

Charles D. Baker, Governor Karyn E. Polito, Lieutenant Governor Stephanie Pollack, Secretary & CEO Jonathan L. Gulliver, Highway Administrator



July 31, 2020

604123-111717

ADDENDUM NO. 1

To Prospective Bidders and Others on:

<u>ASHLAND</u> Federal Aid Project Nos. CMQ-003S(390), STP-003S(390) & TAP-003S(390) Roadway Reconstruction and Related Work along Route 126 (Pond Street)

BIDS TO BE OPENED AND READ ON: TUESDAY, AUGUST 11, 2020 AT 2:00 P.M.

Transmitting revisions to the Contract Documents as follows:

<u>RESPONSES TO</u> <u>CONTRACTORS' QUESTIONS:</u>	2 Pages
DOCUMENT 00010:	Revised page 1
DOCUMENT 00715:	Deleted document in its entirety and inserted new document (54 pages)
DOCUMENT 00813:	Deleted document in its entirety and inserted new document (4 pages)
DOCUMENT A00801:	Revised pages 2, 7, 203, 206, 209, 212, and 215
<u>PLAN SET:</u>	Revised Sheets 135, 137, and 139 of 331

Take note of the above, substitute revised pages and plans for the originals, delete documents indicated, insert new documents in proper order, and acknowledge <u>Addendum No. 1</u> in your Expedite Proposal file before submitting your bid.

Sincerely,

for Eric M. Cardone, P.E. Acting Construction Contracts Engineer

Cc: Lawrence Cash, Project Manager EMC/jmr

ASHLAND Federal Aid Project Nos. CMQ-003S(390), STP-003S(390) & TAP-003S(390) Roadway Reconstruction and Related Work along Route 126 (Pond Street) (604123-111717)

RESPONSES TO CONTRACTORS' QUESTIONS

J. H. Lynch email dated July 23, 2020:

Question #1: The RRFB's (Item 824.211 to 824.227) are not called out on any plans. Please provide plans to show foundations and conduit locations.

Response #1: The Pavement Marking & Signing Plans include the RRFB callouts and the related conduit. Refer to the RRFB Details plan for additional information related to the RRFB foundations.

Question #2: The Traffic Signal plans call out for service connections at Traffic Signal Location # 2 and Traffic Signal Location # 3. Please add the items 813.82 and 813.83 that are shown on sheets 136 and 138 respectively.

Response #2: Per the specification, the service connections are included under Items 815.1, 815.2, and 815.3. Refer to revised Sheets 135, 137, and 139 of 331.

Mass Bay Electrical Corp. email dated July 27, 2020:

Question #3: We cannot find any of bid item 813.30 - WIRE TYPE 7 NO. 10 GENERAL PURPOSE – 45,500 FEET. The No. 10 wire from handholes to light fixtures and receptacles is paid for under item 813.399 – SPLICE AND EXTENSION FRON HANDHOLE TO LIGHTING FIXTURES. Should bid item 813.30 be eliminated?

Response #3: *This question will be addressed in a later addendum.*

Question #4: Are both lighting and pole mounted receptacles to be controlled by contactors? If so, load center details on drawing 180 do not show enough contactors. Our understanding is that there should be two 10-pole contactors in load center 1, and two 8-pole contactors in load center 2. Please advise.

Response #4: *This question will be addressed in a later addendum.*

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RESPONSES TO CONTRACTORS' QUESTIONS

J. H. Lynch email dated July 28, 2020:

Question #5: The Drainage & Utility Details state to see MassDOT Detail E 205.2.0 for the standard leaching basin detail.

Please confirm that the leaching basins may be precast, in lieu of being constructed of cement concrete blocks.

Response #5: Precast leaching basins are acceptable.

Question #6: Sheet 192 Roundabout Apron Detail

Please provide a detail of the expansion and contraction joints, including smooth dowels bars and preformed joint filler.

Please provide clarification of the 12"x12" slate stone, 12" wide patterned accent strips. Are the accent strips to be colored concrete (gray?) or slate stone?

Response #6: *This question will be addressed in a later addendum.*

Advanced Drainage Systems, Inc., email dated July 29, 2020:

Question #7: The Project is currently specified with 12-, 15-, 18-, and 24-inch Reinforced Concrete Pipe (RCP), as well as 12-, 15-, 18-, and 24-inch RCP Class V. Item Number and quantities are as follows:

241.12 = 12-Inch Reinforced Concrete Pipe (2,500 LF) 241.15 = 15-Inch Reinforced Concrete Pipe (475 LF) 241.18 = 18-Inch Reinforced Concrete Pipe (880 LF) 241.24 = 24-Inch Reinforced Concrete Pipe (1,000 LF)

244.12 = 12-inch Reinforced Concrete Pipe Class V (1,900 LF)

244.15 = 15-inch Reinforced Concrete Pipe Class V (500 LF)

244.18 = 18-Inch Reinforced Concrete Pipe Class V (1,750 LF)

244.24 = 24-Inch Reinforced Concrete Pipe Class V (1,170 LF)

We would like to respectfully request that corrugated polypropylene pipe (per AASHTO M330) be allowed under the pipe option for the above referenced items; polypropylene pipe (per AASHTO M330) is included within the Commonwealth of Massachusetts Department of Transportation Standard Specifications for Highways and Bridges (2020 Edition) Division III-Materials Specifications, Section M5.03.10 Corrugated Plastic Pipe. If allowed, the installation of the corrugated polypropylene pipe (per AASHTO M330) would follow MassDOT Installation Guidelines.

Response #7: The concrete pipes, as specified in the contract documents, shall be used.

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DOCUMENT 00010

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DOCUMENT 00210 REQUIREMENTS OF MASSACHUSETTS GENERAL LAWS CHAPTER 30, SECTION 39R; CHAPTER 30, SECTION 390	
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DOCUMENT 00760 REQUIRED CONTRACT PROVISIONS FOR FEDERAL-AID CONSTRUCTION CONTRACTS	
DOCUMENT 00811 MONTHLY PRICE ADJUSTMENT FOR HOT MIX ASPHALT (HMA) MIXTURES	
DOCUMENT 00812 MONTHLY PRICE ADJUSTMENT FOR DIESEL FUEL AND GASOLINE	
DOCUMENT 00813 PRICE ADJUSTMENTS FOR STRUCTURAL STEEL AND REINFORCING STEEL	
DOCUMENT 00814 PRICE ADJUSTMENT FOR PORTLAND CEMENT CONCRETE MIXES	
DOCUMENT 00820 THE COMMONWEALTH OF MASSACHUSETTS SUPPLEMENTAL EQUAL EMPLOYMENT OPPORTUNITY, NON-DISCRIMINATION AND AFFIRMATIVE ACTION PROGRAM	
DOCUMENT 00821 ELECTRONIC REPORTING REQUIREMENTS CIVIL RIGHTS PROGRAM AND CERTIFIED PAYROLL	



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DOCUMENT A00841 MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER QUALITY CERTIFICATE	A00841-1 through 8
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DOCUMENT 00715



SUPPLEMENTAL SPECIFICATIONS

(English Units)

DATE: JUNE 30, 2020

The 2020 Standard Specifications for Highways and Bridges are amended by the following modifications, additions and deletions. This Supplemental Specifications prevail over those published in the Standard Specifications.

The MassDOT-Highway Specifications Committee has issued these Supplemental Specifications for inclusion into each proposal until such time as they are approved as Standard Specifications.

Contractors are cautioned that these Supplemental Specifications are dated and may vary from time to time as they are updated.

DIVISION I GENERAL REQUIREMENTS AND COVENANTS

SECTION 4.00: SCOPE OF WORK

Subsection 4.04 Changed Conditions.

(page I.22) Delete the two sequential paragraphs near the end that begin "The Contractor shall be estopped..." and "Any unit item price determined ... '

SECTION 8.00: PROSECUTION AND PROGRESS

Subsection 8.08 Preservation of Roadside Growth

(page I.74) Delete the last paragraph of this subsection which reads; All scars on trees shall be painted as soon as possible with an approved tree paint.



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DIVISION II CONSTRUCTION DETAILS

SECTION 200: DRAINAGE

SUBSECTION 230: CULVERTS, STORM DRAINS, AND SEWAR PIPES

Subsection 230: CULVERTS, STORM DRAINS, AND SEWAR PIPES

(page II.63) Change SEWAR to SEWER in the title of this subsection.

230.20 General.

(page II.63) Delete the words Reinforced Concrete or Metal.

230.40 General.

230.62 Pipe Joints.

230.82 Payment Items

(page II.63, II.64 and II.68) Replace the words Corrugated Plastic (Polyethylene) Pipe with the words Corrugated Plastic Pipe.

230.64 Field Testing of Corrugated Plastic Pipe

(page II.65) Delete the word thermoplastic in the first sentence of this subsection.

SECTION 400: SUB-BASE, BASE COURSES, SHOULDERS, PAVEMENTS AND BERMS

SUBSECTION 450: HOT MIX ASPHALT PAVEMENT

SUBSECTION 453.93 Payment Items.

(page II.181) Change the pay unit of item 452. Tack Coat from Ton to Gallons and the pay unit of item 453. HMA Joint Sealant from Ton to Foot.

SECTION 700: INCIDENTAL WORK SUBSECTION 702: HOT MIX ASPHALT SIDEWALKS AND DRIVEWAYS

SUBSECTION 702.41 Preparation of Underlying Surface.

(page II.303) Add the following sentence to the end of the first paragraph;

Existing pavements shall be sawcut in accordance with 450.49: Hot Mix Asphalt Joints.

SUBSECTION 702.81 Basis of Payment.

(page II.314) Add the following after the last paragraph;

All required sawcutting in the existing pavement in accordance with this specification will be included in the contract unit price for Hot Mix Asphalt Sidewalks and Driveways.

SUBSECTION 765: SEEDING

SUBSECTION 765.40 General.

(page II.332) Add the following material to the end of this subsection;



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SUBSECTION 765.63 Seeding Grass.

(page II.333) Replace the first sentence with the following;

After the loamed or topsoil areas have been prepared and treated as hereinbefore described, grass seed conforming to the respective formulas hereinbefore specified shall be carefully sown thereon at the rate as specified by the supplier.

SUBSECTION 765.65 Seeding Grass by Spray Machine.

(page II.333) Change the title of this subsection to Hydroseeding. Delete the last paragraph of this subsection that begins with "If the results …", and Replace the first two sentences of the first paragraph with the following;

A hydroseed machine approved by the Engineer and designed specifically for seed dissemination may be utilized. The application of limestone as necessary, fertilizer as necessary and grass seed may be accomplished in one operation by the use of the approved hydroseed machine.

SUBSECTION 765.81 Basis of Payment.

(page II.334) Replace this subsection with the following;

Payment for Seeding and Seeding for Short Term Erosion Control, including all mowing, will be paid for at the contract unit price per square yard, complete in place. When a satisfactory stand of grass has not been established at the time of acceptance, no payment for seeding shall be allowed at the time of acceptance. At the time the final estimate is ready to be forwarded to the Contractor the seeded areas will again be inspected by the Engineer and the seeded areas with a satisfactory stand of grass will be included for payment.

SUBSECTION 765.82 Payment Items.

(page II.334) Add the following payment item;

SUBSECTION 766: REFERTILIZATION

SUBSECTION 766 Refertilization.

(page II.335) Delete this entire subsection.

SUBSECTION 767: MULCHING; SEED FOR EROSION CONTROL

SUBSECTION 767 Mulching; Seed for Erosion Control.

(page II.336) Change the title of this subsection to Mulching and Erosion Control.

SUBSECTION 767.40 General.

(page II.336) Delete Seeding for Erosion Control ... M6.03.1.

SUBSECTION 767.62 Hay Mulch with Seed for Erosion Control.

(page II.337) Change the title of this subsection to Hay Mulch with Seed for Short Term Erosion Control.



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SUBSECTION 767.80 Method of Measurement.

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(page II.338) Delete the last paragraph of this subsection which reads "Seed for Erosion Control will be measured by the pound."

SUBSECTION 767.81 Basis of Payment.

(page II.338) Delete the last paragraph of this subsection which reads "Seed for Erosion Control will be paid for at the contract unit price per pound."

SUBSECTION 767.82 Payment Items.

(page II.339) Delete item 765.2 Seed for Erosion Control.

SUBSECTION 771: PLANTING TREES, SHRUBS AND GROUNDCOVER

SUBSECTION 771.40 General.

(page II.338) Replace the last three paragraphs of third, fourth and fifth paragraphs of this subsection with the following;

All plants shall be northern grown nursery stock. The American Standards for Nursery Stock (ANSI Z60.1 shall serve as the Department's standard for plants and for plant, root ball, and container size, as well as growth and form requirements.

The latest editions of ANSI A300 Standards Part 1 Pruning and Part 6 Planting and Transplanting shall apply for all work of planting and pruning.

Trees and shrubs shall be balled and burlapped (B&B) or containerized. The caliper, height, age and other dimensions as specified for all planting material shall apply at the time planting is done and the plants will be inspected by the Engineer at this time as to these requirements as well as the quality or grade and varieties required. The Contractor shall remove all plants not approved by the Engineer from the project.

SUBSECTION 771.61 Seasons for Planting.

(page II.346) In table 771.61-1: Calendar Guidance for Planting replace "March 21 through May 15" with "March 21 through June 15".





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SECTION 900: STRUCTURES

SUBSECTION 965: MEMBRANE WATERPROOFING FOR NEW BRIDGE DECKS

<u>SUBSECTION 965</u> <u>Membrane Waterproofing for New Bridge Decks.</u>

(page II.552) Add this new section.

SUBSECTION 965: MEMBRANE WATERPROOFING FOR NEW BRIDGE DECKS

DESCRIPTION

965.20: General

Membrane waterproofing systems are defined as a thin impermeable membrane that is used to protect the concrete deck from penetration of moisture and deicing chemicals.

The work to be performed shall consist of the furnishing and application of an approved membrane system and all concrete surface preparation work necessary to install the membrane system. The membrane waterproofing system applied to the surface of the bridge deck as indicated on the plans shall consist of the primer, spray applied membrane (either methyl methacrylate, polyurea, or polyurethane methyl methacrylate), aggregate keycoat, and polymer modified tack coat.

MATERIALS

965.30: General

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

CONSTRUCTION METHODS

965.40: Submittals

The Contractor shall submit to the Engineer for approval the following documents:

- 1. Initial submission (at least 30 days prior to application):
 - The membrane system to be installed.
 - The manufacturer's installation instructions for the applicable system
 - Safety data sheets (SDS) for all components
 - Cleaning solvents approved by the membrane manufacturer
- 2. At the pre-application meeting (at least 14 days prior to application):
 - Manufacturer's written approval of the Applicator's qualifications.
 - List of personnel performing the installation, inspection, and testing.
 - Installation procedure including storage and protection instructions as well as handling and mixing instructions.
 - List of application equipment to be used.
 - Manufacturer's written approval of the proposed polymer modified tack coat and the application rate that it shall be applied at.
 - Certificate of Compliance certifying that the aggregate for the keycoat meets the required hardness.
- 3. A minimum of 48 hours prior to installation a certificate of analysis for the proposed polymer modified tack coat shall be submitted by the Supplier of the tack coat to the Engineer for approval.
- 4. Upon completion of installation:
 - All QC installation test results for the tests specified in the materials section, including the name, address, and contact person of the laboratory that performed the tests and the date of the tests.
 - A Certificate of Compliance, from the membrane waterproofing system manufacturer, certifying that the membrane waterproofing system materials meet the requirements of the manufacturer and the contract specifications.



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965.41: Preconstruction

Membrane waterproofing shall be installed in accordance with the manufacturer's instructions. The handling, mixing, and addition of membrane components shall be performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations. Care shall be taken to prevent adjacent areas from overspray or other contamination.

965.42: Applicator Qualifications

The Contractor applying the waterproofing system shall be certified by the membrane waterproofing system manufacturer and have at least 2 years of experience in membrane installation. The Engineer shall receive the manufacturer's written approval of the contractor's qualifications at least 30 days prior to the application of any system component. This approval shall apply only to the named individuals performing the application.

965.43: Material Delivery and Storage

All components of the membrane system shall be delivered to the site in the manufacturer's original packaging, clearly identified with the products type and batch number. The storage area for all components shall be cool, dry, out of direct sunlight, and comply with relevant health and safety regulations. Copies of safety data sheets for all components shall be given to the Engineer and kept on site at the Contractor's field office.

965.44: Pre-Application Meeting

A minimum of 14 days before the anticipated start of membrane application, the Contractor shall schedule and conduct a pre-application meeting at the site to review the approved submittals, and other pertinent matters related to the application including the schedule for coordination between trades. At a minimum, the Contractor, the subcontractor performing the application and the Engineer shall be present at the meeting.

965.45: Mockup to Validate Bond Strength

For those projects where the concrete will be aged less than 28 days the manufacturer shall concur that the system is acceptable for use with the shortened aging period and a mockup shall be required. The intent is to validate the bond strength using the membrane waterproofing manufacture's primer and membrane.

In order to emulate the actual placement conditions, the mockup shall take place as close as possible to the intended date of the waterproofing application but be a minimum of 7 days before concrete placement. The mockup activities shall be representative of what will take place during the specified final bridge placement. It shall include the placement and surface preparation of the concrete and installation of membrane waterproofing system.

Inspection and testing shall be in accordance with Tables 965.63-1 and 965.64-1. The results of moisture and adhesion testing performed on a mockup of the bridge deck and closure pours shall meet these specifications. The mockup shall simulate the actual job conditions in all respects including air temperature, transit equipment, travel conditions, admixtures, forming, placement equipment, and personnel. If the mockup is unable to validate that the waterproofing membrane meets the project requirements, then the Engineer may require the Contractor to conduct additional mockups.

Removal of the mockup after its completion shall be the responsibility of the Contractor. In addition to the requirements contained herein, all weather and concrete temperature requirements contained in Section 901 shall be satisfied.

Acceptance of the mockup shall be the responsibility of the Engineer.



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965.46: Application

The installation procedure shall consist of preparation of the concrete surface and application of primer, membrane, aggregate keycoat, and polymer modified tack coat. Special attention shall be paid to the bridge deck surface preparation prior to the membrane waterproofing system application. The membrane system shall be installed in accordance with the manufacturer's requirements. The Contractor shall be responsible for the field testing including, but not limited to, adhesion bond testing, deck moisture content measurement, and all other required documentation and reporting.

The membrane waterproofing system shall not be applied in either wet, damp, or foggy weather, or when the ambient temperature is 40°F or below or is forecast to fall below 40°F during the application period. The temperature of the concrete deck surface shall also exceed the dew point by at least 5°F.

The membrane waterproofing shall not be placed until the Contractor is ready to follow within 24 hours with the first layer of hot mix asphalt pavement. A longer period will be allowed only with prior written approval from the Engineer.

Where the areas to be waterproofed are bound by a vertical surface including, but not limited to, a curb or a wall, the membrane waterproofing system shall be continued up the vertical as necessary. A neat finish with well-defined boundaries and straight edges shall be provided.

A. Concrete Surface Preparation

Concrete surfaces which are to be waterproofed shall be screeded to the true cross section and sounded. All spalls and depressions shall be repaired prior to the application of the primer. Depressions shall be filled to a smooth flush surface with 1:2 mortar (1-part cement to two parts sand) or an approved rapid setting patching mortar that is compatible with the membrane waterproofing system. Other surfaces shall be trimmed free of rough spots, projections, or other defects which might cause puncture of the membrane so that the surface profile of the prepared concrete surface shall not exceed a ¹/₄ inch amplitude, peak to valley.

The use of resin or wax-based deck curing membranes are not acceptable. Unless a mockup is completed in accordance with 965.45, the concrete shall be aged a minimum of 28 days, including curing time, before application of the membrane waterproofing system.

Immediately prior to the application of the primer, the concrete to which the membrane is to be applied shall be cleaned of all existing bond inhibiting materials in accordance with ASTM D4259 or as required by the manufacturer. Dust or loose particles shall be removed using clean, dry, oil-free compressed air or industrial vacuums. The surface preparation shall produce a clean dry surface and ensure that the concrete surface is free of asphaltic product, surface laitance, oil staining, soiling, and dust.

Any exposed steel components to receive membrane waterproofing shall be blast cleaned in accordance with the Society for Protective Coatings (SSPC) SSPC-SP6 or as required by the manufacturer and coated with the membrane waterproofing system within the same work shift.

B. Applying Primer

The primer shall only be applied when the temperature of the concrete deck surface exceeds the dew point by at least 5°F and when the concrete deck surface has a moisture content of 5% or less, as confirmed by a portable electronic surface moisture meter supplied by the Contractor.

The primer shall be applied in a manner to ensure full coverage and shall consist of one coat with an overall coverage rate of 125-175 ft²/gallon unless otherwise recommended in the manufacturer's written instructions. All components shall be measured and mixed in accordance with the manufacturer's recommendations. The primer shall be spray applied using a single or multiple component spray system approved for use by the manufacturer. If required by site conditions, brush or roller application shall be allowed. The primer shall be allowed to cure tack-free for a minimum of 30 minutes or as required by the manufacturer's instructions, whichever time is greater, prior to application of the first lift of waterproofing membrane.



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A second coat of primer shall be required if the first coat is absorbed by the concrete. The membrane shall be applied within the primer re-coat drying time allowed by the manufacturer but in no case shall it exceed 24 hours. Beyond this period, the surface shall be prepared again and re-primed following the manufacturer's recommendations prior to membrane application.

C. Applying Membrane

The waterproofing membrane shall be applied following the approved mixing and application procedure. The membrane shall be spray applied, with the mixing of the two components taking place at the nozzle and shall be applied to the primed deck in accordance with the manufacturer's instructions. The spray equipment shall be controlled so that the quantities applied may be monitored and shall allow for coverage rates to be checked.

Following the application of the membrane waterproofing system, the cured surface shall be visually inspected. If any defects or pinholes are found, an appropriate quantity of membrane material shall be mixed and repaired in accordance with Subsection 965.46 Part D. In all cases, the thickness of the repair shall be sufficient to bring the area up to the specified thickness. The thickness of the repair patch, measured over peaks, shall be a minimum of 80 mils or the thickness used to pass the ASTM C1305 Crack Bridging Test, whichever is greater.

For multi-stage construction, the subsequent stage membrane application shall overlap the existing cured membrane from the previous stage to form a continuous layer with a 6-inch overlap onto the existing membrane. The existing membrane shall be cleaned of all contamination including tack coat material or dirt to an edge distance of a least 6 inches and wiped with a solvent as approved by the membrane waterproofing manufacturer.

D. Repairs

If an area of membrane requires repair or if the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the membrane waterproofing system. The damaged area shall be cut back to sound materials and wiped with a solvent up to a width of at least 6 inches beyond the periphery of the damaged area, removing contaminants. The concrete shall be primed as necessary followed by the application of the membrane. A continuous layer shall be obtained over the concrete with a 6-inch overlap onto the existing membrane. The solvent shall be as approved by the membrane waterproofing manufacturer. Repairs shall comply with the manufacturer's guidelines for any over-coating times.

Where the membrane is to be joined to existing cured material and at joints, the new application shall overlap the existing membrane/joint by at least 4 inches. The existing membrane/joint shall be cleaned of all contamination including tack coat material or dirt to an edge distance of a least 6 inches and wiped with a solvent as approved by the membrane waterproofing manufacturer.

If pin holes or holidays are observed in the membrane surface they shall be repaired in accordance with the manufacturer's instructions and the approved Contractor Quality Control Plan (QC Plan).

In all cases, the thickness of the repair shall be sufficient to bring the area up to the specified thickness. The thickness of the repair patch, measured over peaks, shall be a minimum of 80 mils or the thickness used to pass the ASTM C1305 Crack Bridging Test, whichever is greater.

E. Applying Aggregate for Keycoat

Following the membrane application, an additional layer of membrane or resin, compatible with the membrane, shall be spray applied to a thickness of 30 to 40 mils into which an aggregate approved by the membrane manufacturer shall be broadcast ensuring a minimum coverage of 95%. The application rate shall be designated by the manufacturer. Loose aggregate shall be removed with brooms or oil/moisture-free compressed air before applying the tack coat.

For multi-stage construction, the aggregate keycoat of the previous stage shall be applied to a limit of 6-inches from the stage construction joint to allow the subsequent stage membrane material to bond directly to the existing membrane. The application of the aggregate keycoat for the subsequent stage shall cover the 6-inch overlap.



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F. Applying Tack Coat

The polymer modified tack coat shall be applied in accordance with the membrane manufacturer's recommendations after a minimum of three hours from initial membrane application. The tack coat shall be allowed to cool for a minimum of 1 hour prior to HMA paving. The tack coat application rate shall be in accordance with the manufacturer's recommendation. The application rate of the tack coat shall be set at a rate that achieves the specified residual rate and coverage. Tack coat shall be applied to cover a minimum of 95% of the membrane surface. The tack coat application shall be monitored by Quality Control personnel in accordance with the approved QC Plan.

G. HMA Pavement Over Membrane

Placement of the HMA surface shall be in accordance with Section 450 and the contract specifications. During paving, a light soap spray should be applied to the paving equipment wheels to prevent tack coat pick-up.

965.47: Protection of Exposed Surfaces

The Contractor shall exercise care in the application of the waterproofing membrane system to prevent surfaces not receiving treatment from being spattered or marred, such as the face of curbs, copings, finished surfaces, substructure exposed surfaces, and outside faces of the bridge. Any material that spatters on these surfaces shall be removed and the surfaces cleaned to the satisfaction of the Engineer.

CONTRACTOR QUALITY CONTROL

965.60: General

The Contractor shall provide a Quality Control System (QC System) and, when required, a QC Plan, adequate to ensure that all materials and workmanship meet the required quality levels for each specified Quality Characteristic. The Contractor shall provide qualified QC personnel and QC laboratory facilities and perform Quality Control inspection, sampling, testing, data analysis, corrective action (when necessary), and documentation as outlined further below.

965.61: Contractor Quality Control Plan

The Contractor shall provide and maintain a QC Plan which should sufficiently document the QC processes of all Contractor parties (i.e. Prime Contractor, Subcontractors, Producers) performing work required under this specification.

A. QC Plan Submittal Requirements

At the pre-construction meeting, the Contractor shall be prepared to discuss the QC Plan. Information to be discussed shall include the proposed QC Plan submittal date, QC organization, and sources of materials. The Contractor shall submit the QC Plan to the Engineer for approval not less than 30 days prior to the start of any work activities related to membrane waterproofing installation (including preparation of underlying surface) addressed in Subsections 965.40 thru 965.47. The Contractor shall not start work on the subject work items without an approved QC Plan.

B. QC Plan Format and Contents

The QC Plan shall be structured to follow the format and section headings outlined in the MassDOT Model QC Plan. The pages of the QC Plan shall be sequentially numbered. The QC Plan shall address, in sufficient detail, the specific information requested under each section and subsection contained in the MassDOT Model QC Plan.

C. QC Plan Approval and Modifications

Approval of the QC Plan will be based on the inclusion of the required information. Revisions to the QC Plan may be required prior to approval for any part of the QC Plan that is determined by the Department to be insufficient. Approval of the QC Plan does not imply any warranty by the Engineer that the QC Plan will result in completed work that complies with the specifications. It remains the responsibility of the Contractor to demonstrate such compliance. The Contractor may modify the QC Plan as work progresses when circumstances necessitate changes in Quality Control personnel, laboratories, or procedures. In such case, the Contractor shall submit an amended QC Plan to the Department for approval a minimum of three calendar days prior to the proposed changes being implemented.



Proposal No. 604123-111717

ADDENDUM NO. 1, JULY 31, 2020

965.62: Quality Control Personnel Requirements

The Contractor's Quality Control organization shall, at a minimum, consist of the personnel qualified by the manufacturer to perform the required inspection and testing. Every effort should be made to maintain consistency in the QC organization; however, substitution of qualified personnel shall be allowed. When circumstances necessitate substitution of QC personnel not originally listed in the approved QC Plan, the Contractor shall submit an amended QC Plan for approval in accordance with Subsection 965.61 Part C.

965.63: Quality Control Inspection

The Contractor shall perform QC inspection of all work items addressed under this specification. Inspection activities during placement may be performed by qualified production personnel (e.g. Skilled Laborers, Foremen, and Superintendents). However, the Contractor's QC personnel shall have overall responsibility for QC inspection. The Contractor shall not rely on the results of the Engineer's Acceptance inspection for QC purposes. The Engineer shall be provided the opportunity to monitor and witness all QC inspection.

QC inspection activities must address the following four primary components:

- a) Equipment
- b) Materials
- c) Environmental Conditions
- d) Workmanship

The minimum frequency of QC inspection activity shall be in accordance with the requirements below and as outlined in the approved QC Plan. The Contractor shall document the results and findings of QC inspection.

The quality of each waterproofing membrane surface will be inspected and evaluated on the basis of Lots and Sublots. A Lot is defined as an isolated quantity of work which is assumed to be produced by the same controlled process. A Lot shall constitute no greater than the entire waterproofing membrane surface area on the bridge deck completed within the same construction season using the same placement process. Each Lot shall be divided into Sublots of equal sizes unless specified otherwise below.

All inspection reports shall be submitted to the Engineer within 72 hours of the test completion.

A. QC Inspection for Preparation of Underlying Surface

The Contractor's personnel will perform QC inspection during preparation of the underlying surface in accordance with the requirements of Subsection 965.46 Part A. The minimum items to be inspected shall be as outlined in Table 965.63-1. The Contractor shall identify in the QC Plan the specific inspection activities necessary to ensure the quality of the work, including any additional inspection activities not specifically listed in the table.

B. QC Inspection for Placement of Waterproofing Membrane

The Contractor's QC personnel will perform QC inspection at the site of waterproofing membrane field placement to ensure that the production and placement processes are providing work conforming to the contract and manufacturer requirements. The minimum items to be inspected for each waterproofing membrane Lot shall be in accordance with the requirements of Subsection 965.43 thru Subsection 965.47 and as outlined in Table 965.63-1. The Contractor shall identify in the QC Plan the specific inspection activities necessary to ensure the quality of the work, including any additional inspection activities not specifically listed in the table. Inspection shall include:

- a) Pin Hole/Holidays: The surface of the membrane shall be inspected for pin holes and/or holidays. All pin hole/holidays shall be located, marked for repair, documented, and repaired in accordance with a repair procedure developed by the manufacturer and approved by the Engineer.
- b) Coverage Rates: Rates for all layers shall be monitored by checking quantity of material used against the area covered.
- c) Visual inspections shall be conducted throughout the application process. The Contractor shall take progress photos for incorporation with the final review report to the Engineer.



Proposal No. 604123-111717

Highway Division

ADDENDUM NO. 1, JULY 31, 2020

Inspection **Point of Inspection Inspection Method** Inspection Minimum Component Attribute Inspection Frequency As specified in QC Equipment Per QC Plan Per QC Plan Per QC Plan Plan Primer Materials Per QC Plan Per QC Plan Check Manufacturer (Correct Type) COC Membrane Per QC Plan Per QC Plan Check Manufacturer (Correct Type) COC Aggregate Per QC Plan Check Manufacturer Per QC Plan (Correct Type) COC Per QC Plan Check Manufacturer Tack Coat Per QC Plan (Correct Type) COC Environmental Temperature of Air Check Measurement 1 per Day At Project Site Conditions & Underlying Surface Underlying Surface Per QC Plan Underlying Surface Visual Check (Soundness) Surface Per QC Plan Underlying Surface Visual Check (Standing Moisture) & Membrane Surface Surface Per QC Plan Underlying Surface Visual Check (Cleanliness) & Membrane Surface Visual Check Workmanship Pin Hole/Holidays Per QC Plan Membrane Surface Membrane Per QC Plan From Distributor Check Measurement Coverage Rate Visual Check Aggregate Coverage Per QC Plan Membrane Surface Rate Tack Coat From Distributor Per QC Plan Check Measurement **Application Rate**

Table 965.63-1 - Minimum QC Inspection of Waterproofing Membrane Operations



Proposal No. 604123-111717

965.64: Quality Control Sampling and Testing Requirements

The Contractor's QC personnel will perform QC sampling and testing at the site of membrane waterproofing placement to ensure that the production and placement processes are providing work conforming to the contract and manufacturer's requirements. The Engineer will not sample or test for Quality Control or assist in controlling the Contractor's operations. All QC sampling and testing shall be in accordance with the current AASHTO, ASTM, NETTCP, or Department procedures specified in Table 965.64-1. 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.

The following testing shall be conducted and recorded on a test report form to be submitted to the Engineer. All reports shall be submitted to the Engineer within 72 hours of the test completion.

- a) Deck moisture: The concrete deck's surface moisture content shall be measured to determine if it is suitable to allow for installation to proceed.
- b) Primer Adhesion: Random tests for adequate tensile bond strength shall be conducted in accordance with ASTM D7234 using the membrane Manufacture's primer. Minimum bond strength of 100 psi and failure in the concrete will be required for acceptance. Testing shall be at a frequency of 1 test per 5,000 square feet with a minimum of 3 tests per day. Areas smaller than 5,000 square feet shall receive a minimum of 3 tests.
 c) Film Thickness:
- c) Film Thickness:
 - Wet film thickness shall be checked every 300 square feet in accordance with ASTM D4414 using a gauge pin or standard comb type thickness gauge or a magnetic gauge. Film thickness checks shall be carried throughout the application process.
 - Dry Film Thickness: If the membrane waterproofing system cures too quickly to perform wet film thickness testing, dry film thickness shall be checked every 300 square feet in accordance with ASTM D6132 using magnetic or ultrasonic gauges or using a destructive method. If a destructive method is used, areas shall be repaired in accordance with Subsection 965.46 Part C.
- d) Membrane Adhesion: Random tests for adequate tensile bond strength shall be conducted in accordance with ASTM D7234 using the membrane Manufacture's primer and membrane. The portion of the membrane to be tested shall be separated from the rest of the membrane surface prior to performing the test so only that portion under the dolly receives the tensile force. A minimum bond strength of 100 psi and failure in the concrete will be required for acceptance. Testing shall be at a frequency of 1 test per 5,000 square feet with a minimum of 3 tests per day. Areas smaller than 5,000 square feet shall receive a minimum of 3 tests.

The Contractor shall take a representative sample of the membrane from that day's installation. The samples shall consist of 2 10-inch by 10-inch square samples of the membrane with smooth surfaces. The primer and aggregate shall not be incorporated into the sample. The sample shall be sprayed separate from the bridge deck on a non-adhesive surface using the same application techniques used for the deck. These samples shall be peeled off the non-adhesive surface and be provided to the Engineer to be tested by the Department.



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ADDENDUM NO. 1, JULY 31, 2020

Sublot Minimum Point of Sampling Quality **Test Method(s)** Engineering Size Limits Characteristic Test Frequency 1 per Sublot⁽¹⁾ Deck Concrete Manufacturer's 5.000 ft^2 Deck Concrete < 5%Moisture Recommendation Surface Primer **ASTM D7234** 5,000 ft² 1 per Sublot⁽¹⁾ Primed Concrete \geq 100 psi minimum Adhesion to Surface and failure in concrete Concrete Film $300 \ \mathrm{ft}^2$ 1 per Sublot⁽¹⁾ Wet: Membrane Surface \geq 80 mils Thickness ASTM D4414 minimum measured over Dry: ASTM D6132 or peaks other approved or method \geq Thickness used to pass ASTM C1305 (Whichever thickness is greater) 1 per Sublot⁽¹⁾ Membrane **ASTM D7234** 5.000 ft^2 Membrane Surface \geq 100 psi minimum Adhesion to and Concrete failure in concrete

Table 965.64-1: Minimum Quality Control Sampling & Testing of Waterproofing Membrane Lots

⁽¹⁾ In the event that the total daily production is less than three Sublots, a minimum of three random QC samples shall be obtained for the day's production.

DEPARTMENT ACCEPTANCE

965.70: General

The Department is responsible for performing all Acceptance activities and making the final Acceptance determination for each membrane waterproofing surface. The Department's Acceptance system will include monitoring the Contractor's QC activity and performing Acceptance inspection and testing in order to determine the quality and corresponding payment for each Lot.

965.71: Acceptance Inspection

The Engineer will perform Acceptance inspection of all work items addressed under Section 965 to ensure that materials and completed work are in conformance with the contract requirements. Acceptance inspection is intended to visually assess the quality of each Lot produced and placed and will address only the inspection components of Materials and Workmanship in support of the Department's final Acceptance determination.

All Acceptance inspection activities by the Department will be performed independent of the Contractor's QC inspection.



Highway Division

Tuble 703.71-1 – Department Acceptance Inspection of waterproofing membrane Operations				
Inspection Component	Inspection Attribute	Minimum Inspection Frequency	Point of Inspection	Inspection Method
Materials	Primer (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
	Membrane (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
	Aggregate (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
	Tack Coat (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
Workmanship	Pin Hole/Holidays	25% of Sublots	Membrane Surface	Visual Check
	Membrane Coverage Rate	25% of Sublots	From Distributor	Check Measurement
	Aggregate Coverage Rate	25% of Sublots	Membrane Surface	Visual Check
	Tack Coat Application Rate	25% of Sublots	From Distributor	Check Measurement

ADDENDUM NO. 1, JULY 31, 2020 Table 965.71-1 – Department Acceptance Inspection of Waterproofing Membrane Operations

965.72: Acceptance Sampling and Testing Requirements

The 2 10-inch by 10-inch samples fabricated by the Contractor during installation shall be submitted to the Department for testing.

Table 965.72-1: Department Acceptar	ice Sampling and Testing	of Waterproofing Membrane Lots
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Quality Characteristic	Test Method(s)	Engineering Limits
Minimum Thickness (Membrane only)	ASTM D6132 or other approved method	 ≥ 80 mils minimum measured over peaks or ≥ thickness used to pass ASTM C1305 (Whichever thickness is greater)
Percent Elongation at Break	ASTM D638	≥ 130%
Tensile Strength	ASTM D638 Type IV @ 2 in/min	> 1,100 psi
Shore Hardness	ASTM D2240 ⁽¹⁾	≥ 50 Type 00

⁽¹⁾ ASTM D2240 shall be modified in accordance with ASTM C836 Section 6.5.

965.73: Lot Acceptance Determination Based on Inspection Results

The Engineer's Acceptance inspection results will be used in the final Acceptance determination for all Lots. Prior to final Acceptance of each Lot produced and placed, the Engineer will periodically evaluate all Acceptance inspection information for the prepared underlying surface and the Lot. The materials and product workmanship for the completed work will be evaluated for conformance with the plans and the requirements specified in Subsections 965.40 thru 965.47.



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ADDENDUM NO. 1, JULY 31, 2020

When the Acceptance information identifies deficiencies in either material quality or product workmanship for any underlying surface location or waterproofing membrane Sublot(s), the location or Sublot(s) will be isolated and further evaluated by the Engineer through additional Acceptance inspection (or sampling and testing, if relevant or possible). Depending upon the findings of the additional Acceptance inspection activity, the Engineer will determine the disposition of the nonconforming work in accordance with Division I, Subsection 5.03, Conformity with Plans and Specifications.

965.74: Lot Acceptance Determination Based on Testing Data

Evaluation of Testing Data

Prior to final Acceptance of each Lot produced and placed; the Engineer will periodically evaluate all available Acceptance testing data for the Lot.

Conformance with Engineering Limits

The Engineer will evaluate all Acceptance testing data and Contractor QC testing data for each Lot to determine conformance with the Engineering Limits in Tables 965.63-1 and 965.72-1. Each Sublot test value for the Acceptance Quality Characteristics identified in the tables shall be within the Engineering Limits.

If a Sublot test result is outside of the Engineering Limits, the Contractor and Engineer will further assess the Sublot quality to determine whether the material in the Sublot can remain in place. The Engineer will determine the disposition of the Sublot in accordance with Division I, Subsection 5.03, Conformity with Plans and Specifications.

If the Engineer's assessment determines that the material quality is not sufficient to permit the Sublot to remain in place the Sublot shall be removed and replaced. When a nonconforming Sublot is corrected or replaced, the Engineer will perform Acceptance testing of the Sublot and evaluate the test results for conformance with the Engineering Limits. Once the above requirements have been met, the Engineer will accept all completed Sublots.

965.75: Final Lot Acceptance Determination

For each Lot produced and placed, the Engineer will evaluate all Acceptance inspection and testing data for the Lot after all Sublots are complete in place. The final review and visual inspection shall be conducted jointly by the Contractor and Engineer. Irregularities or other items that do not meet the requirements of the specifications and plans shall be addressed/repaired at this time, at no additional cost to the Department.

After each Lot is complete, including any corrective action, the Engineer will perform a final evaluation of all Acceptance data and Contractor QC data for the Lot. The Engineer will accept the Lot if the Engineer's evaluation of all inspection and testing data for the Lot is in conformance with this specification and the contract documents.

COMPENSATION

965.90: Method of Measurement

Membrane Waterproofing for Bridge Decks will be measured by the square foot of the membrane system complete in place with no allowance for overlapping or for edges turned up or carried into recesses for seals, except that the area of the full membrane turned down in back of the backwalls and extended up the face of the curb or under and in back of median curbs shall be included for payment.



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ADDENDUM NO. 1, JULY 31, 2020

965.91: Basis of Payment

Payment under this Item shall be made at the unit bid price per square foot, which includes the primer, spray applied membrane, aggregate for keycoat, polymer modified tack coat, and all labor, materials, equipment, safety devices, tools, inspections and incidentals necessary to complete all work specified under this Item.

965.92: Payment Items

965. Membrane Waterproofing for Bridge Decks

Square Foot

SUBSECTION 966: MEMBRANE WATERPROOFING FOR BRIDGE DECK REPAIRS

SUBSECTION 966 Membrane Waterproofing for Bridge Deck Repairs. (page II.552) Add this new section.

SUBSECTION 966: MEMBRANE WATERPROOFING FOR BRIDGE DECK REPAIRS

DESCRIPTION

966.20: General

Membrane waterproofing applied to the repaired deck surface as indicated on the plan and elsewhere as directed shall consist of one of the following systems:

- Sheet membrane either reinforced rubberized asphalt or reinforced tar and resin.
- Hot applied rubberized asphalt membrane. This system shall not be used on grades in excess of 3 percent.

MATERIALS

966.30: General

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Asphalt Emulsions	M3.03.1
Sheet Membrane	M9.08.2
Hot Applied Rubberized Asphalt Membrane	M9.08.3
Primer	M9.09.1

CONSTRUCTION METHODS

966.40: Application

A. Preparation of Surface

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.

The membrane waterproofing on bridge deck 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.

Immediately prior to the membrane application, the concrete surface shall be thoroughly swept and blown clean with an air compressor 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.



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B. Applying Primer

The primer shall be applied to all surfaces at a rate of 0.015 gallon per square yard. 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 rubberized asphalt membrane. Should the membrane not be placed over the primed surface within 8 hours the surface shall be re-primed.

C. Applying Membrane

(1) Sheet Membranes

This system shall consist of the application of preformed reinforced rubberized asphalt membrane. Composition and dimensional requirements shall be as stipulated by the manufacturer of the sheet membrane.

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 sheet shall be placed in such a manner that a shingling effect is achieved in the direction that water will drain. 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. Wrinkles and air bubbles shall be eliminated to the extent possible.

A mastic, approved by the Sheet Membrane manufacturer, 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.

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 6 inches beyond the defect.

(2) Hot Applied Rubberized Asphalt Membrane

Membrane Application

Melting of the rubberized asphalt membrane shall be in accordance with the manufacturer's instructions. The kettle shall be equipped with a suitable agitator and temperature gauges for the kettle.

Sufficient lead time shall be allowed for heating of the rubberized asphalt so that it will be in a fluid state at the time scheduled for application. Caution should be observed that the melting temperature does not exceed the manufacturer's recommendation. When fluid, the material shall be drawn off in suitable containers and poured onto the primed and dried deck surface.

It shall be evenly spread with a special spray nozzle or silicone squeegees at a uniform rate to yield a coating at a minimum thickness of 1/8 inch and an average of 3/16 inch All horizontal surfaces shall be completely covered and vertical surfaces (curbing, edging, etc.) shall be covered up to 4 inches above the deck surface.

Any defects shall be repaired in accordance with the manufacturer's recommendations prior to HMA pavement overlayment.

Immediately following the application of the hot applied rubberized asphalt membrane and before it cools, the protective covering shall be laid parallel to the roadway centerline covering the entire area of membrane waterproofing.



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D. Repairs

If an area of membrane requires repair or if the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the membrane waterproofing system. The damaged area shall be cut back to sound materials to a width of at least 6 inches beyond the periphery of the damaged area, removing contaminants. The concrete shall be primed as necessary followed by the application of the membrane. A continuous layer shall be obtained over the concrete with a 6-inch overlap onto the existing membrane. The solvent shall be as approved by the membrane waterproofing manufacturer. Repairs shall comply with the manufacturer's guidelines.

Where the membrane is to be joined to existing cured material and at joints, the new application shall overlap the existing membrane/joint by at least 4 inches. The existing membrane/joint shall be cleaned of all contamination including tack coat material or dirt to an edge distance of a least 6 inches.

If pin holes or holidays are observed in the membrane surface they shall be repaired in accordance with the manufacturer's instructions.

E. Applying Tack Coat

Tack coat, meeting Subsection 966.30, shall be applied in accordance with the membrane manufacturer's recommendations after a minimum of three hours from initial membrane application. The tack coat application rate shall be in accordance with the manufacturer's recommendation. The application rate of the tack coat shall be set at a rate that achieves the specified residual rate and coverage.

F. HMA Pavement Over Membrane

Placement of the HMA surface shall be in accordance with Section 450 and the contract specifications. To eliminate any possible damage to the membrane and in accordance with Subsection 450.50, the HMA overlayment shall be applied as soon as possible. Caution must be observed to assure that the paver does not cause damage to the membrane. During paving, a light soap spray should be applied to the paving equipment wheels to prevent tack coat pick-up.

966.41: Protection of Exposed Surfaces

The Contractor shall exercise care in the application of the waterproofing membrane system to prevent surfaces not receiving treatment from being spattered or marred, such as the face of curbs, copings, finished surfaces, substructure exposed surfaces, and outside faces of the bridge. Any material that spatters on these surfaces shall be removed and the surfaces cleaned to the satisfaction of the Engineer.

CONTRACTOR QUALITY CONTROL

966.60: General

The Contractor shall provide Quality Control (QC) activities to ensure that their operations will provide waterproofing that conforms to the specified material and workmanship requirements.

966.61: Quality Control Inspection

The Contractor shall perform QC inspection of all work items addressed under this specification. Inspection activities during placement may be performed by qualified production personnel (e.g. Skilled Laborers, Foremen, and Superintendents). The Contractor shall not rely on the results of the Engineer's Acceptance inspection for QC purposes. The Engineer shall be provided the opportunity to monitor and witness all QC inspection.



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QC inspection activities must address the following four primary components:

- a) Equipment.
- b) Materials.
- c) Environmental Conditions.
- d) Workmanship.

The minimum frequency of QC inspection activity shall be in accordance with the requirements below. The Contractor shall document the results and findings of QC inspection.

A. QC Inspection for Preparation of Underlying Surface

The Contractor's personnel will perform QC inspection during preparation of the underlying surface in accordance with the requirements of Subsection 966.40 Part A. The minimum items to be inspected shall be as outlined in Table 966.61-1.

B. QC Inspection for Placement of Waterproofing Membrane

The Contractor will perform QC inspection at the site of waterproofing membrane field placement to ensure that the production and placement processes are providing work conforming to the contract and manufacturer requirements. The minimum items to be inspected for each waterproofing membrane shall be in accordance with the requirements of Subsection 966.40 Parts C thru F and as outlined in Table 966.61-1. Inspection shall include:

- a) Pin Hole/Holidays: The surface of the membrane shall be inspected for pin holes and/or holidays. All pin hole/holidays shall be located, marked for repair, documented, and repaired in accordance with a repair procedure approved by the manufacturer.
- b) Visual inspections shall be conducted throughout the application process. The Contractor shall take progress photos for incorporation with the final review report to the Engineer.



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Inspection **Point of Inspection** Inspection Method Inspection Minimum Component Attribute Inspection Frequency As specified by Equipment As specified by As specified by As specified by Contractor Contractor Contractor Contractor Materials Primer 1 per Day As specified by Check Manufacturer (Correct Type) Contractor COC Membrane As specified by Check Manufacturer 1 per Day (Correct Type) Contractor COC Tack Coat Per OC Plan Check Manufacturer 1 per Day (Correct Type) COC Environmental Temperature of Air 1 per Day At Project Site Check Measurement & Underlying Conditions Surface Visual Check Underlying Surface Entire Surface Underlying Surface (Soundness) Surface Entire Surface Visual Check Underlying Surface (Standing Moisture) ĸ Membrane Surface Surface Entire Surface Underlying Surface Visual Check (Cleanliness) Membrane Surface Workmanship Pin Hole/Holidays Entire Surface Membrane Surface Visual Check Membrane Entire Surface From Distributor Visual Check Coverage Rates Tack Coat From Distributor Check Measurement 1 per Day Application Rate

ADDENDUM NO. 1, JULY 31, 2020 Table 966.61-1 - Minimum QC Inspection of Waterproofing Membrane Operations

DEPARTMENT ACCEPTANCE

966.70: General

The Department is responsible for performing all Acceptance activities and making the final Acceptance determination for each membrane waterproofing surface. The Department's Acceptance system will include monitoring the Contractor's QC activity and performing Acceptance inspection in order to determine the quality and corresponding payment.

966.71: Acceptance Inspection

The Engineer will perform Acceptance inspection of all work items addressed under Section 966 to ensure that materials and completed work are in conformance with the contract requirements. Acceptance inspection is intended to visually assess the quality of the materials and work and will address only the inspection components of Materials and Workmanship in support of the Department's final Acceptance determination.



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All Acceptance inspection activities by the Department will be performed independent of the Contractor's QC inspection.

Inspection Component	Inspection Attribute	Minimum Inspection Frequency	Point of Inspection	Inspection Method
Materials	Primer (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
	Membrane (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
	Tack Coat (Correct Type)	1 Per Day	At Placement Site	Check Manufacturer COC
Workmanship	Pin Hole/Holidays	Entire Surface	Membrane Surface	Visual Check
	Membrane Coverage Rates	Entire Surface	At Placement Site	Visual Check
	Tack Coat Application Rate	1 per day	At Placement Site	Check Measurement

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966.72: Acceptance Determination

The Engineer's Acceptance inspection results will be used in the final Acceptance determination. Prior to final Acceptance, the Engineer will periodically evaluate all Acceptance inspection information for the prepared underlying surface and the waterproofing membrane. The materials and product workmanship for the completed work will be evaluated for conformance with the plans and the requirements specified in Subsections 966.40 and 966.41.

When the Acceptance information identifies deficiencies in either material quality or product workmanship for any underlying surface location or waterproofing membrane, the location will be isolated and further evaluated by the Engineer through additional Acceptance inspection. Depending upon the findings of the additional Acceptance inspection activity, the Engineer will determine the disposition of the nonconforming work in accordance with Division I, Subsection 5.03, Conformity with Plans and Specifications.

The final review and visual inspection shall be conducted jointly by the Contractor and Engineer. Irregularities or other items that do not meet the requirements of the specifications and plans shall be addressed/repaired at this time, at no additional cost to the Department.

After the work is complete, including any corrective action, the Engineer will perform a final evaluation of all Acceptance data and Contractor QC data. The Engineer will accept the work if the Engineer's evaluation of all inspection data is in conformance with this specification and the contract documents.

COMPENSATION

966.90: Method of Measurement

Membrane waterproofing for bridge deck repairs will be measured by the square foot of surface covered with no allowance for overlapping or for edges turned up or carried into recesses for seals, except that the area of the full membrane turned down in back of the backwalls and extended under and in back of curb or edging will be included for payment.

shall be thoroughly dry before any fill is placed against it.

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966.91: Basis of Payment

The membrane waterproofing will be paid for at the contract unit price per square foot under the item for Membrane Waterproofing for Bridge Deck Repairs, complete in place. Tack coat shall be paid under item 452. Tack Coat.

966.92: Payment Items

966. Membrane Waterproofing for Bridge Deck Repairs

SUBSECTION 970: BITUMINOUS DAMP-PROOFING

SUBSECTION 970 Bituminous Damp-Proofing.

(page II.552) Replace this subsection with the following.

SECTION 970: DAMP-PROOFING

DESCRIPTION

970.20: General

Damp-proofing to be applied as shown on the plans shall consist of a primer and damp-proofing material. If material other than that specified herein is permitted to be used, the method of application shall conform to the published specifications of the manufacturer.

MATERIALS

970.30: General

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Primer	M9.09.1
Damp-proofing	M9.09.2

970.40: General

Concrete surfaces shall be allowed to dry for a period of at least 5 days after the removal of forms before dampproofing is applied.

CONSTRUCTION METHODS

Surfaces to be damp-proofed shall be made reasonably smooth and free from all projections and holes. All holes in concrete surfaces shall be satisfactorily filled with 1-part cement to 2 parts sand mortar before damp-proofing is applied. Concrete surfaces shall be properly cured before being damp-proofed. Surfaces shall be dry and immediately before the application of the damp-proofing shall be thoroughly cleaned of dust and all loose material. Damp-proofing shall not be done during wet, damp, or foggy weather, or when the ambient temperature is 40°F or below or is forecast to fall below 40°F during the application period. The temperature of the concrete surface shall also exceed the dew point by at least 5°F.

One coat of primer shall be uniformly applied to the surface in accordance with the manufacturer's recommendation. The material for damp-proofing shall be mopped or sprayed on the designated surfaces in two coats. Application methods, rates, temperature constraints shall be as recommended by the manufacturer.

The initial coat of damp-proofing shall be allowed to dry thoroughly before a second coat is applied. The final coat

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Square Foot



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ADDENDUM NO. 1, JULY 31, 2020

CONTRACTOR QUALITY CONTROL

970.60: General

The Contractor shall provide Quality Control (QC) activities to ensure that their operations will provide dampproofing that conforms to the specified material and workmanship requirements.

970.61: Damp-proofing Materials and Workmanship

The Contractor shall verify that they are using the correct damp-proofing materials as specified under Subsection 970.30. All damp-proofing operations shall exhibit satisfactory workmanship including ensuring a dry, smooth, and clean concrete surface which is cured properly, as well as, correct application of the primer and damp-proofing.

DEPARTMENT ACCEPTANCE

970.70: General

The Department shall verify that the Contractor is correctly performing the work and QC activities.

970.71: Damp-proofing Materials and Workmanship

The Engineer will verify that the damp-proofing materials and workmanship conform with Subsection 970.61.

COMPENSATION 970.80: Method of Measurement

Damp-proofing will be measured by the actual area of surface covered in square foot.

970.81: Basis of Payment.

Damp-proofing will be paid for at the contract unit price per square foot of surface and shall include the primer and all materials, equipment and labor to install the damp-proofing complete in place.

970.82: Payment Items.

970. Damp-Proofing

Square Foot

DIVISION III MATERIALS SPECIFICATIONS

SECTION M2: AGGREGATES AND RELATED MATERIALS

SUBSECTION M2.01.0 Crushed Stone.

(page III.10) In table M2.01.0-1 under the column for M2.01.6 3/8 Inch Crushed Stone change the percent passing the No.4 sieve from 20-20 to 20-50.

SECTION M3: ASPHALTIC MATERIALS

SECTION M3: ASPHALTIC MATERIALS

(page III.15) Replace this subsection with the following;

M3.00.0 General.

Asphaltic materials (also referred to as bituminous materials) include liquid asphalts as well as Hot Mix Asphalt (HMA) mixtures and other related materials. All asphaltic materials shall conform to the requirements of the specifications as designated hereinafter.

Unless otherwise stipulated, the sampling of liquid asphalt materials shall be in accordance with AASHTO R 66.



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The following procedure shall be followed in obtaining liquid asphalt samples from pressure distributors or tankers used for the transport of liquid asphalt materials:

- 1. Distributors and tankers shall be equipped with approved sampling valves. The sampling valves on tankers shall be installed in the rear bulkhead approximately 1/3 of the height from the bottom. The sampling valves on pressure distributors may be located in the side of the tank somewhere in the middle third of the tank depth.
- 2. At least 1 gallon of material shall be drained off through the sampling valve and discarded before the sample is obtained.
- 3. Sample containers shall be new, clean and sealed with a tight-fitting cap. Washing of sample containers with solvents or water will not be permitted.

M3.01.0 Performance Graded Asphalt Binder.

Performance Graded Asphalt Binder (PGAB) delivered to a project or to an HMA plant must be accompanied by a Bill of Lading (BOL) signed by the asphalt binder Supplier's authorized representative in accordance with AASHTO R 26. Shipments of material not accompanied by a BOL will not be accepted for use in the work.

The PGAB Supplier and the Contractor shall perform random Quality Control (QC) sampling and testing of PGAB as specified in Subsection 450.65F(1). The Contractor shall furnish, to the Engineer, the PGAB Supplier's BOL for each truckload of asphalt binder shipped to the project or HMA plant. The Contractor shall also submit to the Engineer the Supplier's Certificate of Compliance (COC) along with copies of the Certificate of Analysis (COA) showing the certified AASHTO M 320 test results for each Supplier Lot of PGAB. The COA shall meet the requirements of AASHTO R 26. The Contractor shall maintain a copy of the COA for each Lot of PGAB used, with a copy attached to each sample obtained for testing.

The Contractor shall assist the Engineer in obtaining random Department Acceptance samples of PGAB from the HMA plant in accordance with AASHTO R 66 and as specified in Subsection 450.74C. Each sample shall be labeled with the PGAB grade, Supplier source and Lot number, sampling location, quantity represented, project name, plant, date, and the sampling inspector. When the PGAB is used for HMA production under Section 450 the sample shall be obtained from an in-line sample valve located between the asphalt tanks and mixing chamber at a sampling location downstream of all additive injection ports.

The Engineer will test the Department Acceptance samples for verification of the PGAB grade. The material shall conform to the specification requirements for the applicable performance grade as specified herein. Material not conforming to specification requirements shall be subject to corrective action, production suspension, rejection, or removal as determined by the Engineer.

The blending of binder of different grades or binder from different Suppliers at the HMA plants is strictly prohibited without the Engineer's approval. Contractors may switch to another approved source of binder, upon written notification to the Engineer, and by certifying that the tank to be utilized has been drained to an un-pumpable condition. The binder tanks at the HMA production facility shall be managed in a manner which prevents contamination.

Contractors who modify, blend PG binders, or add additives to the PGAB at the HMA production facility will be reclassified as a Supplier and shall be required to certify the binder in accordance with AASHTO R 26.

A copy of the COA for each Lot shall be provided in accordance with AASHTO R 26. The data reported shall meet the requirements of the specific binder specification:

- 1. For AASHTO M 320 Table 1
- 2. For AASHTO M 332 Table 1
- 3. For Crumb Rubber Modified Asphalt ASTM D6114-09 Table 1

M3.01.1 Standard Asphalt Binder Grade.

The asphalt binder for HMA mixtures shall be a PGAB which meets the specification requirements of AASHTO Standard M 320. PGAB shall be provided by an Approved Supplier in accordance with AASHTO R 26. Approved Suppliers shall be listed on the MassDOT Qualified Construction Materials List (QCML).

Unless indicated otherwise on the Plans or in the Special Provisions, the standard PGAB Grade of PG64-28 shall be used.



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M3.01.2 Modified Asphalt Binder Grades.

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When specified by the contract documents, the PGAB shall be modified in accordance with the following:

A. Polymer Modified Asphalt Binder

The polymer modified asphalt binder shall be a PGAB which meets the specification requirements of AASHTO M 332, however "E" grades will not be subject to the J_{nrdiff} difference requirement. PGAB shall be provided by an approved Supplier in accordance with the AASHTO R 26. The modified PGAB Grade of **PG64E-28** shall be used.

B. Crumb Rubber Modified Asphalt Binder

The modified binder shall be in accordance with ASTM D6114-09, Type II. Virgin PGAB for the crumb rubber modified asphalt shall be a PG 58-28 or PG 64-28 provided by an approved Supplier in accordance with the AASHTO R 26. The grade selected shall be based on laboratory testing by the asphalt rubber Manufacturer.

The granulated rubber shall be vulcanized rubber product from the ambient temperature processing of scrap, pneumatic tires. The granulated rubber shall meet the gradation found in Table M3.1.

1 4010 1/101	
Sieve Size	Percent by Weight Passing
#10	100
#16	90 - 100
#30	25 - 75
#80	0 - 20

Table M3.1 – Crumb Rubber Gradation

The use of crumb rubber of multiple types from multiple sources is acceptable provided that the overall blend of crumb rubber meets the gradation requirements. The length of the individual rubber particles shall not exceed 1/8". The rubber shall be certified by the crumb rubber Manufacturer.

The percent of crumb rubber shall be a minimum of 15% by weight of binder. The temperature of the asphalt shall be between 350°F and 400°F at the time of addition of the granulated crumb rubber. The asphalt and crumb rubber shall be combined and mixed together in a blender unit and reacted in the distributor for a period of time as required by design. The temperature of the asphalt rubber mixture shall be above 325°F during the reaction for a period of one hour.

M3.01.3 Asphalt Binder Grade for Recycled Asphalt Materials.

For any HMA mixture containing recycled asphalt materials, a binder that is softer than the standard asphalt binder shall be utilized in the mixture to account for the amount and stiffness of the recycled binder in accordance with Table M3.2.

If greater than 25% Reclaimed Asphalt Pavement (RAP) or any quantity of Recycled Asphalt Shingles (RAS) are used in an asphalt mixture, the virgin PGAB grade when blended with the RAP binder shall meet the binder grade specified by the project. The resulting final PGAB grade shall be in accordance with Table M3.2. Only PGABs meeting the requirements of AASHTO M 320 or M 323 will be used.

The type and amount of virgin asphalt binder to be used in the HMA mixture shall be included as part of the Laboratory Trial Mix Formula (LTMF). The Contractor shall submit certified test results from an AASHTO accredited laboratory showing the testing of the individual binders and the blending.

Amount of RAP in Mixture	Virgin PGAB Grade	Resulting PGAB Grade
\leq 25% RAP by Weight of Mixture	Project Specified Grade	
> 25% to 40% RAP by Weight of Mixture	Follow AASHTO M 323 Appendix X1	Project Specified Grade
\leq 5% RAS by Weight of Mixture	Follow AASHTO PP 78	

 Table M3.2 – PGAB Grades for HMA Containing RAP/RAS



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M3.01.4 Warm Mix Asphalt Additive.

All HMA shall be modified using a warm mix asphalt (WMA) additive. The WMA additive shall be evaluated by AASHTO's National Transportation Product Evaluation Program (NTPEP) and be listed on the MassDOT QCML. No WMA foaming technology which requires the mechanical injection of steam or water into the liquid asphalt will be permitted.

For HMA placed on bridge decks, the WMA additive shall not be used to lower the mixing and compaction temperatures. The mixing and compaction temperatures specified for the binder prior to addition of the WMA additive shall be used.

The WMA additive must be compatible with polyphosphoric acid modified binders, polymer modified binders, and anti-stripping agents. The WMA additive shall be introduced in accordance with the Manufacturer's dosing rates and approved blending methods.

The HMA mixture design shall incorporate the requirements of AASHTO R35 Appendix X2: Special Mixture Design Considerations and Practices for Warm Mix Asphalt (WMA). Laboratory mixing and compaction temperatures shall be reduced per the WMA Manufacturer's recommendations, however, the optimum laboratory compaction temperature for unmodified asphalt binders shall be less than 260°F. Target laboratory mixing and compaction temperatures shall be submitted to the Research & Materials Section (RMS) for review prior to performing a mix design.

When the asphalt binder is modified with the WMA additive at the HMA plant, all WMA additive equipment shall be fully automated and integrated into the plant controls and shall record actual dosage rates on the plant printouts. The Contractor's Quality System Manual shall provide mixture production and placement alterations due to the WMA additive and shall incorporate the modification of asphalt binders when the WMA additive is blended with the asphalt binder at the plant. This plan shall specifically address WMA metering requirements, tolerances and other Quality Control measures.

M3.01.5 Asphalt Anti-Stripping Additive.

An anti-stripping additive may be required in an HMA mixture to increase the resistance of the asphalt binder coating to stripping in the presence of water. An anti-stripping additive may be a liquid anti-strip or hydrated lime.

The Engineer may verify the effectiveness of the anti-strip used in an HMA mixture. When added at the dosage rate recommended by the Manufacturer to an HMA mixture showing moisture susceptibility, the anti-strip shall cause an improvement to the mixture's moisture susceptibility. This shall be determined by testing specimens with and without the liquid anti-strip additive in accordance with AASHTO T 324. If the antistrip does not show an improvement in the moisture susceptibility the additive will not be permitted for use.

The Manufacturer shall certify that the material is in accordance with this specification. The Manufacturer shall submit a COC for each Lot in accordance with Division 1 Section 6.0. The COC shall also include the:

- 1. Brand name and designation.
- 2. Composition or description of the anti-strip additive.
- 3. Manner in which the material will be identified on the containers.

A. Hydrated Lime

The hydrated lime for HMA shall conform to the requirements of AASHTO M 303.

B. Liquid Anti-Strip

The anti-strip Manufacture shall submit product documentation, including the recommended dosage rate, to RMS for approval. Approved anti-strip additives shall be listed on the MassDOT QCML.

Anti-stripping additives shall be an organic chemical compound free from inorganic mineral salts or inorganic mineral soaps. The anti-strip additive shall be chemically inert to asphalt binder and shall not appreciably alter the specified characteristics of the asphalt binder. When blended with asphalt binder, it shall be stable and withstand storage at a temperature of 400°F for extended periods without loss of effectiveness.



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M3.01.6 Asphalt Release Agents.

Approved asphalt release agents will be listed on the MassDOT QCML. The asphalt release agent shall not be detrimental to the HMA and shall not dissolve asphalt binder when applied to the truck bed. Dilution by diesel or other petroleum products will not be permitted.

Asphalt release agents shall be evaluated by AASHTO's National Transportation Product Evaluation Program (NTPEP). Release agents shall meet the following minimum requirements:

- 1. 7-Day Stripping Test
 - a. No stripping or discoloration when used in full strength and diluted forms.
- 2. Mixture Slide Test
 - a. 10.0 grams retained, maximum.
- 3. Asphalt Performance Test
 - a. Able to pull the cooled binder from the metal plate without adherence, a minimum of three pours.
- 4. Flash Point, ASTM D93

a. Have a flash point greater than 400°F on the undiluted product and contain no flammable materials, solvents, or petroleum elements.

The Manufacturer shall submit a Certificate of Compliance (COC) for each Lot of asphalt release agent in accordance with Division 1 Section 6.0. The COC shall also include the:

- 1. Brand name and designation.
- 2. Composition or description of the release agent.
- 3. Manner in which the material will be identified on the containers.

The Manufacturer shall certify that the material is in accordance with this specification. In addition, the Manufacturer shall furnish information for any dilution requirements, including the minimum dilution rate and special application requirements.

M3.02.0 Cutback Asphalts.

These materials shall be blends of asphalt cements and suitable solvents. They shall be homogeneous, free from water and conform to the requirements of AASHTO M 81 for the rapid curing type and AASHTO M 82 for the medium curing type.

M3.03.0 Asphalt Emulsions. M3.03.1 Anionic Emulsified Asphalt.

These materials shall conform to the requirements of AASHTO M 140. Anionic emulsion used for tack coat shall be grade **RS-1h**.

When supplied in 5-gallon buckets the anionic emulsion used for tack coat shall be grade **RS-1**.

M3.03.2 Cationic Emulsified Asphalt.

This material shall conform to the requirements of AASHTO M 208. Cationic asphalt emulsion used for tack coat shall be grade **CRS-1h**.

When supplied in 5-gallon buckets the cationic emulsion used for tack coat shall be grade CRS-1.

M3.03.3 Polymer Modified Emulsified Asphalt.

This material shall conform to the requirements of AASHTO M 316. Polymer modified asphalt emulsion used for tack coat shall be grade CRS-1P.

M3.05.0 Hot Poured Joint Sealer.

This sealer shall meet the requirements of ASTM D6690 Type II. Products shall be evaluated by the National Transportation Product Evaluation Program (NTPEP) as an HMA Crack Sealer (CS) and be listed on the MassDOT QCML.



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M3.05.1 Asphalt-Fiber Joint and Crack Sealer.

This material shall consist of a blend of asphalt cement (PG64-28) and polyester fibers. The asphalt-fiber blend shall consist of 6% fiber by weight of asphalt binder.

M3.05.2 Preformed Bituminous Joint Filler for Concrete.

This material shall be a non-extruding and resilient bituminous type preformed expansion joint filler. It shall conform to the requirements of AASHTO M 213.

M3.05.3 Hot Applied Asphalt Crack Sealer.

This specification covers a hot applied crack sealer suitable for use in cement concrete and hot mix asphalt pavement. This sealer shall meet the requirements of ASTM D6690 Type II. Products shall be evaluated by the National Transportation Product Evaluation Program (NTPEP) as an HMA Crack Sealer (CS) and be listed on the MassDOT QCML.

M3.11.0 Hot Mix Asphalt.

M3.11.1 General.

All Hot Mix Asphalt (HMA) mixtures shall meet the requirements of the Superpave volumetric mix design system as well as the following. Asphalt mixtures shall be composed of the following:

- 1. Mineral aggregate.
- 2. Mineral filler (if required).
- 3. Performance Graded Asphalt Binder (PGAB).

The use of recycled materials shall be at the Contractor's option in accordance with these specifications. And as permitted, recycled materials shall be limited to:

- 1. Recycled Asphalt Pavement (RAP).
- 2. Recycled Asphalt Shingles (RAS).
- 3. Processed Glass Aggregate (PGA).

Each HMA pavement course placed shall be compromised of one of the mixture types listed in Table 450.1HMA Pavement Courses & Mixture Types.

M3.11.2 Aggregate for Hot Mix Asphalt.

A. Coarse Aggregate

The coarse mineral aggregate shall be clean, hard, durable, crushed rock consisting of the angular fragments obtained by breaking and crushing shattered natural rock, reasonably free from thin and/or elongated pieces, free from dirt or other objectionable materials. It shall be surface dry and shall have a moisture content of not more than ½ percent after drying. Aggregates from multiple sources of supply shall not be mixed or stored in the same stockpile.

B. Fine Aggregate

The fine aggregate shall consist of one of the following:

- 1. 100% Natural Sand.
- 2. 100% Stone Sand.
- 3. A blend of sand and stone screenings, the proportions of which shall be approved by the Engineer.
- 4. A blend of natural sand and stone sand.

Natural sand shall consist of inert, hard, durable grains of quartz or other hard, durable rock, free from topsoil or clay, surface coatings, organic matter or other deleterious materials.



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Stone sand shall be a processed material prepared from stone screenings to produce a consistently graded material conforming to specification requirements.

Stone screenings shall be the product of a secondary crusher and shall be free from dirt, clay, organic matter, excess fines or other deleterious material.

C. Consensus Properties

Aggregates utilized in HMA mixtures, including RAP if used in the mixture, shall be tested for conformance with the Consensus Property requirements outlined in AASHTO M 323 Sections 6.2 to 6.6 and Table M3.5 below.

D. Source Properties

The coarse aggregate utilized in asphalt mixtures shall be clean, crushed rock consisting of the angular fragments obtained by breaking and crushing shattered natural rock. It shall be free from dirt or other objectionable materials. The coarse aggregate, including RAP if used in the mixture, shall be tested for conformance with the requirements indicated in Table M3.6. The specific gravity of each aggregate component shall be determined as specified in Table M3.7 below.

To determine the bulk specific gravity of RAP aggregate, the method outlined in FHWA Publication Number FHWA-HRT-11-021 "Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice" shall be used. The following excerpt is the method to be followed:

If the source of RAP is known and original construction records are available, the bulk specific gravity (BSG) value of the virgin aggregate from the construction records may be used as the BSG value of the RAP aggregate. However, if original construction records are not available, the recommended procedure for estimating BSG of the RAP aggregate is a simple three-step process as follows:

Determine the maximum theoretical specific gravity of the RAP mixture, G_{mm}^{RAP} , according to AASHTO T 209.

Calculate the effective specific gravity of the RAP aggregate, G_{se}^{RAP} , using G_{mm}^{RAP} , the asphalt content of the RAP mixture (P_b) and an assumed asphalt specific gravity (G_b) as follows:

$$G_{se}^{RAP} = \frac{100 - P_b}{\frac{100}{G_{mm}} - \frac{P_b}{G_b}}$$

Where $G_b = 1.030$.

The asphalt absorption, P_{ba} , shall be assumed to be 0.5%. Use this value to estimate the BSG of the RAP aggregate, G_{sb}^{RAP} , from the calculated G_{se}^{RAP} .

$$G_{sb}^{RAP} = G_{se}^{RAP} / \left(\frac{P_{ba} \times G_{se}^{RAP}}{100G_b} + 1\right)$$

E. Recycled Asphalt Pavement

Reclaimed Asphalt Pavement (RAP) shall meet the requirements of Subsection M3.11.2C and D as well as the following. RAP shall consist of the material obtained from state highways or streets by crushing or milling existing HMA pavements. This material shall be transported to the HMA production facility yard and processed through an appropriate crusher so that the resulting material will contain no particles larger than the maximum aggregate size of the HMA mixture in which it will be used.

The RAP shall be stockpiled on a free draining base and kept separate from the other aggregates. RAP stockpiles shall be covered in a manner that prevents the intrusion of water but also allows the flow of air. The RAP stockpiles shall have a reasonably uniform gradation from fine to coarse and shall not be contaminated by foreign materials. The RAP used in the HMA mix production shall have a moisture content such that the final HMA contains no more than 0.5% moisture.

The use of RAP will be permitted at the option of the Contractor and provided that the end product is in conformance with the approved Job Mix Formula (JMF). The proportion of RAP to virgin aggregate shall be in accordance with Table M3.4 and Subsection M3.01.3.





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Mix Type	Maximum Amount of RAP Allowed (%)	Maximum Amount of RAS Allowed (%) ⁽¹⁾
Friction Course (OGFC)	0	0
Friction Course (ARGG)	10	0
Surface Course		0
Leveling Course	15	5
Bridge Surface Course	15	0
Bridge Protective Course		0
Intermediate Course	40	5
Base Course	40	5
(1) When RAS is used in HMA mixtures containing RAP or other recycled materials, the RAS will be		

considered as part of the overall allowable weight of recycled materials in the mixture.

F. Recycled Asphalt Shingles

Recycled Asphalt Shingles (RAS) shall consist of only the by-product materials obtained from the roofing shingle manufacturing process. Post-consumer shingle waste and re-roofing shingle scrap will not be allowed. The Contractor or the plant shall provide certification from the roofing shingle manufacturer that RAS material provided is a by-product of the shingle manufacturing process. This material shall be transported to the HMA production facility yard and processed through an appropriate crusher so that the resulting material will contain no particles larger than ½ inch. The material shall be stockpiled on a free draining base and kept separate from the other aggregates. The material contained in the processed stockpile shall not be contaminated by foreign materials. RAS stockpiles shall be covered in a manner that prevents the intrusion of water but also allows the flow of air.

RAS may be used in HMA leveling courses, HMA intermediate courses, and HMA base courses at a maximum rate of 5% by weight. When RAS is used in HMA mixtures containing RAP or other recycled materials, the RAS will be considered as part of the overall allowable weight of recycled materials in the mixture.

G. Processed Glass Aggregate

The use of Processed Glass Aggregate (PGA) meeting the requirements of Subsection M2.01.8 may be added at a maximum addition rate of 10% by weight. This addition will only be allowed in base and intermediate mixtures. PGA in mixes containing RAP will be considered as part of the overall allowable mass of RAP in the mix. If PGA is used in the mix, a separate aggregate bin shall be used and the use of lime as an anti-stripping agent shall be required.

Traffic Level	Design ESALs (Millions) ⁽¹⁾	Fractured Fa Coarse Aggreg % Minimu All Courses (except Base Course)	ces, sate, ⁽²⁾ m Base Course	Uncompacted Content of Fine Aggr % Minimu All Courses (except Base Course)	l Void t egate, um Base Course	Sand Equivalent, % Minimum	Flat and Elongated, ⁽²⁾ % Maximum
1	< 0.3	55/	/	(4)		40	
2	0.3 to < 10	85/80 ⁽³⁾	60/	45	40	45	10
3	≥ 10	95/90	80/75	45	40	45	10
(1) The anticipated project traffic level expected on the design lone over a 20 year period. Regardless of the actual							

Table M3.5 – Aggregate	e Consensus	Property	Requirements
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(1) The anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years.

(2) This criterion does not apply to 4.75 mm nominal maximum size mixtures.

(3) 85/80 denotes that 85 percent of the coarse aggregate has one fractured face and 80 percent has two or more fractured faces.

(4) For 4.75 mm nominal maximum size mixtures designed for traffic levels below 0.3 million ESALs, the minimum Uncompacted Void Content is 40.



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Source Property Test	Test Method	Limit
Toughness	AASHTO T 96	< 30 %
Soundness	AASHTO T 104	< 10 %
Deleterious Materials	AASHTO T 112	< 0.5 %

 Table M3.6 – Aggregate Source Property Requirements

Table M3.7 – Aggregate Specific Gravity Test Method

Aggregate Type	Test Method
Coarse	AASHTO T 85
Fine	AASHTO T 84 or ASTM D7370
Mineral Filler	AASHTO T 100
RAP	From FHWA-HRT-11-021

M3.11.3 Performance Graded Asphalt Binder.

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The PGAB utilized in the HMA mixture shall be specified by the Contract and shall comply with the requirements of Subsection M3.01.0.

M3.11.4 Hot Mix Asphalt Mixture Design.

The Contractor shall be responsible for development of all HMA mixture designs. All HMA surface courses, intermediate courses, base courses, leveling courses, bridge surface courses, and bridge protective courses shall be supported by volumetric mixture designs using the Superpave mixture design system. All Superpave HMA designs shall be developed in accordance with the following AASHTO standards, as modified herein:

- 1. AASHTO M 323
- 2. AASHTO R 35
- 3. AASHTO T 312

Open Graded Friction Course (OGFC) and Asphalt Rubber Gap Graded (ARGG) mixtures shall be designed in accordance with Subsections M3.11.4G and M3.11.4H, respectively.

A. Development of Laboratory Trial Mix Formula

The Contractor shall develop and submit a Laboratory Trial Mix Formula (LTMF) for each HMA mixture type, which is to be proposed as a Job Mix Formula (JMF), a minimum of sixty (60) days prior to HMA production. Each LTMF shall be submitted with supporting documentation and adequate amount of blended aggregate material and PGAB in order to verify the LTMF.

Once verified by the Department, the LTMF may become the Job Mix Formula (JMF) for a project. Two or more JMFs per HMA type may be approved for a particular plant, however, only mixture conforming to one JMF is permitted to be produced and placed on any given day.

B. Estimated Design Traffic

The estimated traffic level to be used for HMA mix designs shall be specified by the contract. The traffic level shall be expressed in Equivalent Single Axle Loads (ESALs) for the design travel lane over a 20-year period in million 18-kip ESALs.


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C. Specific Gravity Requirements

The individual aggregate, mineral filler, and PGAB specific gravities shall be included with the LTMF. The Contractor shall provide samples of each aggregate material a minimum of sixty (60) days prior to production for each LTMF to the Department for verification specific gravity of each stockpile.

D. Superpave Aggregate Gradation Requirements

The combined aggregate blend for each Superpave HMA mixture shall conform to the Gradation Control Point requirements specified in Table M3.8. The results of the selected optimum design aggregate structure shall be plotted on a 0.45 power chart and included with the LTMF.

The combined aggregate gradation shall be classified as coarse-graded when it passes below the Primary Control Sieve (PCS) control point as defined in Table M3.9. All other gradations shall be classified as fine graded.

When a Superpave Surface Course - 19.0 (SSC - 19.0) is specified in the contract, the LTMF aggregate gradation shall provide a fine-graded HMA mixture as defined in Table M3.9.

E. Gyratory Compaction Criteria

Each asphalt mixture shall be designed and controlled during production using an approved gyratory compactor which meets the requirements of AASHTO T 312. Compaction shall be in accordance with the requirements of AASHTO T 312. The density of each HMA mixture shall be evaluated at the initial number of gyrations ($N_{initial}$), the design number of gyrations (N_{design}), and the maximum number of gyrations (N_{max}). The gyratory-compacted specimens for each LTMF shall meet the density requirements specified in Table M3.10 below.

F. Superpave Volumetric Design Requirements.

Each Superpave HMA mixture shall be designed in accordance with the volumetric mixture design specifications contained in AASHTO M 323 and procedures contained in AASHTO R 35, as modified herein. Each HMA mixture LTMF shall be tested for conformance with the following volumetric properties:

- 1. Air Voids at N_{design} (V_a).
- 2. Voids in the Mineral Aggregate at N_{design} (VMA).
- 3. Voids Filled with Asphalt at N_{design} (VFA).
- 4. Fines to Effective Asphalt Ratio $(P_{0.075} / P_{be})$.

The volumetric property test results shall be submitted with the LTMF for each Superpave HMA mixture. The required minimum or maximum criteria for each of the volumetric property tests are specified in Tables M3.10, M3.11, and M3.12.



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	Nominal Maximum Aggregate Size – Control Points (% Passing)											
Sieve	# (4.75	4 mm)	3/ (9.5	8" mm)	1/ (12.5	2" mm)	3/ (19.0	4" mm)	1 (25.0	" mm)	1 1 (37.5	/2" mm)
Inches	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2											100	
1 1/2									100		90	100
1							100		90	100		90
3/4					100		90	100		90		
1/2	100		100		90	100		90				
3/8	95	100	90	100		90						
#4	90	100		90								
#8			32	67	28	58	23	49	19	45	15	41
#16	30	55										
#30												
#50												
#100												
#200	6	13	2	10	2	10	2	8	1	7	0	6

ADDENDUM NO. 1, JULY 31, 2020 Table M3.8 – Superpave Aggregate Gradation Control Points

Table M3.9 – Gradation Classification

PCS Control Point for Mixture Nominal Maximum Aggregate Size (% Passing)						
Nominal maximum accoracte size	3/8"	1/2"	3/4"	1"	1 1/2"	
Nominal maximum aggregate size	(9.5 mm)	(12.5 mm)	(19.0 mm)	(25.0 mm)	(37.5 mm)	
Drimory control size	#8	#8	#4	#4	3/8"	
Primary control sieve	(2.36 mm)	(2.36 mm)	(4.75 mm)	(4.75 mm)	(9.5 mm)	
PCS control point, % passing	47	39	47	40	47	

Traffic Level	Design ESALs	Number of Gyrations			Percent Density of G _{mm} from Asphalt Mixture Gyratory Specimen		
	(millions)	N _{ini}	N _{des}	N _{max}	\mathbf{N}_{ini}	N _{des}	N_{max}
1	< 0.3	6	50	75	≤91.5	96.0	≤98.0
2	0.3 to < 10	7	75	115	≤90.5	96.0	≤98.0
3	≥ 10	8	100	160	≤ 89.0	96.0	≤98.0



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	Nominal Maximum Aggregate Size							
	#4	3/8"	1/2"	3/4"	1"	1 1/2"		
	(4.75 mm)	(9.5 mm)	(12.5 mm)	(19.0 mm)	(25.0 mm)	(37.5 mm)		
Pb								
G _{mb}			LTMF V	alue				
G_{mm}								
Va	4.0							
VMA	≥17.0	≥16.0	≥15.0	≥14.0	≥13.0	≥ 12.0		
VFA	Table M3.12							
Dust/P _{be} ⁽¹⁾	0.9 - 2.0 0.6 - 1.2 0.6 - 1.2 0.6 - 1.2 0.6 - 1.2 0.6 - 1.2				0.6 - 1.2			
Mixture	Unmodified PGAB \leq 325°F							
Temp		N	lodified PGA	$B \le 350^{\circ}F$				
(1) If the ag	(1) If the aggregate gradation passes beneath the PCS Control Point specified in M 323 Table 5,							
the dust	he dust-to-binder ratio range may be increased from 0.6-1.2 to 0.8-1.6 at the Engineer's							
discretio	discretion.							
(2) Laboratory mixing and compaction temperatures shall be based on the PGAB Certificate of								
Analysi	Analysis. When additives such as WMA, polymers, and rubber are introduced the mixing							
and con	mpaction temper	atures may be	e modified f	rom the PG	AB COA.	Temperature		
modific	ations shall be re	commended by	y the binder S	Supplier and a	pproved at th	e Engineer's		

Table M3.11 – Superpave Volumetric Requirements

Table M3.12 –	Supernavo	e Asphalt Mixture	VFA	Requirements
1 abic 1010.12	Superpart	a rispitate ministure	V L I L	Requirements

Traffic	Design		Ve Based of	oids Filled wit n Nominal Ma	h Asphalt (VF. ximum Aggreg	A) gate Size	
Level	(Millions)	#4 (4.75 mm)	3/8" (9.5 mm)	1/2" (12.5 mm)	3/4" (19.0 mm)	1" (25.0 mm)	1 ½" (37.5 mm)
1	< 0.3	70 - 80	70 - 80	70 - 80	70 - 80	67 - 80	64 - 80
2	0.3 to < 10	65 - 78	65 - 78	65 - 78	65 - 78	65 - 78	64 - 78
3	≥ 10	75 - 78	73 – 76	65 - 75	65 - 75	65 - 75	64 - 75



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G. Open Graded Friction Course Design Requirements

Each OGFC asphalt mixture shall be designed in accordance AASHTO PP 77, as modified herein. The combined aggregate gradation shall conform to Table M3.13 and the mixture shall conform to Table M3.14.

- 1. OGFC-P will utilize asphalt binder meeting the requirements of Subsection M3.01.2A.
- 2. OGFC-AR will utilize asphalt binder meeting the requirements of Subsection M3.01.2B.

Table M3.13 – OGFC Aggregate Gradation Control Points

<i>.</i>	Nominal Maximum Aggregate Size Control Points (% Passing)				
Sieve	3/8" (9.5 mm)				
Inches	Min	Max			
1	-	-			
3/4	-	-			
1/2	100	-			
3/8	85	100			
#4	20	40			
#8	5	15			
#200	0	4			

Table M3.14 – OGFC Mixture Requirements

Property	Requirement			
N _{des} , gyrations	50			
P _b , % (Polymer)	≥ 6.5			
P _b , % (Asphalt Rubber)	≥ 7.5			
V _a , %	18 – 22			
VCA _{mix} , %	< VCA _{DRC}			
Draindown, % ⁽¹⁾	≤ 0.3			
Abrasion Loss, % ⁽²⁾	≤15			
Moisture Susceptibility, % ⁽³⁾	≥ 70			
Permeability, in/sec ⁽⁴⁾	≥ 0.0178			
 (1) Draindown shall be tested in accordance with AASHTO T 305 at the production temperature. (2) Abrasion loss shall be tested in accordance with AASHTO TP 108. (3) Moisture susceptibility shall be tested in accordance with AASHTO T 283. (4) Permeability shall be performed in accordance with the procedure outlined by RMS. 				

H. ARGG Design Requirements

Each Asphalt Rubber Gap Graded (ARGG) asphalt mixture shall be designed in accordance with the AASHTO M 323 and procedures contained in AASHTO R 35, as modified herein. The combined aggregate gradation shall conform to Table M3.15 and the mixture shall conform to Table M3.16.

ARGG will utilize asphalt binder meeting the requirements of Subsection M3.01.2B.



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Table M3.15 – ARGG Aggregate Gradation Control Points

Sieve	Nominal Maximum Aggregate Size Control Points (% Passing) ½" (12.5 mm)			
Inches	Min	Max		
1	-	-		
3/4	100	-		
1/2	90	100		
3/8	83	87		
#4	28	42		
#8	14	22		
#200	0	6		

Table M3.16 – ARGG Mixture Requirements

Property	Requirement		
N _{des} , gyrations	100		
P _b , %	≥ 7.6		
V _a , %	3 – 6		
VMA, %	18 – 23		
Draindown, % ⁽¹⁾	≤ 0.3		
(1) Draindown shall be t	tested in accordance with		
AASHTO T 305 at the production temperature.			

M3.11.5 Verification of Laboratory Trial Mix Formula.

The Contractor shall submit an LTMF in accordance with Subsection M3.11.4. The Engineer will perform laboratory verification of each LTMF.

If the Engineer is unable to verify the Contractor's LTMF in accordance with the applicable LTMF Verification Limits in Table M3.17, Table M3.18, or Table M3.19, then the Engineer will work with the Contractor to resolve the verification issue(s). The Contractor shall not proceed with production and placement of a Control Strip under Section 450 until the LTMF is verified by the Engineer.





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 Table M3.17 – Superpave LTMF Verification Limits

Properties	Test Method	LTMF Verification Limit
Asphalt Binder Content (P _b)	AASHTO T 308	Target 0.3%
Gradation Passing #4 (4.75 mm) and Larger Sieves		Target 6.0%
Gradation Passing #8 (2.36 mm) Sieve		Target 5.0%
Gradation Passing #16 (1.18 mm) to #50 (0.30 mm) Sieve	AASHTO T 30	Target 3.0%
Gradation Passing #100 (0.15 mm) Sieve		Target 2.0%
Gradation Passing #200 (75 µm) Sieve		Target 1.0%
Bulk Specific Gravity (G _{mb})	AASHTO T 166	Target ± 0.022
Max. Theo. Specific Gravity (G _{mm})	AASHTO T 209	Target 0.020
Air Voids (V _a)		Target 1.0%
Voids in Mineral Aggregate (VMA)	AASHTO R 35	Target 1.0%
Voids Filled With Asphalt (VFA)		Target 5.0%
Rutting and Moisture Susceptibility	AASHTO T 324	Table M3.20

Table M3.18 – OGFC LTMF Verification Limits

Properties	Test Method	LTMF Verification Limit	
Asphalt Binder Content (P _b)	AASHTO T 308	Target 0.3%	
Gradation Passing #4 (4.75 mm) and Larger Sieves		Target 6.0%	
Gradation Passing #8 (2.36 mm) Sieve		Target 5.0%	
Gradation Passing #16 (1.18 mm) to #50 (0.30 mm) Sieve	AASHTO T 30	Target 3.0%	
Gradation Passing #100 (0.15 mm) Sieve		Target 2.0%	
Gradation Passing #200 (75 µm) Sieve		Target 1.0%	
Bulk Specific Gravity (G _{mb})	AASHTO T 331	Target ± 0.022	
Max. Theo. Specific Gravity (G _{mm})	AASHTO T 209	Target 0.020	
Air Voids (V _a)		Target 2.0%	
Voids in Mineral Aggregate (VMA)	AASHTO R 35	Target 2.0%	
Voids Filled with Asphalt (VFA)		Target 5.0%	
Draindown	AASHTO T 305	$\leq 0.3\%$	
Abrasion Loss	AASHTO TP 108	<u>≤15%</u>	
Tensile Strength Ratio	AASHTO T 283	$\geq 70\%$	

Table M3.19 – ARGG LTMF Verification Limits

Properties	Test Method	LTMF Verification Limit	
Asphalt Binder Content (P _b)	AASHTO T 308	Target 0.3%	
Gradation Passing ³ / ₄ " (19.0 mm) Sieve		Target 0.0%	
Gradation Passing #4 (4.75 mm) to ½" Sieve		Target 6.0%	
Gradation Passing #8 (2.36 mm) Sieve		Target 5.0%	
Gradation Passing #16 (1.18 mm) to #50 (0.30 mm) Sieve	AASH10 I 30	Target 3.0%	
Gradation Passing #100 (0.15 mm) Sieve		Target 2.0%	
Gradation Passing #200 (75 µm) Sieve		Target 1.0%	
Bulk Specific Gravity (G _{mb})	AASHTO T 166	Target ± 0.022	
Max. Theo. Specific Gravity (G _{mm})	AASHTO T 209	Target 0.020	
Air Voids (V _a)	A A GUTO D 25	Target 1.0%	
Voids in Mineral Aggregate (VMA)	AASHIUK 33	Target 1.0%	
Draindown	AASHTO T 305	$\leq 0.3\%$	
Rutting and Moisture Susceptibility	AASHTO T 324	Table M3.20	



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Evaluation of Rutting and Moisture Sensitivity

Each HMA mixture, with the exception of Base Courses and OGFC, shall be tested by RMS for rutting and moisture sensitivity in accordance with the requirements of AASHTO T 324 using the Hamburg Wheel-Tracking Device (HWTD).

The Engineer may also require that mixtures meet the requirements of AASHTO T 283 with a minimum tensile strength ratio of 80%.

Traffic Level	Maximum Rut Depth Inches (mm)	Minimum number of passes before Stripping Inflection Point is observed
1		10,000
2	1/2 (12.5)	15,000
3	15,000	

Table M3.20 - Hamburg Wheel Tracking Device Requirements

M3.11.6 HMA for Driveways, Sidewalks, Berm, and Curb.

HMA mixtures for driveways, sidewalks, berm, and curb shall conform to the master ranges in Table M3.21. The PGAB shall conform to Subsection M3.01.1. The Contractor shall submit a Job Mix Formula (JMF) prior to production which shows the target aggregate gradation and PG asphalt binder content for each HMA mixture for driveways, sidewalks, berm, and curb.

With the approval of the Engineer, the Contractor may substitute a MassDOT approved 9.5 mm or 12.5 mm Superpave Surface Course mixture (Traffic Level 1 or 2) for Driveways and Sidewalks.

The Contractor shall perform QC testing at the start of plant production and in conjunction with the calibration of the plant in order to verify that the JMF can be produced within the Engineering Limits specified in Table M3.22.

The composition limits in Table M3.21 are HMA mix design master ranges for aggregate gradation and asphalt binder content. The JMF for each HMA mixture type shall establish a single percentage of aggregate passing each required sieve size, and a single percentage of asphalt binder material to be added to the aggregate.

The JMF shall be submitted in writing by the Contractor to the Engineer at least 30 days prior to the start of paving operations and shall include the following as a minimum:

- 1. Source of materials.
- 2. Percent of each aggregate stockpile.
- 3. Percent passing each sieve size.
- 4. Combined aggregate specific gravity.
- 5. Percent of asphalt binder.
- 6. Performance grading test results and Certificate of Compliance certifying the PG grade.
- 7. Mixing temperature.
- 8. Compaction temperature.
- 9. Temperature of mix when discharged from the mixer.

10. Maximum theoretical specific gravity of the mixture.

AASHTO T 195 (Ross Count) with a coating factor of 98% will be used when necessary to evaluate proper mixing time.

The use of recycled materials will be permitted at the option of the Contractor and provided that the end product is in conformance with the designated JMF. The proportion of reclaimed materials (including RAP, PGA, and RAS) in the total mix shall be limited to a maximum of 15%.

All HMA JMFs for sidewalks, wheelchair ramps, driveways, and berm will be submitted to the Engineer for approval. The JMF shall bind the Contractor to furnish paving mixtures not only within the master ranges, but also conforming to the exact formula thus set up for the project, within the Engineering Limits found in Table M3.22.

For each project, at least one QC sample shall be randomly obtained by the Contractor for every 2,000 tons produced, but not less than one QC sample per day. The Engineer shall also obtain a minimum of one random Acceptance sample for every 2,000 tons produced. The sample will be tested for conformance with the submitted JMF and Engineering Limits. When testing shows the mixture is not in conformance the Engineer will determine the disposition in accordance with Section 6.04 of Division I.

The JMF for each mixture shall be in effect until modified in writing by the Contractor and approved by the Engineer. Should a change in sources of materials be made, a new JMF must be approved by the Engineer before the new material is used.





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Table M3.21 – Master Ranges for HMA for Driveways, Sidewalks, Berm, and Curb

	Nominal Maximum Aggregate Size Control Points (% Passing)					
Mixture Type	Driveways, S Be	idewalks, and rm	Berm and	Curb Only		
Sieve (Inches)	Min	Max	Min	Max		
1	-	-	-	-		
3/4	100	-	-	-		
1/2	95	100	100	-		
3/8	87	93	87	93		
#4	57	69	62	73		
#8	41	45	52	55		
#16	30	36	40	45		
#30	21	25	28	34		
#50	14	17	18	23		
#100	9	12	10	14		
#200	4	5	6	6		
P _b , %	6.0	6.6	7.4	7.6		

Table M3.22 – Engineering Limits for Aggregate Gradation and Asphalt Binder Content

Sieve Designation / Binder Content	Engineering Limits
Passing No. 4 and larger sieve sizes	JMF Target ± 6%
Passing No. 8 sieve	JMF Target ± 5%
Passing No. 16 to No. 50 sieves (inclusive)	JMF Target ± 3%
Passing No. 100 sieve	JMF Target ± 2%
Passing No. 200 sieve	JMF Target ± 1%
Asphalt Binder Content	JMF Target $\pm 0.4\%$

M3.11.7 Cold Patch for Temporary Patching.

When HMA is not available due to seasonal limitations the Contractor shall use stockpiled cold patch mixtures approved by the Research & Materials Section.

M3.11.8 Stress Absorbing Membrane & Stress Absorbing Membrane Interlayer.

All Stress Absorbing Membrane (SAM) and Stress Absorbing Membrane Interlayer (SAMI) mixtures shall meet the requirements as specified below. SAM & SAMI mixtures shall be composed of the following:

- 1. Mineral aggregate
- 2. Performance Graded Asphalt Binder



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A. Aggregate. The aggregate shall conform to Subsection M3.11.2. Crushed gravel stone will not be permitted. The aggregate shall be pre-heated to a temperature between 200°F and 300°F, and be pre-coated with 0.4% to 0.8% asphalt binder (by weight of aggregate) prior to application. The aggregate shall meet the requirements in Tables M3.23 and M3.24.

	Nominal Maximum Aggregate Size – Control Points						
Туре	3/ (9.5	3/8" 1/2" 3/8" (9.5 mm) (12.5 mm) SAMI ONLY					
Sieve (Inches)	Min	Max	Min Max		Min	Max	
5/8	100	-	100	-	100	-	
1/2	100	-	90	100	100	-	
3/8	85	100	25	65	85	100	
#4	0	8	0	8	0	30	
#8	0	4	0	4	0	5	
#200	0	2	0	2	0	2	

 Table M3.23 – SAM & SAMI Aggregate Control Points

Table M3 24	_ SAM &	SAMI	Aggregate	Source	Property	Requirements
1 abic 1913.24	- SAM &	SANI	Aggregate	Source.	гторенту	Requirements

Source Property Test	Test Method	Limit				
Toughness	AASHTO T 96	< 30 %				
Flakiness Index (For SAM)	TEX-224-F ⁽¹⁾	< 20%				
Flakiness Index (For SAMI)	TEX-224-F ⁽¹⁾	< 30%				
(1) Determined following TxDOT's Test Procedure for Determining						
Flakiness Index.						

B. Performance Graded Asphalt Binder.

The PGAB binder to be applied to the pavement shall be in conformance with Subsection M3.01.2B. Asphalt binder that is pre-coated onto the aggregate shall be in conformance with Subsection M3.01.1.

M3.11.9 Ultrathin Bonded Overlay

All Ultrathin Bonded Overlay (UTBO) mixtures shall meet the requirements as specified below. UTBO mixtures shall be composed of the following:

- 1. Mineral aggregate.
- 2. Mineral filler (if required).
- 3. Performance Graded Asphalt Binder (PGAB).

The use of recycled materials will not be permitted.

A. Coarse Aggregate.

Coarse aggregate shall meet the requirement of M3.11.2A. 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.



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B. Fine Aggregate.

Fine aggregate shall meet the requirement of M3.11.2B as well as one of the following. Fine aggregate shall be 100% crushed and consist of one of the following:

- 1. 100% Stone Sand.
- 2. A blend of stone sand and stone screenings.

Table M3.25 – Fine Aggregate Consensus Property Requirements

Source Property Test	Test Method	Limit
Sand Equivalence	AASHTO T 176	> 60 %
Methylene Blue	AASHTO T 330	$\leq 10 \text{ mg/g}$

C. Mineral Filler

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

Typical acceptable gradation: #30 - 100% passing

#200 - 75-100% passing

D. Performance Graded Asphalt Binder.

The PGAB utilized in the HMA mixture shall be specified by the Contract and shall comply with the requirements of Subsection M3.01.2.

E. UTBO Mixture Design.

The Contractor shall be responsible for development of all UTBO mixture designs. All UTBO designs shall be developed in accordance with the requirements specified below.

F. Development of Laboratory Trial Mix Formula

The Contractor shall develop and submit a Laboratory Trial Mix Formula (LTMF) for each UTBO mixture type, which is to be proposed as a Job Mix Formula (JMF), a minimum of sixty (60) days prior to UTBO production. Each LTMF shall be submitted with supporting documentation and adequate amount of blended aggregate material and PGAB in order to verify the LTMF. Once verified by the Department, the LTMF may become the Job Mix Formula (JMF) for a project.

G. Specific Gravity Requirements

The individual aggregate, mineral filler, and PGAB specific gravities shall be included with the LTMF. The Contractor shall provide samples of each material a minimum of sixty (60) days prior to production for each LTMF to the Department for verification specific gravity of each stockpile.



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H. UTBO Aggregate Gradation Requirements

The combined aggregate blend for each UTBO mixture shall conform to the Gradation Control Point requirements specified in Table M3.26. The results of the selected optimum design aggregate structure shall be plotted on a 0.45 power chart and included with the LTMF.

	Nominal Maximum Aggregate Size – Control Points (% Passing)					
Туре	Тур	be 1	Type 2 ⁽¹⁾		Type 3 ⁽¹⁾	
Sieve (Inches)	Min	Max	Min	Max	Min	Max
3⁄4	100	-	100	-	100	-
1/2	100	-	92	100	85	100
3/8	85	100	55	90	45	85
#4	24	40	24	41	24	41
#8	21	32	21	33	21	33
#16	16	26	15	26	15	26
#30	12	20	11	20	11	20
#50	8	16	8	16	8	16
#100	5	10	5	10	5	10
#200	5	7	4	7	4	7
(1) When asphalt rubber is specified the gradation master ranges may be modified with the prior approval from the Research & Materials Section.						

Table M3.26 – UTBO Aggregate Control Points

I. UTBO Mixture Requirements

The combined mixture for each UTBO mixture shall conform to the mixture requirements specified in Table M3.27. The results of the selected optimum design shall be included with the LTMF.

Property	Requirement			
P _b , % (Polymer)	4.8 - 5.2			
P _b , % (Asphalt Rubber) ⁽¹⁾	5.8 - 6.2			
Draindown, % ⁽²⁾	≤ 0.1			
Moisture Susceptibility, % ⁽³⁾	≥ 80			
 (1) Type 1 UTBO shall not use asphalt rubber. (2) Draindown shall be tested in accordance with AASHTO T 305 at the production temperature. (3) The mixture shall be compacted according to AASHTO T 312 and tested in accordance with AASHTO T 283 				

Table M3.27 – UTBO Mixture Requirements

J. Verification of Laboratory Trial Mix Formula.

The Contractor shall submit an LTMF in accordance with Subsections M3.11.9A to M3.11.9I. The Engineer will perform laboratory verification of each LTMF.

If the Engineer is unable to verify the Contractor's LTMF in accordance with the applicable LTMF Verification Limits in Table M3.28, then the Engineer will work with the Contractor to resolve the verification issue(s). The Contractor shall not proceed with production and placement of a Control Strip under Section 467 until the LTMF is verified by the Engineer.





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Table M3.28 – UTBO LTMF Verification Limits

Properties	Test Method	LTMF Verification Limit
Asphalt Binder Content (P _b)	AASHTO T 308	Target 0.3%
Gradation Passing ³ / ₄ " (19.0 mm) Sieve		Target 0.0%
Gradation Passing #4 (4.75 mm) and Larger Sieves	AASHTO T 30	Target 6.0%
Gradation Passing #8 (2.36 mm) Sieve		Target 5.0%
Gradation Passing #16 (1.18 mm) to #50 (0.30 mm) Sieve		Target 3.0%
Gradation Passing #100 (0.15 mm) Sieve		Target 2.0%
Gradation Passing #200 (75 µm) Sieve		Target 1.0%
Draindown	AASHTO T 305	$\leq 0.1\%$
Tensile Strength Ratio	AASHTO T 283	$\geq 80\%$

M3.12.0 Hot Mix Asphalt Production Facility.

All facilities producing HMA must be approved on an annual basis by the Department. All sources of materials used for the production of HMA must be approved by the Department prior to their use. Such materials shall include:

- 1. Coarse aggregate.
- 2. Fine aggregate.
- 3. Mineral filler.
- 4. Performance graded asphalt binder.
- 5. Modifiers and/or additives.

HMA production operations shall follow industry accepted best management practices including:

- 1. Aggregate handling and stockpile management.
- 2. Recycled asphalt pavement handling and stockpile management.
- 3. PGAB storage.
- 4. Plant process controls.
- 5. Silo loading.
- 6. Truck loading.

The plant shall meet the requirements of AASHTO M 156 as well as the following provisions. HMA plants meeting these requirements and which have been approved by RMS shall be listed on the MassDOT QCML.

An adequate quantity of each size aggregate, mineral filler and asphalt binder shall be maintained at the HMA plant site at all times while the plant is in operation to ensure that the plant can continuously produce mixtures that meet these specifications. The quantity of such materials shall never be less than one day's production capacity.

M3.12.1 Scales.

Plant and truck scales shall be certified:

- 1. At the start of each construction season, prior to use for MassDOT projects.
- 2. At intervals of not more than 90 calendar days.
- 3. Whenever the plant changes location.
- 4. At any time as requested by the Engineer.

M3.12.2 Calibration of Plant Equipment.

The plant's systems shall be calibrated:

- 1. At the start of each construction season, prior to use for MassDOT projects.
- 2. Whenever there is a significant change to the material.

3. Whenever a plant component supply system affecting the ingredient proportions has been repaired, replaced, or adjusted.

4. At any time as requested by the Engineer.



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M3.12.3 Automatic Recordation.

Recordation equipment shall be provided. Each recorder shall include an automatic printer system. The printer shall be so positioned that the digital display and the printer can be readily observed within the plant's control room by the Engineer and the plant operator, simultaneously. The delivery ticket shall be printed with an original and at least one copy. The original shall be furnished to the Engineer at the paving site and the copy to the Engineer at the plant. The delivery ticket format shall be approved by RMS and will include the following information:

- 1. Company / plant location.
- 2. MassDOT contract number and/or distinct project name.
- 3. MassDOT mix ID number and/or distinct mix description.
- 4. Percentage of RAP in the mixture.
- 5. Percentage of asphalt binder in the mixture.
- 6. Date and time of loading.
- 7. Sequential load number for the contract for a 24-hour period.
- 8. Total weight of mix in truck (pay weight).

The following mixture production information shall also be provided:

For Batch Plants

- 1. Date mixed.
- 2. Time of batching.
- 3. Tare weight of aggregate weigh box.
- 4. Tare weight of PGAB weigh bucket.
- 5. Moisture content of recycled materials.
- 6. Target and actual cumulative or net weights as batched for each bin with a batch total for all net ingredients.
- 7. Target and actual weight of PGAB.
- 8. Total weight of mix in truck (pay weight).

Note: This information shall be included on the delivery ticket when the mix is batched directly into a truck. When the mix is batched and stored in a silo the information may be separate from the delivery ticket however it must be provided to the Engineer at the plant.

For Drum Plants

- 1. Percent of mixture as well as the target and actual production rate for each individual mix component including:
 - a. Aggregate
 - b. Mineral Filler
 - c. PGAB
 - d. Recycled materials
 - e. Additives
- 2. Moisture content of aggregates and recycled materials.
- 3. PGAB temperature.
- 4. Target and actual mix temperature.
- 5. Target and actual mix production rate.

Note: This information is not required to be included on the delivery ticket however it must be provided to the Engineer at the plant.



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M3.12.4 Surge and Storage Silo Holding Time.

Unless otherwise permitted by the Engineer, the mixtures shall not be stored in surge and storage bins longer than the following:

- 2. Unheated and insulated with heated gate15 hours
- 3. Insulated and heated24 hours

Note: In order to prevent excessive draindown, OGFC shall not be stored in a surge or storage bin for longer than two (2) hours. ARGG shall not be stored for more than six (6) hours.

M3.12.5 Asphalt Release Agents.

The plant shall have a method of applying MassDOT approved asphalt release agents to the haul units in accordance with the Manufacturer's recommendations. Spray systems may either be manual or automated but application of the release agent must be at the rate specified by the Manufacturer.

M3.12.6 Air Quality.

The plant shall be designed and operated to meet all current Federal and State air quality requirements.

M3.12.7 Equipment Failure.

If at any time the automatic proportioning or recording system becomes inoperative, the plant will cease all HMA production. Work will only be allowed to restart once all automatic controls and recording systems are functional.

M3.12.8 HMA Plant Facility Inspection.

The Engineer shall have access at any time to all parts of the plant for:

- 1. Inspections of the conditions and operations of the plant.
- 2. Confirmation of the adequacy of the equipment in use.
- 3. Verification of the character and proportions of the mixture.
- 4. Determination of temperatures being maintained in the preparation of the mixture.
- 5. Inspection of incidental related procedures.

M3.13.0 Hot Mix Asphalt Materials Testing Laboratory and Equipment.

M3.13.1 Contractor Quality Control Laboratory.

All Contractor QC testing shall be performed in laboratories that are approved by RMS and qualified through the NETTCP Laboratory Qualification Program (LQP) or accredited through the AASHTO Accreditation Program (AAP). All laboratories shall maintain a Quality System Manual (QSM) in accordance with the outline maintained by the Research & Materials Section.

1. Laboratories that perform HMA mix designs or QC testing under Section 450 shall at a minimum be qualified as a NETTCP LQP Category 2 laboratory.

- 2. Laboratories performing only QC testing shall be qualified as a NETTCP LQP Category 3 laboratory.
 - a. Contractors who do not produce mixtures under Section 450 will not be required to have their own laboratory at the production facility but will be required to either test at their central laboratory or hire a Consultant testing company to perform the QC testing required in the specification. The Contractor will still be required to maintain a QSM for the HMA Production Facility.

The Contractor's QC laboratory shall be qualified to perform all testing required by Table M3.29 as well as contract specifications.





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Laboratories meeting these requirements, and which have been approved by the RMS shall be listed on the MassDOT QCML.

The Contractor's QC Manager shall have overall responsibility for ensuring that all laboratories utilized for Quality Control are in compliance with the requirements of the NETTCP LQP. This includes providing required AASHTO, ASTM, and NETTCP reference documents and ensuring that all required equipment and tools are properly functioning and calibrated.

The Engineer shall be permitted unrestricted access to inspect and review the Contractor's laboratory facility. Along with the required testing capabilities the laboratory facilities shall meet the following:

1. Be kept clean and all equipment shall be maintained in proper working condition.

2. Provide adequate environmental control to the satisfaction of the Engineer and must be able to maintain an inside temperature of 68 to 86°F during working hours.

- 3. Adequate ventilation to remove dust and fumes from the laboratory.
- 4. Hot and cold potable water.
- 5. First aid kit and emergency eye wash station.
- 6. Multi-class ABC fire extinguisher.

7. A restroom shall also be made available within 500 ft of the laboratory during all work shifts. The restroom facilities shall be enclosed in a separate room with proper ventilation and comply with applicable sanitary codes as well as:

- a. A flush toilet.
- b. A sink with hot and cold running water.
- c. A sewer or septic tank with connections.
- d. Adequate rest room supplies.
- e. Maintained environmental control and cleanliness.

M3.13.2 Department Acceptance Laboratory at HMA Production Facility

The Engineer shall be provided laboratory working space meeting the requirements of Subsection M3.12.1 as well as the following. A desk must be located in close proximity to the laboratory but be separated from the ovens, sieve shakers, and anything else that can cause poor air and sound quality. The Engineer's desk and laboratory space will not be shared with any other entity.

Contractors who do not produce mixtures under Section 450 will not be required to have a Department Acceptance Laboratory at the production facility but will be required to allow the Engineer to perform Acceptance testing at their central laboratory or Consultant testing company laboratory. These laboratories are still required to meet Subsection M3.12.1.

If the Engineer is unable to perform their duties either due to lack of working space, poor working conditions, or access to equipment it will be considered a laboratory facility deficiency. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. Deficiencies shall be grounds for the Engineer to order an immediate stoppage of work until the deficiencies are corrected.

Unless approved by the Engineer, the plant, silos, and sample rack shall be in view of laboratory when performing testing under Section 450.

The Engineer shall be provided with the following:

A. Computer

For plants producing HMA in accordance with Section 450, the Engineer shall be furnished with a computer with high speed internet access which conforms to the requirements determined by RMS. The minimum requirements shall include:

- 1. The Engineer is required to have one (1) computer at the laboratory.
- 2. Computers shall be required to have the latest MS Office Professional with all security updates, Antivirus software with all current security updates maintained, and any other software required by RMS.
- 3. A laser printer with the capability to also scan and copy. The printer shall be compatible and connected to the laboratory's computer.



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B. Testing Equipment

The Contractor shall supply the Engineer with the following equipment. This equipment shall only be utilized by the Engineer and shall be labeled as such. It shall be the Contractor's responsibility to maintain and replace equipment as needed.

- 1. For T 27 and T 30:
 - a. 12-inch sieve stack (2 inch to #200) with cover and pan.
 - b. Mechanical sieve shaker (only for Section 450 Category A Lots).
 - c. Electronic balance (only for Section 450 Category A Lots).
- 2. For T 166 and T 209:
 - a. Complete setup (only for Section 450).
- 3. For T 312:
 - a. Gyratory mold.

4. For T 308:

- a. Ignition oven sample basket.
- b. Ignition oven and two (2) sample baskets (only for Section 450 Category A Lots).
- 5. Miscellaneous equipment such as sample buckets, scoops, pans, brushes, thermometers, etc.

6. Oven which meets AASHTO R 30 and is capable of storing the sample buckets for 3 samples (only for Section 450 Category A Lots).

7. Supply of sample boxes.

8. Sample rack which is a suitable sampling platform from which the Engineer is able to stand and sample the material in the truck bed adequately and safely. The rack shall:

- a. Be of sturdy construction.
- b. Be able to safely accommodate at least two people at a time (min. standing area of 4 ft x 4 ft).
- c. Have a safe stairway that is attached to the sampling platform.
- d. Be at a height which allows the Technician the ability to reach the HMA in the bed of any size truck safely and efficiently.
- e. Have a mounted spot light to allow for sampling at night.
- f. Be within 100 ft of the laboratory and visible from the laboratory.
- g. Meet applicable OSHA standards.



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ADDENDUM NO. 1, JULY 31, 2020 Table M3.29 – Required Test Methods by Laboratory

Test Method	Description	Mix Design	QC	Department
Test Wiethod	Description	Laboratory	Laboratory	Acceptance Laboratory
AASHTO M 323	Superpave Volumetric Mix Design	Х		
AASHTO R 30 ⁽¹⁾	Mixture Conditioning of HMA	Х		
AASHTO R 35	Superpave Volumetric Design for Asphalt Mixtures	Х		
AASHTO R 47	Reducing Samples of HMA to Testing Size	Х	Х	Х
AASHTO R 66	Sampling of Asphalt Materials		Х	
AASHTO R 76	Reducing Samples of Aggregate to Testing Size	Х	Х	
AASHTO R 79 ⁽²⁾	Vacuum Drying Compacted HMA Specimens		Х	
AASHTO R 90	Sampling of Aggregates		Х	
AASHTO R 97	Sampling Bituminous Paving Mixtures		Х	Х
AASHTO T 11	Material Finer Than #200 Sieve by Washing	Х	Х	Х
AASHTO T 27	Sieve Analysis of Fine and Coarse Aggregates	Х	Х	Х
AASHTO T 30	Sieve Analysis of Extracted Aggregate	Х	Х	Х
AASHTO T 84	Specific Gravity and Absorption of Fine Aggregate	Х		
AASHTO T 85	Specific Gravity and Absorption of Coarse Aggregates	Х		
AASHTO T 96	Coarse Aggregate L.A. Abrasion	Х		
AASHTO T 104	Soundness of Aggregates	Х		
AASHTO T 166	Bulk Specific gravity of HMA	X	Х	Х
AASHTO T 176	Sand Equivalence	X		
AASHTO T 209	Theoretical Maximum Specific Gravity of HMA	Х	Х	Х
AASHTO T 255	Moisture Contents of Aggregates		Х	
AASHTO T 283 ⁽⁴⁾	Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage	Х		
AASHTO T 304	Un-compacted Void Content of Fine Aggregate	Х		
AASHTO T 305 ⁽³⁾	Draindown in Uncompacted Asphalt Mixtures	Х		
AASHTO T 308	Asphalt Binder Content by Ignition Oven		Х	Х
AASHTO T 312	Density of HMA by Superpave Gyratory	Х	Х	Х
AASHTO T 329	Moisture Control of HMA		Х	Х
AASHTO T 331 ⁽⁴⁾	Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing	Х	Х	Х
AASHTO T 335	Determining the Percentage of Fracture in Coarse Aggregate	Х		
ASTM D3549	Thickness of Compacted HMA Specimens		Х	
ASTM D4791	Flat & Elongated Particles in Coarse Aggregate	Х		
ASTM D7370 ⁽²⁾	Relative Density and Absorption of Aggregate Using Combined Vacuum Saturation and Rapid Submersion	Х		
(1) Two ovens shall	ll be required; one to heat binder, aggregate, and	mixing tools to	mixing tempera	ature and one to condition

the loose mixture at the compaction or conditioning temperature.

(2) Optional test.

(3) Required for Open Graded Friction Course and Asphalt Rubber Gap Graded.
(4) Required for Open Graded Friction Course.





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ADDENDUM NO. 1, JULY 31, 2020

SECTION M5: PIPE, CULVERT SECTIONS AND CONDUIT

SUBSECTION M5.03.10 Corrugated Plastic Pipe.

(page III.74) Replace this subsection with the following;

Pipe shall consist of corrugated polyethylene or polypropylene tubing, flare ends, couplings and fittings. Materials, dimensions, physical properties and fabrication shall be in accordance with AASHTO M 294, Type S or D or AASHTO M330 Type S or D. Perforated pipe shall meet Type SP, DP or CP.

SECTION M6: ROADSIDE DEVELOPMENT MATERIALS

SUBSECTION M6.03.0 Long Term Seed Mixes for Lawns and Slopes.

(page III.79) In table M6.03.0-1 Grass Seed Requirements for Lawn Grass Areas change the proportion of Creeping Red and/or Chewing Fescue from 55% to 59% and change the proportion of Dutch White Clover from 5% to 1%. In table M6.03.0-2 Grass Seed Requirements for Slopes and Shoulders change Kentucky Blue Grass to Tall Fescue. Delete table M6.03.0-3 Grass Seed Requirements for Warm Season Mix.

SUBSECTION M5.03.1 Short Term Erosion Control Seed.

(page III.79) Change the subsection number from M5.03.1 to M6.03.1. Change the table number from M5.03.1-1 to M6.03.1-1.

SECTION M9: MISCELLANEOUS MATERIALS

SUBSECTION M9.08.0: Preformed Sheet Membrane

(page III.128) Replace this subsection with the following;

M9.08.0: Waterproofing Membranes

M9.08.1: Spray Applied Waterproofing Membrane

A. General Requirements

Only products listed on the MassDOT Qualified Construction Materials List (QCML) will be accepted for use. The membrane waterproofing system shall consist of:

- Primer
- One or two coat rapid curing cold liquid spray applied seamless methyl methacrylate, polyurea, or polyurethane methyl methacrylate membrane
- Aggregate keycoat
- Polymer modified tack coat

B. Material Requirements

The total minimum base thickness for the membrane shall be 80 mils measured over peaks. The membrane shall easily accommodate the need for day joints and patch repairs. The membrane shall be able to bridge live cracks up to 1/8 inch in width and meet the criteria specified in Table M9.08.1-2.

The membrane waterproofing system shall be asbestos-free. The chemical composition of the primer, membrane, aggregate keycoat and tack coat that make up the membrane waterproofing system shall conform to the manufacturer's specifications for the material. All components shall be approved by the manufacturer as being compatible for use with the specified membrane. Cleaning solvents shall also be approved by the manufacturer for use with the membrane.





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Primer for Spray Applied Membrane

The primer shall promote adhesion of the membrane to the concrete surface.

Table M9.08.1-1: Primer Material Properties				
Property	Requirements			
Gel Time		> 5 minutes		
Tack Free Time		< 2.5 hours, max at 77°F		
Adhesion to Concrete	ASTM D7234	\geq 100 psi minimum and failure in concrete		

Membrane

The membrane shall be meet the requirements in Table M9.08.1-2.

Table M9.08.1-2: Spray Applied Waterproofing	Membrane Material Properties
--	------------------------------

Property	Test	Requirements
Solids Content		100%
Stability	ASTM C836	≥ 6 months
Crack Bridging (Neat Material + Aggregated Keycoat)	ASTM C1305 ⁽¹⁾	Pass, no cracking
Extensibility after Heat Aging	ASTM C1522	For information only
Percent Elongation at Break	ASTM D638	≥ 130%
Tensile Strength	ASTM D638 Type IV @ 2 in/min	> 1,100 psi
Shore Hardness	ASTM D2240 ⁽²⁾	≥ 50 Type 00
Minimum Thickness (Membrane only)	ASTM D6132 or other approved method	 ≥ 80 mils minimum measured over peaks or ≥ thickness used to pass ASTM C1305 (Whichever thickness is greater)
Membrane Waterproofing System Adhesion to Concrete	ASTM D7234	\geq 100 psi minimum and failure in concrete
Permeance	ASTM E96 Water Method, Procedure B	≤ 1.0 perms

⁽¹⁾ ASTM C1305 shall be modified to 25 cycles at -15°F no failure at 1/8 inch per hour.
 ⁽²⁾ ASTM D2240 shall be modified per ASTM C836 section 6.5.

Aggregate for Keycoat

The broadcast aggregate shall be durable and provide shear resistant to prevent the hot mix asphalt (HMA) from shoving. Aggregate shall have a minimum Mohs hardness rating of seven (7) and be approved by the manufacturer.





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Polymer Modified Tack Coat

The tack coat shall consist of either a polymer modified asphalt emulsion, or a polymer modified asphalt binder approved for use by the membrane waterproofing manufacturer and the Engineer.

C. Material Qualification

A manufacturer requesting approval of a spray applied membrane system shall furnish to the Research and Materials Section the following:

- 1. The membrane system material specifications including product performance data.
- 2. Certified independent test reports demonstrating conformance to Table M9.08.1-2.
 - 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. Independent test reports must be dated within two (2) 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.
- 3. MassDOT shall perform prequalification testing on the membrane.
 - Two (2) 10 inch by 10-inch square samples of the proposed membrane with smooth surfaces (no primer or aggregate in the keycoat). The samples shall be a minimum of 80 mils thick or the thickness used to pass the crack bridging requirement found in Table M9.08-4.

All submittals shall be certified to be in conformance with the manufacturer's instructions. Systems qualified by MassDOT per the performance criteria shall be considered for placement on the MassDOT QCML. Membrane waterproofing systems shall remain on the QCML for a period of five (5) years at which time the manufacturer will be required to submit certified test reports demonstrating conformance to this specification.

M9.08.2: Sheet Membrane

A. General Requirements

Only products listed on the MassDOT Qualified Construction Materials List (QCML) will be accepted for use. Chemical composition, physical properties and dimensional requirements of the sheet membrane shall conform to the manufacturer's specifications for the material.

Also, all accessory materials such as, flashing, primer, etc., used in the application of the sheet membrane will be considered a part of this specification and shall conform to the manufacturer's requirements. The membrane waterproofing system shall consist of:

- Primer
- Sheet Membrane
- Mastic

B. Material Requirements

The primer shall meet the requirements of Subsection M9.09.1.

The membrane sheet shall meet the requirements in Table M9.08.2-1.

The mastic for use with 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.



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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 (1)	≥3,000 psi
Elongation	ASTM D412	≥300%
Flexibility	ASTM D1970 ⁽²⁾	Unaffected
Adhesion to Concrete	ASTM D903 (3)	≥ 6 lbs/in.
Permeance	ASTM E96	≤0.1 perms
	Water Method, Procedure B	
Water Absorption	ASTM D570	≤0.5%
Puncture Resistance	ASTM E154	≥40 lbs

 $^{(1)}$ 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 \pm 3.6F. Average 5 samples.

⁽²⁾ ASTM D1970 shall be based on a 180° bend over 1 in. mandrel at -20°F.

⁽³⁾ 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.

C. 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. The peel-off backing material shall be tear resistant to prevent portions of it from remaining after the membrane is applied.
- 3. Certified independent test reports demonstrating conformance to Table M9.08.2-1.
 - 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 the same independent lab
 - Independent test reports must be dated within two (2) 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.





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M9.08.3: Hot Applied Rubberized Asphalt Membrane

A. General Requirements

Only products listed on the MassDOT Qualified Construction Materials List (QCML) will be accepted for use. Chemical composition, physical properties and dimensional requirements of the sheet membrane shall conform to the manufacturer's specifications for the material. The membrane waterproofing system shall consist of:

- Primer
- Hot poured rubberized asphalt membrane consisting of a single component hot applied asphalt
- Protective covering

B. Material Requirements

The primer shall meet the requirements of Subsection M9.09.1.

The membrane shall be able to bridge live cracks up to 1/8 inch in width and meet the criteria specified in Table M9.08.3-1.

The protective covering shall be rolled asphalt sheets conforming to ASTM D6380, Type II.

Property	Test	Requirements
Solids Content		100%
Flash Point	AASHTO T 48	$\geq 500^{\circ}\mathrm{F}$
Bond, Non-Immersed	ASTM D5329	Pass, no separation
Flexibility	ASTM D5329	No delamination or cracking
Flow	ASTM D5329	at $120^{\circ}F = 0$ in.
		at $140^{\circ}F \le 1/8$ in.
Penetration	ASTM D5329	at $77^{\circ}F \le 110$
		at $140^{\circ}F \le 200$
Permeance	ASTM E96	≤ 0.1 perms
	Water Method, Procedure B	

Table M9.08.3-1: Hot Applied Rubberized Asphalt Membrane Material Properties

C. Material Qualification

A manufacturer requesting approval of a hot applied rubberized asphalt membrane shall furnish to the Research and Materials Section the following:

- 1. The membrane system material specifications including product performance data.
- 2. Certified independent test reports demonstrating conformance to Table M9.08.3-1.
 - 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.
 - Independent test reports must be dated within two (2) 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.



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SUBSECTION M9.09.0 Primer and Damp-Proofing.

(page III.15) Add this new subsection.

M9.09.1: Primer

This material shall be suitable for priming concrete and masonry surfaces prior to the application of waterproofing or damp-proofing and shall meet the requirements of ASTM D41.

M9.09.2: Damp-Proofing

This material shall meet the requirements of ASTM D449, Type II.

<<<<<>>>>>>

END OF INTERIM SUPPLEMENTAL SPECIFICATIONS



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ADDENDUM NO. 1, JULY 31, 2020

DOCUMENT 00813

SPECIAL PROVISIONS

PRICE ADJUSTMENTS FOR STRUCTURAL STEEL AND REINFORCING STEEL

July 17 2020

This special provision applies to all projects containing the use of structural steel and/or reinforcing steel as specified elsewhere in the Contract work. It applies to all structural steel and all reinforcing steel, as defined below, on the project. Compliance with this provision is mandatory, i.e., there are no "opt-in" or "opt-out" clauses. Price adjustments will be handled as described below and shall only apply to unfabricated reinforcing steel bars and unfabricated structural steel material, consisting of rolled shapes, plate steel, sheet piling, pipe piles, steel castings and steel forgings.

Price adjustments will be variances between Base Prices and Period Prices. Base Prices and Period Prices are defined below.

Price adjustments will only be made if the variances between Base Prices and Period Prices are 5% or more. A variance can result in the Period Price being either higher or lower than the Base Price. Once the 5% threshold has been achieved, the adjustment will apply to the full variance between the Base Price and the Period Price.

Price adjustments will be calculated by multiplying the number of pounds of unfabricated structural steel material or unfabricated reinforcing steel bars on a project by the index factor calculated as shown below under <u>Example of a</u> <u>Period Price Calculation</u>.

Price adjustments will <u>not</u> include guardrail panels or the costs of shop drawing preparation, handling, fabrication, coatings, transportation, storage, installation, profit, overhead, fuel costs, fuel surcharges, or other such charges not related to the cost of the unfabricated structural steel and unfabricated reinforcing steel.

The weight of steel subject to a price adjustment shall not exceed the final shipping weight of the fabricated part by more than 10%.

Base Prices and Period Prices are defined as follows:

<u>Base Prices</u> of unfabricated structural steel and unfabricated reinforcing steel on a project are fixed prices determined by the Department and found in the table below. While it is the intention of the Department to make this table comprehensive, some of a project's unfabricated structural steel and/or unfabricated reinforcing steel may be inadvertently omitted. Should this occur, the Contractor shall bring the omission to the Department's attention so that a contract alteration may be processed that adds the missing steel to the table and its price adjustments to the Contract.

The Base Price Date is the month and year in which MassDOT opened bids for the project. This date is used to select the Base Price Index.

<u>Period Prices</u> of unfabricated structural steel and unfabricated reinforcing steel on a project are variable prices that have been calculated using the Period Price Date and an index of steel prices to adjust the Base Price.

The Period Price Date is the date the steel was delivered to the fabricator as evidenced by an official bill of lading submitted to the Department containing a description of the shipped materials, weights of the shipped materials and the date of shipment. This date is used to select the Period Price Index.

The index used for the calculation of Period Prices is the U.S. Department of Labor Bureau of Labor Statistics Producer Price Index (PPI) Series ID WPU101702 (Not Seasonally Adjusted, Group: Metals and Metal Products, Item: Semi-finished Steel Mill Products.) As this index is subject to revision for a period of up to four (4) months after its original publication, no price adjustments will be made until the index for the period is finalized, i.e., the index is no longer suffixed with a "(P)".



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Period Prices are determined as follows:

Period Price = Base Price X Index Factor Index Factor = Period Price Index / Base Price Index

Example of a Period Price Calculation:

Calculate the Period Price for December 2009 using a Base Price from March 2009 of \$0.82/Pound for 1,000 Pounds of ASTM A709 (AASHTO M270) Grade A36 Structural Steel Plate.

The Period Price Date is December 2009. From the PPI website*, the Period Price Index = 218.0.

The Base Price Date is March 2009. From the PPI website^{*}, the Base Price Index = 229.4.

Index Factor = Period Price Index / Base Price Index = 218.0 / 229.4 = 0.950Period Price = Base Price X Index Factor = \$0.82/Pound X 0.950 = \$0.78/Pound

Since 0.82 - 0.78 = 0.04 is less than 5% of 0.82, no price adjustment is required.

If the \$0.04 difference shown above was greater than 5% of the Base Price, then the price adjustment would be 1,000 Pounds X 0.04/Pound = 40.00. Since the Period Price of 0.78/Pound is less than the Base Price of \$0.82/Pound, indicating a drop in the price of steel between the bid and the delivery of material, a credit of \$40.00 would be owed to MassDOT. When the Period Price is higher than the Base Price, the price adjustment is owed to the Contractor.

* To access the PPI website and obtain a Base Price Index or a Period Price Index, go to http://data.bls.gov/cgi-bin/srgate

End of example.

The Contractor will be paid for unfabricated structural steel and unfabricated reinforcing steel under the respective contract pay items for all components constructed of either structural steel or reinforced Portland cement concrete under their respective Contract Pay Items.

Price adjustments, as herein provided for, will be paid separately as follows:

Structural Steel

Pay Item Number 999.449 for positive (+) pay adjustments (payments to the Contractor)

Pay Item Number 999.457 for negative (-) pay adjustments (credits to MassDOT Highway Division)

Reinforcing Steel

Pay Item Number 999.466 for positive (+) pay adjustments (payments to the Contractor)

Pay Item Number 999.467 for negative (-) pay adjustments (credits to MassDOT Highway Division)

No price adjustment will be made for price changes after the Contract Completion Date, unless the MassDOT Highway Division has approved an extension of Contract Time for the Contract.



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TABLE

	1 1 1
Steel Type PC	so 36
$\frac{ASTM A015/A015M Olde 00 (AAS1110 M51 Olde 00 01 420) Remotening Steel}{ASTM A027 (AAS1110 M102) St. 1 C. t' H D' $	\$0.30
ASIM A2/ (AASHIO MI03) Steel Castings, H-Pile Points & Pipe Pile Shoes (See Note (8) below.)	\$0.49
ASTM A668 / A668M (AASHTO M102) Steel Forgings	\$0.49
ASTM A108 (AASHTO M169) Steel Forgings for Shear Studs	\$0.54
ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel Plate	\$0.58
ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel	\$0.53
Shapes	
ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel Plate	\$0.58
ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel	\$0.53
Shapes	¢0.50
ASIM A /09/A /09M Grade 50W1 / AASHIO M2/0M/M2/0 Grade 50W1 or 345W1 Structural Steel Plate	\$0.59
ASTM A709/A709M Grade 50WT / AASHTO M270M/M270 Grade 50WT or 345WT Structural	\$0.54
Steel Shapes	\$0.5 T
ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W 345W Structural Steel	\$0.59
Plate	
ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W or 345W Structural	\$0.54
ASTM A709/A709M Grade HPS 50W / AASHTO M270M/M270 Grade HPS 50W or 345W	\$0.62
Structural Steel Plate	ψ0.02
ASTM A709/A709M Grade HPS 70W / AASHTO M270M/M270 Grade HPS 70W or 485W	\$0.65
Structural Steel Plate	
ASTM A514/A514M-05 Grade HPS 100W / AASHTO M270M/M270 Grade HPS 100W or	\$1.00
690W Structural Steel Plate	¢0.50
ASTM A992/A992M Grade 50S / AASHTO M2/0M/M2/0 Grade 50S or 345S Structural Steel Plate	\$0.59
ASTM A992/A992M Grade 50S / AASHTO M270M/M270 Grade 50S or 345S Structural Steel	\$0.54
Shapes	
ASTM A276 Type 316 Stainless Steel	\$2.97
ASTM A240 Type 316 Stainless Steel	\$2.97
ASTM A148 Grade 80/50 Steel Castings (See Note (8) below.)	\$1.03
ASTM A53 Grade B Structural Steel Pipe	\$0.66
ASTM A500 Grades A, B, 36 & 50 Structural Steel Pipe	\$0.66
ASTM A252, Grades 240 (36 KSI) & 414 (60 KSI) Pipe Pile	\$0.51
ASTM 252, Grade 2 Permanent Steel Casing	\$0.51
ASTM A36 (AASHTO M183) for H-piles, steel supports and sign supports	\$0.57
ASTM A328 / A328M, Grade 50 (AASHTO M202) Steel Sheetpiling	\$0.97
ASTM A572 / A572M, Grade 50 Sheetpiling	\$0.97
ASTM A36/36M, Grade 50	\$0.58
ASTM A570, Grade 50	\$0.57
ASTM A572 (AASHTO M223), Grade 50 H-Piles	\$0.58
ASTM A1085 Grade A (50 KSI) Steel Hollow Structural Sections (HSS), heat-treated per ASTM	\$0.66
A1085 Supplement S1	
AREA 140 LB Rail and Track Accessories	\$0.34

<u>NOTE:</u> Steel Castings are generally used only on moveable bridges. Cast iron frames, grates and pipe are not "steel" castings and will not be considered for price adjustments.

END OF DOCUMENT



ADDENDUM NO. 1, JULY 31, 2020

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DOCUMENT A00801

SPECIAL PROVISIONS

ASHLAND

Federal Aid Project Nos. CMQ-003S(390), STP-003S(390) & TAP-003S(390) Roadway Reconstruction and Related Work along Route 126 (Pond Street)

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

The work under this Contract consists of improvements to Route 126 (Pond Street) in the Town of Ashland beginning at the Holliston Town Line and ending at the Framingham Town Line, approximately 9,110 feet.

The project includes the following:

- Geometric improvements
- Full depth pavement reconstruction
- Constructing a roundabout at the intersection of Route 126 and spyglass hill road
- Traffic signal upgrades at the intersection of Route 126 and Eliot Street
- Reconstructing a section of Algonquin Trail to align with Harvard Street
- Installing new traffic signals at the intersection of Route 126 and Algonquin Trail and the intersection of Route 126 and the market basket driveway
- Excavation; pavement milling and box widening; pavement resurfacing
- Furnishing and installing new drainage structures and pipe
- Removing and replacing culverts; constructing headwalls
- Wetland area replication
- Furnishing and installing new granite curb; removing and resetting existing granite curb
- Constructing ADA compliant cement concrete sidewalks and wheelchair accessible ramps
- Constructing cantilever retaining walls
- Supplying and installing erosion control devices
- Furnishing and installing guardrail
- Supplying and placing loam and seed; planting landscape areas
- Installing signs and pavement markings
- Furnishing and setting bounds
- Providing traffic control

All work under this contract shall be done in conformance with the 2020 Standard Specifications for Highways and Bridges, the Supplemental Specifications contained in this book, the 2017 Construction Standard Details, the Traffic Management Plans and Detail Drawings, 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.



1 ADDENDUM NO. 1, JULY 29, 2020

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.

• Paragraph 4

Asbestos Liability Insurance shall be obtained for this project. The Contractor and the Massachusetts Department of Transportation 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 <u>massdotspecifications@dot.state.ma.us</u> The MassDOT project file number and municipality is to be placed in the subject line.

DESIGNER/PROJECT MANAGER

DESIGNER Green International Affiliates, Inc. 239 Littleton Road, Suite 3 Westford, MA 01886 Ko Ishikura, P.E. Tel: (978) 923-0400

MassDOT PROJECT MANAGER

MassDOT Highway Division 10 Park Plaza, Suite 6430 Boston, MA 02116 Lawrence Cash, P.E. Tel: (857) 368-9353



1 ADDENDUM NO. 1, JULY 31, 2020

BIDDERS LIST

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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.

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION FILE NUMBER SIGN

This project is subject to Massachusetts General Laws, Chapter 131, Section 40 as amended. Signs shall be in accordance with the latest MassDOT Construction Standards. All costs for the manufacture, erection, maintenance, moving, and removal of the signs shall be absorbed by the contractor with no additional compensation other than the contract unit prices.

For this project, the Massachusetts Department of Environmental Protection File Number is 95-931.



SUBSECTION M4.02.14 Precast Units

Replace this Subsection with the following :

SUBSECTION M4.02.14 Precast Concrete Highway Units

The following Precast Concrete Highway Units shall meet the materials and fabrication requirements specified herein:

- (a) Standard Temporary and Permanent Barriers
- (b) Box Culverts with spans less than or equal to 10 feet
- (c) Catch basins
- (d) Drainage Pipes
- (e) Pipe Flared Ends
- (f) Manholes
- (g) Handholes
- (h) Proprietary Retaining Wall Systems
- (i) Traffic Light Pole Bases
- (j) Luminaire Bases

Precast Concrete Highway Units shall be fabricated in conformance with the MassDOT Construction Standard Details, Traffic Standard Drawings for Traffic Signals and Highway Lighting, Overhead Signal Structure and Foundation Standard Drawings, and Standard Drawings for Signs and Supports. Circular vertical precast reinforced concrete manholes and structures used in sewer, drainage, and water works shall conform with the requirements of AASHTO M 199. The outside surface of the tapered or cone section of precast drainage structures shall be dried, cleaned, and coated with an RS-1-H coating meeting the requirements of AASHTO M 140.

QUALITY ASSURANCE

A. General.

Quality Assurance includes all the planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service. It is an all-encompassing term that includes Quality Control (performed by the Fabricator) and Acceptance (performed by MassDOT. Fabricator Quality Control activities and MassDOT Acceptance activities shall remain independent from one another. MassDOT Acceptance activities shall not replace Fabricator Quality Control activities.

B. Plant.

Prior to the fabrication of Precast Concrete Highway Units, the Fabricator's precast concrete plant shall obtain the following:

- (a) Certification by the National Precast Concrete Association (NPCA) Plant Certification Program or Precast/Prestressed Concrete Institute (PCI) Plant Certification Program, for the applicable types of Precast Concrete Highway Unit(s) being fabricated
- (b) MassDOT Approval

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1 ADDENDUM NO. 1, JULY 31, 2020

ITEM 996.01 and **ITEM 996.02** (Continued)

SCHEDULE OF BASIS FOR PARTIAL PAYMENTS

Within ten days after the Notice to Proceed, the Contractor shall submit a schedule of unit prices for the major component Sub-Items that make up Item 996.01 and 996.02 as well as their total wall structure Lump Sum cost for the Wall No. 1 and Wall No. 2. The wall structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual wall components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 996.01 and 996.02 and no further compensation will be allowed.

The schedule on the proposal form applies on to Wall No. 1 and Wall No. 2. Payment for similar materials and construction at locations other than at this wall structure shall not be included under this item. Sub-item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Sub-Item	Description	Quantity	Unit	Unit Price	Amount
904.	4000 PSI, 3/4 IN., 610 Cement Concrete	235	CY		
910.1	Steel Reinforcement for Structures - Epoxy Coated	25,700	LB		
970.	Damp-proofing	1,350	SF		

Item 996.01 Wall Structure, Wall No. 1 (Spyglass Wall)

Total Cost of Item 996.01 =

Item 996.02 Wall Structure, Wall No. 2 (Eliot Street Wall)

Sub-Item	Description	Quantity	Unit	Unit Price	Amount
638.1	Protective Screen (Chain Link)	240	FT		
904.	4000 PSI, 3/4 IN., 610 Cement Concrete	860	CY		
910.1	Steel Reinforcement for Structures – Epoxy Coated	83,200	LB		
970.	Damp-proofing	3,690	SF		

Total Cost of Item 996.02 =



ITEM 997.1SPECIAL DRAINAGE STRUCTURE NO.1LUMP SUM

The work under this Item shall conform to the relevant provisions of Subsections 901, 904, 910, 967, 970, and 983 of the Standard Specifications, and the following:

The work under this Item shall consist of furnishing all labor, materials, tools and equipment and the performance of all work required to furnish and install the 2'Wx2'H precast concrete box culvert at Sta. 37+48.51, the cast-in-place headwalls, and stones as shown on the plans. Stone baffles of 6" max thickness, placed every 7' including at the inlet and outlet, shall be provided along the bottom to retain the natural streambed material, as shown in the plans and details.

The Manufacturer shall submit evidence at the request of the Engineer showing that he has successfully completed work of similar magnitude prior to being approved as the source of the material for this work. The manufacturing process shall be closely supervised by experienced plant personnel and records of plastic and concrete strength shall be kept and submitted to the Engineer for control.

Materials

Materials shall meet the requirements specified in the following subsections of Division III, Materials Specifications of the Standard Specifications:

M4.02
M8.01.7
M2.02.3
M2.01.3
M9.50.0

The payment for Stone for Pipe Ends, Crushed Stone and Geotextile Fabric shall be paid under their respective items.

The precast box culvert (2'Wx2'H) shall be reinforced concrete and shall be manufactured in accordance with ASTM C76 standard specifications for reinforced concrete culvert. The culvert shall be designed to support an HS-20 (32,000 lbs.) truck axle load and dead load from earth cover over the top of the culvert as shown on the plans, and shall conform to all applicable 2017 AASHTO LRFD Bridge Design Specifications with current interim Specifications.

The Contractor shall submit shop drawings and structural calculations stamped by a Structural Engineer registered in the Commonwealth of Massachusetts for approval as specified in Section 5.02 of the Standard Specifications. The shop drawings shall show the size and location of all inserts and openings as shown on the Plans.

Existing utility locations shall be verified in the field prior to starting this work. The Contractor shall provide the Engineer with a plan showing existing utility locations and elevations prior to undertaking this work.

<u>**ITEM 997.1**</u> (Continued)

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material and all costs shall be incidental and be paid for under the lump sum price.

NATURAL STREAMBED MATERIAL

The work under this heading shall consist of installation of natural streambed material within the bottom of the culvert to provide a natural streambed for aquatic organisms. The natural streambed construction material is to be placed within the bottom 6" of the culvert with baffles on each end, as depicted on the plans.

The intent of this work is to ensure a natural streambed within the culvert, to provide fisheries and wildlife habitat enhancement as part of the wetland replication area and natural wetlands. The natural streambed material shall be comprised of the stones 4 inches and under, that shall meet the following gradation:

Sieve opening	Percent by Mass Passing Through
4"	95
2"	55 - 65
3/4''	30 - 45
#4	0 - 5

Partially angular rock is preferred over round and shall be able to lock together to prevent movement during high flows. Crushed Stone will not be accepted for any components. The inlet/outlet elevations of the proposed culvert shall match the proposed plans.

Construction of Special Drainage Structure

Work shall include removal and disposal of the existing 2'Wx2'H box culvert and existing headwalls and installing the new box culvert and new cast-in-place headwalls.

The precast concrete box culvert shall be constructed as shown on the Plans.

All precast units shall be carefully loaded, hauled, stored and erected to prevent damage. They shall be erected by experienced workmen, true to the lines and grades as shown on the Plans or directed by the Engineer. Any members superficially damaged during shipment or erection shall be rejected and shall be repaired by experienced workmen. Units badly damaged shall be rejected and shall be replaced with new units at no additional cost to the Owner. The Engineer shall be the sole judge of this damage. No holes shall be cut or drilled in the field without written approval of the Engineer.

Method of Measurement

Work for this item shall be paid on a lump sum basis for all work as shown on the plans, including the removal and disposal of existing headwalls and installing new culvert connecting to existing culvert, control of water and installing new cast-in-place headwalls.



1 ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.1 (Continued)

Basis of Payment

This Item will be paid for at the contract unit price per lump sum installed and completed in place. The Special Drainage Structure lump sum price shall include full compensation for all labor, materials, tools and equipment, removal, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, and other incidental expenses necessary to complete this Item.

Schedule of Basis for Partial Payments

Within ten days after the Notice to Proceed, the Contractor shall submit a schedule of unit prices for the major component Sub-Items that make up Item 997.1 as well as his/her total drainage structure Lump Sum cost for the Special Drainage Structure No. 1. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.1 and no further compensation will be allowed.

The schedule on the proposal form applies only to Special Drainage Structure No. 1. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Sub-Item	Description	Quantity	<u>Unit</u>	<u>Unit</u> Price	<u>Total</u>
901.	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	80	СҮ		
904.3	5000 PSI, ¾ IN., 685 HP CEMENT CONCRETE	10	СҮ		
910.2	Steel Reinforcement for Structures – Coated	2000	LB		
970.	Damp-Proofing	1305	SF		
983.52.	Natural Streambed Material	5	CY		

Total Cost of Item 997.1=



1 ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.2 (Continued)

The schedule on the proposal form applies only to Special Drainage Structure No. 2. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Special Drainage Structure No. 2

Sub-Item	Description	Quantity	<u>Unit</u>	<u>Unit</u> Price	<u>Total</u>
901	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	45	CY		
904.3	5000 PSI, ¾ IN., 685 HP CEMENT CONCRETE	5	CY		
910.2	Steel Reinforcement for Structures – Coated	1200	LB		
912	Drilling and Grouting Dowels	21	EA		
970.	Damp-Proofing	135	SF		
989.222	Repair of Voids in Masonry	4	EA		
989.223	Repair of Crack in Masonry	10	FT		

Total Cost of Item 997.2=


Highway Division

ITEM 997.3SPECIAL DRAINAGE STRUCTURE NO.3LUMP SUM

The work under this Item shall conform to the relevant provisions of Subsections 901, 904, 910, 967, 970, and 983 of the Standard Specifications, and the following:

The work under this Item shall consist of furnishing all labor, materials, tools and equipment and the performance of all work required to furnish and install the 3'Wx2'H precast concrete box culvert at Sta. 80+41.57, the cast-in-place Headwalls, and riprap as shown on the plans. Stone baffles of 6" max thickness, placed every 7' including at the inlet and outlet, shall be provided along the bottom to retain the natural streambed material, as shown in the plans and details.

The manufacturer shall submit evidence at the request of the Engineer showing that he has successfully completed work of similar magnitude prior to being approved as the source of the material for this work. The manufacturing process shall be closely supervised by experienced plant personnel and records of plastic and concrete strength shall be kept and submitted to the Engineer for control.

Materials

Materials shall meet the requirements specified in the following subsections of Division III, Materials Specifications of the Standard Specifications:

Cement Concrete	M4.02
Epoxy Coated Reinforcing Bars	M8.01.7
Stone for Pipe Ends	M2.02.3
Crushed Stone	M2.01.3
Geotextile Fabric	M9.50.0

The payment for Stone for Pipe Ends, Crushed Stone and Geotextile Fabric shall be paid under their respective items.

The precast box culvert (3'x2') shall be reinforced concrete and shall be manufactured in accordance with ASTM C76 standard specifications for reinforced concrete culvert. The culvert shall be designed to support an HS-20 (32,000 lbs.) truck axle load and dead load from earth cover over the top of the culvert as shown on the plans, and shall conform to all applicable 2017 AASHTO LRFD Bridge Design Specifications with current interim Specifications .

The Contractor shall submit shop drawings and structural calculations stamped by an Engineer registered in the Commonwealth of Massachusetts for approval as specified in Section 5.02 of the Standard Specifications. The shop drawings shall show the size and location of all inserts and openings as shown on the Plans.

Existing utility locations shall be verified in the field prior to starting this work. The Contractor shall provide the Engineer with a plan showing existing utility locations and elevations prior to undertaking this work.

<u>ITEM 997.3</u> (Continued)

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material. All costs shall be incidental and be paid for under the lump sum price.

The work under this item shall consist of installation of natural streambed material within the bottom of the culvert to provide a natural streambed for aquatic organisms. The natural streambed construction material is to be placed within the bottom 6" of the culvert with baffles on each end, as depicted on the plans.

The intent of this item is to ensure a natural streambed within the culvert, to provide fisheries and wildlife habitat enhancement as part of the wetland replication area and natural wetlands. The natural streambed material shall be comprised of the stones 4 inches and under, that shall meet the following gradation:

Sieve opening	Percent by Mass Passing Through
4"	95
2"	55 - 65
3/4''	30 - 45
#4	0-5

Partially angular rock is preferred over round and shall be able to lock together to prevent movement during high flows. Crushed Stone will not be accepted for any components. The inlet/outlet elevations of the proposed culvert shall match the proposed plans.

Construction of Special Drainage Structure

Work shall include removal and disposal of the existing 3'Wx2'H box culvert and existing headwalls and installing the new box culvert and new cast-in-place headwalls.

The precast concrete box culvert shall be constructed as shown on the Plans.

All precast units shall be carefully loaded, hauled, stored and erected to prevent damage. They shall be erected by experienced workmen, true to the lines and grades as shown on the Plans or directed by the Engineer. Any members superficially damaged during shipment or erection shall be rejected and shall be repaired by experienced workmen. Units badly damaged shall be rejected and shall be replaced with new units at no additional cost to the Owner. The Engineer shall be the sole judge of this damage. No holes shall be cut or drilled in the field without written approval of the Engineer.



1 ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.3 (Continued)

Basis of Payment

Item 997.3 will be paid for at the contract unit price, Lump Sum. This price shall include all labor, materials, tools, the removal and disposal of existing headwalls, installing new culvert connecting to existing culvert, control of water, installing new cast-in-place headwalls, equipment, removal, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, and incidentals necessary to complete the work.

SCHEDULE OF BASIS FOR PARTIAL PAYMENTS

Within 10 days of the Notice to Proceed, the Contractor shall submit their proposal form a schedule of unit prices for the major component Sub-Items that make up Item 997.3 as well as their total drainage structure Lump Sum cost for the Special Drainage Structure No. 3. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.3 and no further compensation will be allowed.

The schedule on the proposal form applies only to Special Drainage Structure No. 3. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Sub-Item	Description	Quantity	<u>Unit</u>	<u>Unit</u> Price	<u>Total</u>
901	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	30	СҮ		
904.3	5000 PSI, ¾ IN., 685 HP CEMENT CONCRETE	10	СҮ		
910.2	Steel Reinforcement for Structures – Coated	900	LB		
970.	Damp-Proofing	1575	SF		
983.521.	Natural Streambed Material	10	CY		

Special Drainage Structure No. 3

Total Cost of Item 997.3=



1 ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.4 (Continued)

Special Drainage Structure No. 4

Sub-Item	Description	Quantity	<u>Unit</u>	<u>Unit</u> Price	<u>Total</u>
901.	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	35	CY		
904.3	5000 PSI, ³ / ₄ IN., 685 HP CEMENT CONCRETE	15	CY		
910.2	Steel Reinforcement for Structures – Coated	1100	LB		
970.	Damp-Proofing	540	SF		

Total Cost of Item 997.4=

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MAX GREEN 2			11			40			9			25			6			47			12			25				
VEHICLE EXTENSION			3			3			3			3			3			3			3			3				
YELLOW CLEARANCE				3			4			3			3			3			4			3			3			
RED CLEARANCE					4.5			3			5.5			4			4.5			3			5.5			4		
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NOTES:

1. STANDARD NEMA CLEARANCES SHALL APPLY.

2. MAXIMUM GREEN 1 SHALL BE IN EFFECT ON WEEKDAYS FROM 6AM TO 9AM.

3. MAXIMUM GREEN 2 SHALL BE IN EFFECT ALL OTHER TIMES. 4. PREEMPTION MINIMUM GREENS SHALL BE SIX SECONDS.

5. EMERGENCY VEHICLE PREEMPTION SHALL BE ACTUATED BY AN OPTICAL SIGNAL FROM AN OPTICAL EMITTER MOUNTED ON AN EMERGENCY VEHICLE AND RECEIVED BY AN OPTICAL DETECTOR LOCATED AT INTERSECTION. A SEPARATE RECEIVING DETECTOR IS REQUIRED FOR EACH DETECTED APPROACH.

6. NORMAL CLEARANCES SHALL BE PROVIDED ON PHASES THAT ARE TERMINATED BY PREEMPTION DEMAND.

7. PEDESTRIAN PHASE SHOULD ONLY BE SERVED UPON PEDESTRIANS' PUSHBUTTON ACTIVATION.

	FIRI	E PRE-EMPT SCHEDULE	ION	
RECEIVER	PRE-EMPT	APPROACH	VEHICLE	NEXT
AND	PHASE	AND	PHASE	PHASE
PRIORITY	ASSIGNMENT	MOVEMENT	ASSIGNMENT	CALLED
R1	1	ЕВ	Ø 4 + Ø 7	Ø 4 + Ø 8
R2	2	WB	Ø 3 + Ø 8	Ø 4 + Ø 8
R3	3	NB	Ø 1 + Ø 6	Ø 2 + Ø 6
R4	4	SB	Ø 2 + Ø 5	Ø 2 + Ø 6

NOTES:

EMERGENCY VEHICLE PRE-EMPTION SIGNALS SHALL BE OPTICALLY TRANSMITTED 1. BY OPTICAL EMITTERS MOUNTED IN EMERGENCY VEHICLES AND RECEIVED BY OPTICAL RECEIVERS LOCATED AT THE INTERSECTION.

2. PRE-EMPTION SIGNALS SHALL BE SERVICED ON A PRIORITY BASIS WITH RECEIVERS ASSIGNED DESCENDING PRIORITIES AS FOLLOWS: (R2, R1, R4 THEN R3)

3. IN RESPONSE TO A PRE-EMPTION SIGNAL RECEIVED AT AN INTERSECTION BY OPTICAL RECEIVER R4 (OR OTHERS AS PROVIDED) THE CONTROLLER SHALL HOLD OR ADVANCE TO AND HOLD IN EMERGENCE PRE-EMPTION THE ASSOCIATED GREEN PHASE FOR A MINIMUM OF TEN (10) SECONDS OR UNTIL, PRE-EMPTION SIGNAL CEASES. THE CONTROLLER SHALL THEN PROVIDE PRE-EMPTION PHASE CLEARANCE SERVICE THEN RESUME NORMAL OPERATION.

4. MINIMUM GREEN, NORMAL VEHICLE AND PEDESTRIAN CLEARANCE SHALL BE PROVIDED ON PHASES THAT ARE TO BE TERMINATED BY PRE-EMPTION DEMAND.

5. EMERGENCY VEHICLE PRE-EMPTION SHALL OVERRIDE COORDINATION. 6. ONCE PRE-EMPTION TERMINATES THE SIGNAL WILL RETURN TO PHASE SHOWN IN COLUMN "NEXT PHASE CALLED" TO RESUME NORMAL OPERATION.

7/30/2020 \Lambda DELETE REFERENCE TO ITEM 813.81 DESCRIPTION DATE USE ONLY PRINTS OF LATEST DATE





IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC 4. MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT SHALL NOT CHANGE DURING THE CHANGE INTERVAL(S) UNLESS OTHERWISE NOTED.

PREFERENTIAL PHASING SEQUENCE



	1	3	5'X4.5'	2-4-2	6	6	В	-	-
	2	1	5'X4.5'	4-8-8-8-4	2	2	В	-	-
	2	2	6'X23'	4-8-4	2	2	В	-	-
	2	3	6'X23'	2-4-2	2	2	В	-	-
<u>`</u>	2	4	6'X23'	2-4-2	5	2 & 5	В	-	-
	3	1	6'X23'	2-4-2	4	4	В	-	-
	3	2	6'X23'	2-4-2	7	4 & 7	В	-	-
2	3	3	6'X23'	2-4-2	3	3&8	В	-	-
1	3	4	6'X23'	2-4-2	8	8	В	-	-
2	1	4	6'X23'	2-4-2	1	1	В	-	-



ALL VEHICLE SIGNAL HEADS SHALL BE 12 INCHES.

3. ALL HOUSINGS TO BE PROVIDED WITH 3/4 TUNNEL VISORS AND 5-INCH NON-LOUVERED

BACKPLATES WITH 3-INCH YELLOW TAPE RETROREFLECTIVE BORDER.

4. ALL HOUSINGS TO BE FIXED MOUNTED.

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	AI	PPROX. NORTH		Ø 2			Ø 4			Ø 6			Ø 8			Ø 9		
SEQUENCE & TIMING FOR FULL ACTUATED CONTROL ALGONQUIN TRAIL / HARVARD STREET AT ROUTE 126 (POND STREET)		OL STREET				* ጎሥ	↓•	$\sqrt{1}$	$= \begin{array}{c} \downarrow \\ \downarrow \\ \neg \\ \neg \\ \neg \end{array} \qquad \qquad$									FLASHING OPERATION
		HOUSINGS		2	3	1	5	6		ITERVA	LS	10	11	12	13	14	15	_
ROUTE 126 (POND STREET)	SB	ABC		R	R	R	R	R	, ∕ ∕		→ B /R	R	R	R	R	R		FY
ROUTE 126 (POND STREET)	NB	D.E.F	II -⊲FY -/G		− R /R	R	R	R	R	R	R	R	R	R	R	R	R	FY
HARVARD STREET	WB	G,H	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	FR
ALGONQUIN TRAIL	EB	J,K	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	FR
PEDESTRIAN	ALL	P1-P6	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	w	FDW	DW	OFF
		•		-					TIMIN	G IN SE		S			·		-	
MINIMUM GREEN			10			6			10			6						
MAX GREEN 1			36			10			36			10						1
MAX GREEN 2			36			10			36			10						1 ≻
VEHICLE EXTENSION			3			3			3			3						
YELLOW CLEARANCE				3.5			3			3.5			3				<u> </u>	NCY -
RED CLEARANCE					2.5			4.5			2.5			4.5			3	
PED WALK INTERVAL															7			- AER
PED CLEARANCE INTERVAL														14				
DETECTION (MEMORY)	DETECTION (MEMORY)					NON-LOCK		NON-LOCK		K	NON-LOCK		<	LOCK				
RECALL	ALL			MIN			OFF			MIN			OFF			OFF		

NOTES:

- 1. STANDARD NEMA CLEARANCES SHALL APPLY.
- 2. MAXIMUM GREEN 1 SHALL BE IN EFFECT ON WEEKDAYS FROM 6AM TO 9AM.
- 3. MAXIMUM GREEN 2 SHALL BE IN EFFECT ALL OTHER TIMES.
- 4. NORMAL CLEARANCES SHALL BE PROVIDED ON PHASES THAT ARE TERMINATED BY PREEMPTION DEMAND.
- 5. PEDESTRIAN PHASE SHOULD ONLY BE SERVED UPON PEDESTRIANS' PUSHBUTTON ACTIVATION.

	FIRE	E PRE-EMPT	ION	
		SCHEDULE		
RECEIVER	PRE-EMPT	APPROACH	VEHICLE	NEXT
AND	PHASE	AND	PHASE	PHASE
PRIORITY	ASSIGNMENT	MOVEMENT	ASSIGNMENT	CALLED
R1	1	NB	Ø 2	Ø 2 + Ø 6
R2	2	SB	Ø 6	Ø 2 + Ø 6
R3	3	ев 🕂	Ø 4	Ø 4 + Ø 8
R4	4	WB	Ø 8	Ø 4 + Ø 8

NOTES:

- 1. EMERGENCY VEHICLE PRE-EMPTION SIGNALS SHALL BE OPTICALLY TRANSMITTED BY OPTICAL EMITTERS MOUNTED IN EMERGENCY VEHICLES AND RECEIVED BY OPTICAL RECEIVERS LOCATED AT THE INTERSECTION.
- 2. PRE-EMPTION SIGNALS SHALL BE SERVICED ON A PRIORITY BASIS WITH RECEIVERS ASSIGNED DESCENDING PRIORITIES AS FOLLOWS: (R2, R1, R3, THEN R4)
- 3. IN RESPONSE TO A PRE-EMPTION SIGNAL RECEIVED AT AN INTERSECTION BY OPTICAL RECEIVER R4 (OR OTHERS AS PROVIDED) THE CONTROLLER SHALL HOLD OR ADVANCE TO AND HOLD IN EMERGENCE PRE-EMPTION THE ASSOCIATED GREEN PHASE FOR A MINIMUM OF TEN (10) SECONDS OR UNTIL, PRE-EMPTION SIGNAL CEASES. THE CONTROLLER SHALL THEN PROVIDE PRE-EMPTION PHASE CLEARANCE SERVICE THEN RESUME NORMAL OPERATION.
- 4. MINIMUM GREEN, NORMAL VEHICLE AND PEDESTRIAN CLEARANCE SHALL BE PROVIDED ON PHASES THAT ARE TO BE TERMINATED BY PRE-EMPTION DEMAND.
- 5. EMERGENCY VEHICLE PRE-EMPTION SHALL OVERRIDE COORDINATION.
- 6. ONCE PRE-EMPTION TERMINATES THE SIGNAL WILL RETURN TO PHASE SHOWN IN COLUMN "NEXT PHASE CALLED" TO RESUME NORMAL OPERATION.



1. PHASES ASSOCIATED BY A SOLID LINE SHALL NOT

- OPERATE CONCURRENTLY. 2. PHASES ASSOCIATED BY A DASHED LINE MAY OPERATE
- CONCURRENTLY.
- 3. THROUGH MOVEMENTS MAY INCLUDE RIGHT TURNS. 4. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT SHALL NOT CHANGE DURING THE CHANGE INTERVAL(S) UNLESS OTHERWISE NOTED.





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DETECTOR NUMBER	AMPLIFIER NUMBER	CHANNEL NUMBER	LOOP SIZE	NUM. OF TURNS	Ø CALLED	Ø EXT.	MODE A=PULSE B=PRES.	DELAY TIME	EXT. TIME
1	1	1	6'X23'	2-4-2	2	2	В	-	-
	1	2	6'X23'	2-4-2	2	2	В	-	-
	1	3	5'X3.75'	4-8-8-8-4	2	2	В	-	-
	2	1	5'X3.75'	4-8-8-8-4	6	6	В	-	-
	2	2	6'X23'	2-4-2	6	6	В	-	-
	2	3	6'X23'	2-4-2	6	6	В	-	-
	3	1	6'X23'	2-4-2	4	4	В	-	-
	3	2	6'X23'	2-4-2	8	8	В	-	-



* EACH OF THE TWO 35 FT MAST ARMS SHALL BE DESIGNED TO ACCOMMODATE LOADING OF A NEW 12 INCH 1 WAY 4-SECTION LED VEHICLE SIGNAL INDICATION FOR SIGNAL HEAD "C" OR "D". SEE SPECIAL PROVISIONS FOR DETAILS.

LOOP DETECTOR DATA

SEE PLAN SHEET-LOOP DETECTOR DETAILS FOR LOOP CONSTRUCTION. SPLICING, DETAILS & NOTES. DELAY TIME EFFECTIVE ONLY DURING CALLED Ø RED. TIME IN SEC.



PAY JEM QUANTITY

815.2

811.31

1

1

1

2 10

6

6

1 1

1

4

12

2

1 1

- 1. ALL VEHICLE LENSES SHALL BE LED TYPE.
- 2. ALL VEHICLE SIGNAL HEADS SHALL BE 12 INCHES. 3. ALL HOUSINGS TO BE PROVIDED WITH 3/4 TUNNEL VISORS AND 5-INCH
- NON-LOUVERED BACKPLATES WITH 3-INCH YELLOW TAPE
- RETROREFLECTIVE BORDER.
- 4. ALL HOUSINGS TO BE FIXED MOUNTED.

7/30/2020	▲ DELETE REFERENCE TO ITEM 813.82
DATE	DESCRIPTION
USE (ONLY PRINTS OF LATEST DATE

	A	APPROX. NORTH		Ø 2			Ø 4			Ø 5			Ø 6			Ø 9		
SEQUENCE & TIMING FOR FULL ACTUATED CONTROL MARKET BASKET DRIVEWAY AT ROUTE 126 (POND STREET)				γĻ	ŢŢ	٦Ļ		OL L	Ţ	\langle , \rangle		١Ļ	γĻ	▲		, , , , , , , , , , , , , , , , , , ,		FLASHING OPERATION
				INTERVALS														
APPROACH	DIRECTION	HOUSINGS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
ROUTE 126 (POND STREET)	SB	A,H	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	FY
ROUTE 126 (POND STREET)	SB	В	R	R	R	R/ -G-	R/ 	R	R	R	R	G	Y	R	R	R	R	FY
ROUTE 126 (POND STREET)	NB	C,J		- ≺sγ -	- R−		- R−	- R	⊸G	- -6 Υ	-⊲R	-⊲R	- R	-⊲R	- R	-⊲R	- -R	
ROUTE 126 (POND STREET)	NB	D,E	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	FY
MARKET BASKET DRIVEWAY	EB	F,G	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	FR
PEDESTRIAN	ALL	P1-P6	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	W	FDW	DW	OFF
						TIMING	IN SEC	CONDS										
MINIMUM GREEN			8			6			6			8						
MAX GREEN 1			40			6			10			28.5						
MAX GREEN 2			54.5			12			10			42.5						
VEHICLE EXTENSION			3			3			3			3						NL'
YELLOW CLEARANCE	3.5					3			3.5			3.5						
RED CLEARANCE	ED CLEARANCE				2			4			2			2			3] g
PED WALK INTERVAL														7] 🛱	
PED CLEARANCE INTERVAL															20		i ii	
DETECTION (MEMORY)			NON-LOCK			NON-LOCK			NON-LOCK			NON-LOCK	<		LOCK			
RECALL SOFT					OFF		SOFT			SOFT			OFF					

NOTES:

- 1. STANDARD NEMA CLEARANCES SHALL APPLY.
- 2. MAXIMUM GREEN 1 SHALL BE IN EFFECT ON WEEKDAYS FROM 6AM TO 9AM.
- 3. MAXIMUM GREEN 2 SHALL BE IN EFFECT ALL OTHER TIMES.
- 4. NORMAL CLEARANCES SHALL BE PROVIDED ON PHASES THAT ARE TERMINATED BY PREEMPTION DEMAND.
- 5. PEDESTRIAN PHASE SHOULD ONLY BE SERVED UPON PEDESTRIANS' PUSHBUTTON ACTIVATION.



NOTES:

- 1. EMERGENCY VEHICLE PRE-EMPTION SIGNALS SHALL BE OPTICALLY TRANSMITTED BY OPTICAL EMITTERS MOUNTED IN EMERGENCY VEHICLES AND RECEIVED BY OPTICAL RECEIVERS LOCATED AT THE INTERSECTION.
- 2. PRE-EMPTION SIGNALS SHALL BE SERVICED ON A PRIORITY BASIS WITH RECEIVERS ASSIGNED DESCENDING PRIORITIES AS FOLLOWS: (R2 THEN R1)
- 3. IN RESPONSE TO A PRE-EMPTION SIGNAL RECEIVED AT AN INTERSECTION BY OPTICAL RECEIVER R4 (OR OTHERS AS PROVIDED) THE CONTROLLER SHALL HOLD OR ADVANCE TO AND HOLD IN EMERGENCE PRE-EMPTION THE ASSOCIATED GREEN PHASE FOR A MINIMUM OF TEN (10) SECONDS OR UNTIL, PRE-EMPTION SIGNAL CEASES. THE CONTROLLER SHALL THEN PROVIDE PRE-EMPTION PHASE CLEARANCE SERVICE THEN RESUME NORMAL OPERATION.
- 4. MINIMUM GREEN, NORMAL VEHICLE AND PEDESTRIAN CLEARANCE SHALL BE PROVIDED ON PHASES THAT ARE TO BE TERMINATED BY PRE-EMPTION DEMAND.
- 5. EMERGENCY VEHICLE PRE-EMPTION SHALL OVERRIDE COORDINATION.
- 6. ONCE PRE-EMPTION TERMINATES THE SIGNAL WILL RETURN TO PHASES 2+6 TO RESUME NORMAL OPERATION.







- OPERATE CONCURRENTLY. 2. PHASES ASSOCIATED BY A DASHED LINE MAY OPERATE
- CONCURRENTLY.
- THROUGH MOVEMENTS MAY INCLUDE RIGHT TURNS. 3. 4. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT SHALL NOT CHANGE DURING THE CHANGE INTERVAL(S) UNLESS OTHERWISE NOTED.

PREFERENTIAL PHASING SEQUENCE



RETROREFLECTIVE BORDER.

4. ALL HOUSINGS TO BE FIXED MOUNTED.

DETECTOR

NUMBER

 $\sqrt{1}$

2

 $\sqrt{3}$

4

 $\sqrt{5}$

6

 $\sqrt{7}$

8

AMPLIFIER

NUMBER

1

2

3





6'X23'

6'X23'

2-4-2

2-4-2

4

4

4

4

B

1. ALL VEHICLE LENSES SHALL BE LED TYPE.

ALL VEHICLE SIGNAL HEADS SHALL BE 12 INCHES. 3. ALL HOUSINGS TO BE PROVIDED WITH 3/4 TUNNEL VISORS AND 5-INCH

NON-LOUVERED BACKPLATES WITH 3-INCH YELLOW TAPE

_ //30/2020_	<u> /1</u> DELETE REFERENCE TO TIEM 813.83
DATE	DESCRIPTION
USE	ONLY PRINTS OF LATEST DATE

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