

ADDENDUM #1
INVITATION FOR BIDS S-46
LORING/LAFAYETTE/WEST INTERSECTION AND SIGNALIZATION
IMPROVEMENTS
JUNE 21, 2017

Please see attached revisions to the Technical Specifications.

The due date has been extended to **Monday, June 26, 2017 at 11:00 AM.**

GENERAL STATEMENT

Unless otherwise amended by these Technical Specifications or the Contract Drawings, all work and bid items shall conform to the requirements of the applicable "Sections" of The Commonwealth of Massachusetts, Department of Public Works Standard Specifications for Highways and Bridges, 1988 Edition, including any and all amendments or addenda thereto, hereinafter referred to as the "Standard Specifications".

ITEM 415.	PAVEMENT MICROMILLING	SQUARE YARD
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All references to Section 130 Pavement Milling within Section 450 Hot Mix Asphalt Pavement shall be replaced by Item 415 Pavement Micromilling.

DESCRIPTION

This work shall consist of micromilling and removal of existing Hot Mix Asphalt (HMA) pavement courses from the project by the Contractor. Micromilling shall be performed in conformity with the approved QC Plan. The Contractor shall present and discuss in sufficient detail the Quality Control information and activities related to milling at the Construction Quality Meeting required under Section 450. Unless otherwise specified, the milled material shall become the property of the Contractor.

CONSTRUCTION PROCEDURES

All construction procedures under Pavement Micromilling shall also conform to any of the following relevant provisions of Pavement Milling:

Milling Equipment Requirements.

The milling equipment shall be self-propelled with sufficient power, traction, and stability to remove the existing HMA pavement to the specified depth and cross-slope. The milling machine shall be capable of operating at a minimum speed of 10 feet (3 meters) per minute, designed so that the operator can at all times observe the milling operation without leaving the control area of the machine, and equipped with the following:

- (a) A built in automatic grade control system that can control the longitudinal profile and the transverse cross-slope to produce the specified results.
- (b) Longitudinal controls capable of operating from any longitudinal grade reference, including string line, 30 foot (10 meter) ski minimum, 30 foot (10 meter) mobile string line minimum, or a matching shoe.
- (c) The transverse controls shall have an automatic system for controlling cross-slope at a given rate.
- (d) Cutting heads able to provide a minimum 6 foot (2 meter) cutting width and a 0 to 4 inch (0 to 100 mm) deep cut in one pass. The teeth on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture.
- (e) An integral pickup and conveying device to immediately remove milled material from the roadway and discharge the millings into a truck, all in one operation.

TECHNICAL SPECIFICATIONS

- (f) All necessary safety devices such as reflectors, headlights, taillights, flashing lights and back up signals so as to operate safely in both day and night.
- (g) A means of effectively limiting the amount of dust escaping from the milling and removal operation in accordance with local, State, and Federal air pollution control laws and regulations.

When milling smaller areas or areas where it is impractical to use the above described equipment, the use of a smaller or lesser-equipped milling machine may be permitted when approved by the Engineer.

Sweeper Equipment Requirements.

The Contractor shall provide a sufficient number of mechanical sweepers to ensure that the milled surface is free of millings and debris at the end of each day's milling operations. Each sweeper shall be equipped with a water tank, spray assembly to control dust, a pick-up broom, a dual gutter broom, and a dirt hopper. The sweepers shall be capable of removing millings and loose debris from the textured pavement.

Milling Operations.

The milling operations shall be scheduled to minimize the duration and placement of traffic on the milled surface. The milling operations shall not proceed more than 3 miles ahead of the paving operations. Under no circumstances shall the milled surface be left exposed to traffic for a period exceeding seven days. The Engineer may allow the Contractor to adjust the above limitations on milling production when necessary.

The Contractor shall coordinate milling and paving operations to minimize the exposure of milled surfaces to traffic. The Contractor shall ensure that milled surfaces are overlaid in a timely manner to avoid damage to the pavement structure. Any damage to the pavement structure resulting from extended exposure of the milled surface to traffic shall be repaired as directed by the Engineer at the Contractor's expense.

The existing pavement shall be removed to the average depth shown on the plans, in a manner that will restore the pavement surface to a uniform cross-section and longitudinal profile. The longitudinal profile of the milled surface shall be established using a 30 foot (10 meter) mobile ski, mobile string line, or stationary string line. The cross-slope of the milled surface shall be established by a second sensing device or by an automatic cross-slope control mechanism. The Contractor will be responsible for providing all grades necessary to remove the material to the proper line, grade, cross section, superelevation, and transitions shown on the plans or as directed by the Engineer. The requirement for automatic grade or slope controls may be waived by the Engineer in locations warranted by the situation, including intersections and closely confined areas.

The Engineer may adjust the average milling depth specified on the plans by $\pm 3/4"$ ($\pm 20\text{mm}$) during each milling pass at no additional payment to minimize delamination of the underlying pavement course or to otherwise provide a more stable surface. If delamination or exposure of

concrete occurs when milling a HMA pavement course from an underlying Portland Cement Concrete (PCC) pavement, the Contractor shall cease milling operations and consult the Engineer to determine whether to reduce the milling depth or make other adjustments to the operation.

Protection of Inlets and Utilities.

Throughout the milling operation, protection shall be provided around existing catch basin inlets, manholes, utility valve boxes, and any similar structures. Any damage to such structures as a result of the milling operation is the Contractor's responsibility and shall be repaired at the Contractor's expense. To prevent the infiltration of milled material into the storm sewer system the Contractor shall take special care to prevent the milled material from falling into the inlet openings or inlet grates. Any milled material that falls into inlet openings or inlet grates shall be removed at the Contractor's expense.

Vertical Faces.

All permanent limits of the milled area shall be sawcut or otherwise neatly cut by mechanical means to provide a clean and sound vertical face. No vertical faces, transverse or longitudinal, shall be left exposed to traffic. If any vertical face is formed in an area exposed to traffic a temporary paved transition with a maximum 12:1 slope shall be established. If the milling machine is used to temporarily transition the milled pavement surface to the existing pavement surface, the temporary transition shall be constructed at a maximum 12:1 slope.

Opening to Traffic.

Prior to opening a milled area to traffic, the milled surface shall be thoroughly swept with a mechanical sweeper to remove all remaining millings and dust. This operation shall be conducted in a manner so as to minimize the potential for creation of a traffic hazard and to comply with local, State, and Federal air pollution control laws and regulations. Any damage to vehicular traffic as a result of milled material becoming airborne is the responsibility of the Contractor and shall be repaired at the Contractor's expense. Temporary pavement markings shall be placed in accordance with the provisions of Subsection 850.64.

Milled Surface Inspection.

The milled surface shall provide a satisfactory riding surface with a uniform textured appearance. The milled surface shall be free from gouges, excessive longitudinal grooves and ridges, oil film, and other imperfections that are a result of defective equipment, non-uniform milling teeth, improper use of equipment, or otherwise poor workmanship. Any unsatisfactory surfaces produced shall be corrected by remilling at the Contractor's expense and to the satisfaction of the Engineer.

The Contractor shall perform Quality Control inspection of all work items addressed as specified in the table below. Inspection activities during milling of HMA pavement may be performed by qualified Production personnel (e.g. Skilled Laborers, Foremen, Superintendents). However, the

Contractor's QC personnel shall have overall responsibility for QC inspection. The Contractor shall not rely on the results of Department Acceptance inspection for Quality Control purposes. The Engineer shall be provided the opportunity to monitor and witness all QC inspection.

The milled surface of each travel lane shall be divided into longitudinal Sublots of 500 feet (150 meters). The Contractor shall perform a minimum of one random QC measurement within each Sublot with a 10 foot (3 meter) straightedge in the transverse direction across the milled surface. Additional selective QC measurements within each Sublot will be performed as deemed necessary by the QC personnel. All QC inspection results shall be recorded on NETTCP Inspection Report Forms. The Engineer will also randomly inspect a minimum of 25% of the Sublots. The Contractor shall perform surface texture measurements with a 10 foot (3 meter) straightedge in the transverse direction across the milled surface. The milled surface shall have a texture such that the variation from the edge of the straightedge to the top of ridges between any two ridge contact points shall not exceed 1/8 inch (3 mm). The difference in height from the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed 1/16" (1.6 mm). Any point in the surface not meeting these requirements shall be corrected as directed by the Engineer at the Contractor's expense.

In isolated areas where surface delamination between existing HMA layers or a surface delamination of HMA on Portland Cement Concrete causes a non-uniform texture to occur, the straightedge surface measurement requirements stated in the preceding paragraph may be waived, subject to the approval of the Engineer.

Minimum QC Inspection of Milling Operations

Inspection Component	Items 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	Protection of Inlets & Utilities	Per QC Plan	Existing Surface	Visual Check
	Removal of Millings & Dust	Per QC Plan	Milled Surface	Visual Check
Workmanship	Milling Depth	Per QC Plan	Milled Surface	Check Measurement
	Cross-Slope & Profile	Per QC Plan	Milled Surface	Check Measurement
	Milled Surface Texture	Per QC Plan	Milled Surface	Visual Check
	Milled Surface Roughness	Once per 500 feet(150 meters) per milled lane	Milled Surface per Subsection 410.67	10 foot (3 meter) standard straightedge
	Sawcut Limit Vertical Face	Per QC Plan	Sawcut Limits	Visual Check

Micromilling Equipment Requirements.

The micromilling machine shall be equipped with a drum specifically designed to provide the surface specified below.

Control Strip.

The Contractor shall micromill a control strip. The control strip shall be 500 feet minimum in length with a uniformly textured surface and cross slope, as approved by the Engineer.

The micromilled surface of the control strip shall provide a satisfactory riding surface with a uniform textured appearance. The micromilled surface shall be free from gouges, excessive longitudinal grooves and ridges, oil film, and other imperfections that are a result of defective equipment, non-uniform milling teeth, improper use of equipment, or otherwise poor workmanship. Any unsatisfactory surfaces produced in the control strip shall be corrected by additional micromilling at the Contractor's expense and to the satisfaction of the Engineer.

The micromilled pavement surface shall have a transverse pattern of 0.2 – 0.3 inch center to center of each strike area. The Contractor shall perform surface texture measurements with a 10 foot (3 meter) straightedge in the transverse direction across the milled surface. The milled surface shall have a texture such that the variation from the edge of the straightedge to the top of ridges between any two ridge contact points shall not exceed 1/8 inch (3 mm). The difference in height from the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed 1/16" (1.6 mm). Any point in the surface not meeting these requirements shall be corrected as directed by the Engineer at the Contractor's expense.

Micromilled Surface Inspection.

The Contractor shall perform Quality Control inspection of all work items addressed under Section 415. The Contractor shall not rely on the results of Department Acceptance inspection for Quality Control purposes.

The micromilled surface shall meet the requirements of 415.62.

METHOD OF MEASUREMENT

Micromilling - Micromilling will be measured for payment by the number of square yards (square meters) of area from which the milling of existing HMA pavement has been completed and the work accepted. No area deductions will be made for minor unmilled areas such as catch basin inlets, manholes, utility boxes and any similar utility structures.

BASIS OF PAYMENT

Micromilling - Micromilling, removal and disposal of existing HMA pavement will be paid for

at the contract unit price per square yard (square meter). This price shall include all equipment, tools, labor, and materials incidental thereto. No additional payments will be made for multiple passes with the milling machine to remove the existing HMA surface to the grade specified.

No separate payments will be made for: performing handwork removal of existing pavement and providing protection around catch basin inlets, manholes, utility valve boxes and any similar structures; repairing surface defects as a result of the Contractor's negligence; providing protection to underground utilities from the vibration of the milling operation; sawcutting micromilled limits; installing and removing any temporary transition; removing and disposing of millings; furnishing a sweeper and sweeping after milling. The costs for these items shall be included in the contract unit price for Pay Item 415., Pavement Micromilling.

ITEM 431.1	HIGH EARLY STRENGTH CEMENT	CUBIC YARD
	<u>CONCRETE BASE COURSE</u>	

The work under this Item shall conform to the relevant provisions of Section 430 of the Standard Specifications for Highways and Bridges and the following:

The work shall include the furnishing and placing of high early strength cement concrete for pavement base as shown on the plans and as required by the Engineer.

The work shall also include the furnishing and placing of high early strength cement concrete base course for roadway patches, capping of trenches, cradles and/or caps for designated drainage and utility lines as determined at the time of construction and as required.

High early strength cement concrete base course shall be placed to a minimum depth of 6 inches.

High early strength cement concrete that is used for the installation of granite curb shall be paid for under the respective curb items.

METHOD OF MEASUREMENT

High early strength cement concrete will be measured for payment by the cubic yard, complete in place.

BASIS OF PAYMENT

High early strength cement concrete will be paid for at the contract unit price per cubic yard, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

<u>ITEM 451.</u>	<u>HMA FOR PATCHING</u>	<u>TON</u>
<u>ITEM 452.</u>	<u>ASPHALT EMULSION FOR TACK COAT</u>	<u>GALLON</u>
<u>ITEM 453.</u>	<u>HMA JOINT SEALANT</u>	<u>FOOT</u>
<u>ITEM 455.23</u>	<u>SUPERPAVE SURFACE COURSE – 12.5(SSC-12.5)</u>	<u>TON</u>
<u>ITEM 455.32</u>	<u>SUPERPAVE INTERMEDIATE COURSE – 19.0(SIC-19.0)</u>	<u>TON</u>

Work under these Items shall conform to the relevant provisions of Document 00717 SUPERPAVE REQUIREMENTS contained herein (Appendix A) and the following:

The Equivalent Single Axle Loads (ESALs) for the design travel lane over a 20-year period is **4.9** Million 18-kip (80-kn) ESALs. The PGAB Grade selected for this Contract is **PG 64-28**

A Contractor's Quality Control Plan is required for this project.

ITEM 804.3	3 INCH ELECTRICAL CONDUIT	FOOT
	<u>TYPE NM PLASTIC (UL)</u>	

The work under this Item shall conform to the relevant provisions of Section 800 of the MassDOT Standard Specifications for Highways and Bridges, as amended, and the following:

DESCRIPTION

The work shall include the furnishing and installation of 3-inch non-metallic conduit for traffic signal and lighting systems in accordance with the plans and as required by the Engineer. Details have been attached.

MATERIALS

The conduit material shall be Schedule 80 polyvinyl chloride (PVC) plastic conduit. The conduit quantity may be increased or decreased by the Engineer depending upon actual conditions encountered as provided for in Section 4.06 of the Standard Specifications.

Gravel borrow for trench backfill, if required per the Engineer, shall be as specified in Section M1.03.0 Type c of the Standard Specifications.

CONSTRUCTION METHODS

Conduit in Grass or in Planted Areas

Where new conduits are installed in grass and planted areas, work shall include placement of a minimum of 4 inches of loam borrow, seed and any other materials replaced in kind to restore disturbed areas to their original condition. Any existing plants (bushes, flowers, etc.) removed or damaged as a result of this project shall be replaced in kind. No separate payment shall be made for this work, but all costs in connection therewith shall be included in the unit price bid for Item 804.3.

Conduit under Sidewalk, Paved Median or Driveways

Where conduit is installed in sidewalk or paved median or driveway areas, the work shall include excavating and backfilling of trenches, including the required compaction. Payment for cement concrete or asphalt pavement shall be paid for under the respective item.

Conduit Crossing Under Roadways

Trenches in existing asphalt pavements not subject to full depth reconstruction shall be sawcut to an 18 inch width. The existing pavements shall be sawcut through their full depth and the pavement removed.

After conduit installation, the trench shall be backfilled in accordance with the standard specifications and per the details shown on the contract drawings. The finished grade of the backfill shall be below existing pavement surface as shown on the construction details.

Where conduit crosses under roadways, no separate payment shall be made for the excavation, saw cutting of pavement, backfill or incidental materials, but all costs in connection therewith shall be included in the contract unit price for Item 804.3.

METHOD OF MEASUREMENT

Item 804.3, 3 Inch Electrical Conduit Type NM Plastic (UL), shall be measured per Foot of conduit actually installed.

BASIS OF PAYMENT

Item 804.3, 3 Inch Electrical Conduit Type NM Plastic (UL), shall be paid at the contract unit price bid, per Foot, which payment shall be considered as full compensation for all labor, tools, equipment, materials, and incidentals required to complete the work as described above.

ITEM 811.31 PULL BOX 12 X 12 INCHES – SD2.031 EACH

GENERAL

The work under this Item shall conform to the relevant provisions of Section 800 of the MassDOT Standard Specifications for Highways and Bridges, as amended, and the following:

Pull Boxes shall be built to the lines, grades and dimensions as shown on the Contract Drawings with the necessary frames, covers, etc. Construction methods for precast concrete units shall conform to the relevant provisions of Section 901, and Subsection M4.02.14 of the Standard Specifications.

MATERIALS

All pull boxes on this project shall be 12 inch by 12 inch (SD2.031) as detailed in the Standard Specifications. Frames and covers shall be furnished by a fabricator on the MassDOT Approved Fabricators list. The Approved Fabricators list can be found on the MassDOT website; <http://www.massdot.state.ma.us>. Cover shall be fabricated without any identifying marking on the face. Cover shall be blank with cover ribs.

SUBMITTALS

Shop Drawings, Samples, and Product Literature: Prior to ordering the below listed materials, submit Shop Drawings, samples, and product literature for all materials required to complete the work for approval. Delivered materials shall closely match the approved samples.

Coordinated Shop Drawings shall show required sizes, dimensions, sections, and profiles of units; and the arrangement of and provision for delivery and lifting devices required for the installation of work. Submit Shop Drawings with the minimum information as follows:

1. A pull box fabricator shall prepare Shop Drawings.
2. Indicate sizes, quantities, and coordination with adjacent work.
3. Deviations from the Bid Documents shall be clearly noted on the Shop Drawings.
4. No fabrication shall begin until the approval of all Shop Drawings.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment for Item 811.31 shall be at the contract unit price per each for the work specified and shall include the cost of furnishing all materials, labor, tools and equipment and all work and expense incidental and necessary to complete the work in accordance with the Contract Drawings and these specifications. Installation of temporary asphalt pavement for sidewalk repair shall be incidental to the work being performed.

TECHNICAL SPECIFICATIONS

ITEM 816. TRAFFIC SIGNAL RECONSTRUCTION LUMP SUM

GENERAL

The Work to be done under this Item shall conform to the relevant provisions of Section 815 of the MassDOT Standard Specifications for Highways and Bridges, the General Requirements for Demolition, Work Involving Painted Steel and the following:

The work to be done under this Item consists of the furnishing and installation of a new traffic control signal system, complete and ready for operation, at the following location:

- Location 1 – Lafayette Street/ Loring Avenue

The work at this location consists of the installation of one (1) traffic signal controller cabinet, foundation and pad (#1); three (3) ornamental traffic signal mast arms; two (2) mast arm foundations (#3 and #4); seven (7) pedestrian/traffic signal posts and foundations (#5, #6, #7, #8, #9, #10 and #11), five (5) pull boxes and the installation of traffic signal conduit between the foundations and pull boxes, as specified hereinafter and as shown on the drawings.

The work at this location shall be in compliance with ADA/AAB standards and shall include all or part of the following: furnishing and installing traffic control equipment including traffic signal mast arms and foundations, signal posts and foundations, a new controller, cabinet and foundation, installing signal heads, pedestrian pushbuttons, and a complete preemption system. Work shall also include furnishing and installing all materials and equipment necessary for a video detection system including video cameras, video detection processor, wire and cable, and all incidental materials and labor necessary for operating and controlling the traffic control signals at this location, as shown on the Contract Drawings and as specified herein, all in accordance with the applicable provisions of the Standard Specification for Traffic Control Devices (Section 800), NEMA Standards Publication No. TS-2, Type 1 Chassis Configuration, the Manual on Uniform Traffic Control Devices (2009 Edition) and the following:

Timing, sequence, and operation shall be as shown on the Sequence and Timing chart included in the Contract Drawings.

A list of major items required is included on the Signal Timing Plan. The lump sum price bid for Traffic Signal Reconstruction Location 1 shall be full compensation for all labor, materials, and equipment necessary or incidental to the installation of a new traffic control signal system.

Within 10 days following execution of the Contract, the Contractor shall submit shop drawings for signal supports, a list of equipment, and manufacturer's equipment specifications to the Engineer in accordance with the relevant provisions of Section 815.20. All equipment shall be listed on MassDOT's Qualified Construction Materials List.

The Contractor shall not commence any work until approval of the shop drawings and manufacturer's data has been received in writing from the Engineer. Approval of these drawings will be general in character and shall not relieve the Contractor from the responsibility of, or the

necessity of, furnishing materials and workmanship conforming to the plans and specifications.

The Contractor shall deliver to the Engineer a certificate of compliance by the manufacturer for all materials purchased from the manufacturer.

The cost of disposal of the existing signal equipment will be included in this lump sum item.

REGULATIONS AND CODE

All electrical equipment shall conform to the standards of the NEMA and U.L. wherever applicable. In addition to the requirements of the Contract Drawings, Standard Specifications, and Special Provisions, all materials and workmanship shall conform to the requirements of the NEC, ASTM, OSHA and/or ANSI, all applicable State and Local codes and Department of Public Safety regulations.

FINE TUNING, ADJUSTMENT AND TESTING PERIOD

After the Contractor has finished modifying the controller and installing all other associated signal equipment to operate as specified in the contract documents, the fine tuning, adjusting and testing period shall begin. During this period, the Contractor as required by the Engineer, will make necessary adjustments and conduct tests to insure safe and efficient operation of the equipment. This period shall not last for more than 30 days. No request for final acceptance will be considered until successful completion of the testing period.

MAINTENANCE OF TRAFFIC SIGNALS

It shall be the responsibility of the Contractor to provide all labor, equipment and material required for the maintenance of the proposed traffic signal control equipment within the project limits, including damage by automobile accident from the date of written notice given to the Engineer that the Contractor will begin work on the proposed traffic signal control system until the date when the District Highway Director shall recommend acceptance of the completed project. This written notice must be given before the Contractor may proceed with any traffic signal system work.

GUARANTEES OF THE TRAFFIC SIGNAL SYSTEM

The Contractor shall diagnose (troubleshoot) the system and at no additional charge to owner any part of the traffic signal control equipment installed by the Contractor that is found to be defective in workmanship, material, or manner of functioning within six months from date of final acceptance of the installation under this Contract.

The one-year warranty period on equipment stipulated in Subsection 815.20 of the Standard Specifications still applies.

TECHNICAL SPECIFICATIONS

ENTERING PRIVATE UTILITY COMPANY FACILITIES

The electrical service conduit and cable from the utility pole, to the traffic signal control cabinet will be provided by the Contractor. The local electric utility company will connect the terminals of the control cabinet to the source of supply.

The contractor will be responsible for all costs and fees related to the service connection provided by the utility. Their payment shall be the sole responsibility of the Contractor and considered incidental to the item.

The installation of conduit and wiring on or in local electric utility company facilities shall be in strict accordance with the regulations of the utility company. All work performed by the Contractor at local electric utility company structures shall be performed under the direct observation of a utility company inspector or representative.

The Contractor will be responsible for coordinating the electrical work in the vicinity of the control cabinets and for notifying the local electric utility company that construction has started and arranging the necessary time schedule with them for installation of electrical service to the control cabinets. Under no conditions shall the Contractor make permanent patch to the roadway or apply the final roadway surface if the roadway is to be resurfaced, or until services to the control cabinets have been completed.

For the purpose of these paragraphs, the phrase "Traffic Signal Control Equipment" is intended to include, but is not limited to: controllers, detectors, signal housings, supporting structures, cabinets, wires, conduit and all other ancillary electrical equipment used for traffic control.

MAST ARM FOUNDATIONS

Cement Concrete foundations for mast arm structures shall conform to the "Massachusetts Department of Transportation Highway Division – Mast Arm & Foundation Details Standard Drawings", which are included in the Contract Drawings.

In the event that soil conditions or ledge prevent the use of the MassDOT standard foundation types, the Contractor is responsible for the selection and design of alternative foundation types. Alternative foundation types could include spread footings, coring and socketing into rock or other foundations previously used to support similar loads. The Contractor shall obtain the necessary soil borings and soil information required for use in the selection and design of the appropriate mast arm foundations.

The Contractor shall submit Shop Drawings of any bolt circle details for approval by the Engineer. Anchor bolts shall be set accurately and tops shall be formed neatly.

The top forming of cast in place units shall extend downward for a minimum of 24 inches on the side of the foundation. The lower portion of all foundations shall be placed directly against undisturbed earth. No forms or reinforcing for foundations for mast arms and control cabinet

shall be set, nor shall concrete be placed until the excavation has been inspected by the Engineer and approval to proceed has been given.

Where soil conditions are such that, in the opinion of the Engineer, the typical foundation design is not suitable, the Engineer will provide a modified design for the foundation.

Cement Concrete foundations for mast arm structures shall conform to the “Massachusetts Department of Transportation Highway Division – Mast Arm & Foundation Details Standard Drawings”, which are included in the Contract Drawings. An assumed wind speed of 130 mph shall be used.

The Mast Arm Foundation for Foundation #2 has already been installed by others. The total depth for this 4-foot diameter mast arm foundation at the corner of Lafayette Street and West Avenue was constructed to be 19 feet deep to support a 45-foot mast arm.

Soil borings have been collected in the vicinity of the remaining proposed mast arm foundations (#3 and #4) at the corners of Lafayette Street and Loring Avenue (included hereinafter). Boring (B-1) was located in the existing sidewalk. The results indicate the soil is classified as dense dry sand. The foundation shall be a diameter of 4'-0" and a depth of 11'-0" to support a 45-foot mast arm. Boring (B-3) was located in the existing roadway. The results indicate the soil is classified as loose dry sand. The foundation shall be a diameter of 3'-6" and a depth of 13'-6" to support a 40-foot mast arm.

In the event that soil conditions or ledge prevent the use of the MassDOT standard foundation types, the Contractor is responsible for the selection and design of alternative foundation types. Alternative foundation types could include spread footings, coring and socketing into rock or other foundations previously used to support similar loads.

The Contractor shall submit Shop Drawings of bolt circle details for approval by the Engineer prior to any work being performed. Anchor bolts shall be set accurately and tops shall be formed neatly.

The top forming of cast in place units shall extend downward for a minimum of 24 inches on the side of the foundation. The lower portion of all foundations shall be placed directly against undisturbed earth. No forms or reinforcing for mast arm foundations shall be set, nor shall concrete be placed, until the excavation has been inspected by the Engineer and approval to proceed has been given.

TEST BORING LOG										SHEET 1	
Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391				Stantec Site: Intersection of Loring Ave. and Lafayette St. Salem, MA				BORING B-1 PROJECT NO. 17-0529 DATE: May 17, 2017			
Ground Elevation: Date Started: May 17, 2017 Date Finished: May 17, 2017 Driller: TF Soil Engineer/Geologist:						GROUNDWATER OBSERVATIONS					
						DATE	DEPTH	CASING	STABILIZATION		
Depth Ft.	Casing bl/ft	No.	Pen/Sec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample				
1		1	4"	0'0"-2'0"	3-5-5-9	3'0"	Medium dense loam into fine to medium sand, some coarse sand, little fine gravel, some inorganic silt.				
5		2	12"	5'0"-7'0"	7-14-12-12						
10		3	12"	10'0"-12'0"	19-28-29-35		Medium dense to very dense, fine to coarse sand, fine to coarse gravel, cobbles and inorganic silt.				
15		4	12"	15'0"-17'0"	21-25-37-46						
20		5		20'0"-21'6"	53-71-88	20'0"	Very dense, fine to medium sand, inorganic silt, some coarse sand, little fine gravel.				
25						21'6"	End of boring 21'6" Dry. No water encountered upon completion.				
30											
35											
39											
Notes: Hollow Stem Auger Size - 4 1/4"											
Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 - 30 M Dense, 30 - 50 Dense, 50+ V Dense. Cohesive: 0 - 2 V Soft, 2 - 4 Soft, 4 - 8 M Stiff 8 - 15 Stiff, 15 - 30 V. Stiff, 30 + Hard.					Trace 0 to 10% Little 10 to 20% Some 20 to 35% And 35% to 50%		CASING ID SIZE (IN) HAMMER WGT (LB) HAMMER FALL (IN)		SAMPLE SS 140 lb. 30"		CORE TYPE

TEST BORING LOG										SHEET 3		
Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391					Stantec Site: Intersection of Loring Ave. and Lafayette St. Salem, MA			BORING B-3 PROJECT NO. 17-0529 DATE: May 17, 2017				
Ground Elevation: Date Started: May 17, 2017 Date Finished: May 17, 2017 Driller: TF Soil Engineer/Geologist: 						GROUNDWATER OBSERVATIONS						
						DATE	DEPTH	CASING	STABILIZATION			
						 	 	 	 			
						 	 	 	 			
						 	 	 	 			
Depth Ft.		Casing bft		Sample No. Pen. Rec.		Depth		Blows/6"		Strata		
Visual Identification of Soil and / or Rock Sample												
1		1		12"		0'4"-2'4"		4-5-6-8		4" Concrete sidewalk.		
5		2		6"		5'0"-7'0"		8-10-8-11		3'0" Medium dense, fine to medium sand, some crushed stone, some inorganic silt, little coarse sand.		
10		3		10"		10'0"-12'0"		8-8-9-12		8'0" Medium dense, fine to coarse sand, fine gravel, little inorganic silt.		
15		4		12"		15'0"-17'0"		9-10-10-18		15'0" Medium dense, fine sand, little inorganic silt, little medium to coarse sand.		
20		5		10"		20'0"-22'0"		23-26-34-29		22'0" Medium dense to very dense, fine to coarse gravel, cobbles, little inorganic silt. Dry.		
25										End of boring 22'0" Dry. No water encountered upon completion.		
30												
35												
39												
Notes: Hollow Stem Auger Size - 4 1/4"												
Cohesionless: 0-4 V. Loose, 4-10 Loose, 10-30 M Dense, 30-50 Dense, 50+ V Dense, Cohesive: 0-2 V Soft, 2-4 Soft, 4-8 M Stiff 8-15 Stiff, 15-30 V. Stiff, 30+ Hard						Trace 0 to 10% Little 10 to 20% Some 20 to 35% And 35% to 50%		ID SIZE (IN) HAMMER WGT (LB) HAMMER FALL (IN)		CASING 	SAMPLE SS 140 lb. 30"	CORE TYPE

MAST-ARM ASSEMBLIES

Traffic signal Mast Arm assemblies shall be ornamental.

The assemblies shall conform to the relevant provisions of Subsection 815.43 of the Standard Specifications and shall be constructed of galvanized steel without a transformer base. Shoe bases shall be provided. Shop drawings and structural calculation submittals will be required for all mast arm assemblies. The wind speed utilized for the calculations shall be 130 mph. The length of mast arm shaft shall be according to the plans.

The Contractor shall furnish to the Engineer longhand design calculations and weld details for the mast arm assembly selected. Longhand design calculations shall be submitted with the Shop Drawings. All drawings and calculations must be stamped by a Professional Engineer registered in the Commonwealth of Massachusetts. The complete mast arm assembly shall be designed and constructed in accordance with the MassDOT Mast Arm & Foundation Details and Standard Drawings. Only poles from MassDOT prequalified manufacturers shall be used. A list of prequalified manufacturers can be obtained from the Bridge Engineer of the Massachusetts Department of Transportation (MassDOT).

Vertical mounting brackets of the type regularly supplied by the manufacturer and conforming to applicable provision of section 815 of the Standard Specifications shall be used for the attachment of signal heads to the mast arm. Sign brackets for mast arms shall be used in all locations where a sign is to be mounted to the mast arm. Mast arm sign brackets shall consist of a mast arm clamp assembly, mounting bracket, stainless steel bands, clamp screw, hardware, and all miscellaneous materials necessary to fix mount the sign to the mast arm.

EQUIPMENT FINISH AND COLOR

All traffic signal equipment including but not limited to mast arms, signal posts, bases, signal heads, visors (outside), doors, controller cabinets, service meter socket boxes, pedestrian push button assemblies, hardware, and rigid mounting brackets for signals and signs shall be the color Black, as approved by the City of Salem. The color shall be Powder Coated Black which shall match color number 17038 of the Federal Standard 595C "Colors Used in Government Procurement." The inside of visors shall be Flat Black in accordance with Federal color number 37038. The Contractor shall submit to the Engineer and City of Salem for approval, paint chips and sample finishes on aluminum and steel of the intended color prior to any equipment being ordered.

TRAFFIC SIGNAL POSTS AND BASES

All traffic signal posts and bases shall follow MassDOT standards. Shop drawings will be required for all traffic signal posts and bases.

Bases shall be provided with a door opening and a cast aluminum door, complete with a cap

screw fastening device and a tapped hole for a grounding lug.

CONCRETE BASES

All sweeps to be installed in concrete bases shall be $\frac{3}{4}$ inch steel sweeps with sufficient three inch steel riser to project above the finish grade of the base.

One spare sweep and riser, capped at both ends, shall be poured in place in each signal support foundation or base. The Engineer shall determine the location of the spare sweep. In any case no more than three sweeps shall be in any foundation.

CONTROLLERS AND CABINETS

The controllers, malfunction management units, detector amplifiers, bus interface units and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the National Electrical Manufacturers Association (NEMA) Standard No. TS 2, Traffic Controller Assemblies.

The top of the concrete base for the controller cabinet shall be 18 in. above grade. Controller cabinet foundations shall not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. Anchor bolts shall be internal to the cabinet. The foundation shall provide a spare sweep as required by the engineer.

All sweeps to be installed in cabinet foundation shall be 3-inch (PVC) sweeps with sufficient 3 inch PVC riser to project above the finish grade of the base. A cement concrete pad and walkway shall abut the front of the cabinet and shall be built in accordance with the MassDOT's sidewalk specifications. The width of the concrete pad and walkway shall be a minimum of 3 feet wide and shall be equal to the length of the long side of the cabinet foundation.

TS 2 TYPE 1 CONTROLLERS

Controllers shall conform to Section 3, Controller Units of NEMA No. TS 2, Traffic Controller Assemblies. The controllers shall be supplied in an 8-phase TS 2 Type 1 configuration. Controllers shall utilize an input/output interface conforming to Section 3.3.1 of the NEMA TS 2 Standard for all input/output functions with the backpanel terminals and facilities, the malfunction management unit, detector rack assemblies and auxiliary devices.

The local controller shall be capable of being operated in the full-actuated mode, in the free mode and as semi-actuated in the coordinated mode. The controller shall be Type 8DW, keyboard entry, menu-driven unit mounted in an eight-phase cabinet. The controller unit shall meet all applicable requirements of the N.E.M.A. Standard Publication No. TS-2, Type 1, MassDOT's Current Standard Specifications, and include the following as minimum requirements for the "Keyboard Entry Controller Unit":

- a. The Keyboard Entry Controller Unit must be type-tested and approved by the Department.
- b. The controller shall have hard-wire interconnect capability and internal time base coordination logic. The coordination control shall have the capabilities to operate as described under Section 815.41 of the Standard Specifications.
- c. The controller shall have a data transfer/printer port for data transfer to another controller, printer or laptop PC computer. A port shall be provided for uploading or downloading controller-operating parameters from a laptop PC computer.
- d. The controller shall have a security code function.
- e. The controller unit shall have internal fire preemption control capabilities.
- f. The phase or phases selected for "call to non-actuated" (C.N.A.) modes shall be determined as needed by keyboard entries.

The Contractor's attention is directed to Table 2, Required Signal Light Switching Assemblies, Section 815.41 of the Standard Specifications. The Contractor shall furnish the appropriate type and number of load switches and place unutilized load switches in the control cabinet for future use. Load relays shall be easily replaced using a screwdriver. Component relays requiring soldering are not acceptable.

In addition to the convenience outlet as described under Subsection 815.41, a lamp with an on/off switch shall be installed in the controller cabinet.

Construction Methods

The unit shall consist of a mainframe suitable for shelf mounting, with appropriate interface harnesses.

Operator programmable data entry shall be accomplished through a menu driven keyboard and a display located on the front panel.

Connectors shall be provided for interconnecting all inputs and outputs with their external control circuits.

Timing shall be accomplished by digital methods and with power applied shall use the power line frequency as the time base.

All components shall be operated in accordance with good commercial practice to optimize life and performance.

The design goal shall be such that, under 24 hour a day operating conditions in their circuit applications, all components shall have a life of not less than 5 years.

The circuit reference designation for each component on the printed circuit board shall be clearly

marked immediately adjacent to the component.

Electrical

The controller shall be designed for use of nominal 120 volt, 60 Hz single phase alternating current. It shall operate correctly in the voltage range of 95 to 135 volts AC.

All DC inputs and outputs shall conform to NEMA TS2 - Type 1 standards for transition zone, response time, current capability, surge and noise immunity, as well as all other applicable electrical specifications.

Environmental

The controller shall maintain all its programmed functions from -30 degrees F to +165 degrees F.

The unit shall perform to this specification when operated in relative humidity from 5% to 95%.

The unit shall conform to all applicable portions of the Environmental and Operating Standards as described in the NEMA Standards TS2-1992.

Functional

The control equipment shall also be capable of providing a yearly time program for selecting four cycle lengths, three splits, and three offsets plus flashing operation for control of local controllers. The schedule shall be as included and/or as shown on the plans.

The controller shall be fully compatible with all existing and proposed local controllers and capable of communicating with a computer at a remote location - via a telephone linkage (dial up modem) to the nearest telephone pole or manhole. The modem shall have a data rate of 1,200 baud minimum and use a 10- or 11-bit asynchronous protocol. The power on which the modem runs shall be 12 VDC. The interface shall be through an RS232 port. The modem shall have a 5-year warranty. The modem shall meet the environmental aspects of the NEMA specifications for controllers and corollary equipment.

The Contractor shall provide graphics required for intersection and system monitoring. These graphics shall be customized to reflect the exact geometry, detection, and signalization of the intersections included in the subsystem listed herein. All street names shall be labeled.

The Contractor shall program each programmable local hardware component according to the "Time of Day Schedule" as follows:

TIME OF DAY SCHEDULE (BACK UP)

	6 AM- 10 AM	10 AM- 11 AM	11 AM- 3 PM	3 PM- 7 PM	7 PM- 9 PM	9 PM- 6AM
Mon - Fri	Free	Free	Free	Free	Free	Free
Sat	Free	Free	Free	Free	Free	Free
Sun/Hol	Free	Free	Free	Free	Free	Free

NOTE: CYCLE-SPLIT-OFFSET

NOTE: Patterns shown on the plans are as follows:

AM	1-1-1
PM	2-2-2

Note: Following implementation of the system, thresholds shall be revised as fine tuning occurs.

CABINET

The TS 2 Type 1 cabinet shall meet the requirements of configuration 3 as defined in Table 5.3.1-1, "Type 1 Configurations" of the NEMA TS 2 Standard. The cabinet shall be fabricated of sheet aluminum to size six (6) dimensions as specified in Table 7.3-1 of the NEMA TS 2 Standards.

It is intended that equipment be mounted and that all necessary provisions for mounting and wiring all equipment shall be made at the factory of the controller equipment manufacturer prior to shipping the cabinet and the control components. All necessary terminal strips, brackets, etc., shall be installed at the factory. Thus, the amount of field wiring shall be kept to a minimum. Terminals for auxiliary equipment to be installed shall be clearly and permanently labeled as to functions.

No equipment components shall be stacked. Brackets, shelves, hangers, or other supports designed to assure convenient accessibility for inspection and maintenance shall be installed at the factory. Adjustable aluminum shelving is required. No plywood shelving, side panels or rear panels shall be used in any cabinet.

The cabinet shall include 4 video suppressors. The controller cabinet shall contain a video compressor mounted on the side of the cabinet for video detection.

FLASHER

Flashers shall comply with Subsection 6.3 of the NEMA TS 2 Standard and be equipped with two output indicator lights which will show flashing power out to the cabinet assembly.

FLASH TRANSFER RELAYS

Flash transfer relays shall comply with Subsection 6.4 of the NEMA TS 2 Standard.

The field electrical loading for flash operation shall be wired through the transfer relays such that the load on the 2-circuit flasher is a balanced as possible within the limitations of the signal phasing.

LOAD SWITCHES

Load switches shall comply with Subsection 6.3 of the NEMA TS 2 Standard and be equipped with two output indicator lights which will show flashing power out to the cabinet assembly. A full complement of load switches to accommodate each available position of the back panel shall be provided.

BUS INTERFACE UNITS

The Bus Interface Unit (BIU) shall comply with Section 8 of the NEMA TS 2 Standard. The BIU shall be fully interchangeable with any other manufacturer's unit and interchangeable in a NEMA TS 2 Type 1 cabinet assembly.

The BIU shall perform the interface function between port 1 at the controller unit, the malfunction management unit, detector rack assembly, and the backpanel terminal and facilities.

At a minimum, two LED indicators shall be provided on the BIU front panel. One indicator shall serve a dual use; as a power-on indication and as a diagnostic indicator for proper operation of the device. The second indicator shall serve as a transmit indicator illuminating each time data is transmitted.

MALFUNCTION MANAGEMENT UNIT

The malfunction management unit (MMU) shall comply with Section 4 of the NEMA TS 2 standard. The MMU shall be capable of operating as either a Type 16 with 16 channels (8-vehicle, 4-pedestrian, 4-overlap) or a Type 12 with 12 channels (8-vehicle, 4-overlap). The MMU's supplied shall be configured to operate as Type 16 units.

The MMU's, in either the Type 16 or Type 12 configuration, shall be capable of operating in a NEMA TS 2 Type 1 cabinet or a NEMA TS 1 cabinet without loss of functionality.

VIDEO DETECTION SYSTEM

The Contractor shall provide Video Detection Systems to detect vehicles on the intersection approaches. The system shall also provide full motion video output showing zones highlighted during detection for fine-tuning. All hardware and software within the traffic signal cabinet shall be NEMA TS-2 compliant.

The Contractor shall supply and install Video Detection Systems. The major components of the Video Detection System are further described as follows:

- A. Prior to installation of the Video Detection System a detailed site survey shall be conducted by a factory trained and certified representative. The site survey shall ensure that the design of the camera, camera location, camera optics, and video/data interconnect is appropriate for the application.
- B. The supplier of the Video Detection System shall supervise the installation and testing of the Video Detection System and computer software. A factory certified representative from the supplier shall be on site during installation. The supplier shall provide 8 hours of training in operation and maintenance of the Video Detection System.
- C. The Video Detection System shall provide one National Television Standards Committee (NTSC) color composite video output, as well as a liquid crystal display (LCD) monitor to view and adjust video detection zones.
- D. The Video Detection System shall provide flexible, user configurable detection zone placement at any orientation within the field of view of the Video Detection System Camera. It shall be possible to overlap detection zones. It shall be possible to configure the Video Detection System to provide detection signals to the traffic signal controller which is comprised of Boolean combinations of detection zones.
- E. The Video Detection System shall provide failsafe operation whereby it places continuous vehicle calls to the traffic signal controller on all detection zones in the event it senses unacceptable video from the Video Detection System Camera.
- F. The Video Detection System shall include a configuring device and/or a Windows based computer software that provides for configuring the Video Detection System, viewing real time video, and updating the flash memory of the Video Detection System with updated application software.
- G. The Video Detection System shall provide count & presence detection performance with at least 96% accuracy under normal (day and night) conditions.
- H. The Video Detection System shall utilize FLASH memory to store the resident application software.
- I. The Video Detection System shall be comprised of a Video Detection System Camera, Video

Detection System Cable, and Video Detection System Hardware.

J. Video Detection System Camera

- 1) The Video Detection System Camera shall operate without degradation over a temperature range of -34 to 60 degrees Celsius at a relative humidity of 10% to 90% condensing.
- 2) The Video Detection System Camera shall be housed in a water resistant, dust proof NEMA-4 housing. The housing shall be field rotatable to allow for proper alignment between the camera and the traveled road surface.
- 3) The Video Detection System Camera shall have a heater to prevent the formation of ice and condensation in cold weather and allow the camera to operate correctly while exposed to precipitation and direct sunlight.
- 4) The Video Detection System Camera shall have a sunshield to protect the lens from direct sunlight and direct precipitation exposure.
- 5) The Video Detection System Camera shall provide useable video and resolvable features in the video image when those features have luminance levels as low as 0.1 lux at night, and as high as 10,000 lux during the day. The Video Detection System Camera shall contain an automatic gain control (AGC) to provide a satisfactory image over the full range of light levels.

K. Video Detection System Cable

- 1) The Video Detection System Cable shall interconnect the Video Detection System Camera with the Video Detection System Hardware in the traffic signal control cabinet.
- 2) The Video Detection System Cable shall meet the design requirements of the Video Detection System Camera manufacturer, and shall be designed and manufactured specifically for the Video Detection System Camera supplied.
- 3) The Video Detection System Cable shall be capable of withstanding the rigors of outdoor environments, including all combinations of precipitation, heat and cold from -34 to 74 degrees Celsius, and direct exposure to sunlight without exhibiting any signs of deterioration over time.
- 4) The Video Detection System Cable shall be installed with a suitable drip loop to prevent the entrance of water into the housing.

L. Video Detection System Hardware

- 1) The Video Detection System Hardware shall operate without degradation over a temperature range of -34 to 74 degrees Celsius at a relative humidity of 10% to 90% condensing.
- 2) The Video Detection System Hardware shall include interface device(s) which shall be installed in the traffic control cabinet.
- 3) The interface device(s) shall be used to terminate the traffic controller cabinet end of the Video Detection System Cable.
 - a) The interface device(s) shall contain transient suppression devices for all signals

transported on the Video Detection System Cable, including but not limited to video, data, and power.

- The surge protector shall be electrically connected to the cabinet ground rod.
 - Surge protectors should have peak surge current protection of at least 10K amperes with a response time of less than 5 nanoseconds. The protector complies when a lab report from an independent test laboratory stating the product passes this specification is submitted with the shop drawings.
 - Units should be pre-approved or unconditionally warranted for at least 10 years and certified to comply with the product's published specifications by an independent laboratory.
- b) The interface device(s) shall contain a switch or shut-off mechanism that shall allow the user to turn off AC service to all components of the Video Detection System.
- c) The interface device(s) shall contain a connector for interfacing to a configuring device and/or a Windows based computer in the field for the purpose of configuring the Video Detection System, viewing real time video, and for updating the flash memory of the Video Detection System with updated application software.
- 4) The Video Detection System Hardware shall include all required cables for interconnection to the traffic signal controller, AC power service, a modem for transport of NTSC video to the traffic operations center, and a configuring device and/or a Windows based computer in the field.

All limbs and/or branches of trees, regardless of size, that restrict camera visibility shall be trimmed or removed. All locations for tree trimming shall be determined by, and all tree trimming work shall be done to the satisfaction of the City. The quality and method of work shall conform to accepted tree trimming practices. All trees to be trimmed must be within the City Right of Way.

SPARE EQUIPMENT

The Contractor shall provide the following spare signal equipment in the traffic signal controller cabinet:

1. A full complement of load switches to accommodate each available position of the back panel;
2. A full complement of flash transfer relays to accommodate each available position of the back panel;
3. A 25 foot RS-232 cable for communication function with a laptop computer.
4. Two spare BIUs.

OPTICAL FIRE PREEMPTION SYSTEM

To be consistent with equipment provided at other locations in the City of Salem, the optical Fire Preemption System shall be manufactured by OPTICOM.

The work consists of furnishing and installing optical traffic signal preemption systems ready for operation, as described herein and shown on the plans. Included in the work are the furnishing and installing of traffic signal preemption unit and related equipment, optical detection equipment and all necessary connections to the traffic signal controller. A separate cable shall be installed for the fire preemption equipment, apart from the traffic signal cable.

The fire preemption system shall consist of a data-encoded phase selector to be installed within the existing control cabinet. This unit will serve to validate, identify, classify, and record the signal from the optical detectors located on support structures at the intersection. Upon receiving a valid signal from the detector, the phase selector shall generate a preempt call to the controller initiating a preemption operation as shown on the plans.

The phase selector shall be a rack-mounted plug-in four channel, dual priority device. Programming the phase selector shall be via a PC-based computer utilizing unit specific software. One copy of software on a disk shall be supplied and licensed to the City as part of this contract. A hard copy of final programming data shall be left in the control cabinet. The Contractor shall supply a complete set of interface cables for phase selector to laptop connection.

Emergency vehicles equipped with optical energy emitters transmit optical energy impulses to optical detectors mounted at the intersection. When optical energy impulses are received at the intersection, control of the signals shall transfer from the local controller to show a selected display shown on the plans to assist the vehicle through the intersection without conflict. After the vehicle has passed through the intersection, control of the signals shall then return to the local controller which shall restore the appropriate timings that were in effect prior to preemption.

1. General Operation and Description of Work

The following description of work specifies the responsibilities involved in the installation of optical preemption equipment.

The Contractor is required to supply material and labor, required or shown for the complete installation of optical preemption equipment at the specified location in this project. Intersection preemption equipment required includes optical detectors, phase selectors, card rack, preemption indicator lights, cable, interfacing of preemption equipment to the local and system master, making electrical connections and all required incidentals.

The following area the operational requirements of the optical preemption system:

- Operating sequence, as specified, shall be initiated when detector receives optical energy of the required repetition rate from an emitter.
- Detector shall transform the optical signals into electrical signals and transmit the electrical signal to the phase selector for processing.
- Phase selector shall cause the local or closed loop system master to show a selected display identical to one of the color interval displays normally available in the controller which will assist the emergency vehicles through the intersection without conflict.
- Phase selector shall allow the controller to release from hold and resume normal operation after optical energy signals are lost provided the desired green display has already been obtained. The controller shall not allow service following released to normal operation to any phase where an active call from a waiting vehicle or pedestrian does not exist. Detector cable for optical preemption equipment shall meet specifications of the system manufacturer.

The Contractor shall arrange for a trained representative of the manufacturer of the optical energy preemption equipment to perform the following field supervision and turn-on services:

- The representative shall select the proper quantity and place and method of installing all components on each controller, to comply with the operational requirements shown in the preemption schedule included in these special provisions.
- The representative shall instruct the Contractor and municipal personnel in the procedures of installation and operations.
- The representative shall be available to assist, supervise and check all wiring to insure proper operation.
- The representative shall perform a final checkout to include initial adjustment of range and timing to acceptable standards within the capabilities of the intersection.
- The representative shall initiate documentation for as-built drawings.
- The representative shall demonstrate the system and instruct the drivers of fire fighting vehicles in the operation of the system.
- Any operation problems occurring within the next 30 days shall be corrected by the Field Service representative. This requirement is not intended to modify the Contractor's six-month guarantee obligation, as set further in an earlier portion of these Special Provisions.

The cost of these field supervision and turn-on services shall be included in the lump sum prices bid for traffic signal controls and no additional payment shall be made therefor.

2. Installation

The preemption equipment manufacturer shall be responsible for preemption system design and documentation.

Preemption System Design and documentation shall include the following:

- Provide the installing agency with locations for detector installation. Suggested detector locations are shown on the plans and may be changed to improve the operation. Notice shall be given to the Engineer prior to any change.
- Provide the controller manufacturer, Engineer and owner with electrical diagrams.

The installer shall install the equipment consistent with the preemption equipment manufacturer's recommended installation procedures and electrical diagrams in a neat and workmanlike manner.

Operating checkout includes the following:

- Verifying that the pre-emption system is properly installed as per the pre-emption equipment manufacture's recommendations and the electrical diagrams as provided by the pre-emption equipment manufacturer.
- Verifying that the priority system timing and range are property set. Pre-emption equipment warranties are put into effect.
- Instructing the vehicle drivers or their representative(s) in the operation of the pre-emption system.

3. Warranty

All components of the preemption system specified herein, shall be warranted by the manufacturer to be free of defects in materials and workmanship for a period of two years from the date of delivery or one year from the date of installation, whichever occurs first.

The Contractor shall repair or replace, free of charge to the City of Salem, any part that fails in any manner during the warranty period, and six months after final acceptance of the project by the Owner.

PREEMPTION CONFIRMATION LIGHT

A preemption confirmation light shall be provided and mounted as shown on the plans. It shall be located in a position where it may be visible from all preemption approaches to each intersection. The light shall be weather tight and consist of a double flash clear (white) strobe which shall be illuminated whenever the controller is in the emergency preemption phase. The indicator light shall meet ITE, NEMA, IMSA and MassDOT standards. It shall be capable of flashing at a rate of 60 to 75 flashes per minute. Candela intensity shall be a minimum of 1,000 for clear lenses.

SIGNAL HOUSINGS

Vehicle Signal Heads - All indications shall be equipped with a cut-away visor, and red, yellow, and green LED signal modules. All signal head shall have 5 inch backplates with a reflective border.

Pedestrian Signal Heads - All indications shall be equipped with a hood visor, and lunar white and portland orange LED signal modules.

The final adjustment of the facing of signals shall be made as required by the Engineer after all the signals at an intersection are operating, but prior to installing the through bolt above.

LIGHT EMITTING DIODE (LED) SIGNAL MODULE

Any equipment that has been type-tested and approved according to Section 815.21 of the Standard Specifications prior to the date of award of this Contract will be considered as meeting these Specifications.

All Red, Yellow and Green LED signal housings with the exception of optically programmed and fiber-optic housings shall conform to the following:

All Red and Green LED signal modules shall conform to "Interim LED Purchase Specification of the Institute of Transportation Engineers, Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules", July, 1998, or most current version, Institute of Transportation Engineers (ITE), 1627 Eye Street, NW, Suite 600, Washington, DC 20006.

Yellow LED signal modules shall conform to the above specifications with the exception that yellow modules shall meet maintained Minimum Luminous Intensity values of Table 1, Section 4 of the above referenced ITE specification of compliant green signal modules at 25°C at 120 volts AC, throughout the useful life based on normal use in traffic signal operation over the operating temperature range.

All signal modules shall conform to the following: (In the case of a conflict, the following special provision shall overrule.)

An independent laboratory shall certify that the LED signal module complies with Section 6 Quality Assurance of the above stated ITE LED Purchase Specification.

LED signal modules must be type-tested and approved by the Department according to the requirements of Subsection 815.21 of the Standard Specifications for Highways and Bridges.

On the backside of the LED signal module there shall be a permanently marked "up" arrow to aid in the proper orientation of the module during installation.

The manufacturer's name, trademark, serial number and other necessary identification shall be permanently marked on the backside of the LED signal module.

Physical and Mechanical Requirements

LED signal modules shall fit without modifications into existing traffic signal housings conforming to "Vehicle Traffic Control Signal Heads" (VTCSH) published in the Equipment and Materials Standards of the Institute of Transportation Engineers. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation. The LED signal assembly construction shall conform to the applicable ASTM specifications for the materials used to fabricate the module.

Each red LED signal module shall be comprised of a smooth surfaced Red, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Each yellow LED signal module shall be comprised of a smooth surfaced Yellow, or transparent, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Each green LED signal module shall be comprised of a smooth surfaced Green, or transparent, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Optical and Light Output Requirements

The minimum luminous intensity values and light output shall be maintained within the rated input voltage of 117 Volts AC. Red and Green LED signal modules shall not be allowed to fall short of the minimum intensity values at any of the 44 measuring points of the standard when the lamp is turned on cold for measurements and after a 30 minute warm-up time period at 100% duty cycle. Yellow LED signal modules shall not be allowed to fall short of the minimum intensity values for green modules as described above, at any of the 44 measuring points of the standard.

Electrical

The maximum wattage for red and green 300-mm balls shall be 20 Watts and 10 Watts for the 300-mm red and green arrows. The maximum wattage for 300-mm yellow balls shall be 24 Watts and 12 Watts for the 300-mm yellow arrows.

The LED sources shall not be powered above 70% of the manufacturer's specified rated load. This shall be clearly shown in layman's terms through calculations, schematics, catalogue cuts, etc.

Red LED sources shall be AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Yellow LED sources shall be AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Green LED sources shall be InGaN (Indium Gallium Nitride) type shown clearly in a catalogue cut or similar literature.

Warranty

The LED signal module will be replaced or repaired by the manufacturer if it exhibits a failure due to workmanship or material defects within the first 60 months of field operation.

The LED signal module will be replaced or repaired by the manufacturer if it exhibits either a greater than 40 percent light output degradation or a fall below the minimum intensity levels within the first 36 months of field operation.

PEDESTRIAN SIGNAL HEADS

The pedestrian signal heads shall be 16 inch countdown pedestrian signals. The signal shall consist of international symbols of an LED upright hand symbolizing "DON'T WALK" and a walking person symbolizing "WALK". The internal countdown module shall be comprised of two 7 segment digits, 8 inches high and made of 88 red LED's. The countdown module shall display the number of seconds remaining throughout the flashing "DON'T WALK" pedestrian, and blank out when not activated. All LED indications on the pedestrian signal shall have an automatic dimming circuit for night illumination to reduce long-term degradation to the LED's.

PEDESTRIAN PUSH BUTTON

Pedestrian push buttons shall be located as close as practicable to the sidewalk curb ramp serving the controlled crossing and shall permit operation from a clear ground space. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian push buttons and/or legends on the pedestrian push button signs should clearly indicate which crosswalk signal is actuated by each pedestrian push button.

Pedestrian pushbuttons shall be installed on a saddle of cast aluminum with the approved MassDOT, Highway Division instructional legend, firmly attached to the casting. The saddle shall have a clear coat finish. The plunger shall be a maximum of 42 inches above the finished sidewalk and a minimum of two inches in the smallest dimension. The force required to activate

controls shall be no greater than 5 lbs. This sign and saddle shall be used in locations where a pushbutton is shown on the plans

ACCESSIBLE PEDESTRIAN SIGNALS

Audible pedestrian signals shall be provided at the locations shown on the Contract Drawings. The accessible pedestrian signals/pedestrian push button shall provide visually impaired pedestrians with a locator tone that will allow them to find the push button to actuate the walk signal. Once the push button call has been placed, the button will provide both an audible and a tactile response during the WALK phase of the cycle. The push buttons shall clearly indicate by means of tactile arrows which crosswalk signal is actuated by each push button. Audible pedestrian signals shall be of the type which produces a percussive tone during the walk signal. The assemblies shall be capable of adjusting audible volume to ambient noise levels. Audible pedestrian signals shall conform to the requirements of the MUTCD, including sound level requirements for locator tone and percussive tone during the walk signal.

The push button assembly and hardware shall be the color Black , with approval by the City of Salem. The color shall match color number 17038 of the Federal Standard 595C “Colors Used in Government Procurement.”

BACKPLATES

Backplates shall be aluminum with a non-louvered profile. Backplates shall have a 5 inch border width and which includes a 3” reflectorized yellow border. The border shall be made from an adhesive-backed retroreflective yellow micro-prismatic sheeting, Type III or IV, and cover the entire perimeter of the backplate. The sheeting shall be placed no closer than ½-inch to any single louver, and no sheeting shall cover any portion of a louver.

VISORS

All vehicular traffic signal indications shall come equipped with cut-away visors.

Pedestrian signal heads shall come equipped with cut-away visors.

Pedestrian Signal Heads – Heavy duty blind clamp fittings are required for mounting hardware.

Where mast arm mounting is required, including at intermediate arm locations, signal heads shall be all vertically fixed-mounted.

The final adjustment of the facing of signals shall be made as required by the Engineer after all the signals at an intersection are operating, but prior to installing the through bolt above.

TRAFFIC SIGNAL INTERSECTION CABLE

Intersection Cable - All traffic signal cable placed underground in conduit shall be stranded copper No. 12 AWG per IMSA 20-1. All traffic signal cable placed from the transformer base to the signal shall be stranded copper No. 14 AWG per IMSA 20-1.

Circuit protective device for the tap from No. 12 AWG to No. 14 AWG at the signal base shall not exceed 15 amps and shall comply with the N.E.C.

All traffic cables shall be labeled with suitable, durable, permanently legible tags or markers. Individual conductors, when not enclosed by the cable outer jacket, shall be bundled by phase and labeled with the appropriate phase designation.

A single cable shall be used in all conduit runs requiring up to 30 conductors. No more than 2 cables may be used for runs of 31 to 60 conductors, and no more than 3 cables may be used for runs of 61 to 90 conductors. These shall be the only cables carrying signal or pushbutton circuits in any one conduit.

A minimum of five (5) spare conductors shall be provided in the base of each signal post, mast arm pole and strain pole. Openings, where cables enter the base of a cabinet, shall be sealed with an approved elastic sealing compound. The open ends of conduits entering or leaving mast arms, posts and pull boxes shall also be sealed with the approved elastic sealing compound.

WIRING DIAGRAMS

Five sets of modified wiring diagrams for the control cabinet and all accessories shall be furnished including one mylar reproducible copy for the control cabinet when installed. All actual and potential terminal strip connections shall be shown. Accessory equipment includes flashers, switches, relays, logic modules, detectors, etc. All identification on the diagrams shall be as installed, and all field labeling shall be consistent with the diagrams. Furthermore, the format symbols, identifications, operating sequence, etc., common to all the intersection wiring diagrams shall be standardized and consistent with appropriate MassDOT standards. Before acceptance of the job, the five copies of all operating and maintenance manuals and complete and accurate parts lists shall be supplied.

All tests and any necessary repairs and replacements required to produce a fault-free system shall be included in the lump sum price bid for this Item.

SERVICE CONNECTION

All service cable shall be stranded copper No. 6 AWG. All power supply cable shall be labeled.

The Contractor shall furnish and install, or cause to be installed, all service equipment (120 volt, 60 cycle) to the satisfaction of the utility company (120/240 volt service connection will not be acceptable).

METHOD OF MEASUREMENT

Traffic Signal Reconstruction Location 1 shall be measured per Lump Sum per location.

BASIS OF PAYMENT

Traffic Signal Reconstruction Location 1 will be paid for at the Contract Lump Sum price for Item 816., which price shall include all labor, materials, equipment and incidental costs to complete the work and include disposal of the existing traffic signal equipment.

ITEM 841.1 SUPPORTS FOR GUIDE SIGN (D6 w/D8 - 5 INCH EACH
TUBULAR POST) STEEL

The work under this Item shall conform to the relevant provisions of Section 840 Sign Supports of the MassDOT Standard Specifications for Highways and Bridges, as amended, and the following:

The Work shall include the removal, storage, protection, handling, and re-installation of ground mounted guide sign panels onto new supports at two locations as shown on the contract drawings. The work includes all associated excavations, concrete foundations, the supplying and placing of compacted gravel, as required by the Engineer, and the restoration to original condition of any adjacent natural features disturbed in any way or manner by the operation.

Work shall also include the excavation (including Class “B” rock) of any existing foundations to be removed to a depth of at least 6 inches below grade.

MATERIALS

If in the opinion of the Engineer, the existing sign panels are unsuitable for reuse, new sign panels of a size and composition equal to the existing sign panels shall be furnished, as required by the Engineer, at no additional cost.

CONSTRUCTION METHOD

The sign panels shall be mounted in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and the 1990 Standard Drawings for Signs and Supports.

When the visibility of the relocated sign panels is obstructed by trees and other vegetation, the Contractor shall clear the obstruction for proper sight distance. All clearing shall be done within the roadway layout, as approved by the Engineer.

Existing sign panels to be re-used shall be cleaned before being re-installed. Damage during removal or resetting to any sign panel designated for reuse by the Engineer shall be repaired or replaced by the Contractor at his own expense.

METHOD OF MEASUREMENT

The quantity of Supports for Guide Sign (D6 w/D8 – 5 inch Tubular Post) Steel to be installed shall be measured by EACH sign support installation, complete in place, including all excavations, foundations, backfill and the reinstallation of existing sign panels or the furnishing and installation of new sign panels, as required by the Engineer.

BASIS OF PAYMENT

Payment for Supports for Guide Sign (D6 w/D8 – 5 inch Tubular Post) Steel to be installed at the locations shown on the contract drawings or as directed by the Engineer, will be made at the contract unit price per each complete installation, regardless of the number of existing or new sign panels installed on each new sign support.

The Contract Price shall constitute full compensation for furnishing and installing all materials, labor, equipment, tools, appurtenances and incidentals necessary to satisfactorily perform the work, complete in place, and accepted.

No separate payment will be made for all excavation including class “B” rock excavation; removal, storage, protection, handling, and re-installation of existing ground mounted guide sign panels or furnishing of new sign panels; gravel backfill, as required by the Engineer; compaction and restoration work but all costs in connection therewith shall be included in the price bid.

The cost of any work or materials required, due to the Contractor's negligence, shall be borne by the Contractor.

ITEM 864.35	SLOTTED PAVEMENT MARKER	EACH
	<u>TWO WAY YELLOW/YELLOW</u>	

DESCRIPTION

The work to be done under these items shall consist of furnishing and installing two-way yellow, reflectorized pavement markers (slotted in pavement) in accordance with the construction plans, the relevant provisions of Traffic Standard TR.6.5 "Typical Pavement Markings for Conventional Roadways", and the following:

CONSTRUCTION METHODS

The work shall include cutting the tapered pavement slot to the dimensions shown on the typical details for the two-way markers, application of the manufacturer's recommended epoxy adhesive, and placing the reflectorized pavement marker in the proper position within the slot so that the reflective face is visible and perpendicular to oncoming traffic and so that the top of the marker is set 1/8± inch below the top of the adjacent pavement.

Surface preparation and installation shall be strictly in accordance with the manufacturer's instructions.

MATERIALS

Reflectorized pavement markers shall be 3M Series 291-2Y, Ennis-Flint Stimsonite C80, Ray-O-Lite Model 2004 Type D or an approved equal.

METHOD OF MEASUREMENT

The number of two-way yellow reflectorized pavement markers (slotted in pavement), completely furnished and installed, shall be measured by the Unit Each as a complete installation.

BASIS OF PAYMENT

Two-way yellow reflectorized pavement markers (slotted in pavement) will be paid at the contract unit price each under Item 864.35, and shall include cutting the tapered pavement slot, furnishing and installation of the reflectorized markers, including all necessary materials, labor, incidentals, and equipment to complete the work.

<u>ITEM 874.2</u>	<u>TRAFFIC SIGN REMOVED AND RESET</u>	<u>EACH</u>
<u>ITEM 874.4</u>	<u>TRAFFIC SIGN REMOVED AND STACKED</u>	<u>EACH</u>

The work under these Items shall conform to the relevant provisions of Section 840 of the Standard Specifications and the following:

The work to be done consists of removing and resetting existing street, warning and regulatory sign panels to new locations as shown on the Plans or as required by the Engineer and removing and stacking existing street, warning and regulatory sign panels as required by the Engineer.

The Contractor shall replace, at Contractor's own expense, all sign panels that are damaged or lost either directly or indirectly as a result of his carelessness.

MATERIALS

Materials for street sign and traffic sign panels removed and reset shall be the existing sign panels. If, in the opinion of the Engineer, an existing sign panel is unsuitable for reuse, a new sign panel of a size and composition equivalent to the existing sign panel, shall be furnished, as required by the Engineer.

CONSTRUCTION

Signs shall be mounted in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and the 1990 Standard Drawings for Signs and Supports.

When the visibility of sign panels, as reset, is obstructed by trees and other vegetation, the Contractor shall clear the obstruction for proper sight distance. All clearing shall be done within the roadway layout, as approved by the Engineer.

Existing sign panels shall not be removed until the new sign panels replacing them are in place and ready for traffic, unless otherwise required by the Engineer. Sign panels to be removed and reset shall be cleaned before being reset. Sign panels to be removed and stacked shall be stored at locations designated by the City of Salem.

Damage during removal or resetting to any sign panel designated for reuse by the Engineer shall be repaired or replaced by the Contractor at his own expense.

METHOD OF MEASUREMENT

Traffic Sign Removed and Reset and Traffic Sign Removed and Stacked will both be measured per Each unit, as determined by actual count of existing sign panels.

BASIS OF PAYMENT

Traffic Sign Removed and Reset and Traffic Sign Removed and Stacked shall each be paid for at the contract price per Each unit and shall include full compensation for furnishing all labor, tools,

materials, equipment and incidentals, and for doing all the work. The price paid per Each unit for Traffic Signs Removed and Reset shall also include all required mounting fixtures (nuts, bolts and other miscellaneous items) to complete the work.

If required by the Engineer, new Traffic Sign panels shall be furnished, installed and paid for under Item 832. Warning - Regulatory and Route Marker - Aluminum Panel (Type A).

The cost of any work or materials required as a result of any damage to sign panels due to the Contractor's negligence shall be paid for by the Contractor at his own expense.

ITEM 877.	SIGN POST REMOVED AND RESET	EACH
ITEM 877.1	SIGN POST REMOVED AND DISCARDED	EACH

The work under these Items shall conform to the relevant provisions of Section 840 of the Standard Specifications and the following:

The work to be done consists of removing and resetting existing street, warning and regulatory sign posts to new locations as shown on the Plans or as required by the Engineer and removing and discarding existing street, warning and regulatory sign posts as required by the Engineer.

The Contractor shall replace, at Contractor's own expense, sign supports designated for reuse, that are damaged or lost either directly or indirectly as a result of his carelessness.

MATERIALS

Materials for street sign and traffic sign posts removed and reset shall be the existing posts. If, in the opinion of the Engineer, an existing sign post is unsuitable for reuse, a new sign post of a size and composition equivalent to the existing sign post, shall be furnished, as required by the Engineer.

CONSTRUCTION

Sign posts shall be installed in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and the 1990 Standard Drawings for Signs and Supports.

When the visibility of sign panels, as reset, is obstructed by trees and other vegetation, the Contractor shall clear the obstruction for proper sight distance. All clearing shall be done within the roadway layout, as approved by the Engineer. The exact locations for sign posts shall be determined in the field by the Engineer, in cooperation with a representative of the City of Salem Traffic Department.

Sign posts to be removed and reset shall be cleaned before being reset. All posts shall be reset prior to placing the cement concrete for the new sidewalks. Sign posts to be removed and discarded shall be properly discarded by the Contractor.

Damage during removal or resetting to any sign post designated for reuse by the Engineer shall be repaired or replaced by the Contractor at his own expense.

METHOD OF MEASUREMENT

Sign Post Removed and Reset and Sign Post Removed and Discarded will both be measured per Each unit, as determined by actual count of existing sign posts. Measurement for Sign Post Removed and Reset will be measured in place by Each unit, complete and approved. Sign Posts Removed and Discarded shall be removed and properly discarded by the Contractor.

BASIS OF PAYMENT

Sign Post Removed and Reset and Sign Post Removed and Discarded shall each be paid for at the contract price per Each unit and shall include full compensation for furnishing all labor, tools, materials, equipment and incidentals, and for doing all the work.

The price paid per Each unit for Sign Post Removed and Reset shall be full compensation for all other miscellaneous items to complete the work, including excavation and backfill.

The unit price bid for Item 877. Sign Post Removed and Reset shall be full compensation for removal and resetting existing sign posts, including all excavation (except rock); for all backfill, including 3,000 psi, 1-1/2 inch maximum aggregate cement concrete; and for all labor, equipment, tools and incidentals necessary to complete the work in accordance with these Specifications and as directed by the Engineer.

The unit price bid for ITEM 877.1 Sign Post Removed and Discarded shall be full compensation for the dismantling, removing and discarding of the sign post and for all labor, materials, equipment, tools, and incidentals necessary to complete the work, all as shown on the Contract Drawings, as specified in these Specifications and as required by the Engineer.

If required by the Engineer, new Sign Posts shall be furnished, installed and paid for under Item 847.1. Sign Support (Non-Guide) and Route Marker w/Breakaway Post Assembly - Steel.

The cost of any work or materials required as a result of any damage to sign posts due to the Contractor's negligence shall be paid for by the Contractor at his own expense.