, curb upturn) shall be executed using factory-fabricated "universal 90" or custom transition assemblies supplied by the manufacturer of the pre-compressed seal. Transitions shall be warranted to be watertight at inside and outside corners through the full movement capabilities of the product.

**ITEM 973.** (Continued)

The additional reinforced membrane waterproofing layer shall be centered over the joint as shown on the plans and installed in accordance with the manufacturer's specifications. It shall extend to the curb lines and be cut to match the joint skew. The reinforced membrane shall be a minimum of 5mm thick, and consist of a prefabricated polyester reinforced atactic polypropylene modified bitumen product specially designed for heat-welded applications. The reinforcement shall be a non-woven fiber polyester mat in combination with a steel reinforcing mat, and stabilized with fiberglass thread to for longitudinal stability. The top finish of the membrane shall be silica sand. Testing shall conform to ASTM-D5147 for thickness, low temperature, elongation, and tear resistance. Final product selection shall be submitted to the Engineer for approval.

**CONSTRUCTION METHOD**

The Contractor shall produce uniform and parallel surfaces in the forming within the reinforced concrete deck slabs as detailed on the plans. The joint opening shall be protected by the Contractor to prevent any edge damage by any site equipment throughout the on-going construction process.

Prior to installation of the joint system, the existing seal shall be completely removed, the existing joint steel armoring where the seal is be secured shall be abrasive-blast and be blown clean using compressed air. The compressed air shall be free of moisture and oil. To insure cleanliness, the joint walls shall be wiped clean with a clean wet cloth to the depth of the bottom of the pre-compressed seal material plus 1" to remove any dust remaining. The joint gap shall be inspected for cleanliness by The Engineer. Should any contaminates remain, the joint must be re-cleaned.

The pre-compressed seal, epoxy adhesive, and injected silicone sealant band shall be installed in accordance with the Plans. The pre-compressed joint sealant shall be continuous through sidewalks, curbs, medians, and parapets as appropriate to the conditions at hand. Continuity of seal shall be achieved through the use of factory-fabricated universal or custom transitions supplied by the pre-compressed joint seal manufacturer. Due to continuity and traffic concerns the Engineer may require this work be done at night.

**Manufacturer's Field Representative**

1. The Contractor shall arrange with the pre-compressed sealant's manufacturer or distributor to have the services of a competent field representative at the work site prior to any installation to instruct the work crews in the proper installation procedures. The field representative shall remain at the job site after work commences and continue to instruct until the representative and the Contractor, Inspector and/or Engineer are satisfied that the crew has mastered the technique of installing the system successfully. The representative shall make periodic visits to the project as the work progresses and shall confer on each visit with the Contractor, Inspector and/or Engineer.
2. The manufacturer's field representative must be fully qualified to perform the work and shall be subject to the approval of the Engineer.

**ITEM 973.** (Continued)

3. The Contractor shall be completely responsible for the expense of the service of the required field representative and the bid contract price shall be full compensation for all costs in connection therewith.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 973. will be measured for payment by the Foot, measured along the joint centerline at the roadway, safety curb, sidewalk, parapet, and median, complete in place.

Item 973. will be paid for at the Contract unit price per Foot, which price shall include all labor, materials, equipment, manufacturer's representative, and all incidental costs required to complete the work.

The installation of the reinforced membrane shall be considered incidental to this item.

No separate payment will be made for removal and resetting of guardrail for access to replace the longitudinal joint seal and all items incidental for the completion of this work, but all costs in connection therewith shall be included in the Contract unit price bid.

**ITEM 975.01****METAL BRIDGE RAILING – TOP RAIL****FOOT**

The work under this Item shall conform to the relevant provisions of Subsection 975 of the Standard Specifications, Materials Subsection M8.13.0, and the following:

The work under this Item shall consist of fabrication, furnishing and installing, and replacing in-kind damaged or missing sections of aluminum bridge top rail for the locations shown on the drawings and as directed by the Engineer. The intent is to reinstall all new elements in-kind, matching the existing adjacent in-tact members in geometry, spacing, and connections. Details taken from the existing record bridge drawings are provided on the plans for reference only.

The Contractor shall field measure and verify all existing geometry and conditions prior to developing shop drawings for replacement elements. Shop drawings must be submitted for review and approval by the Engineer prior to fabrication. Shop drawings shall indicate all locations where the elements will be replaced in-kind, which sections of rail require removal and resetting as part of the replacement, and provide all necessary railing component drawings and connections details.

**METHOD OF MEASUREMENT**

Item 975.01 will be measured for payment by the Foot, measured end to end along the top rail of all newly installed rail sections.

**BASIS OF PAYMENT**

Item 975.01 will be paid for at the Contract unit bid price per Foot, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

All removal and disposal of existing damaged railing shall be considered incidental to this item. Also incidental to this item will be all hardware for newly installed rails, including hardware replaced during any resetting of rail sections.

All removal and resetting of sections of rails for replacing adjacent damaged or missing elements shall be considered incidental to this item.

---

**ITEM 975.02**                      **METAL BRIDGE RAILING – BOTTOM RAIL**                      **FOOT**

The work under this Item shall conform to the relevant provisions of Subsection 975 of the Standard Specifications, Materials Subsection M8.13.0, and the following.

The work under this Item shall consist of fabrication, furnishing and installing, and replacing in-kind damaged or missing sections of aluminum bridge bottom railing for the locations shown on the drawings and as directed by the Engineer. The intent is to reinstall all new elements in-kind, matching the existing adjacent in-tact members in geometry, spacing, and connections. Details taken from the existing record bridge drawings are provided on the plans for reference only.

The Contractor shall field measure and verify all existing geometry and conditions prior to developing shop drawings for replacement elements. Shop drawings must be submitted for review and approval by the Engineer prior to fabrication. Shops drawings shall indicate all locations where the elements will be replaced in-kind, which sections of rail require removal and resetting as part of the replacement, and provide all necessary railing component drawings and connections details.

**METHOD OF MEASUREMENT**

Item 975.02 will be measured for payment by the Foot, measured end to end along the bottom rail of all newly installed rail sections.

**BASIS OF PAYMENT**

Item 975.02 will be paid for at the Contract unit bid price per Foot, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

All removal and disposal of existing damaged railing shall be considered incidental to this item. Also incidental to this item will be all hardware for newly installed rails, including hardware replaced during any resetting of rail sections.

All removal and resetting of sections of rails for replacing adjacent damaged or missing elements shall be considered incidental to this item.

**ITEM 975.03****METAL BRIDGE RAILING – POSTS****EACH**

The work under this Item shall conform to the relevant provisions of Subsection 975 of the Standard Specifications, Materials Subsection M8.13.0 and the following.

The work under this Item shall consist of fabrication, furnishing and installing, and replacing in-kind damaged or missing aluminum bridge rail posts for the locations shown on the drawings and as directed by the Engineer. The intent is to reinstall all new elements in-kind, matching the existing adjacent in-tact members in geometry, spacing, and connections. Details taken from the existing record bridge drawings are provided on the plans for reference only.

The Contractor shall field measure and verify all existing geometry and conditions prior to developing shop drawings for replacement elements. Shop drawings must be submitted for review and approval by the Engineer prior to fabrication. Shops drawings shall indicate all locations where the elements will be replaced in-kind, which sections of rail require removal and resetting as part of the replacement, and provide all necessary railing component drawings and connections details.

**METHOD OF MEASUREMENT**

Item 975.03 will be measured for payment by Each new post installed complete in place.

**BASIS OF PAYMENT**

Item 975.03 will be paid for at the Contract unit bid price per Each post, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

All removal and disposal of existing damaged posts shall be considered incidental to this item. Also incidental will be all hardware, anchor bolts, and base plates for newly installed posts.

All removal and resetting of sections of rails for replacing adjacent posts in-kind shall be considered incidental to this item.



---

**ITEM 994.1                      TEMPORARY PROTECTIVE SHIELDING                      SQUARE FOOT**

The work under this item consists of furnishing, installing, and maintaining a protective shielding system on and under bridge(s), in locations required by the Engineer.

No portion of the bridge deck shall be removed until the protective shielding is in place and complete.

Please note that some of the bridges, due to their height (vertical clearance) will require special lifting equipment in order to place shielding for the assigned bridge repair work. Any equipment necessary to erect forms will be considered incidental to this Item.

The quantities in this contract assume that the northbound bridges will be shielded first and then the shielding is removed and reset for the southbound bridges. Regardless of construction sequence chosen by the Contractor, compensation for the shielding will be based on no more than two bridge decks paid under this Item.

Any existing formwork on the bridge shall also be removed and disposed by the Contractor away from the job area at no additional expense.

All shielding shall meet the following requirements:

1. Temporary Protective Shielding must be used on bridges over the roadway during full depth excavation and when, in the opinion of the Engineer, there is the possibility of dislodging concrete from the bottom of the deck, parapets or coping. In some cases the Contractor may be able to utilize the bottom flanges of existing steel beams as supports for the protective shielding.
2. The Contractor may be required to submit drawings and calculations stamped by a Professional Structural Engineer registered in the Commonwealth of Massachusetts, of the proposed temporary shielding to the Engineer for his approval prior to its installation. The drawings shall include details of all connections, brackets and fasteners. However, when the spacing between existing beams is 70" or less, the Contractor may utilize a wood plank shielding scheme.
3. Shielding shall be designed to safely withstand all loads that it will be subjected to. The allowable design stresses shall be in accordance with AASHTO Standard Specifications for Highway Bridges (latest edition). The design shall also include a description of the equipment and construction methods proposed for the deck, parapet, or coping excavation and also the maximum size of the area being excavated. The shielding shall also be designed to withstand the maximum size of the excavated area should it fall during excavation or removal. No debris shall be swung over traffic, on or below the bridge.

**ITEM 994.1** (Continued)

4. Shielding shall be designed such that impact on traffic during installation and removal shall be minimal. The Contractor shall submit his traffic plan to the Engineer for approval.
5. The shielding shall extend a sufficient distance above and beyond the deck overhang at the fascia where full depth concrete deck excavation is required outside the fascia beams.  
  
The shielding shall extend the length of the damaged or distressed portion of the deck a length of sufficient distance to do the required deck demolition and a minimum of one beam bay beyond the demolition limits as directed by the Engineer. The Contractor may utilize the bottom flanges of existing steel beams as supports for the protective shielding. However, the Contractor will not be permitted to weld onto, drill into, or cut any existing beams. All spaces along the perimeter of the shielding and at the seams shall be sealed to prevent dust, water, and debris from escaping and falling onto traffic below the bridge.
6. The Engineer may request that the shielding be designed so that it may also serve as false work (forms) for all areas of full-depth concrete replacement/repair.
7. The shielding shall not decrease the minimum vertical bridge clearance to the roadway unless otherwise approved by the Engineer.
8. The shielding shall be maintained and remain in place until the strength of the concrete used to repair the deck has cured and reached the design strength requirement, except where shielding needs to be removed and reset in order to install forming for the areas of full depth repair. The shielding shall remain the property of the Contractor and shall be removed by him from the site when no longer needed.

If the Contractor's operations damage any existing portions of the bridge that are to remain, such damage shall be repaired at his own expense.

All materials used in the temporary shielding system shall become the property of the Contractor and shall be removed and properly disposed from the site upon the completion of the project.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 994.1 will be measured and paid at the Contract unit bid price per Square Foot of shielding installed, maintained, and removed upon completion of repair work.

The Contract price shall include all labor, materials, tools, equipment, and incidental costs required to complete the work as required by the Engineer.

60% of the Unit bid Price will be paid upon installation of the shielding and the remaining 40% will be paid upon removal.

**ITEM 994.12**

**TEMPORARY PROTECTIVE SHIELDING  
REMOVED AND RESET**

**SQUARE FOOT**

The work to be performed under this item consists of removing any installed protective shielding and resetting shielding at a subsequent repair within the same work location after the initial repair has been completed.

The Contractor's attention is directed to the fact that previously installed protective shielding may interfere with his operations for full depth concrete deck repairs. Prior to the commencement of the Work, the Contractor shall submit for approval, construction methods of the removing and resetting protective shielding. Any debris that falls on the shielding shall be completely cleaned off and disposed of by the Contractor, outside the project location, and subject to the regulations and requirements of local authorities governing the disposal of such materials. The disposal shall be done at no additional compensation. Any shielding damaged by the Contractor's operations shall be replaced by him at his own expense.

**METHOD OF MEASUREMENT**

Item 994.12 will be measured for payment by the Square Foot of shielding removed and reset, complete in place.

**BASIS OF PAYMENT**

Item 994.12 will be paid at the Contract unit price per Square Foot of protective shielding actually removed and reset. The Contract Price shall include all labor, materials, tools, equipment, and all incidental costs required to complete the work.