SPECIAL PROVISIONS

October 23, 2026

BOSTON PUBLIC WORKS DEPARTMENT

SPECIAL PROVISIONS
REFERENCES

All work shall conform to these Special Provisions and the relevant provisions of MassDOT Highway Division 2026 Edition of the Standard Specifications for Highways and Bridges with latest supplements, and the most current versions of the Boston Public Works Department (PWD) Roadway Design Standards, Boston Transportation Department (BTD) Standards, and the Boston Water and Sewer Commission (BWSC) Standard Details and Construction Specifications, where applicable.

Special attention is directed to the fact that the Special Provisions are pre-printed, and some items may not be pertinent to this contract, but all pertinent items are included.

TABLE OF CONTENTS

ITEM 101.1	CLEARING AND GRUBBING	1
ITEM 103.	TREE REMOVED (DIAMETER UNDER 24 INCHES)	2
ITEM 104.	TREE REMOVED (DIAMETER 24 INCHES AND OVER)	2
ITEM 105.	STUMP REMOVED	2
ITEM 105.1	STUMP CUT	2
ITEM 119.1XX	RODENT CONTROL HIGH R-FACTOR (LOCATION #XX)	3
ITEM 120.1	UNCLASSIFIED EXCAVATION	5
ITEM 121.	CLASS A ROCK EXCAVATION	6
ITEM 129.1	HOT MIX ASPHALT MILLING 0"-6"	6
ITEM 129.7	PAVEMENT AND/OR BASE REMOVED	11
ITEM 144.	CLASS B ROCK EXCAVATION	11
ITEM 145.	DRAINAGE STRUCTURE ABANDONED	12
ITEM 146.	DRAINAGE STRUCTURE REMOVED	12
ITEM 151.02	GRAVEL	13
ITEM 153.5	CONTROLLED DENSITY FILL FLOWABLE & EXCAVATABLE	14
ITEM 153.6	CONTROLLED DENSITY FILL VERY FLOWABLE & EXCAVATABLE	14
ITEM 154.01	SAND FOR CONDUIT TRENCH	18
ITEM 156.12	CRUSHED STONE FOR CURB FOUNDATION	19
ITEM 184.11	DISPOSAL OF TREATED WOOD PRODUCTS	20
ITEM 191.61	TEST PIT EXCAVATION	21
ITEM 220.1	BRADLEY HEAD ADJUSTED	21
ITEM 220.3	DRAINAGE STRUCTURE CHANGE IN TYPE	21
ITEM 220.5	DRAINAGE STRUCTURE REMODELED	21
ITEM 269.04	GROUND WATER DRAIN	22
ITEM 401.006	6 INCH RECLAIMED ASPHALT/AGGREGATE BASE	24
ITEM 401.008	8 INCH RECLAIMED ASPHALT/AGGREGATE BASE	24
ITEM 401.010	10 INCH RECLAIMED ASPHALT/AGGREGATE BASE	24
ITEM 401.012	12 INCH RECLAIMED ASPHALT/AGGREGATE BASE	24
ITEM 401.015	15 INCH RECLAIMED ASPHALT/AGGREGATE BASE	24
ITEM 402.1	DENSE GRADED CRUSHED STONE FOR SUB-BASE	27
ITEM 431.1	HIGH EARLY STRENGTH CEMENT CONCRETE BASE COURSE	27
ITEM 440.	CALCIUM CHLORIDE FOR ROADWAY DUST CONTROL	28
ITEM 443.	WATER FOR ROADWAY DUST CONTROL	28
ITEM 450.45	FIBER SEALING CRACKS	29
ITEM 451.25	HOT MIX ASPHALT FOR ROADWAY REPAIRS (NON-ARTERIAL STREETS - 6 ½") (MAINTENANCE)	31
ITEM 451.75	HOT MIX ASPHALT FOR ROADWAY REPAIRS (ARTERIAL STREETS - 7 ½") (MAINTENANCE)	31
ITEM 454.5	HMA LATEX POLYER MODIFIER	34
ITEM 455.215	SUPERPAVE SURFACE COURSE – 4.75 (SSC – 4.75mm)	34
ITEM 455.225	SUPERPAVE SURFACE COURSE – 9.5 (SSC – 9.5mm)	34
ITEM 455.235	SUPERPAVE SURFACE COURSE – 12.5 (SSC – 12.5mm)	34
ITEM 455.245	SUPERPAVE SURFACE COURSE – 9.5(b) (SSC – 9.5(b)mm)	34
ITEM 455.325	SUPERPAVE INTERMEDIATE COURSE – 19.0 (SIC – 19.0mm)	34
ITEM 455.415	SUPERPAVE BASE COURSE – 25.0 (SBC – 25.0mm)	34
ITEM 455.425	SUPERPAVE BASE COURSE – 37.5 (SBC – 37.5mm)	34
ITEM 456.	WARM MIX ADDITIVE	34
ITEM 460.5	HOT MIX ASPHALT BASE COURSE	34
ITEM 460.65	HOT MIX ASPHALT DENSE BINDER COURSE	34
ITEM 460.7	HOT MIX ASPHALT TOP COURSE	34
ITEM 460.8	HOT MIX ASPHALT SURFACE TREATMENT	34
ITEM 460.9	HOT MIX ASPHALT MODIFIED TOP COURSE	34
ITEM 460.95	HOT MIX ASPHALT TOP COURSE (DENSE MIX)	34
ITEM 463.5	BITUMINOUS TACK COAT	85
ITEM 472.	HOT MIX ASPHALT FOR MISCELLANEOUS WORK	87
ITEM 472.10	HOT MIX ASPHALT USED FOR PATCHING (MAINTENANCE)	87
ITEM 472.5	UTILITY TRENCH REPAIR	88

ITEM 475.	REPLACEMENT OF SPEED HUMPS (MAINTENANCE)	90
ITEM 482.4	SAW CUT	90
ITEM 486.11	SCORED CEMENT CONCRETE PAVEMENT	92
ITEM 504.	GRANITE CURB TYPE VA4 – STRAIGHT	93
ITEM 504.01	GRANITE CURB TYPE VA4 – STRAIGHT (FOR LOW RETAINING WALL)	93
ITEM 504.1	GRANITE CURB TYPE VA4 – CURVED	93
ITEM 504.11	GRANITE CURB TYPE VA4 – CURVED (FOR LOW RETAINING WALL)	93
ITEM 507.	TRAVERSABLE GRANITE CURBING, TYPE T-100 STRAIGHT	93
ITEM 507.1	TRAVERSABLE GRANITE CURBING, TYPE T-100 CURVED	93
ITEM 510.11	GRANITE CURB TYPE VA4 – SLOPED	93
ITEM 510.12	GRANITE CURB TYPE VA4 – SLOPED (RADIUS 10 FEET OR LESS)	93
ITEM 514.	GRANITE CURB INLET – STRAIGHT	93
ITEM 515.	GRANITE CURB INLET – CURVED	93
ITEM 516.	GRANITE CURB CORNER TYPE A	93
ITEM 516.60	GRANITE CURB CORNER TYPE VA4 – 6 FOOT RADIUS	93
ITEM 580.	CURB REMOVED AND RESET	93
ITEM 583.5	GRANITE BLOCK HIP GUTTER RELAID	96
ITEM 584.	GRANITE BLOCK HIP GUTTER EXCAVATED FOR SALVAGE	97
ITEM 590.	CURB REMOVED AND STACKED	97
ITEM 620.1	STEEL BEAM HIGHWAY GUARD (SINGLE FACED)	98
ITEM 635.1	HIGHWAY GUARD REMOVED AND DISCARDED	99
ITEM 645.148	48 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	100
ITEM 645.160	60 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	100
ITEM 645.172	72 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	100
ITEM 645.196	96 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	100
ITEM 666.	CHAIN LINK FENCE REMOVED AND RESET	101
ITEM 670.1	IRON FENCE REMOVED AND RESET	101
ITEM 670.2	WOOD FENCE REMOVED AND RESET	102
ITEM 697.1	CATCH BASIN INSERT FOR SEDIMENT CONTROL	103
ITEM 698.3	NON-WOVEN GEOTEXTILE FABRIC	104
ITEM 698.6	IMPERMEABLE LINER	104
ITEM 701.	CEMENT CONCRETE SIDEWALK	108
ITEM 701.001	CONCRETE WALKING SURFACE (MAINTENANCE)	108
ITEM 701.1	CEMENT CONCRETE SIDEWALK AT DRIVEWAYS	108
ITEM 701.2	CEMENT CONCRETE PEDESTRIAN RAMP	108
ITEM 701.993	CAST-IN-PLACE RESIN DETECTABLE WARNING PANEL (MAINTENANCE)	116
ITEM 701.995	COMPOSITE DETECTABLE WARNING PANEL (MAINTENANCE)	118
ITEM 701.999	CAST IRON DETECTABLE WARNING PANEL (MAINTENANCE)	119
ITEM 702.	HOT MIX ASPHALT WALK SURFACE	121
ITEM 702.1	HOT MIX ASPHALT WALK SURFACE (MAINTENANCE)	121
ITEM 703.	HOT MIX ASPHALT DRIVEWAY	121
ITEM 703.1	HOT MIX ASPHALT DRIVEWAY (MAINTENANCE)	121
ITEM 706.05	BRICK WALK – MORTAR JOINTS	123
ITEM 706.15	BRICK WALK RESET OR REPLACED IN KIND	129
ITEM 706.151	BRICK WALK RESET OR REPLACED IN KIND (MAINTENANCE)	129
ITEM 706.25	BRICK SIDEWALK ON STONE DUST SETTING BED	131
ITEM 706.26	BRICK SIDEWALK ON HOT MIX ASPHALT SETTING BED	134
ITEM 706.261	BRICK SIDEWALK ON HOT MIX ASPALT SETTING BED (MAINTENANCE)	134
ITEM 706.35	MISCELLANEOUS PAVEMENTS EXCAVATED FOR SALVAGE	138
ITEM 706.4	BLACK STEEL BOLLARD 4-INCH DIAMETER	139
ITEM 706.5	BOLLARD RESET	141
ITEM 706.7	PERMEABLE PAVERS	142
ITEM 707.4	STEEL EDGE	153
ITEM 710.41	BOUND – PLAIN GRANITE (MUNICIPAL STANDARD)	154
ITEM 711.	BOUND REMOVED AND RESET	154
ITEM 720.	CITY COVERS ADJUSTED	155
ITEM 751.5	LOAM AND SEEDING	156

ITEM 767.6	AGED PINE BARK MULCH	157
ITEM 811.999	PULLBOX COVER REPLACED (STREET LIGHTING OR TRAFFIC)	157
ITEM 826.53	FIRE ALARM BASE AND MIDDLE SECTION ADJUSTED	159
ITEM 826.54	FIRE ALARM BASE AND MIDDLE SECTION REMOVED AND STACKED	159
ITEM 826.55	FIRE ALARM BASE AND MIDDLE SECTION	159
ITEM 826.56	FIRE ALARM SERVICE CONNECTION	159
ITEM 832.1	WARNING – REGULATORY AND ROUTE MARKER – ALUMINUM PANEL (TYPE A)	162
ITEM 832.2	REGULATORY SIGN – TYPE A - ALUMINUM (MAINTENANCE)	163
ITEM 834.19	FLEX POST REMOVAL (MAINTENANCE)	164
ITEM 852.	SAFETY SIGNING FOR TRAFFIC MANAGEMENT	165
ITEM 852.12	TOW ZONE NO PARKING SIGNS ALUMINUM PANEL (TYPE A)	166
ITEM 853.11	TEMPORARY PRE-CAST CONCRETE MEDIAN BARRIER	169
ITEM 853.3	PORTABLE BREAKAWAY BARRICADE TYPE III	170
ITEM 854.014	TEMPORARY PAVEMENT MARKINGS – 4-INCH (PAINTED)	171
ITEM 854.2	PAVEMENT MARKING REMOVAL	171
ITEM 856.12	PORTABLE CHANGEABLE MESSAGE SIGN	172
ITEM 859.	REFLECTORIZED DRUM	173
ITEM 859.1	REFLECTORIZED DRUM WITH FLASHER (TYPE A)	173
ITEM 864.04	PAVEMENT ARROWS AND LEGENDS REFLECTORIZED WHITE (THERMOPLASTIC)	174
ITEM 864.05	PAVEMENT BIKE SYMBOLS REFLECTORIZED WHITE (THERMOPLASTIC)	174
ITEM 864.11	PREFORMED SHARROW FOR BIKE LANE REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	174
ITEM 864.12	PREFORMED BIKE LANE RIDER REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	174
ITEM 864.13	PREFORMED 6' BIKE LANE ARROW REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	174
ITEM 864.14	PREFORMED ENGLISH BIKE SYMBOL REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	174
ITEM 864.15	COLORED HIGH FRICTION SURFACE TREATMENT FOR PAVEMENTS (HFST)	176
ITEM 865.1	CROSSWALKS AND STOP LINES REFLECTORIZED WHITE (THERMOPLASTIC)	174
ITEM 866.104	4 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	174
ITEM 866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	174
ITEM 866.108	8 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	174
ITEM 866.112	12 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	174
ITEM 867.104	4 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	174
ITEM 867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	174
ITEM 867.108	8 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	174
ITEM 867.112	12 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	174
ITEM 874.09	STREET NAME SIGN (BOSTON) 9-INCH STREET NAME BLANK	180
ITEM 874.018	STREET NAME SIGN (BOSTON) 18-INCH ON MAST ARM	183
ITEM 874.2	TRAFFIC SIGN REMOVED AND RESET	184
ITEM 874.3	TRAFFIC SIGNS REMOVED AND STACKED	185
ITEM 877.2	SIGN POST REMOVED AND STACKED	185
ITEM 875.11	PARKING METER POST REMOVE AND REPLACE	186
ITEM 875.12	PARKING METER POST AND BASE	186
ITEM 875.13	MULTI-SPACE PARKING METER REMOVE AND RESET	187
ITEM 877.	SIGN POST REMOVED AND RESET	188
ITEM 877.3	SIGN POST 2-INCH STEEL	189
ITEM 877.4	SIGN POST 2 1/2-INCH STEEL	189
ITEM 879.3	SPECIAL DUTY POLICE (STATE TROOPER)	190
ITEM 902.41	CONCRETE WALL FOR BACKING UP SIDEWALK	191
ITEM 904.72	MISCELLANEOUS CLASS D CEMENT CONCRETE MANSONRY	192
ITEM 908.11	PARGING OR REPOINTING OF WALLS AND FOUNDATIONS	193

ITEM 101.1 CLEARING AND GRUBBING SQUARE YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 101 of the MassDOT Standard Specifications and the following:

CONSTRUCTION METHODS

Clearing and Grubbing is restricted to those areas so indicated on the plans. The Contractor shall remove all vegetation, plant growth, roots, and any dead or dying plant material including previously fallen trees, branches, and other debris within the right of way, extended over the right of way restricting the pedestrian path of travel, or interfering with the performance of work under this contract. The work shall be performed to produce a 10-foot minimum vertical clearance over the sidewalk and 20-foot vertical clearance over the roadway.

METHOD OF MEASUREMENT

Clearing and Grubbing will be measured by the horizontal plane area and will be the actual number of square yards cleared and grubbed within those areas designated on the plans, as directed by the Engineer.

BASIS OF PAYMENT

Removal of trees located within the clearing and grubbing area having a diameter less than 9 inches in diameter will be included under this item. Removal of trees and stumps outside of the clearing and grubbing area having a diameter under 9 inches will be included in the price bid under Item 120.1, Unclassified Excavation.

Trees 9 inches in diameter and larger, that are designated for removal will be paid for under their respective items, Item 103., Tree Removed (Diameter Under 24 Inches), and Item 104., Tree Removed (Diameter 24 Inches and Over).

Clearing and Grubbing will be paid for at the contract unit price per square yard which price shall be full compensation for furnishing all tools, labor, equipment and all incidentals necessary to complete the work.

ITEM 103.	TREE REMOVED (DIAMETER UNDER 24 INCHES)	EACH
ITEM 104.	TREE REMOVED (DIAMETER 24 INCHES AND OVER)	EACH
ITEM 105.	STUMP REMOVED	EACH

GENERAL

Work under these items shall conform to the relevant provisions of Section 101 of the MassDOT Standard Specifications and the following:

METHOD OF MEASUREMENT

Measurement of tree diameter will be made at a level of 3 feet above the ground line. If a tree separates into multiple trunks below the 3-foot level as defined above, the diameter measurement will be made at the point on the main trunk where the branching of multiple trunks begins.

The diameter of the stump will be measured at the cutoff. If a stump separates into multiple trunks below the cutoff, the diameter measurement will be made at the point on the main trunk where the branching of multiple trunks begins.

BASIS OF PAYMENT

Payment for the removal of trees under Item 103. and Item 104. will include the removal of both the tree and the stump. Item 105. will apply only to stumps existing prior to the commencement of the project.

Removal of trees and stumps outside of the clearing and grubbing area having a diameter under 9 inches will be included in the price bid under Item 120.1, Unclassified Excavation.

ITEM 105.1	STUMP CUT	EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 101 of the MassDOT Standard Specifications and the following:

All stumps (9 inches or more in diameter) which cause too much damage if removed, as determined by the Engineer, shall be cut off by means of a mechanical saw 14 inches below the finished grade of the sidewalk.

METHOD OF MEASUREMENT

The quantity of Stumps Cut to be measured for payment will be the number cut by the Contractor in the completed and accepted work as determined by count.

BASIS OF PAYMENT

Stump Cut will be paid for at the contract unit price each which price shall include all labor, equipment, supplies, tools, and incidentals necessary to complete the work.

ITEM 119.1XX RODENT CONTROL HIGH R-FACTOR (LOCATION #XX) PER LOCATION

GENERAL

The work under these items shall include all work necessary to provide High R-Factor rodent control in the areas of proposed construction under this contract. This work will include but not be limited to pre-construction baiting and a maintenance-baiting program that will extend for the duration of the proposed construction.

CONSTRUCTION METHODS

The Contractor shall hire a pest control operator who will provide adequate liability insurance and be prepared to respond to changes in rodent populations and any rodent related complaints associated with the proposed construction activities.

All baiting locations shall be approved by the Engineer prior to the commencement of work. All baiting work as defined in the steps below shall be logged and reported to the Engineer and/or the Inspectional Services Department Inspector every 2 weeks.

The pest control operator shall follow the steps below in order to control and/or eliminate the rodent population.

30 to 45 Days Prior to Commencement of Work (1st Service/Preconstruction)

Inspect all public areas within 300 feet of proposed construction. Investigate signs of rodent activity and perform corrective treatment if necessary. Contractor shall be responsible for providing pest control for any premises impacted by related rodent activity within 300-foot radius of project limits.

Perform sub-surface baiting treatment to all sewer lines within 300' radius of proposed construction. Rodenticide applications shall be made with bait formulations labeled for use in sewers. Method of applications shall be consistent with label directions for use.

7 to 10 Days After 1st Service (2nd Service Follow-Up/Preconstruction)

1. Reinspect all public areas within 300 feet of proposed construction. Retreat active locations.
2. Perform sub-surface treatment. Rebait all active sewer lines treated during first service.

10 to 14 Days After 2nd Service (3rd Service Follow-Up/Preconstruction)

1. Reinspect all public areas within 300 feet of proposed construction and retreat active

locations.
2. Perform sub-surface treatment. Rebait all active sewer lines.

Every 2 Weeks After 3rd Service (Periodic Service/Maintenance During Construction)

1. Reinspect all public areas within 300 feet of construction site and retreat active areas.
2. Perform sub-surface treatment. Retreat all active sewer lines.

20 Days After Conclusion of Construction (End Service Post Construction)

1. Retrieve all rodenticides and rodent control equipment from public areas and sewer lines.

MONITORING STATUS AND REPORTING

Contractors shall be responsible for performing, monitoring and status reporting.

1. Notify the Rodent Control Division of all construction starting dates and areas where construction will begin
2. Give notice of all changes in construction which involve construction in new areas.
3. Obtain and provide rodent control reports from sub-contractors performing control operations. Reports shall be forwarded to the Rodent Control Division within 10 days after completion of each treatment. Reports shall include locations of treatment and percentage of bait consumption.
4. The above procedures have been established as guidelines. They are not intended in any way to relieve rodent control contractors of their responsibilities to exercise good judgment. If any questions arise please contact the Rodent Control Division.

METHOD OF MEASUREMENT

Rodent Control High R-Factor – Location #XX will be measured for payment on a per location basis.

BASIS OF PAYMENT

Rodent Control High R-Factor – Location #XX will be paid for at the contract unit price per location which price shall include full compensation for all activities required to accomplish the control of rodent populations from pre-inspection up to and including post construction baiting and reports in those areas specified above or as directed by the Engineer. The unit price shall also include full compensation for furnishing all materials, labor, tools, equipment and all other incidentals necessary to complete the work to the satisfaction of the Engineer.

ITEM 120.1 UNCLASSIFIED EXCAVATION CUBIC YARD

GENERAL

The work to be done hereunder shall conform to the relevant provisions of Section 120 of the MassDOT Standard Specifications and the following:

All excavation required to complete the work as shown on the plans will be paid for under this item.

The excavation required to remove debris including unsuitable material consisting of any material that does not meet the "contaminated soil" thresholds as noted in 310 CMR 40.0361, existing walls of brick, cement concrete (reinforced or non-reinforced), granite, or stone, and existing pavements of hot mix asphalt (HMA), cement concrete (reinforced or non-reinforced), brick, or cobblestone that measure less than 1 cubic yard and **do not** require blasting or power tools (such as jackhammers, etc.) for removal shall also be included under this item.

Grading and compacting the subgrade, as directed, shall be included in the price bid under this item. Use of a grader and roller will be required when ordered by the Engineer.

Any railroad track encountered shall be removed, where directed, and paid for under this item. Track, as called for in this item, shall consist of the pair of parallel streetcar rails, ties, track & fastenings, frogs, switches, and any other appurtenance that could be considered part of the track system.

If track is indicated on the plans, it shall be removed under this item with no additional compensation. If it is found that track lies partially or wholly within the limits of an excavation, and is not shown on the plans, the Contractor shall completely remove it where directed by the Construction Engineer. Payment shall be made as follows:

1. If rails and ties exist, payment for removal and disposal shall be made at 2 ½ times the contract unit price per cubic yard of Unclassified Excavation. Measurement for depth shall be from top of rail to bottom of tie, and for width shall be to the outside limits of the tie.
2. If only ties exist, payment for removal and disposal shall be made at 1 ½ times the contract unit price per cubic yard of Unclassified Excavation. Measurement for depth shall be from top of tie to bottom of tie, and for width shall be to the outside limits of the tie.

METHOD OF MEASUREMENT

Measurement will conform to subsection 120.80 of the MassDOT Standard Specifications.

BASIS OF PAYMENT

Payment will be at the contract unit price per cubic yard of Unclassified Excavation as defined hereinbefore.

ITEM 121. CLASS A ROCK EXCAVATION CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 120 of the MassDOT Standard Specifications and the following:

Reinforced and non-reinforced concrete walls, brick walls, granite masonry walls, ledge, boulders, and any other brick or granite masonry which require blasting or power tools (such as jackhammers, etc.) for their removal will be included in this item.

Boulders measuring one cubic yard or more which do not require blasting or compressed air for their removal will also be included in this item and will be measured by the Engineer at the point of removal.

Class A Rock is to be defined as rock removed to a maximum depth of 6 inches below subgrade and up to a maximum of 12 inches beyond the street line.

METHOD OF MEASUREMENT

Class A Rock Excavation will be measured per Subsection 120.80 of the MassDOT Standard Specifications.

BASIS OF PAYMENT

Class A Rock Excavation will be paid for per Subsection 120.81 of the MassDOT Standard Specifications.

All rock removed in trenches will be paid for under Item 144., Class B Rock Excavation.

ITEM 129.1 HOT MIX ASPHALT MILLING 0"-6" SQUARE YARD

GENERAL

The work covered by these specifications shall consist of removal of hot mix asphalt by cold milling; hauling of cuttings; cleaning of asphaltic concrete pavement in preparation for an overlay; and may include stockpiling for reuse in a Recycling Program, in conformity with these specifications, and to the lines, grades, and cross sections shown on the plans or ordered by the Engineer. This work may include milling of intersecting streets to the limits shown on the plans or ordered by the Engineer.

All salvaged hot mix asphalt pavement shall become the property of the Contractor and shall be removed from the site.

The Contractor shall visit the site of the proposed work and fully acquaint himself with the existing conditions relating to construction, labor, and traffic and should fully inform himself as to the facilities involved, and the difficulties and restrictions regarding the performance of the contract.

Scheduling of Milling and Paving - When the milling operation exposes the existing base course, the Contractor must place the new hot mix asphalt binder course within 24 hours of milling. When only partial depth milling of the bound materials is required, the final wearing surface must be placed no longer than 3 weeks after milling. The Contractor will be allowed to cold mill only as much pavement as he can overlay within the time limits specified herein. The Engineer may decrease the time limits when conditions warrant.

EQUIPMENT

Pavement Profilers

The Contractor shall furnish one or more milling machine(s) operated by experienced operators. The equipment for removing the pavement surface shall be a cold planing (milling) machine specifically designed for automatically controlled profiling which has operated successfully for a minimum of one year on similar work, or equipment proven through test results to be satisfactory to the Department.

The Equipment shall be maintained in a satisfactory working condition so as not to cause delays and the machine must be equipped with taillights, headlights, and necessary reflectors so that it can be operated in traffic with complete safety.

The equipment shall have a means of loading by an integral loading belt and it shall have the ability to cold mill concrete patches when encountered in the bituminous pavement.

Restrictions

Track mounted cold milling equipment will be required for primary operations, on roadway surfaces in which the Department anticipates pavement milling down to within ¾ inch of an unbound base course. Either track or conventional wheel milling machines will be acceptable on work requiring only partial depth milling of the bound materials such that sufficient pavement materials exist after removal to support the cold milling operation. Wheel machines of sufficient size will be permitted for trimming operations.

Grade Control

The automatic controls on the milling machine shall provide accurately established profile grades at each edge of the machine by referencing from the existing pavement or an independent grade reference, where required, or be capable of automatically maintaining a designated cross slope from a single reference.

The milling machine shall be self-propelled and shall have sufficient power, traction, and stability to maintain an accurate depth of cut.

Documentation

Each bidder will submit, as part of his bid, full details concerning the machine to be used, including type, weight, milling width (60-inch minimum for primary operations), maximum milling depth per pass (2-inch minimum), operating speeds, air pollution control, dust

suppression, and assurance that no tree damage will occur as a result of the process used, for review by the Department.

Sweepers

The surface shall be left clean and dust free using self-propelled power sweepers, vacuums, hand sweepers, or other methods approved by the Engineer.

Pollution Control

All equipment will be operated such that it will effectively control dust generated by cutting, loading, and/or cleaning operations. All equipment must meet or be lower than the current standards set by the Air Quality Act of noise and air pollution.

TRANSPORTATION OF MATERIAL

Clean Vehicles

Caution shall be taken to ensure that any vehicle used to transport milled material intended for use in reclaimed asphalt concrete will be free from any foreign matter (such as dirt, debris, leaves, solvents, etc.).

Disposal of the sweepings or oversized pieces of pavement will not be permitted near the cold milling stockpiles.

CONSTRUCTION METHODS

Surface

The milled surface produced by the planing operation should be characterized by uniform discontinuous longitudinal striations or other patterns which will meet the requirements of the contract documents, and in the opinion of the Engineer, provide a satisfactory riding surface and suitable surface for paving.

Structures

Care shall be utilized by the Contractor to ensure that no damage occurs to curbing, manholes, water boxes, and/or similar equipment installed in the street, and the Contractor must guarantee repair or replacement of any structures damaged by his negligence.

Intersecting Streets

All streets intersecting the proposed work area shall be milled to a minimum 1 ½-inch depth within the limits shown on the plans or where directed by the Engineer and shall match the new grade line of said work area. All irregularities shall be eliminated to the satisfaction of the Engineer. At street intersections where more than a 2-inch vertical face is anticipated, the butt joint created by the milling operation shall be stepped in such a manner that the rise is no greater than 2 inches and the run (horizontal distance) is no less than 12 inches.

Joints

The termination joints of the milled pavement will be skewed such that the longitudinal length of the skewed line measured at the curb or pavement edge will be one-half the width of the roadway being milled.

Where the milling area terminates and abuts the existing adjacent bituminous pavement, a neat straight line shall be cut with suitable power-driven equipment before commencing the pavement removal with a milling machine. It is the intention of this operation and the obligation of the Contractor to produce a uniform straight skewed line at the joint.

All butt joints created by the milling operation at driveways and intersecting streets which are greater than 2 inches in depth shall be filled with millings or cold patch material and maintained by the Contractor to allow a safe egress and ingress for the travelling public at all times.

Safety

The Contractor will provide all necessary labor, materials, and equipment for protection of motorists and pedestrians from any protruding structures that may result from the milling operation. The Contractor shall also be responsible for the protection of motorists and pedestrians from any irregularities and pavement drop-offs that may result from the milling operation.

Sweeping

The Contractor shall provide sweeping equipment to remove all cuttings from the surface on a daily basis. The Contractor shall sweep and remove loose cuttings, dust or other objectionable material from the roadway by the end of each working day using power brooms, power vacuums or both; and whatever ancillary equipment, tools and labor necessary to properly prepare the road for subsequent tack coat and paving.

The pavement removal and cleaning operations shall be conducted in such a manner as to effectively minimize the amount of dust being emitted. The operation shall be planned and conducted to be safe for persons and property adjacent to the work, including the travelling public.

Asphalt concrete that cannot be removed by cold planing equipment because of physical or geometrical restraints should be removed by other methods acceptable to the Engineer.

Patching

During the cold milling operation, any localized areas of exposed base materials will be repaired by the Contractor at the expense of the City only if the Contractor has held to the specified milling depth. Areas of base exposure caused by the milling contractor as a direct result of adjusting profiling equipment, overcut beyond specified depths, use of jackhammer around structures, or utilizing equipment not specifically designed to cold plane pavements will be repaired and paid for by the Contractor. Any leveling or patching required shall be repaired with hot bituminous plant mix before the end of the working day, and in a manner satisfactory to the Engineer.

The Engineer may require re-milling of any area where a non-uniform surface has resulted from the Contractor's operations; these areas will be corrected at no additional expense to the City.

SURFACE TOLERANCE

Deviation

The milled surface deviation should not exceed $^{3}/_{16}$ inch in 10 feet in any direction in preparation for placing a final wearing surface, or ¼ inch for a binder course.

Milling work shall be of varying depths, as required by the plans and/or specifications, or as directed by the Engineer, and shall be such that the pavement is not torn, gouged, shoved, broken, sooted, oil coated, or otherwise injured by the planing operation.

STOCKPILING MATERIALS

For Recycling

The salvaged material intended for use in the reclaimed asphalt concrete shall be segregated and stockpiled separately so as not to be contaminated by any foreign matter.

The planing operation shall be conducted so as not to permit the contamination of the salvaged pavement material by any unbound pavement materials, shoulder debris, grass, sweepings, oversized cuttings, leaves, or dirt.

Gradation

The Engineer may instruct the Contractor to increase or decrease the forward speed or depth of cutting so as to create a desired gradation of which 99% to 100% shall pass a 3 ½-inch square mesh sieve with 95% to 100% passing a 2-inch sieve.

METHOD OF MEASUREMENT

Hot Mix Asphalt Milling 0” to 6” will be measured by the number of square yards of surface area milled to a specified depth in accordance with this specification, as shown on the plans, and accepted by the Engineer.

BASIS OF PAYMENT

Hot Mix Asphalt Milling 0” to 6” will be paid for at the contract unit price per square yard which price shall include full compensation for milling, loading, hauling, cleaning the milled pavement surface, and stockpiling the reclaimed milled material, and for all labor, tools, equipment, materials, supplies, sweeping, and all incidentals necessary to complete the work.

ITEM 129.7 PAVEMENT AND/OR BASE REMOVED SQUARE YARD

GENERAL

The work under this item shall consist of removing pavement and/or base where directed. The work will include, but not be limited to, removal of pavement and/or base to correct grade problems along the curb line and at the front of driveway openings.

No work will be done under this item where compensation has been provided for under other items of this contract.

CONSTRUCTION METHODS

The Contractor shall remove the pavement and/or base by a method approved by the Engineer. The work shall be done in a manner so as not to cause any damage to the remaining pavement and base.

METHOD OF MEASUREMENT

Pavement and/or Base Removed will be measured by the square yard removed.

BASIS OF PAYMENT

Pavement and/or Base Removed will be paid for at the contract unit price per square yard, regardless of the depth or number of courses removed which price shall include disposal of all materials removed, and all labor, tools, equipment, and all incidentals necessary to complete the work.

Any pavement removed at the back of street line shall be paid for under Item 120.1 Unclassified Excavation.

ITEM 144. CLASS B ROCK EXCAVATION CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 140 of the MassDOT Standard Specifications amended as follows:

Subsection 140.25 - Class B Rock Excavation

Class B rock shall include existing walls of brick, cement concrete (reinforced or non-reinforced), granite, or stone and all solid rock that require blasting or breaking by power tools (such as jackhammers, etc.) prior to removal.

Only such rock or boulders encountered in conduit and edgestone trenches or at locations where installing pull boxes, traffic handholes, light bases, traffic signal foundations, control box foundations, or any other foundation or subsurface structure as directed by the Engineer will be measured and paid for at the contract unit price per cubic yard.

Removal of masonry from the walls, covers, and other portions of existing drainage structures is provided for under Item 145., Drainage Structure Abandoned, and Item 146., Drainage Structure Removed.

Removal of rock for water, sewer, or drainage work shall be paid for under Item A1-3, Rock Excavation.

METHOD OF MEASUREMENT

Class B Rock Excavation will be measured per Subsection 140.80 of the MassDOT Standard Specifications.

BASIS OF PAYMENT

Class B Rock Excavation will be paid for per Subsection 140.81 of the MassDOT Standard Specifications.

ITEM 145.	DRAINAGE STRUCTURE ABANDONED	EACH
ITEM 146.	DRAINAGE STRUCTURE REMOVED	EACH

GENERAL

Work under these items shall conform to the relevant provisions of Section 140 of the MassDOT Standard Specifications and the following:

Work under this item shall conform to Boston Water and Sewer Commission Construction Specifications. These items shall apply to drainage structures.

Any casting considered reusable shall be transported to the Boston Water and Sewer Commission, 980 Harrison Avenue, Boston, or where directed by Engineer. Abandonment or removal of Bradley Head Catch Basins shall include the careful removal and transporting of existing granite top and iron work to a location as directed by the Boston Water and Sewer Commission. Payment for this work will be included under these items.

METHOD OF MEASUREMENT

Drainage Structure Abandoned will be measured per each, as accepted by the Engineer.

Drainage Structure Removed will be measured per each.

BASIS OF PAYMENT

Drainage Structure Abandoned will be paid for per Subsection 140.81 of the MassDOT Standard Specifications.

Drainage Structure Removed will be paid for per Subsection 140.81 of the MassDOT Standard Specifications.

ITEM 151.02 GRAVEL TON

GENERAL

Work under this item shall conform to the relevant provisions of Section 150 of the MassDOT Standard Specifications and the following:

Handwork shall be required at locations where full depth construction occurs in narrow strips along the curb lines and hard-to-reach places.

Mechanical tampers shall be used to compact the gravel subbase. Use of a grader and roller will be required when ordered by the Engineer.

The gravel shall conform to the requirements of gravel borrow, M.1.03.0 Type b. Should gravel borrow not be available, the gravel shall conform to the requirements of processed gravel for subbase, M1.03.1 and the following gradation schedule:

Sieve Size	Percent by Weight Passing
3 inch	100
1 ½ inch	70-100
¾ inch	50-85
No. 4	30-60
No. 200	0-10

Recycled backfill material may be used after approval from the City of Boston. Approval shall be made on a case by case basis after the Contractor submits test results signed by a registered Professional Engineer. The test results shall certify the components and the percentages of each recycled material and their proportions and that the material meets the following requirements:

1. Recycled material is inert consisting of hard, durable stone, coarse and allowable recycled material as described below.
2. Not more that 50% of the material shall be comprised of recycled material such as non-reinforced cement concrete. Not more than 5% of the recycled material shall be reclaimed asphalt pavement (RAP).
3. Cement concrete shall have less than 12% volume by weight after five cycles by the magnesium sulfate soundness test.
4. The recycled material shall be free of loam, clay, roots, wood and other deleterious material.
5. The gradation shall meet the requirements for MassDOT's Processed Gravel for Sub-base M.1.03.1.
6. The coarse aggregate shall have a percentage of wear, by the LA Abrasion Test, of not more than 50.

The use of Processed Glass Aggregate (PGA) will not be allowed.

METHOD OF MEASUREMENT

Gravel will be measured per ton as certified by a public weigher or by a representative approved by the Engineer, subject to the following restrictions:

If the Engineer determines that the Contractor is unable to make reasonable arrangements for weighing the gravel by a certified weigher, the weight will be determined based on 3,300 pounds of gravel per cubic yard compacted in place. The Engineer will determine the volume of gravel by the cross-section method or by actual test of depths, or by a combination of both methods. The Engineer will then use the above-referenced 3,300 pounds per cubic yard as a conversion factor in determining the weight of gravel furnished.

BASIS OF PAYMENT

Gravel will be paid for at the contract unit price per Ton which price shall include full compensation for loading, hauling, and for all labor, tools, equipment, materials, and all incidentals necessary to complete the work. Grading and compacting the gravel subbase, including hand placing and tamping, use of mechanical tampers, and use of a grader and roller, shall also be included in the price for this item.

The Contractor will be paid for all gravel delivered and placed in the roadway area up to a maximum of 2 inches deeper than the specified depth. No payment will be made for any gravel furnished by the Contractor more than the specified depth plus the above-referenced tolerance of 2 inches, except where poor soil below the subgrade is removed and replaced with new gravel, in which case the Contractor will be paid for the amount of gravel used.

All gravel furnished for foundations for edgestone and sidewalk will be paid for based on the weight of material delivered up to a maximum of the depths and widths specified, except where poor soil below subgrade is removed and replaced with gravel, in which case the Contractor will be paid for the amount of gravel used.

ITEM 153.5	CONTROLLED DENSITY FILL FLOWABLE & EXCAVATABLE	CUBIC YARD
ITEM 153.6	CONTROLLED DENSITY FILL VERY FLOWABLE & EXCAVATABLE	CUBIC YARD

GENERAL

The Contractor shall furnish Controlled Density Fill to be used as backfill material for all locations shown on the plans, specified herein or ordered by the Engineer. The Contractor shall not encapsulate gas pipes, including gas services, with controlled density fill.

Controlled Density Fill - Flowable & Excavatable (CDF-FE) shall be used to fill existing street lighting pullboxes that are to be abandoned.

MATERIALS

Controlled Density Fill (CDF) shall be excavatable after setting and be designated as either

CDF-VFE (very flowable, excavatable) or CDF-FE (flowable, excavatable).

CDF-FE and CDF-VFE are backfill materials, which are delivered by ready mixed concrete mixers (R/M). CDF-FE and CDF-VFE are a flowable, excavatable, self-compacting and self-leveling material, which after solidifying will have the structural characteristics of a well-compacted bearing soil. CDF-FE is used primarily for backfilling trenches, foundations, utilities, etc. in an efficient and complete manner with the minimum use of labor and equipment. CDF-VFE's are used for those purposes plus the areas where long flowable movements are required such as filling pipes, annular rings in jacked pipes and hard-to-get to areas requiring long lateral movements.

The mixes for CDF-VFE and CDF-FE will have the following ingredients and appropriate quantities:

1. Portland Cement - ASTM C150 - the range of cement content will be between 40 lb to 100 lb per cubic yard. Trial batches by the R/M operator shall be done as soon as possible, if the R/M intends to be a bona fide supplier of CDF-FE or CDF-VFE.

2. Fly Ash - Type F - Fly Ash will be used in CDF-VFE mixes. The Fly ash content can vary but the City will recommend a 250 # minimum, which can be increased for more flowability and/or pumpability. Type C Fly ash or high lime Fly ash is not to be used, since it tends to increase the long-term strength and may render the mix un-excavatable in the future.

3. Water - shall be potable and will be used as needed to achieve the proper flowability (slump).

4. Air-Entraining Admixture - the air shall be in the 12-18% range. The air tends to help control the maximum strength as well as aid in the flowability.

5. No admixtures that tend to increase strength with time may be used without the written consent of the Engineer and an appropriate change of the mix where required.

6. Aggregate - ASTM C33 for the excavatable mixes - the well-graded concrete sand will make up the remaining volume of the mix to achieve the full cubic yard.

ACCEPTANCE OF MIX AND SUPPLIER

The acceptance of the mix and the supplier will be based on the range and length of experience of the supplier and the mix backup data. The primary properties are the maximum and minimum strengths, air content, setting times, flowability and yield. The supplier shall submit to the Contractor and then to the Engineer, documentation of his experience in his mixes and in his personnel's ability to deliver them. If these are sufficient to start the placement, the Engineer can waive the pre-job testing and the testing can be done on the initial placements.

The Engineer requires a testing program that shall begin as soon as possible after the contract award. The Contractor shall submit the materials to be used to the designated approved laboratory along with the suppliers proposed mix. The lab will perform all the tests required by the specification at the supplier’s cost, to include setting times, 3, 7, 28 and 90-

day strength tests, air contents, and the ASTM tests on the Cement and Aggregate. In lieu of trial mixes, the materials Engineer may allow the use of the following mix until there is sufficient test feedback.

NOTE: The mix is a guideline only and shall be adjusted for proper yield, specific gravity (SP GR) and other properties specified.

Product	CDF-FE			CDF-VFE		
	Weight	SP GR	Volume	Weight	SP GR	Volume
Cement	60	3.15	0.29	60		0.29
Fly ash		2.3	0.00	250		1.74
Sand	2800	2.62	17.00	2650		16.21
Air		12%	3.24		12%	3.24
Water	406	1.0	6.52	347	1.0	5.57
			27.05			27.05

Lab Mix Targets

Slump: 11 inches
Air: 14%
Strength: 25 PSI @ 7 Days MIN
80 PSI @ 28 Days MAX
100 PSI @ 90 Days MAX

NOTE: The use of slump, on the job, lower than the design slump can push the strength beyond its excavatable property and shall not be allowed. If a lower slump is desired, the mix shall be designed for that lower slump. Test cylinders shall not be rodded but simply overfilled and struck off. Use waxed cardboard cylinders that can be torn apart with little damage to the cylinder to be tested. Low early strengths (3 day) may require a soil bearing plate test in lieu of cylinders.

SPECIFICATIONS: The following is the specification format:

Cement - Range of cement contents 40-100 pounds per cubic yard

Fly Ash - 250 pounds, minimum, when used

Slump - 8-11 inches or, an alternative method is to achieve an 8-15-inch diameter spread from a 6-inch long 3-inch diameter tube filled vertically and lifted off vertically

Unconfined Compressive Strength Targets

@ 3 days	@ 7 days	@ 28 days	@ 90 days
MIN 10 PSI	25 PSI	30 PSI	
MAX		80 PSI	100 PSI

NOTE: If strength targets are not reached, the Engineer may direct the Contractor to increase the testing pace until s/he is satisfied with the results.

CONSTRUCTION METHODS

In general, Control Density Fill shall be placed in two layers. The first layer shall be placed from the bottom of the trench to a point 6 inches above the crown of the pipe. The CDF material shall be poured from one side of the pipe at the lowest slump (approximately 4 inches) necessary to allow the CDF to flow under the pipe. The Contractor shall allow sufficient setting time for the embedment layer prior to pouring the full height CDF backfill to prevent uplift of the pipe. The setting time will vary, but typically shall be under one hour.

Bedding for sanitary or drain pipes shall consist of setting the pipe to the grade as shown on the plans and bedding the pipe in new bank run gravel at all bells, wyes or as ordered by the Engineer. The Contractor shall then follow the above procedures for backfilling with CDF materials.

Bedding for water pipes shall consist of supporting the water pipe at all bell connections, tees, gates or as ordered by the Engineer with new bank run gravel. The bank run gravel is acting as a support for the pipe and is not to be used to backfill the entire trench width. The Contractor shall use extreme care when backfilling with CDF around gate valves, air valves, or any other device the City, BWSC, or private utility company may need direct access to. The Contractor shall carefully seal the riser pipes around gate valves to ensure that no CDF material interferes with the operation of the gate valves. If required, the Contractor will be required to re-excavate around the gate valve, ensure the operation of the gate valve and backfill again at no cost to the City. The Contractor will not use CDF material for his backfill operations around fire hydrants, which will be backfilled with bank run gravel.

METHOD OF MEASUREMENT

The quantity of Controlled Density Fill for the type specified shall be that quantity delivered to the site and used for backfill of excavation. Such quantity will be measured in place by the cubic yard. Such measurements shall be made by the Engineer and will be based upon the depth of normal trench excavation (or ordered below grade excavation), the length of the trench and the width of the trench.

BASIS OF PAYMENT

Payment for the type of Controlled Density Fill specified will be made at the contract unit price per cubic yard. This unit price shall also include all laboratory and test costs as specified herein as ordered by the Engineer.

No payment shall be made for the furnishing of controlled density fill to backfill any excavation done for the Contractor's convenience or excavation beyond the limits set forth on the plans or as directed by the Engineer.

No payment shall be made for re-excavating around a gate valve, service shut off or any other device that the City, BWSC, or private utility company needs direct access to that has been interfered with by CDF material entering the access tube. The Contractor will be required to excavate, remove and clean out the access tube, clean around the operating nut and backfill at no additional cost to the City.

ITEM 154.01 SAND FOR CONDUIT TRENCH TON

GENERAL

The work under this item shall consist of furnishing and placing sand in trenches in conjunction with the use of rigid non-metallic conduit.

MATERIAL

Sand shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coating, and deleterious materials. Sand shall conform to the following grading limitations, as determined by AASHTO T 11 and T 27:

Sieve Size	Percent by Weight Passing
½ inch	100
⅜ inch	85-100
No. 4	60-100
No. 16	35-80
No. 50	10-55
No. 100	2-10

METHOD OF MEASUREMENT

Sand for Conduit Trench will be measured by the ton by tickets delivered with each load. Tickets shall be signed by an Inspector. Weight will be as certified to by a public weigher.

BASIS OF PAYMENT

Sand for Conduit Trench will be paid for by the contract unit price per ton which price shall constitute full compensation for furnishing, placing, and grading, all tools, equipment, and labor necessary to complete the work.

ITEM 156.12 CRUSHED STONE FOR CURB FOUNDATION TON

GENERAL

This work shall consist of furnishing, placing, and compacting crushed stone for curb foundations at locations specified on the plans and/or as directed.

Crushed stone shall meet the requirements specified in sub-section M2.01.2 of Division III, Materials of the MassDOT Standard Specifications.

The trench for the curb is to be 18 inches wide and the sub-grade is to be 24 inches below the top of the finished VA4 curb. Upon this sub-grade a foundation is to be made consisting of clean crushed stone, thoroughly rammed, so that it will be 6 inches thick and the full width of the trench when completed. Upon this foundation other crushed stone is to be spread where necessary, the VA4 curb laid thereon, and thoroughly tamped so that the stone will bear throughout its whole length and be at the line and grade required. The crushed stone foundation shall be laid across all driveways and pedestrian ramps unless directed otherwise. When catch basins are encountered within the trench limits, the Contractor shall connect the crushed stone trench to the basin using a 4-inch diameter PVC pipe. The outer end of the pipe is to be covered with a screen of ¼-inch mesh of heavy galvanized wire. The pipe shall be laid just below the trench and covered with crushed stone.

METHOD OF MEASUREMENT

Crushed Stone for Curb Foundation will be measured by the ton and will be the verified tonnage, complete-in-place and approved. The quantity will be determined only by weight slips that have been properly countersigned by the Inspector at the time of delivery.

BASIS OF PAYMENT

Crushed Stone for Curb Foundation will be paid for at the contract unit price per ton which price shall constitute full compensation for furnishing all labor, tools, equipment, materials, supplies, transportation, installation, and all other incidentals necessary to complete this item.

ITEM 184.11 DISPOSAL OF TREATED WOOD PRODUCTS TON

GENERAL

This item shall apply to the disposal of all treated wood. Any tracks encountered shall be removed and paid for under Item 120.1, Unclassified Excavation. Track shall consist of the pair of rails, fastenings, frogs, switches and any other appurtenances that could be considered part of the track system, excluding the timber ties. The timber ties are suspected to be treated with creosote, pentachlorophenol and/or CCA. This item shall include all costs for sampling, laboratory testing, loading, transportation and disposal of the treated wood to a waste-to-energy facility that is licensed to burn treated wood. The Contractor is encouraged to: 1) if necessary, solicit competitive bids from certified analytical laboratories to meet the sampling requirements/frequency of the waste-to-energy facility; 2) solicit competitive recycling bids from a licensed waste-to-energy facility.

The Contractor is required to arrange for the loading and transportation of the treated timber to the waste-to-energy facility. The Contractor shall deliver the timber in a condition acceptable to the waste-to-energy facility. The Contractor is required to submit manifests and certificates of destruction to the Engineer prior to the completion of the project. All aspects of this Item are to be completed in accordance with state and federal regulations.

METHOD OF MEASUREMENT

Disposal of Treated Wood Products will be measured by the weight, in tons, of treated timber removed and subsequently accepted at the waste-to-energy facility.

BASIS OF PAYMENT

Disposal of Treated Wood Products shall be paid at the contract unit price per ton which price shall be considered full compensation for all labor, tools, equipment, materials, testing, loading, transportation, approvals, and permits necessary to complete the work.

ITEM 191.61 TEST PIT EXCAVATION CUBIC YARD

GENERAL

Work under these items shall conform to the relevant provisions of Sections 140 and 190 of the MassDOT Standard Specifications and the following:

During construction the Engineer may direct the Contractor to excavate test pits for but not limited to, locating underground structures or utilities, determining subsurface materials and conditions prior to further work, or obtaining material samples for analysis. The Contractor shall make an excavation only to the depth and width as directed by the Engineer. When test pits are required in existing pavements the Contractor shall at the direction of the Engineer either saw cut or jackhammer the pavement to cause minimal damage to the remaining pavement. The excavation may require handwork. The excavated area shall be backfilled and compacted with suitable materials.

METHOD OF MEASUREMENT

Test Pit Excavation will be measured by the cubic yard complete in place.

BASIS OF PAYMENT

Test Pit Excavation will be paid for at the contract unit price per cubic yard which price shall be full compensation for all labor, tools, equipment, compaction, and disposal of all excavated materials necessary to complete the work. Materials used for backfilling shall be paid for under their respective bid items. Test pits excavated by the Contractor prior to the reclamation process for purposes of determining subsurface conditions shall be incidental to the price bid for the respective depths of reclamation.

ITEM 220.1	BRADLEY HEAD ADJUSTED	EACH
ITEM 220.3	DRAINAGE STRUCTURE CHANGE IN TYPE	EACH
ITEM 220.5	DRAINAGE STRUCTURE REMODELED	EACH

GENERAL

Work under these items shall conform to the relevant provisions of Section 220 of the MassDOT Standard Specifications and amended by the following:

Work under this item shall conform to Boston Water and Sewer Commission Construction Specifications. These items shall apply to drainage and sanitary structures.

METHOD OF MEASUREMENT

Any drainage structure requiring modifications in excess of 2 feet below grade, will be paid for under Item 220.5, Drainage Structure Remodeled. Any drainage structure requiring modifications up to 2 feet below grade, will be paid for under BWSC Item D3-1A, Adjust Sewer or Drainage Casting to Grade. Any adjustments to Bradley Head structures will be paid for under Item 220.1, Bradely Head Adjusted.

Bradely Head Adjusted will be measured per each, complete in place.

Drainage Structure Change in Type will be measured per each, complete in place.

Drainage Structure Remodeled will be measured per each, complete in place.

BASIS OF PAYMENT

Bradley Head Adjusted will be paid for at the contract unit price per each which price shall be full compensation for all labor, tools, equipment and materials necessary to complete the work.

Drainage Structure Change in Type will be paid for at the contract unit price per each which price shall be full compensation for all labor, tools, equipment and materials necessary to complete the work.

Drainage Structure Remodeled will be paid for at the contract unit price per each which price shall be full compensation for all labor, tools, equipment and materials necessary to complete the work.

Any new castings, frames, and/or covers required shall be considered incidental to the price for these items.

Any casting considered reusable shall be transported to the Boston Water and Sewer Commission, 980 Harrison Avenue, Boston 02119, or where directed. Payment for this work will be included under these items.

ITEM 269.04 GROUND WATER DRAIN LINEAR FOOT

GENERAL

The work shall consist of installing ground water drain as directed.

MATERIALS

4-inch Polyvinyl Chloride (PVC) perforated pipe shall conform to the requirements of ASTM D2729.

Crushed stone shall conform to the requirements of M2.01.5.

Geotextile fabric shall conform to the requirements of M9.50.0.

CONSTRUCTION METHODS

The drain trench shall be excavated to the width and depth designated on the plans. Filter fabric shall be rolled out as a continuous piece in the trench floor, up the sides, and the excess shall be folded over, as indicated on the plans. The pipe shall be laid in the trench with the

necessary fittings and all joints shall be sealed with the appropriate solvent-cement. The trench shall be backfilled with crushed stone as shown on the plans.

The drain pipe shall be connected to catch basins where indicated on plans or where directed. The Contractor shall break into the catch basin, insert the pipe, and shall mortar the opening between the pipe and at the structure to provide a water-tight joint.

METHOD OF MEASUREMENT

Ground Water Drain will be measured by the actual length of drain installed, complete in place.

BASIS OF PAYMENT

Ground Water Drain will be paid for at the contract unit price per linear foot which price shall include full compensation for furnishing and installing perforated PVC pipe and fittings, furnishing and installing filter fabric, furnishing and installing crushed stone connection to catch basins, mortar, all necessary excavation (except rock), all labor, materials, tools, and equipment, and all incidentals necessary to complete the work.

Rock excavation related to this work will be paid for under Item 144., Class B Rock Excavation.

ITEM 401.006	6 INCH RECLAIMED ASPHALT/AGGREGATE BASE	SQUARE YARD
ITEM 401.008	8 INCH RECLAIMED ASPHALT/AGGREGATE BASE	SQUARE YARD
ITEM 401.010	10 INCH RECLAIMED ASPHALT/AGGREGATE BASE	SQUARE YARD
ITEM 401.012	12 INCH RECLAIMED ASPHALT/AGGREGATE BASE	SQUARE YARD
ITEM 401.015	15 INCH RECLAIMED ASPHALT/AGGREGATE BASE	SQUARE YARD

GENERAL

Work under this item shall consist of establishing a reclaimed asphalt/aggregate base utilizing the existing asphalt pavement surface and gravel base materials. The work includes, but it is not limited to: (a) scarification and pulverization of the existing asphalt surface and base, and (b) final grading and compaction of the reclaimed asphalt/aggregate base to the lines and grades shown on the plans, or as directed by the Engineer. The intent is to provide a suitable base for the placement of a hot mix asphalt binder and top course.

MATERIALS

Existing - It is anticipated that existing in-place materials only will be used to create a homogenous mixture and to satisfy the grades supplied by the Engineer.

Gradation - The material shall be processed in such a manner that the final gradation will meet the requirements set forth in the following Table:

Gradation Table for Reclaimed Asphalt/Aggregate Base

Sieve Size	Percent by Weight Passing
3 inch	100
1 ½ inch	70-100
¾ inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	0-8

EQUIPMENT

Pulverizing and Compaction - The Contractor shall provide a list of the specific equipment to be used in the performance of this work for approval by the Department. The pulverizing equipment shall include, but not be limited to:

A. pavement and base reclaimer capable of pulverizing material to meet gradation requirements and mixing to a minimum width of 6 feet and a minimum depth of 12 inches

B. motor grader or tractor mounted rippers, scarifiers, or asphalt cutters

C. travelling hammer-mills

D. cold planers or pavement profilers

Compaction equipment required shall be a 10-ton (minimum) steel wheel roller or other equipment capable of achieving the specified density.

All equipment shall be maintained in satisfactory working condition at all times.

CONSTRUCTION METHODS

Depth of Reclamation - The existing pavement shall be pulverized, processed, blended, and compacted to depth indicated on the plans or established by the Engineer. The depth will be measured from the existing pavement surface.

Structures - The Contractor shall be responsible for determining the exact location of all structures and obstructions that may affect the reclaiming operation. The Contractor at his option may make as many test pits as he deems necessary to verify the feasibility of the reclaiming process. If at the time of reclamation extensive obstructions are observed which may hinder the process the Contractor shall notify the Engineer in writing and requesting a review of the pavement rehabilitation method. The City will not be responsible for any damage to the Contractor's equipment as a result of the reclamation process. Care shall be utilized by the Contractor to insure that no damage occurs to curbing, catch basins, gate valves or similar structures or equipment installed in the pavement. The Contractor shall repair or replace any structures or equipment damaged by his negligence.

Processing - The operation shall overlap the adjacent pass for not less than 6 inches. The work shall cover the entire surface of the pavement as shown on the plans with uniform overlapping of each preceding track or pass. The reclaiming operation shall be conducted so as not to permit the contamination of the asphalt/aggregate material with any shoulder debris, grass, leaves, or dirt. If additional materials are required, they shall be placed over the entire area and uniformly blended with the pulverized base prior to grading and compacting.

Unsuitable Material - Any exposed cobbles or rocks greater than 3 inches in diameter within the reconstituted area shall be "culled-out" and removed from the site. The Contractor shall be aware that within the limits of the project there may exist patches of cement concrete. These include but are not limited to collars around castings, previous utility repairs, and edgestone trenches. The concrete shall be considered as unsuitable material and will be removed. Payment for this work shall be considered part of the item and it will be the responsibility of the Contractor to remove "cobbles" and other unsuitable material from the work and dispose of them in a satisfactory manner.

Grading & Compacting - The material shall be uniformly graded and compacted to establish a reclaimed asphalt/aggregate base to the lines and grades shown on the plans, or as directed by the Engineer. The compacting and binding operation shall be continued until the voids in the aggregates have been reduced to provide a firm and uniform surface satisfactory to the Engineer.

Excess Material - If excess material exists after formation of the reclaimed asphalt/aggregate base course to the specified grades and cross-slope, the Contractor shall dispose of the excess material in a manner acceptable to the Engineer.

Thickness - After grading, compaction, and removal of excess material, the reclaimed asphalt/aggregate base shall have a minimum thickness of 6 inches. The Contractor shall demonstrate to the Engineer that the thickness of the compacted base course, as determined at intervals of not more than 1,500 square yards, meets the dimensions specified.

Contamination - Should any unsuitable subbase/subgrade material become churned up or mixed with the reclaimed base course material at any time, the Contractor shall remove the contaminated mixture. The Contractor shall add new subbase material, if required, and reshape and re-compact the subbase in accordance with these specifications. Base course material shall be added, compacted, and bound as herein before specified, to match the surrounding surface.

Weather Limitations - Work on the base course shall not be permitted when temperatures are less than 35°F or when the subgrade is frozen or excessively wet. Any damage caused to the reclaimed asphalt/aggregate base course resulting from work performed during these adverse weather conditions shall be repaired by the Contractor at his own expense.

Tolerances - The final surface of the reclaimed asphalt/aggregate base course shall be fine graded so that, after final compaction and just prior to placement of the pavement courses, the surface elevation shall not vary more than ¼ inch above or below the designed line and grade at any location unless approved by the Engineer. If, after approval, the base course becomes displaced or disturbed in any way for any reason, the Contractor shall repair the damage then regrade the base to the satisfaction of the Engineer. All repaired sections shall be re-compacted until they meet the requirements of this specification.

Density - The reclaimed asphalt/aggregate base material will be thoroughly compacted with a roller(s) to produce 100% compaction and uniform base density when compared to the modified Proctor Test (AASHTO T 180) of the reclaimed base materials. Water shall be applied to ensure optimum moisture content during compaction and to aid in achieving maximum compaction.

METHOD OF MEASUREMENT

Reclaimed Asphalt/Aggregate Base Course will be measured by the square yard of base course completed, in place, to the depth specified and accepted by the Engineer.

BASIS OF PAYMENT

Reclaimed Asphalt/Aggregate Base, at the depth specified, will be paid for at the contract unit price per square yard which price shall include full compensation for all excavation of test pits, pulverizing, milling, blending, grading, and compacting, excavation and disposal of all excess and/or unsuitable materials and for all labor, tools and equipment, supplies, and for all incidentals necessary to complete the work.

ITEM 402.1 DENSE GRADED CRUSHED STONE FOR SUB-BASE TON

GENERAL

Work under this item shall conform to the relevant provisions of Section 402 of the MassDOT Standard Specifications and the following:

CONSTRUCTION METHODS

The dense graded crushed stone shall be placed in successive layers not more than 6 inches in depth, each layer thoroughly compacted by a method approved by the Engineer.

METHOD OF MEASUREMENT

Dense Graded Crushed Stone shall be measured by the ton, complete-in-place and approved. The quantity shall be determined only by weight slips that have been properly countersigned by the inspector at the time of delivery.

BASIS OF PAYMENT

Dense Graded Crushed Stone will be paid for at the contract unit price per ton which price shall constitute full compensation for furnishing all labor, including handwork, tools, equipment, materials, supplies, transportation, installation, and all other incidentals necessary to complete the work.

ITEM 431.1 HIGH EARLY STRENGTH CEMENT CONCRETE BASE COURSE CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 430 of the MassDOT Standard Specifications and the following:

METHOD OF MEASUREMENT

High Early Strength Cement Concrete Base Course will be measured in place by the cubic yard conforming to the length, width, and depth required by the plans or as directed including any encasement of conduits.

BASIS OF PAYMENT

High Early Strength Cement Concrete Base Course will be paid for at the contract unit price per cubic yard which price shall constitute full compensation for all labor, tools, equipment and materials necessary to complete the work.

ITEM 440. CALCIUM CHLORIDE FOR ROADWAY DUST CONTROL POUND

GENERAL

This work shall consist of furnishing and applying calcium chloride for the alleviation or prevention of dust nuisance as directed in accordance with these Specifications.

MATERIALS

Calcium chloride shall conform to the requirements of AASHTO M 144, Type I or Type II.

APPLICATION

Calcium chloride shall be uniformly applied at a rate of 1½ pounds per square yard or at any other rate as directed by the Engineer, by means of mechanical spreader, or other approved methods.

METHOD OF MEASUREMENT

Calcium Chloride for Roadway Dust Control will be measured by the pound, complete in place.

BASIS OF PAYMENT

Calcium Chloride for Roadway Dust Control will be paid for at the contract unit price per pound which price shall constitute full compensation for all labor, tools, equipment and materials necessary to complete the work.

ITEM 443. WATER FOR ROADWAY DUST CONTROL M. GALLONS

GENERAL

This work shall consist of furnishing and applying water for the alleviation or prevention of dust nuisance, as directed in accordance with these Specifications.

Water shall be applied only at locations and at such times and in the amount as may be directed by the Engineer. Quantities of water wasted or applied without authorization will not be paid for.

Watering equipment shall consist of pipelines, tanks, tank trucks or other devices, approved by the Engineer, which are capable of applying a uniform spread of water over the surface. A suitable device for a positive shut-off and for regulating the flow of water shall be located so as to permit positive operator control.

METHOD OF MEASUREMENT

Water for Roadway Dust Control will be measured for payment by the number of M gallons (1000 Gallons) applied. The water will be measured in tanks or tank trucks of predetermined capacity, or by means of satisfactorily installed meters. All measuring devices shall be

furnished by the Contractor.

BASIS OF PAYMENT

Water for Roadway Dust Control will be paid for at the contract unit price per M gallons which price shall include all water, labor, tools and equipment required to furnish, apply and measure the water applied to surfaces designated by the Engineer and at times specified.

ITEM 450.45 FIBER SEALING CRACKS GALLON

GENERAL

The work to be done under this item shall consist of performing all operations and furnishing all materials, labor, and equipment necessary for cleaning, and sealing cracks in the existing pavement, as shown on the plans or as directed by the Engineer.

MATERIALS

Components - The sealing compound shall be a liquid bituminous material which is reinforced with a polyester fiber conforming to the following properties:

Asphalt - Paving grade specification asphalt cement AC-0, ASTM D3381, TABLE 2.

Fibers – To meet the requirements below:
Length - ¼-inch cut polyester
Diameter - 0.0008 inch ± 0.0001 inch
Specific Gravity - 1.32 to 1.40
Melt Temperature - 480°F minimum
Ignition Temperature - 1000°F minimum
Tensile Strength - 75,000 PSI ± 5,000 PSI
Break Elongation - 33% ± 9% (Fully drawn)

The fiber is a polyester which is the polymerized product of crude oil components. These fibers will not shrink, distort, or lose their strength at temperatures below 480°F The fibers are produced by continuous melt-spinning.

Composition - The fibers shall be a minimum of 5% by weight of the sealant. The sealant shall be composed of a mixture of materials that will form a resilient and adhesive compound capable of effectively sealing cracks in pavements against the infiltration of moisture and foreign material throughout repeated cycles of expansion and contraction with temperature changes, and that will not, at ambient temperatures, flow from the crack or be picked up by vehicle tires. The material shall be capable of being brought to a uniform pouring consistency suitable for completely filling the cracks without inclusion of large air holes or discontinuance's and without damage to the material. It shall remain relatively unchanged in application characteristics for at least 6 hours at the recommended pouring temperature in the field.

EQUIPMENT

Requirements - Equipment used in the performance of the work required by this section of the specification shall be subject to the approval of the City.

Air Compressor - Air compressors shall be portable and capable of furnishing not less than 100 cubic feet of air per minute at not less than 90 lbs. per square inch pressure at the nozzle. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water.

Self-Propelled Vacuum Sweeper - A small self-propelled vacuum sweeper designed specifically for use in cleaning highway and airfield pavements shall be used to remove debris, dirt, and dust from cracks.

Hand Tools - Hand tools shall consist of brooms, shovels, metal bars with chisel shaped ends, and any other tools which may be satisfactorily used to accomplish this work.

Melting Kettle - The unit used to melt the joint sealing compound shall be a double boiler, indirect fired type. The space between the inner and outer shells shall be filled with a suitable heat transfer oil or substitute having a flash point not less than 530°F. The kettle shall be equipped with a satisfactory means of agitating the crack sealer at all times. This may be accomplished by continuous stirring with mechanically operated paddles and/or by a continuous circulating gear pump attached to the heating unit. The kettle must be equipped with thermostatic control calibrated between 200°F. and 550°F.

Applicator - The in-place hot extrusion shall be performed using a wand with a minimum 5-inch dish applicator suitable for use with fiber reinforced asphaltic compounds.

CONSTRUCTION METHODS

Forming Cracks - Prior to applying the fiber reinforced membrane, all cracks ½ inch and wider shall be thoroughly cleaned of all unsuitable material using compressed air, as directed by the Engineer.

Limitations - In areas where hot poured rubberized joint material was previously used, this material shall be removed prior to cleaning. After the cleaning of the cracks, all material removed from the cracks shall be removed from the pavement surface by means of power sweepers, and hand brooms, to the satisfaction of the Engineer. No crack sealing material shall be applied in wet cracks or where frost, snow or ice is present nor when the ambient temperature is below 40°F.

Sealing Compound - The pre-packaged fibers shall be supplied in polyethylene bags which will dissolve when introduced into the hot (above 275°F) asphalt cement. The melting kettle shall mix and agitate the compounds until a homogenous mixture is achieved. When the mixture has attained an application temperature between 310°F and 360°F, the cracks shall be filled flush with the pavement surface such that the membrane is well bonded to the pavement. Any sealant which is greater than 3/16 inch below the pavement surface when cooled, shall be resealed to the satisfaction of the Engineer.

METHOD OF MEASUREMENT

Fiber Crack Sealing will be measured per gallon, complete in place.

BASIS OF PAYMENT

Fiber Crack Sealing will be paid for at the contract unit price per gallon which price shall constitute all labor, tools, equipment, materials and all incidentals necessary to complete the work, such as asphalt cement, polyester fibers, cleaning and removal of existing joint material as required.

ITEM 451.25	HOT MIX ASPHALT FOR ROADWAY REPAIRS (NON-ARTERIAL STREETS – 6 ½") (MAINTENANCE)	SQUARE FOOT
ITEM 451.75	HOT MIX ASPHALT FOR ROADWAY REPAIRS (ARTERIAL STREET – 7 ½") (MAINTENANCE)	SQUARE FOOT

GENERAL

Work under this item shall consist of excavating existing temporary hot mix asphalt (HMA) and cold patch and other patching material including backfill to the depth specified under the type of pavement to be placed. The patch shall be backfilled and compacted with appropriate HMA and identified with a Utility Repair Tag (A-tag) placed in the wearing surface of the finished patch. A-tags shall be in accordance with Boston PWD requirements as specified on the City of Boston website:

https://www.boston.gov/departments/public-works/accountability-and-road-repair

CONSTRUCTION METHODS

All cold patch and/or other patching material including backfill shall be removed to the depth specified under the type of pavement to be placed. The exposed gravel sub-base shall then be tamped with pneumatic tamper to eliminate any voids, which may have been due to improper backfill methods when the excavation was made. Any new gravel to compensate for improper backfill methods or to replace improper backfill material and/or as directed shall conform to the relevant provisions of Item 151.02, however, the cost of this material shall be considered incidental to Items 451.25 or 451.75 and no additional compensation will be allowed. The use of gravel upon the properly prepared subgrade repairs shall be made as follows:

On Non-Arterial Streets:

The vertical edges of all patches will be sawcut and painted with a tack coat. Place a wearing surface of Superpave Surface Course – 9.5(b) (SSC – 9.5 (b) mm) averaging one and one half (1 ½) inches in depth over five (5) inches of HMA Intermediate Course (Superpave Intermediate Course – 19.0 (SIC – 19.0 mm)).

On Arterial Streets:

The vertical edges of all patches will be sawcut and painted with a tack coat. Place a wearing surface of Superpave Surface Course – 12.5 (SSC – 12.5) mm) averaging two (2) inches in depth on five and one half (5 ½) inches of (Superpave Intermediate Course – 19.0 (SIC – 19.0 mm)).

Where a granite block pavement or cement concrete subbase pavement exists, repairs shall be made by providing a minimum six (6) inch high early strength air entrained concrete pavement base. High early strength concrete shall be in conformance with the relevant provisions of Item 431.1. In cases where the existing granite block pavement or cement concrete exceeds six (6) inches, the repair shall be made to match the depth of the existing concrete and/or pavement blocks. The hot mix asphalt repair shall be made to match the depth of the existing adjacent HMA pavement.

For all repairs, a Utility Repair Tag (A-tag) shall be placed with the wearing surface, set flush with the surface of the finished patch. The wearing surface must be placed within three days of binder placement.

All HMA must be obtained from a plant approved by the Boston Public Works Department.

The HMA used for base material shall conform to the relevant specifications of Superpave Intermediate Course – 19.0 (SIC – 19.0 mm).

The HMA used for wearing surface material shall conform to the relevant specifications for Superpave Surface Course – 9.5(b) (SSC – 9.5 (b) mm) or Superpave Surface Course –12.5 (SSC – 12.5 mm), as directed by Engineer.

All construction methods and materials shall conform to the relevant City of Boston Special Provisions for HMA (Items 455.215 – 460.95).

The Boston Public Works Department requires tack coat (emulsified asphalt) on all surfaces to be paved; this includes leveling, base or intermediate layers of HMA, any freshly placed layers of hot HMA unless the underlying HMA layer was placed during the same day. Particular attention must be given to the application along joints. Any areas on joints without sufficient tack coat will require either re-application or localized handwork as directed by the Engineer or his representative.

Tack coat shall be consistent with the applicable provisions of Item 463.5 and applied at a residual binder amount on the pavement between 0.03 to 0.05 gallons per square yard. The Contractor shall use the lower application rate (0.03 gallons per square yard) between new lifts and the higher application rate (0.05 gallons per square yard) on milled or cement concrete surfaces. RS-1 and CRS-1 type asphalt emulsions for tack coating shall be utilized. Tack coat shall be supplied as part of the HMA operation.

The Contractor shall allow the tack coat to dry from a brown color to a black color prior to paving.

The vertical surface of the existing pavement shall be painted with asphalt cement emulsion

(RS-1). After the wearing surface of the specified HMA surface course has been spread, it shall be thoroughly compressed with a tandem roller not less than ten (10) tons. The mixture shall be compacted with tampers and hand rollers.

Upon completion of every pavement course (base or wearing surface), joints shall be painted with the asphalt cement emulsion (RS-1). Upon completion of the wearing surface of the specified hot mix asphalt surface course, joints shall be painted asphalt cement emulsion (RS-1) and then sanded.

Barriers, as specified or directed by the Engineer, must be left in place around a patch until the material does not unravel with traffic.

The Contractor shall provide sweeping equipment, at his expense, when required, to remove all cuttings from the trench or patch areas on a daily basis. The Contractor shall sweep and remove loose cuttings, dust, or other objectionable material from the roadway by the end of each working day using power brooms, power vacuums, and/or whatever ancillary equipment, tools, and labor necessary to properly prepare the road.

In accordance with BTD regulations, all pavement markings must be installed within three days after construction is complete.

METHOD OF MEASUREMENT

Hot Mix Asphalt for Roadway Repair (Non-Arterial Streets 6 ½") and Hot Mix Asphalt for Roadway Repair (Arterial Streets 7 ½") will be measured by the actual number of square feet of roadway patch repair installed on the roadway surface as measured by the Engineer complete in place.

BASIS OF PAYMENT

Hot Mix Asphalt for Roadway Repair (Non-Arterial Streets 6 ½") and Hot Mix Asphalt for Roadway Repair (Arterial Streets 7 ½") will be paid at the contract unit price per square foot complete in place, including any applicable price adjustments. This payment shall be full compensation for all excavation, furnishing and placing all hot mix asphalt materials, tack coat, sawcutting, cutting of keys or stripping of pavement to produce neat joints, mechanical sweeping of streets, and for all labor, tools, equipment, materials, and all incidentals necessary to complete the work.

Any repairs made to the existing granite block or concrete base shall be paid for under Item 431.1, High Early Strength Cement Concrete Base Course.

All excavation and disposal of existing concrete or granite block base shall be considered incidental to this item.

ITEM 454.5	HMA LATEX POLYER MODIFIER	TON
ITEM 455.215	SUPERPAVE SURFACE COURSE – 4.75 (SSC – 4.75mm)	TON
ITEM 455.225	SUPERPAVE SURFACE COURSE – 9.5 (SSC – 9.5mm)	TON
ITEM 455.235	SUPERPAVE SURFACE COURSE – 12.5 (SSC – 12.5mm)	TON
ITEM 455.245	SUPERPAVE SURFACE COURSE – 9.5(b) (SSC – 9.5(b)mm)	TON
ITEM 455.325	SUPERPAVE INTERMEDIATE COURSE – 19.0 (SIC – 19.0mm)	TON
ITEM 455.415	SUPERPAVE BASE COURSE – 25.0 (SBC – 25.0mm)	TON
ITEM 455.425	SUPERPAVE BASE COURSE – 37.5 (SBC – 37.5mm)	TON
ITEM 456.	WARM MIX ADDITIVE	TON
ITEM 460.5	HOT MIX ASPHALT BASE COURSE	TON
ITEM 460.65	HOT MIX ASPHALT DENSE BINDER COURSE	TON
ITEM 460.7	HOT MIX ASPHALT TOP COURSE	TON
ITEM 460.8	HOT MIX ASPHALT SURFACE TREATMENT	TON
ITEM 460.9	HOT MIX ASPHALT MODIFIED TOP COURSE	TON
ITEM 460.95	HOT MIX ASPHALT TOP COURSE (DENSE MIX)	TON

1.0 GENERAL

Special Notice to Bidders

The bidder's attention is directed to the following:

The Department reminds all bidders that they are required to call the Engineer to schedule inspection of newly placed asphalt. Failure to contact the Engineer shall result in material rejection and the Contractor shall be required to remove and replace all material at no additional cost to the City.

1.1 Scope

Work under this item shall consist of producing and furnishing hot mix asphalt composed of mineral aggregate and asphalt binder, mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and conformance to the lines, grades, thickness and typical cross sections shown on the plans or as directed by the Engineer.

Each course shall be constructed to the depth, typical section, or elevation required by the contract and/or plans and shall be rolled, finished, and approved before the placement of the next course. Each course shall be placed to a smooth, dense, and uniform appearance.

2.0 QUALITY ASSURANCE

The Contractor shall establish, provide, and maintain a Quality Control System (QCS) that will detail the methods and procedures that will be taken to assure that all materials and completed construction conform to project specifications, plans, technical specifications and other requirements, whether manufactured or processed by the Contractor or procured from subcontractors or vendors. The Contractor will be required to complete daily Quality Control testing for the RAP material for each day of production in accordance with these

specifications. Failure to complete the necessary Quality Control testing will result in the suspension of further production of any additional RAP material for the City.

The Contractor assumes the responsibility of the quality for all materials and construction incorporated into the work and will control all the processes leading to the final result through this function. Quality Control activities should include:

A. Maintain a Contractor Quality Control System
B. Proficiency Testing prior to production with Engineer
C. Inspection and Testing of Hot Mix Asphalt Production
D. Inspection and Testing of Hot Mix Asphalt Placement

See Section 7.17 "Contractor Quality Control of HMA Pavement" of these specifications for additional information.

The City of Boston, or their authorized agent, will perform the Quality Acceptance function for this work. All material will be considered for acceptance through a sampling, testing and inspection program performed by the Engineer or their agent. Quality Acceptance activities include:

A. Proficiency Testing prior to production with Contractor
B. Inspection of HMA Production Plant and Testing Laboratory
C. Production Trials of HMA Products Intended for Use in Boston
D. Inspection/Testing for Acceptance of Hot Mix Asphalt Production
E. Inspection/Testing for Acceptance of Hot Mix Asphalt Placement
F. HMA Quality Acceptance Daily Report of Activities

3.0 MATERIALS

3.1 Aggregate

Aggregate shall consist of crushed stone, with or without sand or other inert finely divided mineral aggregate. The portion of the materials retained on the No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and being retained by the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler when tested in accordance with AASHTO T 27 and AASHTO T 11.

A. Coarse Aggregate

1. Coarse aggregate shall consist of sound, tough, durable particles of uniform quality, free from adherent coatings of clay, organic matter, and other deleterious substances that would prevent thorough coating and bonding with the binder. It shall show no more wear than 30% loss when tested in accordance with AASHTO T 96, nor shall the sodium sulfate soundness loss exceed 9%, or the magnesium soundness loss exceed 12%, after five cycles, when tested in accordance with AASHTO T 104.

2. The coarse aggregate shall not contain more than 1% of material such as crusher dust, sand or soft, disintegrated pieces The coarse aggregate shall not

contain more than 10%, by weight, of flat or elongated pieces, when tested in accordance with ASTM D4791 at a ratio stated within the standard specifications, or in lieu of, a ratio of 3:1. A flat particle is one having a ratio of width to thickness greater than the stated ratio; an elongated particle one having a ratio of length to width greater than the stated ratio. An aggregate particle whose maximum length is the stated ratio times its maximum thickness is considered flat and elongated.

3. The aggregate shall contain a minimum coarse aggregate angularity of 75% having at least one fractured face for the base, intermediate courses and surface course, when tested in accordance with ASTM D5821. For the Superpave mixes, the coarse aggregate angularity shall conform to the minimum requirements listed in Table 4 for the designated traffic level and depth within the pavement structure.

4. The use of steel slag or blast furnace slag shall not be permitted as a coarse aggregate.

B. Fine Aggregate

1. Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing natural stone, or gravel that meets the requirements for wear and soundness specified for the coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter and shall contain no clay balls. The combined materials that passed the No. 100 mesh sieve shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO T 90.

2. Fine aggregates shall have sand equivalent values of 40 or greater when tested in accordance with AASHTO T 176. The sand equivalent value shall be determined for the combined mix aggregates, including coarse and fine aggregates and mineral filler portions.

3. In the fine aggregate sieve analysis passing No. 4 the amount between two successive sieves No. 16, No. 30, No. 50, and No. 100 shall not exceed 33% of the fine aggregate total.

4. Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The aggregate shall have a fine aggregate angularity value of 40% or greater when tested in accordance with AASHTO T 304, Method A. The uncompacted void content shall be evaluated for the combined mix aggregates including both coarse and fine aggregate portions. For the Superpave mixes, the fine aggregate angularity shall conform to the minimum requirements listed in Table 4 for the designated traffic level and depth within the pavement structure.

5. The fine aggregate, as delivered to the mixer, shall meet the following gradation requirement:

Table 1. Fine Aggregate Grading

Sieve Size	Percent by Weight Passing
⅜ inch	95-100
No. 8	70-95
No. 50	20-40
No. 200	2-16

C. Mineral Filler: If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of AASHTO M 17.

HMA mixtures shall contain a dust to effective asphalt ratio by mass between 0.6 and 1.2. For Superpave designed mixtures, mixtures that pass beneath the Primary Control Sieve (PCS) control point established by AASHTO M 323 may contain a dust to effective asphalt ratio by mass between 0.8 and 1.6.

D. Reclaimed Asphalt Pavement (RAP): A limited amount of production may include RAP. The use of a maximum of 10% RAP will be allowed in the surface courses limited to 9.5 mm and 12.5 mm HMA mixes. The use of a maximum of 20% RAP will be allowed in the intermediate courses and base courses limited to 19 mm and 37.5 mm HMA mixes.

1. The RAP, incorporated into the HMA mixtures, shall be maintained as a separate captive stockpile and shall not be added to without prior approval. RAP shall consist of asphalt pavement recovered by cold milling or other removal techniques. The RAP shall be crushed so that 100% passes the maximum aggregate size of the HMA mix in which it will be used. The Contractor's Quality Control system shall assure that the RAP is free from detrimental amounts of contaminating substances such as joint seal compound and is reasonably uniformly graded from fine to coarse. Please refer to the RAP testing requirements in this specification.

2. The coarse aggregate in the RAP shall be crushed stone and the top-size shall not exceed the maximum aggregate size established by the DMF/JMF. The final HMA mixture containing RAP shall conform to all the specification requirements contained herein.

3. The Contractor shall indicate the percentage of RAP, the moisture content (as a minimum, determined twice daily - once prior to daily production and halfway through daily production) and record the net dry weight of RAP added to the mixture on each delivery ticket. For mixtures containing 15% or less RAP, the asphalt binder shall be a PG 64-28 or PG 64-22.

4. For mixtures containing greater than 15% and up to 25% RAP, the asphalt binder grade shall be a PG 58-34 or that which satisfies AASHTO M 320 and AASHTO M 323.

5. The laboratory RAP-virgin binder blend viscosity value established from the RTFO residue at 140°F (60°C) shall establish the maximum viscosity allowed for the binder after discharge from the HMA plant and/or silo storage, if applicable, when recovered by AASHTO T 170 and tested in accordance with AASHTO T 202 and AASHTO TP 48.

6. For design purposes, the specific gravity of the combined aggregate blend with RAP used in a HMA mixture shall be determined in accordance with the attached test method for BULK SPECIFIC GRAVIY OF AGGREGATE BLENDS WITH RAP.

3.1.1 Sampling and Testing - All aggregate samples required for testing shall be furnished by the Contractor when requested. AASHTO T 2 shall be used in sampling coarse aggregate and fine aggregate, and AASHTO T 127 shall be used in sampling mineral filler. All tests for initial aggregate submittals necessary to determine compliance with requirements specified herein will be conducted by the Contractor under their Quality Control System. No aggregate shall be used in the production of mixtures without prior approval.

3.1.2 Sources of Supply – All sources of aggregate shall be selected well in advance of the time the materials are required in the work. Preliminary approval may be given when the materials are obtained from a previously approved source or an existing quarry source producing aggregates that has a satisfactory service record in hot mix asphalt construction for at least 5 years. Samples shall be submitted upon contract award. When time permits, samples shall be submitted 14 days prior to the start of production. An inspection of the producer's operation will be made by the Engineer. When new sources are to be developed, the Contractor shall indicate the sources and submit a plan of operation 30 days in advance of starting production. Samples from test pits, borings, and other excavations shall be submitted at the same time. Approval of the source of aggregate does not relieve the Contractor in any way of the responsibility for delivery at the job site of aggregates that meet the requirements specified herein.

3.1.3 Samples – All samples of aggregates shall be furnished by the Contractor at the start of production and at intervals during production of HMA mixtures. The intervals and points of sampling will be designated by the Engineer.

3.2 Asphalt Binder Material

The types, grades, and controlling specifications, the maximum mixing temperatures and compaction temperatures for the asphalt binder materials shall conform to the following:

3.2.1 Performance Graded Asphalt Binder - The Asphalt Binder shall be a Performance Graded Asphalt Binder (PGAB) which meets the specification requirements of AASHTO M 320 and AASHTO R 29. Acceptance of the PGAB will be in accordance with AASHTO R 26 "Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders". PGAB shall be provided by an Approved Supplier (AS) under the Approved Supplier Certification (ASC) system.

THE PGAB grade shall be PG 64-28 or 64-22. If traffic speed and/or level warrant, the PGAB may be adjusted by the Engineer for the Design Traffic conditions in accordance with Table 2

below. **No chemically modified PGAB shall be used in the City.**

A. A separate DMF/JMF with TSR results shall be submitted for each PGAB grade proposed for use on this project.
B. Limit one binder grade per production day unless otherwise adjusted by the Engineer for the Design Traffic conditions.
C. Documentation of the type of binder used per production day is to be stated on the weigh slips.

Table 2. Superpave PGAB Adjustment for Design Traffic Conditions

Traffic Loading	Adjustment to PGAB Grade
Standing <12mph	Increase high temperature grade by 2 grades (12°C), or 76-XX. Use low temperature grade as determined by LTTP BIND software.
Slow Transient 12 to 44 mph	Increase high temperature grade by 1 grade (6°C), or 70-XX. Use low temperature grade as determined by LTTP BIND software.

Traffic Level (ESALs)	Adjustment to PGAB Grade
1×10^7 to 3×10^7	Consideration should be given to increasing high temperature grade by 1 grade (6°C), or 70-XX. Use low temperature grade as determined by LTPP BIND software.
$>3 \times 10^7$	Increase high temperature grade by 1 grade (6°C), or 70-XX. Use low temperature grade as determined by LTTP BIND software.

The Contractor shall furnish manufacturers' certified test reports for each carload or equivalent of binder shipped to the project as well as applicable Materials Certificates for the shipment of each carload or equivalent to the production plant. The reports shall be delivered to the Engineer before production of the HMA. The furnishing of the vendor's certified test reports and material certificates for the PGAB material can be used as the basis for final acceptance of the bituminous material, or tested by the Engineer. If the Engineer elects to test the binder material at their costs, then the Contractor shall set aside one 1-quart sample of the asphalt binder material obtained from each truckload, shipment, or equivalent of asphalt binder material shipped to the production facility. Each sample shall be labeled with the PG grade, source and batch number, quantity, project name, plant, date, and the sampling inspector. The Contractor shall maintain documentation in the form of a Materials Certificate of each shipment, with a copy attached to each quart sample.
After receiving the quart samples, obtained by the Contractor, the Engineer may test the samples for verification of the performance grade. 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, removal, or reduced payment as determined by the Engineer.

The blending at the HMA plants of PG binder from different suppliers is strictly prohibited. Contractors may switch to another approved source of PG 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 tank shall not retain more than 0.5% in volume capacity of previous residue source. Contractors who blend PG binders will be reclassified as a supplier and required to certify the binder in accordance with AASHTO M 320 and AASHTO R 26. Also,

if any modifications, blending, or addition of additives occurs, the Contractor shall re-certify the material in accordance with AASHTO M 320 and AASHTO R 26.

A copy of the Certified Test Reports shall be provided in accordance with the frequency requirements established in the latest version of AASHTO M 320, and shall include the following:

A. Flash point
B. Rotational viscosity at 275°F and 329°F
C. Specific gravity at 77°F
D. Original G*/sinδ and phase angle at test temperature
E. RTFO percent mass loss
F. RTFO - G*/sinδ and phase angle at test temperature
G. PAV Residue - G*(sinδ) and phase angle at test temperature
H. Creep stiffness and m-value at test temperature
I. Direct tension results (when equipment available)
J. Strain sweep in accordance with AASHTO T 315 (optional)
K. Physical hardening after 24 hours in accordance with AASHTO T 313 (optional)

3.2.2 Latex Modifier – The latex compound used in conjunction with the asphalt binder shall be a cold polymerized un-vulcanized virgin synthetic rubber in latex form and conform to the following requirements:

Latex Compound

Type of Latex	Anionic
Total Rubber Solids, % by weight	60 – 72
Ash, % of total rubber solids by weight	3.5 max.
pH	9 - 11
Viscosity, Brookfield #2 @ 20 rpm, 77F	2,000 max.
Styrene Butadiene Ratio	24:76 + 2
Residual Styrene, % by weight	0.1 max.

The manufacturer of the latex compound shall furnish certification showing actual test results conforming to the specifications. The Contractor shall submit typical samples of the latex compound and the unmodified bitumen to be used for the project to the Engineer prior to production. See Table 2. SUPERPAVE PGAB Adjustment for Design Traffic Conditions.

The quantity of latex rubber solids shall be a minimum of 3% by weight of the binder content of the mix. (Example: A latex polymer weighs 8 pounds per gallon and contains 70% latex rubber solids by weight. For a HMA design requiring 6% binder; the weight of binder per ton of HMA mix is 2000 lb x 6% = 120 lb; the weight of latex rubber solids per ton is 120 lb x 3% = 3.6 lb; the volume of liquid latex polymer additive required per ton is 3.6 lb / (8 lb x 70% solids) lb/gal = 0.643 gallons per ton) The polymer modifier (latex) is injected into the mix at the time of manufacture. In a drum plant, the polymer is pumped into the asphalt binder through a spud welded to the asphalt binder line just prior to where it enters the drum. The constant rate at which the polymer is pumped is determined by the mix speed of the drum. In a batch plant, the amount of polymer per batch is determined by the size of the batch and is introduced as follows: A feed hose from the polymer pump is inserted into and above the mixer or pug mill and the polymer is pumped directly into the mix 5 seconds after the asphalt binder starts to dump into the pug mill. Mix time per batch after polymer is pumped in is 45 to 60 seconds. The manufacturer will have a professional representative available at the asphalt plant during the first day of mix production and placement, and as required thereafter by the Engineer. The manufacturer of the SBR latex shall provide certified test results for Styrene Butadiene ratio, total rubber solids percentage by weight, pH, ash content, and viscosity to the Engineer prior to mix production.

Mixing and Compaction Temperatures Based on Modified PG Grade

PG Grade	Mixing Temp	Compaction Temperature
76-22 or 76-28	330°-315°F	315°-300°F
70-22 or 70-28	315°-300°F	300°-285°F

3.2.3 Asphalt Binder Anti-Stripping Additive - This specification provides for an additive to asphalt to assist in the coating of wet aggregate and to increase the resistance of the binder coating to stripping in the presence of water. The additive shall be chemically inert to asphalt (heat stable) and when blended with asphalt shall withstand storage at a temperature of 400°F for extended periods without loss of effectiveness.

Composition: Anti-stripping compound shall be an organic chemical compound, free from inorganic mineral salts or inorganic mineral soaps. It shall contain no ingredient harmful to the binder material or to the operator and shall not appreciably alter the specified characteristics of the binder material.

Anti-stripping additive shall be incorporated and thoroughly dispersed in the asphalt binder material in an amount equal to the percent by weight established by the Job Mix Formula/Design Mix Formula. This percent is based on the efficiency of the additive as determined by laboratory tests. The treated composite mixture shall have a minimum tensile strength ratio (TSR) of not less than 80, when tested in accordance with AASHTO T 283 with the freeze/thaw cycle. The specimens for the AASHTO procedure shall be 4 inches in diameter compacted to the desired air void level of 7.0 $\pm$ 0.5%. If the TSR ratio is less than 80, the aggregates shall be treated with an approved antistrip in sufficient quantity to produce

acceptable results. The hot mix asphalt materials and asphalt binder material that require antistrip additives (either liquid or mineral) shall continue to meet all requirements specified herein for binder and HMA. The anti-strip agent shall be included in the bid price.

3.2.4 Tack Coat - Emulsified asphalt; AASHTO M 140/ASTM D997 or AASHTO M 208/ASTM D2397, RS-1 or CRS-1

3.3 Preliminary Material Acceptance

Prior to delivery of HMA materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials certified under the Contractor's quality control system:

3.3.1 Coarse Aggregate

A. Percent of wear
B. Soundness
C. Flat and elongated
D. Coarse aggregate angularity

3.3.2 Fine Aggregate

A. Liquid limit
B. Plastic index
C. Sand equivalent
D. Fine aggregate angularity

3.3.3 Mineral Filler

3.3.4 Performance Graded Asphalt Binder - The certification(s) shall show the appropriate AASHTO and/or ASTM test(s) for each material, the test results, and a signed statement that the material meets the specification requirement.

3.3.5 The Engineer may request samples for testing, including but not limited to, modifiers, truck coatings, and emulsion, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

4.0 COMPOSITION OF HMA MIXTURES

4.1 Hot Mix Asphalt

HMA plant mix may be composed of a homogeneous mixture of aggregate, filler if required, bitumen, and/or additives, combined to meet the composition limits by weight and other characteristics as specified. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of these specifications.

4.2 Hot Mix Asphalt Mix Design

The Contractor shall be responsible for the development of all Job Mix Formula/Design Mix Formulas. All Job Mix Formula/Design Mix Formulas other than for Surface Treatment and Base mix shall be based on Superpave method. Superpave mix designs may be utilized. Superpave mix designs shall be based on Asphalt Institute SP-2 and AASHTO M 323, AASHTO R 35, AASHTO R 30, AASHTO T 312, and the requirements contained herein. For the Superpave volumetric mix design, the mixture of asphalt and aggregate shall be oven aged at the mixture's specified compaction temperature in accordance with AASHTO R 30.

4.3 DESIGN MIX FORMULA/JOB MIX FORMULA (DMF/JMF)

Work shall not begin on any Boston project nor shall any mixture be accepted until the Contractor has submitted to the City an approved Job Mix Formula/Design Mix Formula. The City will require HMA producers to qualify their facilities, in accordance with the requirements of this specification, for use on City projects annually or as needed. HMA producers will be responsible for obtaining an approved DMF/JMF from the City. Producers wishing to supply mixture to any Boston project must have a current approved DMF/JMF signed by the Engineer. Producers must send a written request along with each DMF/JMF they wish to have approved to the City for review. The City will compare last season's DMF/JMF and quality assurance tests to determine the acceptability of the DMF/JMF submittal. The City will notify the producer in writing which mixtures are approved and which mixtures will require trials. A separate Job Mix Formula/Design Mix Formula shall be submitted and approved for each mixture prior to any work beginning on any Boston project.

4.3.1 DMF/JMF Submittal - The Job Mix Formula/Design Mix Formula shall establish the percentage of each additional aggregate required, a single percentage of aggregate passing each required sieve size, a single percentage and the grade of asphalt binder to be added, a single temperature at which the mixture is to be discharged from the plant, and the number of seconds for dry mixing time and the number of seconds for wet mixing time. The Job Mix Formula/Design Mix Formula shall also specify a single source or uniform blend of particular sources for fine aggregate, a single source for each nominal size of coarse aggregate, and a single source of supply for mineral filler and for asphalt.

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

A. Percent of each individual aggregate and passing each sieve size
B. Percent of asphalt binder
C. Performance grading test results and Material Certificate certifying the PG grade
D. Number of gyrations for the estimated design ESAL loading for Superpave
E. Mixing temperature
F. Compaction temperature
G. Temperature of mix when discharged from the mixer
H. Plot of the combined gradation on the Federal Highway Administration (FHWA) 0.45 power gradation curve
I. Densification curve for each asphalt content plotting density, %Gmm, versus the logarithm of the number of gyrations for Superpave design
J. Fine and Coarse aggregate angularity (Percent fractured faces)

K. Percent flat and elongated particles
L. Tensile Strength Ratio (TSR), ALL Superpave Courses
M. Antistrip agent – type and quantity
N. Sand equivalent value
O. Fine aggregate angularity value
P. Percentage of wear
Q. Sulfate soundness loss
R. Combined aggregate specific gravity
S. Dust to effective asphalt ratio
T. Graphical plot of air voids, voids in mineral aggregate (VMA), voids filled with asphalt (VFA). Graphical plot of density at $N_{initial}$, density at N_{design}, and density at $N_{maximum}$ versus asphalt content for Superpave design
U. Gradation, asphalt content, specific gravity, and moisture content of the RAP

The Contractor shall submit samples to the Engineer, upon request, for DMF/JMF verification testing.

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

4.3.2 DMF/JMF Tolerances - The Job Mix Formula/Design Mix Formula, operating within the allowable action limits for individual measurements as specified in Table 8 herein, shall be set within the design master limits specified for each mixture class in Table 6 except that the Engineer may modify the design limits if they determine this to be necessary and in the best interest of the Engineer.

4.3.3 Plant Trial Mixtures - After receiving the Job Mix Formula/Design Mix Formula prepared by the Contractor, the Engineer will notify the Contractor regarding a verification of the optimum asphalt content and/or pre-production trials and Control Section for those mixtures so designated by the Engineer. AASHTO T 195 (Ross Count) with a coating factor of 98% will be used when necessary to evaluate proper mixing time. The moisture content of all hot mix asphalt upon discharge from the mixer shall not exceed 0.5% when tested in accordance with AASHTO T 110 (Standard Method of Test for Moisture or Volatile Distillates in Hot-Mix Asphalt) or AASHTO T 329-05 (Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method). A minimum of one trial mix shall be produced at the Contractor's proposed asphalt binder content and aggregate gradation.

4.3.4 DMF/JMF Approval - The Contractor will be notified by the Engineer if the DMF/JMF submittals are approved for production. The approved DMF/JMF for the mixture shall be in effect until modified in writing. As indicated in Section 4.3.3, Plant Trial Mixtures, of this specification, the Engineer will notify the Contractor regarding the placement of a Control Section (See Section 5.0). Following placement and testing of the Control Section, the DMF/JMF may have to be modified to meet both production and placement requirements of this specification. If warranted, the DMF/JMF resubmittal shall follow the applicable requirements of Section 4.3 of this specification. A DMF/JMF, once approved, will not be required for further mix approval for the construction season unless a change has occurred that warrants a new DMF/JMF approval or as directed by the Engineer. The approval of all DMF/JMFs will terminate on December 31st each year, regardless of if the work is carried over to the following year. Control strips are required by the contractor for in-place mat thickness, uniformity, longitudinal joint characteristics, and density requirements before approval.

4.4 HMA Mixture Design Criteria

Table 3. Percent Voids in Mineral Aggregate (VMA)

Nominal Maximum Aggregate Size	Percent Minimum
No. 4 (4.75mm)	16
⅜ inch (9.5 mm)	15
½ inch (12.5 mm)	14
¾ inch (19.0 mm)	13
1 inch (25.0 mm)	12

4.4.1 Hamburg Wheel Tracking Device Test (HWTD) AASHTO T 324

Evaluate the moisture susceptibility of each mixture, testing in accordance with AASHTO T 324 “Hamburg Wheel Track Testing of Compacted Hot-Mix Asphalt. Mixtures Failing Moisture Susceptibility shall be repeated with Anti-Strip or Hydrated Lime additive.

A standard test length will be 20,000 passes of the loaded wheel. The data collected during the test will report rut depth versus number of wheel passes. The data analysis for this test will include the creep slope, SIP (stripping Infection point) and stripping slope.

Hamburg Wheel Tracking Device Test (HWTD) AASHTO T 324
Specification

Maximum Rut Depth @ 20,000 Passes	≤ 12.5 mm
Striping Infection Point (SIP)	≥ 15,000 Passes

Table 4. Consensus Properties of Combined Aggregate Structure for Superpave Mixtures.

Traffic Levels	Design ESALs (80 kN)	Coarse Aggregate Angularity (1) ASTM D5821		Fine Aggregate Angularity (1) AASHTO T 304		Flat and Elongated Particles ASTM D4791	Sand Equivalent AASHTO T 176
	(million)	(Depth from final surface) ≤ 100 mm	(Depth from final surface) > 100 mm	(Depth from final surface) ≤ 100 mm	(Depth from final surface) > 100 mm	> 9.5 mm	- - - - -
1	< 0.3	55/- -	- -/- -	- -	40	- - -	40
2	0.3 to < 3.0	75/- -	50/- -	40	40	10	40
3	3.0 to < 30.0	95/90(2)	80/75(2)	45	40	10	45
4	≥ 30.0	100/100	100/100	45	45	10	50
	Design ESALs are the anticipated project traffic level expected on the design lane, projected over a 20-year period, regardless of the actual expected design life of the roadway.	Criteria presented as minimum values. 95/90 denotes that a minimum of 95% of the coarse aggregate, by mass, shall have one fractured face and that a minimum of 90% shall have two fractured faces.		Criteria presented as minimum percent air voids in loosely compacted fine aggregate passing the 2.36 mm sieve.		Criteria presented as maximum Percent by mass of flat and elongated particles of materials retained on the 4.75 mm sieve, determined at 5:1 ratio. Not applicable for the 4.75 mm Nominal Max Aggregate size mix	Criteria presented as minimum values for fine aggregate passing the 4.75 mm sieve.

Note 1: If less than 25 % of a given layer is within 100 mm of the anticipated top surface, the layer may be considered to be below 100 mm for mixture design purposes.
Note 2: For Superpave mixtures with design ESALs between **3.0 and 10.0 million**, the coarse aggregate angularity criteria shall be **85/80** for layers < 100 mm depth from final surface and a criterion of **60/- -** for layers >100 mm from final surface.

Table 5. Hot Mix Asphalt and Volumetric Properties for Superpave Mixtures.

Traffic Levels	Design ESALs (million)	Number of Gyrations by Superpave Gyratory Compactor			Percent Density of Gmm from HMA specimen			Voids Filled with Asphalt (VFA) Based on Nominal mix size					
		Nini	Ndes	Nmax	Nini	Ndes	Nmax	4.75 mm	9.5 mm	12.5 mm	19.0 mm	25.0 mm	37.5 mm
1	< 0.3	6	50	75	≤ 91.5	95 - 97	≤ 98	70 – 80	70 - 80	70 - 80	70 - 80	67 – 80	64 – 80
2	0.3 to < 3.0	7	75	115	≤ 90.5	95 - 97	≤ 98	65 – 78	65 - 78	65 - 78	65 - 78	65 - 78	64 - 78
3	3.0 to < 30	8	100	160	≤ 89.0	95 - 97	≤ 98	75 – 78	73 - 76	65 - 75	65 - 75	65 - 75	64 - 75
4	≥ 30	9	125	205	≤ 89.0	95 - 97	≤ 98	75 - 78	73 - 76	65 - 75	65 - 75	65 - 75	64 - 75

Table 6. Superpave Hot Mix Asphalt Mixtures
Percent by Weight Passing Sieves

Sieve Size in. (mm)	4.75mm (Item 455.215) Control Points		9.5mm (Item 455.225) Control Points		9.5mm(b) (Item 455.225) Control Points		12.5mm (Item 455.235) Control Points		19.0mm (Item 455.325) Control Points		25.0mm (Item 455.415) Control Points		37.5mm (Item 455.425) Control Points	
	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %
2 (50)											-	-	100	
1 ½ (37.5)	-	-	-	-	-	-	-	-	-	-	100	-	90	100
1 (25.4)	-	-	-	-	-	-	-	-	100	-	90	100	-	90
¾ (19)	-	-	-	-	-	-	100	-	90	100	-	90	-	-
½ (12.5)	100	-	100	-	-	-	90	100	-	90	-	-	-	-
⅜ (9.5)	95	100	90	100	80	100	-	90	-	-	-	-	-	-
#4 (4.75)	90	100	-	90	50	76	-	-	-	-	-	-	-	-
#8 (2.36)	-	-	32	67	37	54	28	58	23	49	19	45	15	41
#16 (1.18)	30	60	-	-	26	40	-	-	-	-	-	-	-	-
#30 (0.600)	-	-	-	-	17	31	-	-	-	-	-	-	-	-
#50 (0.300)	-	-	-	-	10	23	-	-	-	-	-	-	-	-
#100 (0.150)	-	-	-	-	6	16	-	-	-	-	-	-	-	-
#200 (0.075)	6	12	2	10	2	7	2	10	2	8	1	7	0	6
Notes					*50 to 75 Gyrations to meet Voids Spec. [4]:									
Dust to Binder Ratio [3]:	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

Note 3: The Engineer may increase the Dust to binder ratio from 0.6-1.2 to 0.8-1.6 if the proposed aggregate gradation passes beneath the Primary Control Sieve (PCS) control point established in AASHTO M 323.
Note 4: The contractor may submit a 50 to 75 gyration LTMF design to meet the air void requirements specified herein.

Table 7. Marshall Design Master Range Tolerances

Sieve Size in. (mm)	Base Course (Item 460.5)	Dense Binder Course (Item 460.65)	Modified Top Course (Item 460.9)	Top Course (Item 460.7)	Top Course Dense Mix (Item 460.95)	Surface Treatment (Item 460.8)	Ultra-Thin Surface [c]
2 (50)	100						
1 ½ (37.5)							
1 (25.4)	57 – 87	100					
¾ (19)		80 – 100	100				
½ (12.5)	40 – 65	65 – 80	90 – 100	100	100		100
⅜ (9.5)			70 – 90	80 – 100	80 – 100	100	90 – 100
#4 (4.75)	20 – 45	48 – 65	45 – 70	50 – 76	55 – 80	80 – 100	55 – 85
#8 (2.36)	15 – 33	37 – 51	28 – 55	37 – 54	48 – 63	64 – 5	32 – 47
#16 (1.18)			18 – 40	26 – 40	36 – 49	46 – 68	18 – 31
#30 (0.600)	8 – 17	17 – 30	10 – 30	17 – 31	24 – 38	26 – 50	11 – 22
#50 (0.300)	4 – 12	10 – 22	6 – 23	10 – 23	14 – 27	13 – 31	7 – 18
#100 (0.150)			4 – 15	6 – 16	6 – 18	7 – 17	4 – 12
#200 (0.075)	0 – 4	0 – 6	2 – 7	2 – 7	4 – 8	3 – 8	3 – 10
Asphalt Content	4.0 – 5.0	5.0 – 6.0	5.0 – 7.0	5.5 – 7.0	7.0 – 8.0 [a]	7.0 – 8.0	6.5 – 8.0 [b]
Temp. Mix (°F)	255 – 295	265 – 325	265 – 325	265 – 325	265 – 325	275 – 325	330 – 360
Temp. Mix (°C)	124 – 146	129 – 163	129 – 163	129 – 163	129 – 163	135 – 163	166 – 182
Marshall Blows	N/A	50	75	50	50	N/A	50
Stability, lbs. min		1000	1500	1000	1000		1800
Stability, Newtons		4500	6750	4500	4500		8000
Flow,0.01” (.25mm)		8 – 16	8 – 16	8 – 16	8 – 16		8 – 16
Air Voids, %		3 – 6	3 – 5	3 – 6	3 – 6		3 – 5

Note a: Dense mix including approved anti-stripping compound shall be furnished and used for protective (bottom) courses of pavement on bridges, and elsewhere shown on the plans.
Note b: The total asphalt content in this mixture shall contain 5% ± 0.5% of rubber solids.
Note c: The aggregates used for the production of the Ultra-Thin Surface will contain all crushed aggregates, natural sand is not allowed.
The asphalt content of all mixtures shall be calculated on the percentage basis by weight of the total mix.

4.5 Additional HMA Criteria – In addition to the above HMA design requirements, the HMA mixtures shall also conform to the following:

A. Stripping: Each surface course mixture shall be evaluated for stripping by performing indirect tensile tests on compacted mixtures. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by AASHTO T 283 with freeze/thaw, is less than 80, the aggregates shall be rejected, or the asphalt treated with an approved anti-stripping agent. The amount of anti-stripping agent added to the asphalt shall be sufficient to produce a TSR of not less than 80. If an antistrip agent is required, it will be provided by the Contractor at no additional cost.

B. Aggregate Composition: The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 6when tested in accordance with AASHTO T 27 and AASHTO T 11. The gradations in Table 6, represent the limits which shall determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the DMF/JMF) and blended, shall have a gradation within the limits designated in either Table 6, whichever is applicable, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

C. DMF/JMF Deviations: Deviations from the final approved mix design for asphalt binder content and gradation of aggregates shall be within the action limits for individual measurements as specified in Table 8. The limits still will apply if they fall outside the master grading band in Table 6.

D. Minimum Lift Thickness Consideration: The maximum size aggregate used shall not be more than one-half of the compacted thickness of the course being constructed on a prepared surface or that which can be placed to achieve specification requirements. The maximum size is defined as one sieve size larger than the nominal maximum size. The nominal maximum size is defined as one sieve size larger that the first sieve to cumulatively retain more than 10%.

E. HMA may be stored in surge or storage bins provided that the mixture used from the bins is of a uniform quality and meets all the specification requirements of Section 6.1.1-M, and the recovered asphalt from the mix samples obtained 30 days after production shall meet the following requirements:

Recovered Asphalt
ASTM D1856
Abson Method

Test Property	Min.	Max.
Viscosity, poises @ 140°F		6000
Penetration, dmm @ 77°F	45	
Ductility, cm @ 77°F	75	

5.0 HMA CONTROL SECTION.

Prior to full production, for the City, the Contractor shall place a quantity of hot mix asphalt according to the DMF/JMF and the project specifications. The amount of mixture should be sufficient, at a minimum, to construct a test section 300-feet long and 20 to 30 feet wide placed in two lanes, with a longitudinal joint, and shall be of the same depth specified for the construction of the course which it represents. The underlying grade or pavement structure upon which the Control Section is to be constructed shall be the same as the remainder of that project course represented by the Control Section. The equipment used in construction of the Control section shall be the same type and weight to be used on the remainder of the course represented by the Control Section. The control strip may be as large as one production day on a City street as long as a longitudinal joint has been constructed.

Two random sample(s) shall be taken at the plant by the Engineer and tested for air voids in accordance with the Section 8.1, Plant-Produced Material. One random sample of mixture shall be taken at the plant and tested for aggregate gradation and asphalt binder content in accordance with the Section 8.1, Plant-Produced Material.

Three randomly selected cores shall be taken from the finished pavement mat in the Control Section, and three from the longitudinal joint, and tested in accordance with Section 8.2, Field Placed HMA Material. Random sampling shall be in accordance with procedures contained in ASTM D3665.

Mat density and air voids shall be evaluated in accordance with Section 8.2, Field Placed HMA Material.

The performance control strip shall be considered acceptable if the uniformity, thickness, longitudinal joint density and mat density, and plant air voids, are within the requirements of this specification.

If the initial Control section should prove to be unacceptable, the necessary adjustments to the DMF/JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second Control section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional Control sections, as required, shall be constructed, and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable section has been constructed and accepted by the Engineer. The initial Control section, whether acceptable or unacceptable, and any subsequent section that meets specification requirements shall be paid for in accordance with the Section 10.0, PAYMENT.

DMF/JMF quality control testing is to be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the DMF/JMF. It should be recognized that the aggregates produced by the plant might not satisfy the gradation requirements or produce a mix that exactly meets the DMF/JMF. In those instances, it will be necessary to re-evaluate and re-design the mix using plant-produced aggregates. Specimens should be prepared, and the optimum asphalt binder content determined in the same manner as for the original design tests. A revised DMF/JMF will need to be submitted and a test section constructed prior to approval and full production. The test section and

DMF/JMF submittal shall conform to all the specification requirements contained herein.

6.0 EQUIPMENT

6.1 Hot Mix Asphalt Mixing Plant

If the supplier is equipped with an automated plant, the automation feature shall be used in the production of HMA for the project. If the supplier is equipped with a recordation feature, it also shall be used. Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier. The storage yard shall be neat and orderly, and separated stockpiles shall be readily accessible for sampling.

The plant shall be equipped in such a manner to divert new aggregate, asphalt binder, mineral filler, and/or modifiers to facilitate an accurate method of calibration. The dryer-drum plant shall be equipped with a surge bin of a minimum capacity of 50 tons. Separate bins or compartments shall be provided for each size group of aggregate and separated reclaimed pavement material. Preloading of the reclaimed material bins shall be avoided to prevent unnecessary congealing and bridging. The Contractor is to use his best judgment on the use of a bin vibrator, air or mechanical impact equipment for the reclaimed material bin(s).

Plants used for the preparation of HMA mixtures shall conform to all requirements under 6.1.1, except that scale requirements shall apply only when weight proportioning is used. In addition, batch mixing plants shall conform to the requirements under 6.1.2, and drum mixers shall conform to the requirements under 6.1.3.

6.1.1 Requirements for All Plants

A. Plant Access - Mixing plant shall be of sufficient capacity to adequately handle the proposed HMA construction. The Engineer shall have access at all times to all areas of the yard, laboratory, and plant, for checking adequacy of equipment, inspecting operations of the plant, verifying weights, proportions, material properties and checking the temperatures maintained in the preparation of the mixtures.

B. Plant scales - Scales for measuring materials into the mixtures shall be springless dial or digital type and shall be of standard make and design. Scale graduations and markings shall be plainly visible, and dials must be so located as to be easily readable from the operator's normal workstation by direct sight, through repeating dials or digital displays. Parallax effects shall be reduced to the practical minimum with clearance between indicator index and scale graduations not exceeding 0.06 inches. Dials shall be equipped with a full complement of adjustable index pointers for marking the required mass of each material to be weighed into the batch.
Digital scales will be either electronic/mechanical (load cell and lever system) or fully electronic (all load cell). Digital indicators shall be of standard make and design. Scale graduations and capacity shall be plainly visible on the faceplate of the indicator, of panel mounted. If the unit is of desktop or wall-mounted variety, a data sticker shall be located on the side of the unit. Indicators must be located as to be easily readable from the operator's normal workstation by direct sight.

Binder scales shall be accurate to 0.05%, have minimum graduations not greater than 0.025%, and must be readable and sensitive to 0.0125% or less. Scales for any box or hopper shall be accurate to 0.5%, have minimum graduations not greater than 0.5% and must be readable and sensitive to 0.25% or less. The preceding percentages for both binder and aggregate scales are to be based on the maximum total batch mass of the mixtures.

Truck Scales: Truck scales shall be located on the plant property and shall be within a reasonable walking distance for the plant inspectors. Scales shall be accurate to within ± 0.5%.

Testing of Scales:

1. All plant scales, including truck scales, shall be tested at the expense of the Contractor by a competent scale technician as follows:

    a. Annual prior to use in Engineer's work
    b. At intervals of not more than 90 calendar days
    c. At any time ordered by the Engineer.

2. Where appropriate and at the direction of the Engineer, an approved cradle or platform for each scale and at least ten standard 50-pound test masses shall be provided for testing scales whenever directed by the Engineer. The use of a set of test masses for two or more plants will be permitted only when they can be made easily available with no more than one hour's notice.

C. Automatic Proportioning - All mixing plants furnishing hot mix asphalt mixture shall be equipped with approved automatic proportioning devices. Such devices shall include equipment for accurately proportioning batches containing the various components of the mixture by weight in the proper sequence and for controlling the sequence and timing of mixing operations. Interlocks shall be provided which will hold or delay the automatic batch cycling whenever the batched quantity of any component is not within the specified weight tolerance, when any aggregate bin becomes empty or when there is a malfunction in any proportion of the control system. The weight setting and time controls shall be so equipped that they may be locked when directed by the Engineer.

D. Automatic Recordation - Recordation Equipment shall be provided in all plants providing hot mix asphalt under these provisions. Each recorder shall include an automatic printer system. The printer shall be positioned so that the scale dial and the printer can be readily observed at one location by the plant inspector. Use of the repeating dials or an additional printer to achieve this condition will be permitted. The printer will print, in digital form, on a delivery ticket the data specified below:

1. Date mixed
2. Time of batching
3. Tare mass of aggregate box
4. Tare mass of binder bucket

5. Accumulative or net masses as batched for each bin with a batch total for all net ingredients.
6. Mass of binder
7. Latex Additive by weight (when applicable)
8. Total mass of mix in truck

This printed ticket will be used in lieu of truck scale masses.

E. Equipment for Preparation of Bituminous Material - Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. Heating shall be accomplished by approved means so that flames will not contact the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provision shall be made for measuring quantities and for sampling the material in the storage tanks. The temperature of the bituminous materials when placed in the cold mixer shall be not less than 275°F (135°C) or more than 375°F (190°C), as directed. Cutback binders will require lower temperature requirements; check these carefully for safety considerations.

F. Cold feeders - The plant shall be provided with accurate mechanical or electrical means for uniformly feeding the aggregates into the drier to obtain uniform production and temperature. When added mineral filler is specified, a separate bin and feeder shall be furnished with its drive interlocked with the aggregate feeders.

G. Drier - The plant shall include a drier(s) which continuously agitates the aggregate during the heating and drying process.

H. Screens - Plant screens, capable of screening all aggregates to the, specified sizes and proportions and having normal capacities in excess- of the full capacity of the mixer, shall be provided.

I. Bins - The plant shall include storage bins of sufficient capacity to supply a mixer operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. When used, separate dry storage shall be provided for filler or hydrated lime, and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes of such size and at such location to prevent backup of material into the compartments or bins. Each compartment shall be provided with its individual outlet gate to prevent leakage. The gates shall cut off quickly and completely. Bins shall be constructed so that samples may be obtained readily. Bins shall be equipped with adequate tell-tale devices which indicate the position of the aggregates in the bins at the lower quarter points.

J. Bituminous Control Unit - Satisfactory means, either by weighing or metering, shall be provided to obtain the specified amount of bituminous material in the mix. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

K. Thermometric Equipment - An armored thermometer of adequate range shall be placed in the bituminous feed line at a suitable location near the charging valve of the mixer unit. The plant shall also be equipped with an approved thermometric instrument placed at the discharge chute of the heated aggregates. The Engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregate.

L. Dust Collector - The plant shall be equipped with a dust collector to waste any excess material collected or to return any part of the material uniformly to the mixture as directed by the mixture design.

M. Temporary Storage of HMA Mixture - Use of surge bins or storage bias for temporary storage of hot mix asphalt will be permitted as follows:

1. The hot mix asphalt mixture may be stored in surge bins for a period of time not to exceed three hours.
2. The hot mix asphalt mixture may be stored in insulated and heated storage bins for a period of time not to exceed 12 hours, provided an inert gas atmosphere is maintained in the bin during the storage period.
3. If the Engineer determines that there is an excessive amount of heat loss, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

N. Truck Scales - Unless an automatic batching plant with automatic printers is used, the HMA mixture shall be weighed on approved scales furnished by the Contractor or on public scales at the Contractor's expense. Scales shall be inspected for accuracy and sealed as often as the state deems necessary.

O. Safety Requirements - Adequate and safe stairways to mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Means shall be provided to raise and lower scale calibration equipment, sampling equipment and other similar equipment between the ground and the mixer platform. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free of drippings from the mixing platform.

P. Sampling Platform - A safe and adequate platform or catwalk with stairway and railing shall be provided to accommodate the inspector while checking temperatures and obtaining samples of the mixture from haul vehicles. The height of the platforms and raised platforms shall be adequate to accommodate safe acquisition of mix samples from the type of hauling unit(s) being utilized on the project.

Q. Testing Laboratory - The Contractor or producer shall provide a testing laboratory at the production plant for quality control and quality acceptance functions during periods of mix production, sampling, and testing, and whenever materials subject

to the provisions of these specifications are being supplied or tested. The laboratory shall contain adequate equipment, space, and utilities as required for the performance of the specified tests.

It shall be available for joint use by the Contractor for quality control testing, if applicable, and by the Engineer for acceptance testing. And must have adequate equipment for the performance of the tests required by these specifications and the requirements of NETTCP. The Engineer shall have priority in use of the equipment necessary for acceptance testing. All the necessary testing equipment shall be located at the HMA plant supplying material to the project. In addition, all ancillary and miscellaneous equipment needed to perform the testing in accordance with these specifications shall be provided by the Contractor at no additional cost.

The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70°F $\pm$ 5°F.

The plant laboratory shall further contain and be kept supplied with the following laboratory equipment:

Balance: 20,000gm capacity minimum, sensitivity 0.1gm.

Marshall Equipment - Automatic hot mix asphalt compactor mounted in accordance with ASTM D1559 and conforming to specifications for AASHTO T 245 which consists of totally enclosed, rigidly mounted operated frame, a standard circular foot compaction hammer assembly designed to ensure an 18-inch drop regardless of specimen height, a ⅓-horsepower motor with belt guard and controls, an automatic counter that shuts off the power after the set number of hammer drops, and a standard compaction pedestal with guide pins for centering one standard (4-inch diameter) HMA mold at a time. The Contractor shall also provide 2 stability compaction molds conforming to ASTM D1559 and suitable for use with the automatic HMA compactor.

NOTE: The Soil Test Model AP 800 automatic HMA compactor and AP 166 stability compaction molds have been found suitable.

Superpave Gyratory Compactor (For plants supplying materials contained in Table 6) conforming to the requirements of AASHTO R 30, AASHTO R 35, AASHTO M 323, AASHTO T 312 and the Asphalt Institute Manual SP-2.

Bulk specific gravity determination equipment (AASHTO T 166), and theoretical maximum specific gravity equipment (AASHTO T 209).

Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor’s laboratory facility and witness quality control activities, if applicable. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting test results, the incorporation of the

materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

6.1.2 Requirements for Batching Plants

A. Weigh Box or Hopper - The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material can leak into the mixer while a batch is being weighed.

B. Bituminous Control - The bituminous material bucket shall be of a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than ¾ the length of the mixer and it shall discharge directly into the mixer. The bituminous material bucket, its discharge valve (s), and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained, and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least 15% more than the weight of bituminous material required in any batch. The plant shall have an adequately heated, quick-acting, non-drip charging valve located directly over the bituminous material bucket.

   The indicator dial shall have a capacity of at least 15% more than the quantity of bituminous material used per batch. The controls shall be constructed to lock at any dial setting and automatically reset to that reading after each additional batch of bituminous material. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled to begin when the dry mixing period is over. All the bituminous material required for one batch shall be discharged in not more than 15 seconds after the flow has begun. The size and spacing of the spray-bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and the spray bar shall have a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

C. Mixer - The batch mixer shall be an approved type capable of producing a uniform mixture within the job mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The clearance of blades from all fixed and moving parts shall not exceed 1 inch.

D. Control of Mixing Time - The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh-box gate after the charging of the mixer and keep it locked until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh-box gate and the introduction of bituminous material. The wet mixing period is the interval of time between the introduction of bituminous material and the opening of the mixer gate.

The timing control shall be flexible and shall be capable of settings of 5-second intervals or less throughout a 3-minute cycle. A mechanical batch counter shall be installed as part of the timing device and shall be designed to register only completely mixed batches.

6.1.3 Requirements for Drum Mixers

A. Exclusions - Sections 6.1.1-G through 6.1.1-K do not apply to drum mixers.

B. Aggregate Delivery System - An automatic plant shutoff shall be provided to operate when any aggregate bin becomes empty. Provisions shall be provided for conveniently sampling the full flow of materials from each cold feed and the total cold feed. Total cold feed shall be weighed continuously. The weighing system shall have an accuracy of 0.5% when tested for accuracy. The plant shall provide positive weight control of the cold aggregate feed by use of a belt scale, or other appropriate device, which will automatically regulate the feed gate and permit instant correction of variations in load. The cold feed flow shall be automatically coupled with the asphalt flow to maintain the required proportions of each material. Provisions shall be made for introducing the moisture content of the cold feed aggregates into the belt weighing signal and correcting wet aggregate weight to dry aggregate weight. Screens or other suitable devices which will reject oversize particles or lumps of aggregate that have been cemented together shall be installed in the feeder mechanism between the bins and the dryer drum.

   Dry weight of the aggregate flow shall be displayed digitally in appropriate units of weight and time and totalized.

C. Bituminous Material and Additive Delivery Systems - Satisfactory means of metering shall be provided to introduce the proper amount of bituminous material and additives into the mix. Delivery systems shall prove accurate to plus or minus 1% when tested for accuracy. The bituminous material and additive delivery shall be interlocked with the aggregate weight. The bituminous material and additive flow shall be displayed digitally in appropriate units of volume (or weight) and time shall be totalized.

D. Thermometric Equipment - A recording thermometer of adequate range shall be located to indicate the temperature of the bituminous material in storage. The plant shall also be equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the drum mixer.

E. Drum Mixer - A drum mixer of satisfactory design shall be provided. It shall be capable of drying and heating the aggregate to the moisture and temperature requirements set forth in the paving mixture requirements and capable of producing a uniform mixture.

6.2 Hauling Equipment

Trucks used for hauling hot mix asphalt mixtures shall have tight, clean smooth metal beds which have previously been cleaned of all foreign material. To prevent the mixture from adhering to them, the beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, soluble oils, or other approved material. When coating is applied, truck bodies shall be raised immediately prior to loading to remove any excess coating material in the truck bed. Containment of the excess anti-adhesive material may be required for environmental concerns depending on the type of anti-adhesive agent used. Each truck shall have a securely fastened, both front and rear, waterproof cover to protect the mixture at all times. When necessary, so that the mixture will be delivered to the site at the specified temperature within 25°F of the approved DMF/JMF, truck beds shall be insulated.

6.3 Pavers

Pavers shall be self-contained, heated, power-propelled units with an activated screed or strike-off assembly, and shall be capable of spreading and finishing courses of hot mix asphalt material which will meet the specified thickness, smoothness, and grade. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of hot mix asphalt material in widths shown on the plans.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the mixture.

The paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture.

The paver shall be equipped with hoppers and distributing screws of the reversing type to place the mixer evenly in front of adjustable screeds. They shall be equipped with a quick and efficient steering device and shall have reverse as well as forward traveling speeds.

The paver shall employ mechanical devices such as equalizing runners, straight edge runners, evener arms or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. They shall be capable of spreading the mixture without segregation in layers to the depths and widths required. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between adjacent strips or courses of the same thickness.

The paver screed may be equipped with a Longitudinal Notched - Wedge Joint paver attachment or Straight Wedge Joint paver attachment and screed mounted roller attachment. When placing HMA pavement courses at a thickness of 1.5 inches or greater, the notched wedge is recommended; when placing HMA pavement courses less than 1.5 inches, the straight wedge is recommended. The notched wedge joint includes a variable notched vertical edge (the notch vertical height to be equal to the mixture's maximum aggregate size). The sloped surface of the diagonal wedge joint shall not exceed a 6:1 slope.

The screed shall be adjustable for profile and shall have an indicating level attached.

An approved device will be required for heating the screed to the temperature required for the laying of the mixtures without pulling or marring.

The term "screed" includes any device operated by cutting, crowding, or other practicable action, which is effective on the mixtures at permissible workable temperatures without tearing, shoving, or gouging and which produces a finished surface of the evenness and texture required.

The pavers employed on projects requiring more than 15,000 tons shall operate by the use of a sensing grid for operation to a stringline, and a matching shoe for joints. For greater than 15,000-ton municipal roadway projects, an automatic grade control device shall be used. The paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within ± 0.1%.

The controls shall be capable of working in conjunction with any of the following attachments:

A. Ski-type device of not less than 30 feet in length
B. Taut stringline (wire) set to grade
C. Short ski or shoe
D. Laser control
E. Sonic control

The paver employed on deep-lift construction shall be capable of satisfactorily feeding the mix without intermittent stopping during the discharge of the mix from the trucks into the paving machine.

6.4 Rollers

Rollers of the vibratory, steel wheel, oscillatory, and pneumatic-tired type may be used. They shall be in good condition, capable of reversing direction without backlash, and operating at slow speeds to avoid displacement of the hot mix asphalt. Static rollers shall be operated at speeds not to exceed 3 mph and vibratory rollers shall be operated at a minimum of 10 to 12 impacts/ft in vibratory mode. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

The use of equipment which causes excessive crushing of the aggregate or that which does not produce a smooth, dense, and uniform HMA mat will not be permitted.

The Contractor shall exercise great caution when using vibratory rollers so as not to cause damage to buried infrastructure or adjacent infrastructure. Damage to buried or adjacent infrastructure will be the responsibility of the Contractor. The new Oscillation type rollers are acceptable for use for intermediate compaction and back rolling of HMA in Boston.

The Contractor is encouraged, when applicable; to use a pneumatic square edge-tired compaction roller (either one or both axles) as another acceptable alternate for the Intermediate and Final rolling of hot mix in Boston.

7.0 HMA CONSTRUCTION

7.1 Weather Limitations

The hot mix asphalt shall not be placed when weather conditions of fog or rain prevail or when the pavement surface or base shows signs of free moisture (film of water). When the surface temperature of the underlying course is less than 50°F the Contractor shall determine the time available for compaction. The time available for compaction shall be calculated based on the time, date, air temperature, average wind speed, sky conditions, latitude, mix type, PG grade, lift thickness, mix delivery temperature, existing surface type, existing moisture content of surface, existing state of moisture in surface, and surface temperature. The estimated time available for compaction can be calculated with computer programs, e.g., Pave Cool Tool 2.2.

This program is available at the following web location:
http://www.dot.state.ia.us/construction/hot_mix_asphalt.htm
The information regarding the air temperature, average wind speed, sky conditions, mix delivery temperature, and existing moisture conditions shall be evaluated by the Engineer and a Contractor's representative located at the paving operation. The estimated time available for compaction shall be provided by the Contractor to the Engineer. The Engineer and the Contractor shall determine if there is an adequate amount of time available to compact the mixture. Options can be explored to extend the time available for compaction. If there is an adequate amount of time available to compact the mixture, the temperature requirements may be waived by the Engineer; however, all other requirements including compaction shall be met. The Contractor assumes responsibility for constructing the pavement to meet compaction and specification requirements.

The Engineer will not permit work to continue when overtaken by sudden storms until the pavement surface shows no signs of free moisture. The material in transit at the time of shutdown will not be placed until the pavement surface shows no signs of free moisture, provided the mixture is within temperature limits as specified.

The construction of hot mix asphalt concrete pavements shall terminate on November 15 and shall not be resumed prior to April 1 except as determined and directed in writing by the Engineer.

7.2 Thermometer

The Contractor will supply an approved dial type thermometer with a temperature range of 50°F to 500°F (10°C to 260°C) and an infrared pistol thermometer for each paving machine in operation during HMA placement on the project. The infrared pistol thermometer shall be Fahrenheit or Celsius selectable and conform to the following requirements:

- Portable and battery operated
- Accuracy of ± 2%

- Repeatability of ± 5°F (± 3°C)
- Emissivity preset at 0.95
- LCD Display to nearest 1°F (1°C)
- Temperature operating range of -4°F to 752°F (-20° to 400°C)

The thermometers will remain the property of the Contractor upon completion of the project.

7.3 Pre-Paving Conference

Prior to the placing of any HMA, a pre-paving conference shall be held to discuss and approve the paving schedule, source of HMA, Job Mix Formula/Design Mix Formula approvals, type and amount of equipment to be used, sequence of paving pattern, rate of HMA supply, all sampling, testing and reporting procedures to be used, traffic control, safety, and general continuity of the operation. Engineer's representatives, Contractor's plant, quality control and field representatives and Engineer's testing and inspection agents shall attend this meeting. All equipment used shall be approved on the project site prior to starting up each day.

7.4 Preparation of the Underlying Surface

Immediately before placing the hot mix asphalt, the underlying course shall be thoroughly cleaned of all dust and debris by a self-propelled sweeper. Areas inaccessible by power sweepers shall be broom swept until the pavement surface is clean. Extra care shall be required during fall leaf fall.

Proof roll prepared base material surface, if applicable, to identify areas requiring removal and re-compaction, and to provide a uniform degree of compaction over the entire pavement area.

Do not begin paving work until deficient base material areas and utility trenches have been corrected and are ready to receive paving. Paving shall not be applied until the Engineer inspects and approves the finished base.

When an existing surface or new base upon which the bottom course is to be placed contains unsatisfactory irregularities, in the Engineer's judgment, such irregularities may be eliminated by an adequate placing and compaction of HMA mixture to furnish a surface with true contour and grade before placing any specified course of mixture.

Check all frames, covers, grates, water valve boxes and other miscellaneous castings that are located in the proposed pavement areas to ensure that all have been correctly positioned and set to the proper slope and elevation. All covers and grates shall be set flush with the required finished surface. No depressions or mounds will be permitted in the pavement to accommodate inaccuracies in the setting of castings.

The Contractor shall furnish, set, and maintain all line and grade stakes necessary to guide the automated grade control equipment. Where required these control stakes shall be maintained by the Contractor and used throughout the operations, from the grading of the subbase material up to and including the final layers of the pavement.

Adequate artificial lighting shall be provided during night placements. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to an internal temperature of 140°F minimum.

Proper precautions shall be taken to prevent damage by construction operations to edges adjacent to the hot mix asphalt. These edges may be, but are not limited to, gutters, catch basins, curbs, concrete structures, and hot mix asphalt concrete. If damage occurs, repairs shall be made to the satisfaction of the Engineer with no additional payment.

7.5 Utility Trenches

Utility trenches that are the result of construction under this contract, including water trenches, trenches for electrical conduit, and trenches for catch basin and drop inlet connections, shall be repaired with Superpave intermediate course in the following manner:

Upon the properly prepared subbase shall be laid Superpave intermediate course which after spreading and rolling shall be 5-inches thick (minimum). The Superpave intermediate course shall be laid in two courses, with a maximum depth of 2 ½ inches for any one course, and each course is to be thoroughly compacted by a power roller weighing not less than 5 tons. Where space does not permit the use of a roller, each course shall be thoroughly tamped or otherwise compacted by a method approved by the Engineer. The binder course shall be flush with adjacent pavement on streets that are to be resurfaced.

On streets where no resurfacing is scheduled the Superpave intermediate course shall be 2 inches below and parallel to the finished surface. The vertical surfaces of the existing pavement shall be painted with bitumen, and after the Superpave top course has been spread it shall be thoroughly compressed with a power tandem roller of not less than 10 tons. Along curbs and similar structures and all places not accessible to a 10-ton roller, the mixture shall be compacted with tampers and hand rollers.

For repair of utility trenches existing prior to construction under this contract, see the specification for Item 472.5, Utility Trench Repair in the Special Provisions.

7.6 Tack Coat

Contact surfaces of manholes, structures, vertical pavement edges, etc. shall be painted with a thin, uniform tack coat just before the material is placed against them.

Tack coat is required on all surfaces to be paved; this includes leveling, base, or intermediate layers of HMA, unless the underlying HMA layer was placed during the same day. Particular attention should be made during the application that the longitudinal joint areas be treated with no bare spots. Missing areas on the longitudinal joint area will require either re-application or localized hand work application as directed by the Engineer.

Tack coat shall be applied at a residual binder amount on the pavement between 0.03 to 0.05 gallons per square yard. Use the lower application amount between new lifts and the higher application rate on milled or Portland cement surfaces. This amounts to a very thin application that needs to be carefully applied. Massachusetts uses RS-1 and CRS-1 type asphalt emulsions for tack coating. These can be applied, as an emulsion, between

approximately 0.05 to 0.08 gallons per square yard. Tack coat shall be supplied as part of the HMA operation.

Allow tack coat to dry from a brown color to a black color prior to paving.

7.7 HMA Production

The aggregates and the asphalt binder material shall be weighed or metered and introduced into the mixer in the amount specified by the DMF/JMF and within the allowable action limits as stated in Table 8 (HMA Production Limits for Individual Measurements). These limits shall be applied to the target values established in the DMF/JMF. Corrective action shall be taken by the Contractor when the calculated individual result for gradation or asphalt content falls outside the target DMF/JMF value beyond the action limit listed in Table 8 (HMA Production Limits for Individual Measurements). The Contractor shall take the appropriate action when results indicate the material is out of tolerance. The Contractor shall be required to suspend production when the calculated individual result for gradation falls outside the target DMF/JMF value beyond the suspension limit listed in Table 8, or when the asphalt binder content is below the minimum values stated in Table 6 (HAM Superpave Hot Mix Asphalt Mixtures), whichever is applicable. The Contractor shall be required to suspend production if two points in a row fall outside the Action Limits for individual measurements or if three nonconsecutive samples fall outside the Action limits. The Contractor shall be required to suspend production if one point falls outside the Suspension Limits for individual measurements. The Contractor shall also be required to suspend production if one point falls outside the Suspension Limits for range listed in Table 9 (Control Chart Limits Based on Range).

7.7.1 Plant Trials - If production is suspended, the production facility shall be required to produce material on a trial basis for testing purposes without shipment to the project. No payment will be made for material and labor employed for nonconforming plant trials. The Engineer or his representative shall pay for acceptance sampling and testing for the first set of trials necessary to determine conformance with the specification requirements. If the first set of trials does not conform to specification requirements, the Contractor shall pay for any additional trial sampling and testing for acceptance. When trials have been approved, the plant will return to its normal operation.

The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer.

The temperature of the mixture shall be in accordance with the Performance Graded Asphalt Binder (PGAB) allowable mixing and compaction temperature range. The temperature of the mixture when discharged from the mixer or silo shall be $\pm$ 20°F from the value stated in the DMF/JMF. Mixtures exceeding these limits shall be subject to rejection.

Failure to stop production and make adjustments when required due to an individual test(s) not meeting the specified requirements may subject all of the mix from the stop point to be considered unacceptable.

RAP Verification – The City of Boston will allow the use of a maximum of 10% RAP in the wearing surfaces and a maximum of 20% in the intermediate and base courses of the HMA.

The City will randomly test HMA mixtures from the production plant or storage silos to determine the quality of the PG binder. For non-modified binder mixtures, the absolute viscosity of the recovered asphalt shall be no greater than 6,000 poises at 140°F. If the absolute viscosity is greater than 6,000 poises, then a full PG binder test verification will be run for conformance to the PG grade specified. For modified asphalt binder mixtures, a full PG binder test verification will be run for conformance to the PG grade specified. Failure of the PGAB to conform to specification requirements may be cause for rejection of the Lot. Further PGAB tests may be conducted on previous Lots; all costs for the PGAB tests will be the responsibility of the Producer if the results do not meet specifications for PG 64-28 or PG 64-22 recently placed.

7.8 Transporting, Placing and Finishing

HMA deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver.

Upon arrival, the mixture shall be placed to the full width by a hot mix asphalt paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the hot mix asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet except where edge lanes require less width to complete the area. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one foot, however, the joint in the top layer shall be at the centerline of the pavement. Transverse joints in one layer shall be offset by at least 2 feet from transverse joints in the previous layer. The placement of the material along the longitudinal joint may be performed by setting the screed to overlap the first mat. The elevation of the screed above the surface of the first mat should be equal to the amount of roll-down expected during compaction of the new mat. The overlapped material shall be bumped by the lutes, if necessary, to optimize the density along the longitudinal joint. Under no circumstances should the overlapped material be broadcast across the mat. Excess material should be removed by hand. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools. When hand spreading is permitted, the mixture shall be distributed into place by means of hot shovels and spread with lutes in a loose layer of uniform density and correct depth. The use of rakes to spread the hot mix asphalt shall not be permitted. Loads shall not be dumped any faster than they can be properly handled by the shovelers and the shovelers shall not distribute the dumped load any faster than it can properly be handled by the luters. The luting shall be carefully and skillfully done to avoid segregation and so that, after the first passage of the roller over the luted mixture, no back patching will be necessary. Compaction must immediately follow hand spreading such that specification density is achieved while the

mixture temperature is above the manufacturers recommended compaction temperature for the performance graded binder.

The mixtures shall be placed and compacted only at such times as to permit the proper inspection and checking by the Engineer.

The mixtures shall only be placed in the work when they can be efficiently and satisfactorily placed, compacted, smoothed, and made uniform in accordance with these specifications. Unless otherwise permitted by the Engineer for special particular conditions, only machine methods of placing shall be used.

No mixture shall be placed unless the breakdown, and intermediate rolling can be completed by the time the material has cooled to 150°F, or that minimum compaction temperature specified by the binder manufacturer and provided that the density and uniformity of the completed pavement attains specification compliance.

No traffic of any kind shall be permitted on the HMA intermediate or HMA base when dirt or any other foreign substance may be tracked thereon.

Immediately after any course is screeded and before roller compaction is started, the surface shall be checked, any irregularities adjusted, any accumulation from the screed removed by rake or lute, and all fat spots in any course removed and replaced with satisfactory materials. Irregularities in alignment and grade along outside edges shall be corrected by the addition or removal of mixture before the edges are rolled. Indiscriminate casting of mix on the new screeded surface, where irregularities are not evident, shall not be permitted.

All hot mix shall be placed and compacted in such a manner as to ensure a continuous bond between the tacked hot mix pavement surfaces and obtain the required density.

7.8.1 Second Control Strip Requirement - If it is determined, during the performance of the contract, that the pavement does not conform to the surface tolerance, density and uniformity requirements, the Engineer may order the Contractor to cease all operations and construct an HMA Control Section consisting of a sufficient quantity of surface course mixture. The Contractor shall construct a control section as directed by the Engineer either: a minimum of 100 feet long by 12 feet wide, or a minimum of 50 feet long by a minimum of 24 feet wide depending upon the problem. A control section may be required each time a change is made in the Job Mix Formula/Design Mix Formula, sources of supply or paving and rolling equipment.

The mixture shall be prepared, placed, and compacted in accordance with this specification. When the control section pavement has cooled sufficiently, a total of 6 samples of the finished pavement shall be taken and tested in accordance with the requirements of Section 5.0, HMA Control Section.

If the tests by the Engineer indicate that pavement does not conform to specification requirements, necessary adjustment to plant operation and placement/rolling procedures shall be made.

Where the average density of the core samples does not conform to specification requirements, the pavement shall be removed at no cost to the Engineer. No payment will be made for material and labor employed, either in placement or removal of the nonconforming control section.

The second control strip may be removed at the direction and at no cost to the Engineer if the test result of any one mat core density falls below 90% of theoretical maximum laboratory density and/or any one longitudinal joint density falls below 88% of theoretical maximum laboratory density.

The Contractor shall not be permitted to place surface course pavement until a control section is approved by the Engineer.

7.9 Joints

The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade. When abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure.

7.9.1 Transverse Joints - The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course, in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical face. In both methods, all contact surfaces shall be given tack a coat of bituminous material before placing any fresh mixture against the joint.

7.9.2 Longitudinal Joints - All longitudinal joints shall be constructed with the first paver pass in a neat straight line. Deviation from trueness will negate the ability to form a properly compacted longitudinal joint.

The paver screed may be equipped with a Longitudinal Notched - Wedge Joint or Straight Wedge Joint paver attachment and screed mounted roller attachment when placing HMA pavement courses. Use the Notched Wedge Joint for thicknesses of 1.5 inches or greater and use the Straight Wedge Joint for thicknesses less than 1.5 inches. The notched wedge joint shall include a variable notched vertical edge (the notch vertical height to be equal to the mixture's maximum aggregate size). The sloped surface of the diagonal wedge joint shall not exceed a 6:1 slope. Prior to placing the adjacent paver pass, all joint contact surfaces shall be given a tack coat of approved bituminous material prior to placing any fresh mixture against the joint.

Vertical butt joints which are not constructed straight, are not constructed with an edge restraining device (either a commercial paver screed attachment or by dropping the end gate down to the surface) or are damaged (or otherwise defective) shall be cut back 3 inches to expose a clean, sound surface for the full depth of the course and all contact surfaces shall be given a tack coat of approved bituminous material prior to placing any fresh mixture against the joint.

7.9.3 Longitudinal and Transverse Joints - Longitudinal and transverse joints shall have an in-place density when measured by the average of three 6-inch cores of between 90% to 98% of maximum theoretical.

7.10 Compaction of HMA Mixture After Placing

The mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. Rolling shall be initiated with the drive roll or wheel towards the paving machine. When rolling on steep grades, the previous procedure may need to be altered.

The speed of the roller shall, at all times, be sufficiently slow and of uniform speed to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring because of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. The number of rollers and passes required shall be governed by the compaction results; however, at least two, rollers shall be provided for each paver employed on the paving operation. Boston is encouraging the use of pneumatic or oscillation rollers. If one of the selected rollers is pneumatic, it shall be equipped with the European square edge tires. This will allow the pneumatic roller to handle both the intermediate compaction as well as the back-rolling responsibilities on two-roller trains. An alternate to a full pneumatic European tired roller would be a combination 10-ton steel vibratory with large pneumatic square edge rear wheels. An acceptable alternative to the vibratory or pneumatic tired rollers would be the “Hamm” Oscillatory roller (HAMM Compaction Division, Antioch, TN 37013; 615-501-0600). Each roller shall be operated by a competent, experienced roller operator and shall be kept in as nearly continuous operation as practicable while work is underway. A plate shall be attached to each roller showing the ballasted and unballasted weight per length-width of tread.

To prevent adhesion of the mixture to the steel roller, the drums or shall be kept properly moistened, cocoa mats kept clean and scrapers used, but excessive water will not be permitted. Pneumatic rollers shall be operated on adjacent pavement surfaces to get the tires warm to hot from friction, then moved to the fresh mat.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers and vibratory plate compactors.

Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor’s expense. Skin patching shall not be allowed.

Along any adjoining edge such as curb, gutter or an adjoining pavement, and after the HMA is placed by the paver, just enough of the hot HMA shall be placed by hand method to fill any

space left open. These joints shall be properly 'set up' with the back of a lute at the proper height and level to receive the maximum compaction. Any areas where the rollers cannot access shall be hand tamped or plate compacted.

7.10.1 Shaping Edges - While the surface is being compacted and finished, the Contractor shall carefully trim the outside edges of the pavement to the proper alignment. Edges so formed shall be beveled while still hot with the back of a lute or smoothing iron and thoroughly compacted by tampers or by other satisfactory methods.

7.11 Surface Smoothness

The finished surfaces of the pavement shall be uniform in appearance, free from irregularities in contour and texture and shall present a smooth-riding surface. Smoothness evaluation applies to all hot mix asphalt concrete roadways receiving 1.5 inches or more in plan (compacted) thickness of HMA pavement.

Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.

The finished surface of the pavement, when measured with a 10-foot straightedge, shall not vary more than ¼ inch for the surface course and ⅜ inch for the intermediate course measured perpendicular and parallel to the centerline. If, in the opinion of the Engineer, the surface visually appears wavy, but meets the surface tolerance test with the 10-foot straightedge, the Engineer reserves the right to additionally test with the use of Inertial Profile Equipment which records cumulative vertical deviations per unit length using a statistic called International Roughness Index (IRI). Boston street upset limit is set at 135 in/mile using similar equipment that MHD specifies in their Quality Assurance HMA projects.

After the completion of final rolling, the smoothness of the course shall again be tested; humps or depressions exceeding the specified tolerances shall be immediately corrected by removing the defective work and replacing with new material, as directed by the Engineer. This shall be done at the Contractor's expense.

Skin patching will not be permitted.

When profile corrections are required, the Contractor shall use one or more of the following corrective methods:

A. Removing and replacing the entire pavement thickness;
B. Diamond grinding or micro milling;
C. Overlaying (not patching) with the specified surface course;
D. Removing the surface by milling and applying a lift(s) of the specified course(s);
E. Use of other methods that will provide the desired results;

The corrective method(s) chosen by the Contractor shall be performed at the Contractor's expense, including all necessary equipment and traffic control. Areas of removal and replacement shall be removed the full width of the lane. The removal areas shall begin and

end with a transverse butt joint which shall be constructed with a transverse saw cut perpendicular to the centerline. Replacement materials shall be placed in sufficient quantity, so the finished surface will conform to grade and smoothness requirements. The corrective area shall conform to all material and density specification requirements. When the corrective work consists of an overlay, the overlay shall cover the full width of the pavement including shoulders. The area overlaid shall begin and end with a transverse butt joint which shall be constructed with a transverse saw cut and asphalt removal. All materials shall meet contract requirements. The overlay shall be placed so the finished surface will conform to grade and smoothness requirements. The overlaid area shall be compacted to the specified density.

The Engineer shall retest any sections where corrections were made to verify that the corrections produced a surface that conforms to the grade and smoothness requirements

7.12 Uniformity

The HMA mat shall be smooth, dense, and uniform. Uniformity is generally affected by Thermal and/or Aggregate segregation.

If segregation is evident and discernable by either the Contractor or the Engineer, the Contractor shall immediately cease production and take steps to correct and eliminate the cause(s) of the segregation to the satisfaction of the Engineer.

The Contractor shall review all potential causes of segregation as it relates to its operation, including but not limited to HMA Plant issues, loading and transportation issues, placement issues, thermal segregation, and hand work. The Contractor shall employ additional investigation methods and make the necessary changes in their operation such that segregation is eliminated, and mat uniformity is acceptable.

7.13 Thickness

The thickness requirements contained herein shall apply only when each pavement layer is specified to be a uniform compacted thickness of 1 inch or greater. Thickness shall be evaluated for acceptance by the Engineer to the requirements shown on the plans. Measurements of thickness may be checked periodically by the Contractor in following their QC system for field operations. Measurements of thickness for acceptance shall be made by the Engineer using 4-inch minimum diameter pavement cores removed also for subsequent density measurement.

The finished surfaces of each HMA pavement course shall not vary from that specified or cross sections shown on the contract drawings by more than ¼ inch. The Contractor shall correct pavement areas varying more than this amount by removing and replacing the defective work or as ordered by the Engineer. Skin patching will not be permitted.

7.14 Grade

The finished surface of the pavement shall not vary from the gradeline elevations as shown on the plans by more than ½ inch. The Contractor shall remove deficient areas and replace with new material. Sufficient material shall be removed to allow at least 1 ½ inches of hot

mix asphalt to be placed. Skin patching for correcting low areas shall not be permitted. High points may be ground off.

7.15 Leveling Course

Any HMA used for truing and leveling shall meet the requirements of the mix design methods and the requirements of Tables 5 and 6 for the applicable mixtures. Leveling courses shall not be subject to density requirements. The thickness of the Leveling Course shall be measured off the interface with the existing milled or un-milled pavement surface. The leveling course shall be compacted with the same effort used to achieve placement and density of the test section. The truing and leveling course shall not exceed a nominal thickness of 1.5 inches.

7.16 Opening to Traffic

No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to an internal temperature of 140°F or less. If the climatic or other conditions warrant, or if the PGAB manufacturer recommends, the period of time before opening to traffic may be extended at the discretion of the Engineer.

7.17 Contractor Quality Control of HMA Pavement

7.17.1 General

Contractor Quality Control shall be required as indicated. The Contractor assumes the responsibility of the quality for all materials and construction incorporated into the work and will control all the processes leading to the final result through this function. The QC system addresses all elements which affect the quality of the pavement including, but not limited to:

A. Mix Design
B. Aggregate Grading
C. Quality of Materials
D. Stockpile Management
E. Proportioning
F. Mixing and Transportation
G. Placing and Finishing
H. Joints
I. Compaction
J. Surface smoothness and uniformity
K. Thickness and grade

The Contractor shall be prepared to discuss and present, at the pre-paving conference, their understanding of quality control for this contract.

7.17.2 Control Charts

Contractor may develop production control charts and post for visual reference in the testing laboratory. The control charts should identify the project number, the contract item number,

the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the production test results. If the project data during production indicates a problem and the Contractor is not taking satisfactory corrective action, then the Engineer may suspend production or acceptance of the material, in accordance with these specifications.

A. Individual Measurements. Control charts for individual measurements may be established to indicate production quality control within given tolerances for aggregate gradation and asphalt binder content. The control charts will use the DMF/JMF target values as the indicator of central tendency for the following test parameters with associated Action and Suspension Limits:

Table 8. HMA Production Limits for Individual Measurements

Sieve Size	Action	Suspension
1 inch (25.4 mm)	0%	0%
¾ inch (19.0 mm)	±6%	±9%
½ inch (12.5 mm)	±6%	±9%
⅜ inch (9.5 mm)	±6%	±9%
No. (4.75 mm)	±6%	±9%
No. 8 (2.36 mm)	±5%	±7.5%
No. 16 (1.18 mm)	±5%	±7.5%
No. 30 (0.600 mm)	±4%	±5.5
No. 50 (0.300 mm)	±3%	±4.5
No. 100 (0.150 mm)	±3%	±4.5
No. 200 (0.075 mm)	±2%	±3%
Asphalt Binder Content	±0.4%	±0.70%

When 1-inch maximum size aggregate is specified, the 1½-inch sieves should be deleted from the Individual Measurements Chart and the 1-inch sieve Action and Suspension Limits should be changed to 0%. When ¾-inch (19.0mm) maximum size aggregate is specified, the 1-inch sieves should be deleted from the Individual Measurements Chart and the ¾-inch sieve Action and Suspension Limits should be changed to 0%. When ½-inch maximum size aggregate is specified, the ¾-inch sieves should be deleted from the Individual Measurements Chart and the ½-inch sieve Action and Suspension Limits should be changed to 0%. When ⅜-inch maximum size aggregate is specified, the ½-inch sieves should be deleted from the Individual Measurements Chart and the ⅜-inch sieve Action and Suspension Limits should be changed to 0%.

B. Range. Control charts for range may be established to indicate production variability for the test parameters and Suspension Limits listed below. The range may be computed as the difference between the high and low test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. If more than two tests per lot were used, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Table 9. Control Chart Limits Based on Range (Based on n = 2)

Sieve Size	Suspension Limit
1 ½ inch (38.1 mm)	11 %
1 inch (25.4 mm)	11 %
¾ inch (19.0 mm)	11 %
½ inch (12.5 mm)	11 %
⅜ inch (9.5 mm)	11 %
No. 4 (4.75 mm)	11 %
No. 8 (2.36 mm)	10 %
No. 16 (1.18 mm)	9 %
No. 50 (0.30 mm)	6 %
No. 200 (0.075 mm)	3.5 %
Asphalt Binder Content	0.8 %

C. Corrective Action. The Contractor should review the control charts on a continuous basis making adjustments to the process when necessary to keep the product consistent. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

1. One point falls outside the Suspension Limit line for individual measurements or range; or
2. Two points in a row fall outside the Action Limit line for individual measurements.
3. Three nonconsecutive samples fall outside the Action Limit line for individual measurements.

D. RAP Production. The Contractor is required to determine the moisture content of the RAP at a minimum twice daily – once prior to daily production and halfway through daily production. The moisture content shall be determined in accordance with AASHTO T 255 Total Evaporable Moisture Content of Aggregate by Drying. The moisture contents shall be recorded in a log book kept in the laboratory.

E. Coefficient of Variability of RAP. The Contractor shall develop and maintain production control charts for the RAP on the days of production for the City as a minimum. The control chart shall include the asphalt content and gradation of the material for each sample obtained and tested and shall be posted in the laboratory. The Contractor shall take one stockpile sample of RAP for every 500 tons of HMA Top produced with RAP and take one stockpile sample of RAP if the gradation or asphalt content of the HMA (Engineer's Quality Assurance Sample or Quality Control sample) falls outside of the suspension limits in Table 8. The RAP gradation and asphalt content information shall be updated on the control chart before the end of each production day. Failure to update the control chart may result in suspension of the material until the updates are complete.

The coefficient of variability shall be calculated after each test on the RAP for all of the sieves as well as the asphalt content. The coefficient of variability shall be calculated using the following formula:

CV = ((average) / (standard deviation)) x 100

When the coefficient of variability on any sieve greater than and including the No. 16 sieve is greater than 20% the production of the RAP material shall be suspended. When the coefficient of variability on any sieve smaller than the No. 16 and/or the asphalt content is greater than 15% the production of the RAP material shall be suspended. The Contractor may resume production when the variability is within specification requirements or the Contractor may revise the DMF/JMF to reduce the percentage of RAP.

RECLAIMED ASPHALT PAVEMENT (RAP) TESTING REQUIREMENTS

RAP must be processed prior to use in hot mix applications. RAP processing will consist of a crusher run screened material. RAP will be produced such that the material is coarse to permit control over input to the hot mix plant and better control of the mix design.

The Hot Mix Asphalt Producer Quality Control shall provide the following as part of their internal Quality Control.

Reclaimed Asphalt Pavement Testing Requirements

Property	Frequency (Prior to Start of Production)	Minimum Frequency (Prior to Start of Production)
Moisture Content	2 per 1000 tons of production	once prior to daily production and halfway through daily production
Gradation (Sieve Analysis)	2 per 1000 tons of production	one per day of production
Binder Content (Liquid Asphalt)	2 per 1000 tons of production	one per day of production

Properties of Reclaimed Asphalt Pavement

Minus 0.075 mm (No. 200 sieve)	<12%
Moisture Content	<7%

8.0 QUALITY ACCEPTANCE OF HMA

Acceptance testing requirements are the responsibility of the Engineer.

All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor, unless otherwise stated herein. Testing organizations performing these tests shall meet the requirements of ASTM D3666. All equipment in Contractor furnished laboratories shall be calibrated and verified by a testing organization prior to the start of operations. Such verification/certification shall be furnished to the Engineer prior to production. Engineer's testing personnel shall be certified by the New England Transportation Technician Certification Program (NETTCP). This function does not relieve the Contractor from performing their daily quality control tasks as part of their normal operating business.

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

A. Inspection of the condition and operations of the yard, plant and laboratory.
B. Confirmation of the adequacy of equipment in use.
C. Verification of the character and proportions of the mixture.
D. Determination of temperatures being maintained in the preparation of the mixtures.
E. Inspection of incidental related procedures.

Samples of all material including compacted specimens and certified copies of all reports and printouts shall be made available to the Engineer or its agent as often as requested including: asphalt binder; virgin aggregates; RAP, modifiers, loose and compacted mixture specimens; and combined aggregate samples.

8.1 Plant-Produced Material

Plant-produced material shall be sampled and tested for VMA, gradation, asphalt binder content, and air voids (Superpave at N_{design}), on a lot basis. The Engineer's testing personnel shall be certified by the New England Transportation Technician Certification Program (NETTCP), as HMA Plant Technicians. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. A lot will consist of one day's production

Where more than one plant are simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

8.1.1 Sampling

Sufficient material for analysis and preparation of test specimens will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Other methods can be used to randomly determine the location of Field Samples, including the use of a random number generator function on a hand-held calculator or laptop computer. Each Agency will specify whether this approach is acceptable as an alternate to ASTM D3665. A hand-held calculator or ASTM D3665 will be acceptable for this work.

A minimum of one set of laboratory compacted specimens will be prepared for each lot in accordance with AASHTO T 312, at the number of gyrations required by Table 5 herein (for Superpave only), or in accordance with Marshall design criteria, Table 7. Each set of laboratory compacted specimens will consist of two test portions prepared from the same field sample.

The sample of hot mix asphalt may be put in a covered metal tin and placed in an oven for not more than 30 minutes to maintain the heat. The compaction temperature of the specimens should be as specified in the DMF/JMF.

In addition to the hot mix asphalt samples, the Contractor shall take one, one-quart sample of the PG binder used to produce the hot mix asphalt at the start of the work. The PG sample shall be turned over to the Engineer on the first day of project production.

8.1.2 Testing

A. Bulk Specific Gravity - Sample specimens shall be tested for bulk specific gravity in accordance with AASHTO T 166 or AASHTO T 275 whichever is applicable, for use in computing air voids and density. Air voids shall be computed in accordance with AASHTO T 269.

B. Gradation and Asphalt Binder Content - The gradation and asphalt binder content of the mixture shall be measured for each lot in accordance with the following:

1. Asphalt Binder Content - A minimum of 3 extraction tests shall be performed in accordance with AASHTO T 164 or AASHTO T 308 for determination of asphalt content. The weight of ash portion of the extraction test, as described in AASHTO T 164, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture. If utilizing AASHTO T 308 for asphalt content determination, the calibration process and calibration factor, as described in AASHTO T 308, shall be determined as stated, prior to acceptance testing. A verification shall be performed as part of every twentieth test performed thereafter or when changes in the mix are apparent.

   The use of the nuclear method for determining asphalt content in accordance with AASHTO T 287 is permitted, provided that it is calibrated for the specific mix being used.

2. Gradation - Aggregate gradations shall be determined from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and AASHTO T 27 (Dry Sieve). When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants and tested in accordance with AASHTO T 27 (dry sieve) using actual batch weights to determine the combined aggregate gradation of the mixture.

C. The Dust-to-Effective Asphalt ratio shall be determined once for each sublot from the mechanical analysis of extracted aggregate and the asphalt binder content. The Dust-to-Effective Asphalt ratio shall be determined by the Engineer in accordance with AASHTO PP 28-02.

D. The Theoretical Maximum Specific Gravity of the mixture shall be measured for each lot in accordance with AASHTO T 209, Type C, D, or E container. Samples shall be taken on a random basis in accordance with ASTM D3665. The value used in the field placed void computations shall be the average of the maximum specific gravity measurements for the street paved.

E. Temperatures. Temperatures shall be checked, at least three times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the mixture at the plant, and the mixture at the job site.

F. VMA and air voids, for each plant field sample, will be determined by the Engineer in accordance with the applicable AASHTO test method. The VMA, and air voids for each lot shall be computed by averaging the results of the two test specimens representing that lot.

8.1.3 Acceptance of Plant Produced HMA

Acceptance of plant produced HMA material will be based upon plant air voids, VMA, gradation, asphalt binder content, and temperature, and shall be determined by the Engineer in accordance with these specifications.

A. RAP produced mixtures. To estimate the percentage of RAP incorporated in to the mixture, binder and recovered binder testing may be completed. The contractor shall provide 2 one-quart containers of the PG 64-28 or PG 64-22 being incorporated in to the material. Random samples of the RAP shall be obtained, and the binder recovered through AASHTO T 319 (Rotovap) or AASHTO T 170 (Abson). Sufficient material from the RAP produced mixture shall be obtained and the binder recovered through AASHTO T 319 (Rotovap) or AASHTO T 170 (Abson). The frequency of testing will be determined by the Engineer. Material indicating the presence of excess RAP shall be subject to reduced payment or rejection. If requested, the Contractor shall be allowed one retest on the placed material, all costs for retesting shall be at the Contractor's expense.

B. RAP Percentage Verification. The performance of the RAP produced material will be compared to the performance of the virgin material through the Dynamic Modulus and Flow Number test, AASHTO TP 79. Three specimens of RAP mix and three specimens of virgin mix will be compacted in the gyratory compactor to a height of 170mm $\pm$ 5.0mm. Target air void contents will be set at 7.5 $\pm$ 0.5% for the compacted specimens. Due to the construction schedule, samples will not need to be fabricated on the same day and specimens may represent different days of production. The stiffness of the materials will be evaluated, and the virgin material shall be within 15% of the RAP mixture.

8.2 Field Placed HMA Material

HMA material placed in the field shall be tested for both joint and mat density on a completed street or public facility basis. The Engineer may conduct any necessary testing to monitor that the specified density, uniformity and smoothness is being achieved. A properly correlated nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

8.2.1 Sampling

Samples shall be neatly cut with a core drill. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be 4 inches. The minimum diameter of the base samples shall be 6 inches. Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The Engineer or the Owner's agent shall furnish all tools, labor, and materials for cutting samples and filling the cored pavement.

Pavement cores will be taken upon project street/public facility completion to determine the average percent density. Cores will be taken randomly by the Engineer based on five cores for mat density and three cores for longitudinal joint density per 1000 tons of material placed. A minimum of five core samples for mat and three core samples for joint density will be removed from each street. The average density of the core samples will be used to determine the density of the street. The removal and patching of cores shall be paid for by the Engineer. Cored holes shall be filled in a manner acceptable to the Engineer and within one day after sampling. Resampling of pavement shall be in accordance with applicable provisions of the NETTCP Quality Assurance Technologist Manual, latest edition.

8.2.2 Testing

The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with AASHTO T 166 or AASHTO T 275, whichever is applicable. The theoretical maximum specific gravity shall be the average maximum specific gravity for the street in accordance with the plant-produced material section. The theoretical value used for the percent density of the core samples shall be the average of the measurements for maximum specific gravity for the street. The percent density of each sample will be determined in accordance with AASHTO T 269, using the bulk specific gravity of each sample and the average theoretical maximum specific gravity. Retesting of pavement shall be in accordance with applicable provisions of the NETTCP Quality Assurance Technologist Manual, latest edition.

A. Mat Density. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Cores shall not be taken closer than 1 foot from a longitudinal joint and 10 feet from a transverse joint.

B. Joint Density. Three 6-inch diameter cores of finished longitudinal joint, will be taken by the Engineer or the Engineer's representative from each street or public facility. Core locations will be determined by the Engineer on a random basis over the joint, not adjacent to the joint.

8.2.3 Adjustment Pay Schedule for Mat Density

The pay factor based on the density adjustment schedule will be applied to the bid price per ton for compacted mixtures greater than or equal to 1½-inch thickness as shown in the contract award.

Table 10. Hot Mix Asphalt Mat Density Adjustment Schedule

Avg. Percent of Maximum Density (minimum 5 samples)	Percent Payment
100.0 - 98.1	98
98.0 - 95.0	102
94.9 - 92.0	100
91.9 - 89.0	90
88.9 - 87.0	75
86.9 or less	50% or rejection

8.2.4 Adjustment Pay Schedule for Longitudinal Joint Density

The pay factor based on the joint density adjustment schedule will be applied to the bid price per ton for compacted mixtures greater than or equal to 1½-inch thickness as shown in the contract award.

Table 11. Hot Mix Asphalt Longitudinal-Joint Density Adjustment Schedule

Average Percent of Maximum Density (minimum 3 samples)	Percent Payment
100.0 - 98.1	98
98.0 – 95.0	102
94.9 – 90.0	100
89.9 - 89.0	90
88.9 - 88.0	80
87.9 - 87.0	70
86.9 or less	50% or rejection

The total hot mix asphalt adjustment will be based on the weighted sum as follows:

.60 Mat Adjustment + .40 LJ Adjustment = Total HMA Adjustment

When the construction of the pavement does not include the construction of a longitudinal joint, the payment adjustment will be based on Table 10 only, no weighted sum will be calculated. Any bonus will be credited against any payment adjustment in the contract for HMA, but in no case will the payment for HMA exceed 100%.

8.2.5 Rejection of Inferior HMA

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of hot mix asphalt which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. Similarly, the Engineer may at any time, notwithstanding field acceptance for mat density, reject and require the Contractor to correct any HMA pavement that was placed with unacceptable mat uniformity or paving joints due to low density, segregation, improper elevation, or tearing. In the event of such rejection, the Contractor and Engineer may take random split samples of the area(s) in question in the presence of the Engineer, and if it can demonstrate in the laboratory, in the presence of the Engineer, that such material/pavement was erroneously rejected, payment will be made for the material at the contract unit price.

8.3 Rounding

Numbers used in all calculations shall be carried to the correct significant figures and rounded according to AASHTO R 11 Rounding Method. For example:

A. When the first digit after those you want to drop is 4 or less, that digit and all others to the right are dropped. Ex. 62.9437 to 3 significant digits = 62.9

B. When the first digit after those you want to retain is 5 or greater, that and all others

to the right are dropped and the last digit retained is increased by one. Ex. 1.955234 to 3 significant digits = 1.96.

C. All Intermediate calculations should not be rounded and shall be reported to two more significant figures than the least number of significant figures in the data values.

D. Test Standards and technical look-up tables serve as first priority over the AASHTO standard rounding rules.

9.0 MEASUREMENT

9.1 Method of Measurement

The quantity of hot mix asphalt to be paid for will be measured by the ton complete in place. The quantity of each truck load shall be obtained from printed tickets indicating the recorded batch weights or certified truck scale weights that have been properly countersigned by an authorized representative of the Engineer at the time of delivery. HMA quantities shall be verified by the Engineer using HMA yield calculations which will include the in-place bulk specific gravity and actual area and nominal depth for the mixture placed.

10.0 PAYMENT

10.1 Basis of Payment

Payment will be made at the contract unit prices per ton with any applicable adjustments. This payment shall be full compensation for furnishing and placing all quality hot mix asphalt materials, including tack coat where specified, cutting of keyways or milling/stripping of pavement to produce neat joints, mechanical sweeping of streets and for all labor, tools, equipment, materials, and all incidentals necessary to complete the work.

10.2 Adjustment for Density

Adjustment for mat and joint density shall be made when the HMA material varies from the specification target limits but is within the tolerances stated in Sections 8.2.3 “Adjustment Pay Schedule for Mat Density” and 8.2.4 "Adjustment Pay Schedule for Longitudinal Joint Density", respectively. The material will be allowed to remain in place with the specified adjustment in payment with the exception of mixtures placed with a mat density below 86.9% of maximum. Any bonus (102% payment for 95% to 98% density) will be credited against any payment adjustments in the contract for HMA, but in no case will the Payment for HMA exceed 100%.

11.0 TESTING REQUIREMENTS

Testing requirements shall adhere to the following standards:

AASHTO T 2 Sampling of Aggregates

AASHTO T 11 Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO M 17 Mineral Filler for Bituminous Paving Mixtures

AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates

AASHTO T 30 Mechanical Analysis of Extracted Aggregate

AASHTO T 89 Determining the Liquid Limit of Soils

AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils

AASHTO T 96 Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

AASHTO T 104 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T 110 Moisture or Volatile Distillates in Hot Mix Asphalt

AASHTO T 127 Sampling and the Amount of Testing of Hydraulic Cement

AASHTO T 164 Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt

AASHTO T 166 Bulk Specific Gravity of Compacted Hot Mix Asphalt Mixtures Using Saturated Surface-Dry Specimens

AASHTO T 170 Recovery of Asphalt from Solution by Abson Method

AASHTO T 176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

AASHTO T 195 Determining Degree of Particle Coating of Asphalt Mixtures

AASHTO T 202 Viscosity of Asphalts by Vacuum Capillary Viscometer

AASHTO T 209 Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)

AASHTO T 240 Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)

AASHTO T 255 Total Moisture Content of Aggregate by Drying

AASHTO T 269 Percent Air Voids in Compacted Dense and Open Asphalt Mixtures

AASHTO T 275 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

AASHTO T 283 Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture Induced Damage

AASHTO T 287 Asphalt Cement Content of Asphalt Concrete Mixtures by the Nuclear Method

AASHTO T 304 Uncompacted Void Content of Fine Aggregate

AASHTO T 308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

ASTM D2950 Density of Bituminous Concrete in Place by Nuclear Method

ASTM D3665 Random Sampling of Paving Materials

ASTM D3666 Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

ASTM D4791 Flat or Elongated Particles in Coarse Aggregate

ASTM D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate

ASTM E178 Practice for Dealing with Outlying Observations

The Asphalt Institute's Mix Design Methods for Asphalt Concrete Manual No. 2 (MS-2)

ADDITIONAL REQUIREMENTS

AASHTO M 140 Emulsified Asphalt

AASHTO M 208 Cationic Emulsified Asphalt

AASHTO M 320 Standard Specification for Performance Graded Asphalt Binder

AASHTO M 323 Standard Specification for Superpave Volumetric Mix Design

AASHTO R 26 Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders

AASHTO R 29 Grading or Verifying the Performance Grade of an Asphalt Binder

AASHTO R 30 Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)

AASHTO R 35 Standard Practice for Superpave Volumetric Design of Hot Mix Asphalt (HMA)

AASHTO T 312 Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor

AASHTO T 315 Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

AASHTO T 316 Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

AASHTO TP 79 Determining the Dynamic Modulus and Flow Number for Hot Mix Asphalt (HMA) Using the Asphalt Mixture Performance Tester (AMPT)

11.1 Method of Test for Bulk Specific Gravity of Aggregate Blends With RAP

Scope

This test method covers the procedure to determine the bulk specific gravity (Gsb) of a combined aggregate blend with RAP used in a HMA mixture.

This test method may involve hazardous materials, operations, and equipment. This test method does not purport to address all of the safety problems associated with the test method's use. The test method user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Referenced Documents

AASHTO Standards:
AASHTO T 2 Sampling Aggregates
AASHTO T 84 Specific Gravity and Absorption of Fine Aggregates
AASHTO T 85 Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 100 Specific Gravity of Soils
AASHTO T 164 Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
AASHTO T 170 Recovery of Asphalt from Solution by Abson Method
AASHTO T 209 Maximum Specific Gravity of Hot Mix Asphalt Mixtures
AASHTO T 228 Specific Gravity of Semi-Solid Bituminous Materials (Pycnometer Method)

Other References:
MS-2 Mix Design Methods for Asphalt Concrete by the Asphalt Institute

Terminology

Terms and Abbreviations. Definitions for terms and abbreviations shall be in accordance with the Standard Specifications.

Significance and Use

This test method is used to determine the bulk specific gravity of a combined aggregate blend with RAP used in HMA mixture.

The bulk specific gravity (Gsb) of a combined aggregate blend is calculated using an estimate of the bulk specific gravity of the aggregate in the RAP and the actual bulk specific gravity of the other aggregates.

The bulk specific gravity of an aggregate blend is used to perform a volumetric analysis on compacted HMA in accordance with the Mix Design Methods for Asphalt Concrete by the Asphalt Institute.

Apparatus

Apparatus shall be as stated in the referenced test methods.

Sampling

Sampling shall be as stated in the referenced test methods.

Procedure

Identify the coarse aggregate(s), fine aggregate(s) and RAP selected for use in the mix designs.

Identify and record the actual percentages for each of the aggregate components used in the combined aggregate blend of the mix design.

Obtain a representative sample of the coarse aggregate, fine aggregate mineral filler and RAP in accordance with the AASHTO procedures.

Determine and record the bulk specific gravity of each of the coarse aggregate(s) in accordance with AASHTO T 85.

Determine and record the bulk specific gravity of each of the fine aggregate(s) in accordance with AASHTO T 84.

Determine and record the maximum specific gravity of the RAP in accordance with AASHTO T 209, Type C, D, or E container.

Determine and record the asphalt content of the RAP using AASHTO T 164.

Calculate and record the effective specific gravity of the RAP aggregate in accordance with the following:

$$Gse = (100 - Pbrap)/((100/Gmmrap) - (Pbrap/Gbrap))$$

Where:
Gse = Effective specific gravity of the RAP aggregate
Pbrap = Percent binder of the RAP
Gmmrap = Maximum specific gravity of the RAP
Gbrap = Specific gravity of asphalt in the RAP (AASHTO T 228)

Calculate and record the effective specific gravity of the combined aggregate blend as follows.

$$GsbBlend = \frac{\%CA1 + \%CA2 + \%FA1 + \%FA2 + \%BHF + \%RAP}{\frac{\%CA1}{Gsb} + \frac{\%CA2}{Gsb} + \frac{\%FA1}{Gsb} + \frac{\%FA2}{Gsb} + \frac{\%BHF}{Gsb} + \frac{\%RAP}{Gse}}$$

Where:
GsbBlend = Bulk specific gravity of the combined aggregate blend.
Gsb = Bulk specific gravity of each respective aggregate.
Gse = Effective specific gravity of the RAP.
%CA1 = Percent of aggregate blend that is course aggregate #1.
%CA2 = Percent of aggregate blend that is course aggregate #2.
%FA1 = Percent of aggregate blend that is fine aggregate #1.
%FA2 = Percent of aggregate blend that is fine aggregate #2.
%BHF = Percent of aggregate blend that is bag house fines.
%RAP = Percent of aggregate blend that is RAP.

Report
Report the Gsb of the combined aggregate blend to the nearest 0.001.

ITEM 463.5 BITUMINOUS TACK COAT GALLON

GENERAL

This work shall consist of furnishing and applying emulsified asphalt to previously prepared bituminous or cement concrete pavement surfaces in accordance with these specifications, at the locations shown on the plans or as directed by the Engineer.

MATERIALS

Bituminous Materials - The bituminous material to be used for the tack coat shall be liquid asphalt emulsion, SS-1, SS-1h, CSS-1, CSS-1h, RS-1, or CRS-1, conforming to ASTM D977 for anionic and ASTM D2397 for cationic emulsions.

EQUIPMENT

Cleaning - Self-propelled power sweepers, vacuums or hand sweepers shall be used, and any combination thereof or other method necessary, to leave the surface clean and dust free.

Dust Control - All equipment will be operated such that it will effectively control dust and meet current State of Massachusetts Air Quality Requirements.

Applicators - The equipment used by the Contractor shall include a self-powered, pressure bituminous material distributor (i.e. a distributor truck). A pressure tank with hand held "wand type" applicator shall be used only upon approval by the Engineer.

a) The distributor shall have pneumatic tires of such width and number that the load produced on the surface shall not exceed 650 pounds per inch of tire width, and it shall be designed, equipped, and operated so that at an even heat the bituminous material may be applied uniformly on variable widths of surface at readily controlled rates from 0.05 to 2.0 gallons per square yard. The material shall be applied within a pressure range of 25 to 75 pounds per square inch and with an allowable variation from any specified rate not to exceed 5%. Distributor equipment shall include a tachometer, pressure gauges, volume-measuring devices, and a thermometer for reading the temperature of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

b) The wand applicator shall be capable of delivering the specified coverage in a uniformly speckled appearance free from globs, runs or other conditions which in the opinion of the Engineer may offset the performance of the tack coat.

CONSTRUCTION METHODS

Weather Limitations - The tack coat shall be applied only when the existing surface is dry, when the atmospheric temperature is above 50°F, and when the weather is not foggy or rainy. The temperature requirements may be waived, but only when so directed by the Engineer.

Preparation of Surface - Immediately before applying a tack coat, the full width of surface to be treated shall be swept with a power broom and/or vacuumed to remove all loose dirt and

other objectionable material.

Application of Bituminous Material - The temperature of the emulsion shall be between 75°F and 130°F when applied. The bituminous material shall be uniformly applied at such a rate that the residual asphalt on the surface after curing shall be 0.03 to 0.05 gallons per square yard depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Engineer prior to application.

Following the application, the surface shall be allowed to cure without being disturbed for such period of time as may be necessary to permit drying out, setting, or breaking (turning from brown to black) of the tack coat. Suitable precautions shall be taken by the Contractor to protect the surface against damage during this interval including any coarse sand necessary to blot up excess bituminous material.

Slow-setting emulsified asphalt may be diluted by the addition of water when directed by the Engineer and shall be applied a sufficient time in advance of the paver to ensure that all water has evaporated before any of the mixture is placed on the tacked surface.

Quality Assurance - Samples of the bituminous material that the Contractor proposes to use, together with a statement as to its source and character must be submitted and approved before use of such material begins. The Contractor shall require the manufacturer or producer of the bituminous material to furnish material subject to this and all other pertinent requirements of the contract. Only satisfactory materials so demonstrated by service tests will be acceptable.

The Contractor shall furnish vendor's certified test reports for each load, or equivalent, of bituminous material shipped to the project. The report shall be delivered to the Department before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports may be subject to verification by testing samples of material received at the project for use on the project.

METHOD OF MEASUREMENT

Bituminous Tack Coat will be measured by the gallon of emulsion (undiluted) used in the work. Before the final estimate is allowed, the Contractor shall have filed receipted bills of the bituminous materials actually used in the construction. The Contractor shall not remove bituminous material from the tank truck or storage tank until the initial outage and temperature measurements have been obtained by the Department at the project site.

BASIS OF PAYMENT

Bituminous Tack Coat will be paid for at the contract unit price per gallon of undiluted emulsified asphalt. This payment shall be full compensation for all labor, tools, equipment, materials, sand, and all incidentals necessary to complete the item as specified.

ITEM 472. HOT MIX ASPHALT FOR MISCELLANEOUS WORK TON

GENERAL

Work under this item shall conform to the relevant provisions of Section 472 of the MassDOT Standard Specifications and the following:

METHOD OF MEASUREMENT

Hot Mix Asphalt for Patching will be measured as required in Section 472 of the MassDOT Standard Specifications.

BASIS OF PAYMENT

Hot Mix Asphalt for Patching will be paid for at the contract unit price per ton which shall constitute full compensation for all labor, tools, equipment and materials necessary to complete the work. This price will include full compensation for the satisfactory removal and disposal of the material at a later date, if required.

Only hot mix asphalt furnished and placed for temporary repair of trenches, temporary pedestrian ramps, and at other locations where directed by the Engineer will be considered for payment under this item. Hot mix asphalt used to build-up to newly constructed ramps and driveways to provide access before the roadway has been paved to the finished grade will be paid for under the appropriate items for roadway hot mix asphalt.

ITEM 472.10 HOT MIX ASPHALT USED FOR PATCHING (MAINTENANCE) TON

GENERAL

Work under this item shall consist of furnishing Hot Mix Asphalt composed of a mineral aggregate, asphalt cement, mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and conformance to the lines, grades, thickness and typical cross sections shown on the plans or as directed by the Engineer.

Hot Mix Asphalt Used for Patching and any other area assigned by the Engineer will be conform to the specifications for Item 455.245 Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm) or Item 455.235 Superpave Surface Course – 12.5 (SSC -12.5mm), as specified by the Engineer.

Each course shall be constructed to the depth, typical section, or elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

The repair shall be made by providing a one and one half (1 – ½) to three (3) inch HMA Surface Course as directed by the Engineer.

The depth of the edgestone trench repair shall be a minimum of two (2) inches placed on the high early strength concrete within the edgestone trench.

Tack coat shall be applied in a manner consistent with the applicable provisions of Items

463.5, 451.25, and 451.75 and/or as directed by the Engineer.

The depth of repair for those areas removed under Item 129.7, Pavement and/or Base Removed in the roadway shall be a minimum of two (2) inches or as directed by the Engineer.

MATERIALS

All materials shall conform to the relevant provisions of Item 455.245 Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm) or Item 455.235 Superpave Surface Course – 12.5 (SSC -12.5mm), as specified by the Engineer and must be obtained from a plant approved by the Boston Public Works Department.

METHOD OF MEASUREMENT

Hot Mix Asphalt Used for Patching will be measured per ton installed complete in place. The measured tonnage amount shall be certified by a public weigher. The Contractor must submit a certified weight ticket to the Engineer for his signature and approval.

BASIS OF PAYMENT

Hot Mix Asphalt Used for Patching will be paid for at the unit price per ton including full compensation for all labor, tools, equipment, material and all other incidental expenses necessary to complete the work and be accepted by the Engineer.

The price bid shall include full compensation for HMA pavement, tack coat, and for furnishing all materials, labor, tools, equipment, and incidentals needed to complete this work.

Cutting and removal of existing pavement shall be paid for under Item 129.7, Pavement and/or Base Removed.

ITEM 472.5 UTILITY TRENCH REPAIR SQUARE YARD

GENERAL

The work under this item shall consist of repairing utility trenches existing prior to construction under this contract, where shown on plans or where required by the Engineer.

MATERIALS

Hot mix asphalt binder course shall conform to the specifications for Item 455.325, Superpave Intermediate Course – 19.0 (SIC – 19.0mm). Hot mix asphalt binder course may also conform to Item 460.65, Hot Mix Asphalt Binder Dense Course, with approval from the Engineer.

For arterial streets hot mix asphalt surface course shall conform to the specifications for Item 455.235, Superpave Surface Course – 12.5 (SSC – 12.5mm). Hot mix asphalt surface course may also conform to Item 460.9, Hot Mix Asphalt Modified Top Course, with approval from the Engineer.

For residential streets hot mix asphalt surface course shall conform to the specifications for Item 455.245, Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm). Hot mix asphalt surface course may also conform to Item 460.7, Hot Mix Asphalt Top Course, with approval from the Engineer.

CONSTRUCTION METHODS

All existing utility trenches, including water trenches, that have been backfilled with hot mix asphalt material and/or gravel shall be excavated to a depth as directed by the Engineer to place the hot mix asphalt pavement courses. The material thus removed shall be disposed of by the Contractor off the site.

Existing pavement and base shall be cut through vertically with a saw or by other methods approved by the Engineer, to produce a neat joint where the trench abuts the existing pavement.

The trench shall be repaired with hot mix asphalt binder in the following manner:

Upon the properly prepared gravel subbase shall be laid Superpave Intermediate Course – 19.0 (SIC – 19.0mm), which after spreading and rolling, shall be 5 inches thick (minimum). The Superpave Intermediate Course shall be laid in 2 courses, with a maximum depth of 2½ inches for any one course, and each course is to be thoroughly compacted by a power roller weighing not less than 5 tons. Where space does not permit the use of a roller, each course shall be thoroughly tamped or otherwise compacted by a method approved by the Engineer. The binder course shall be flush with the adjacent pavement on streets that are to be resurfaced.

On streets where no resurfacing is scheduled, the Superpave Intermediate Course – 19.0 (SIC – 19.0mm), shall be 2 inches below and parallel to the finished surface and overlaid with 2 inches of surface course. The vertical surfaces of the existing pavement shall be painted with bitumen, and after Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm), has been spread it shall be thoroughly compressed with a tandem roller with a weight of not less than 10 tons. Along curbs and similar structures and all places not accessible to a 10-ton roller, the mixture shall be compacted with tampers and hand rollers. All applicable methods of construction shall conform to the Standard Specifications.

METHOD OF MEASUREMENT

Utility Trench Repair will be measured by the square yard within the limits shown on the plans or established by the Engineer.

BASIS OF PAYMENT

Utility Trench Repair will be paid for at the contract unit price square yard for which price shall include full compensation for cutting pavements, excavation except as provided hereinbefore, furnishing hot mix asphalt binder, bitumen, labor, tools, equipment, and all incidentals necessary to complete the work.

Where no resurfacing is planned, and hot mix asphalt surface course is required, the hot mix

asphalt surface course will be paid for under Item 455.245, Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm).

Excavation of all material to the depth required for placing the binder course shall be considered incidental to Item 472.5, Utility Trench Repair. All material removed below this depth shall be measured and paid for under Item 120.1, Unclassified Excavation.

ITEM 475. REPLACEMENT OF SPEED HUMPS (MAINTENANCE) EACH

GENERAL

Work under this item shall consist of replacement of existing speed humps removed as a result of roadway milling or damaged as a result of utility work through the existing hump

HMA used for replacement of speed humps assigned by the Engineer shall conform to the relevant provisions of 455.245 Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm) or Item 455.235 Superpave Surface Course – 12.5 (SSC -12.5mm), as specified by the Engineer, in accordance with this specification and in conformance to the lines, grades, thickness and typical cross sections shown on the details and/or as directed by the Engineer. Each pavement course shall be rolled, finished, and approved before the placement of the next course.

Tack coat shall be applied in a manner consistent with the applicable provisions of Items 463.5, 451.25, and 451.75 and as directed by the Engineer.

MATERIALS

Asphalt materials shall conform to the specifications of 455.245 Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm) or Item 455.235 Superpave Surface Course – 12.5 (SSC - 12.5mm), as specified by the Engineer and must be obtained from a plant approved by the Boston Public Works Department.

METHOD OF MEASUREMENT

Replacement of Speed Humps will be paid for per each speed hump replaced.

BASIS OF PAYMENT

Replacement of Speed Humps will be paid at the contract unit price bid per each and shall include full compensation for cutting of pavement, HMA pavement, tack coat, and for furnishing all materials, labor, tools, equipment, and incidentals needed to complete this work and be accepted by the Engineer.

Pavement markings will be paid for under the appropriate pavement marking items.

ITEM 482.4 SAW CUT LINEAR FOOT

GENERAL

This item shall include the sawing of existing bituminous pavement and other roadway pavements. The work may also include saw cutting existing brick or cement concrete sidewalks along the back of the right of way and at other locations as directed by the Engineer. The saw cuts shall be made vertical and to a depth as directed. Care shall be taken to keep the face of all cuts smooth. The use of cutting wheels is prohibited.

Saw cut shall be made only where shown on the plans and detail sheets, or where directed by the Engineer. The cutting of roadway pavements for lateral trenches and other trenches shall be to a width as directed and done in such a manner to produce a neat finished trench patch.

When saw cutting hot mix asphalt surfaces the Contractor shall paint the entire exposed surface of the cut with an application of emulsified asphalt adequate to ensure proper bonding of the new pavement.

METHOD OF MEASUREMENT

Saw Cut will be measured per linear foot.

BASIS OF PAYMENT

Saw Cut will be paid for at the contract unit price per linear foot which price shall include all materials, tools, labor, equipment, and all incidentals necessary for making the saw cuts, and for painting hot mix asphalt with emulsified asphalt.

Any water that is necessary in the performance of this item of work shall be considered as incidental to the item.

ITEM 486.11 SCORED CEMENT CONCRETE PAVEMENT SQUARE YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 476 of the MassDOT Standard Specifications and the following.

Scored cement concrete shall be air-entrained 5000 psi, ¾ inch, 705 lb per cubic yard in accordance with M4.02.00 of Division III, Materials, of the MassDOT Standard Specifications. Installation shall be as indicated on the plans.

METHOD OF MEASUREMENT

Scored Cement Concrete Pavement will be measured per square yard.

BASIS OF PAYMENT

Scored Cement Concrete Pavement will be paid for at the contract unit price per square yard which price shall include all materials, tools, labor, equipment, and incidentals necessary to complete the work.

ITEM 504.	GRANITE CURB TYPE VA4 – STRAIGHT	LINEAR FOOT
ITEM 504.01	GRANITE CURB TYPE VA4 – STRAIGHT (FOR LOW RETAINING WALL)	LINEAR FOOT
ITEM 504.1	GRANITE CURB TYPE VA4 – CURVED	LINEAR FOOT
ITEM 504.11	GRANITE CURB TYPE VA4 – CURVED (FOR LOW RETAINING WALL)	LINEAR FOOT
ITEM 507.	TRAVERSABLE GRANITE CURBING, TYPE T-100 STRAIGHT	LINEAR FOOT
ITEM 507.1	TRAVERSABLE GRANITE CURBING, TYPE T-100 CURVED	LINEAR FOOT
ITEM 510.11	GRANITE CURB TYPE VA4 – SLOPED	LINEAR FOOT
ITEM 510.12	GRANITE CURB TYPE VA4 – SLOPED (RADIUS 10 FEET OR LESS)	LINEAR FOOT
ITEM 514.	GRANITE CURB INLET – STRAIGHT	EACH
ITEM 515.	GRANITE CURB INLET – CURVED	EACH
ITEM 516.	GRANITE CURB CORNER TYPE A	EACH
ITEM 516.60	GRANITE CURB CORNER TYPE VA4 – 6 FOOT RADIUS	EACH
ITEM 580.	CURB REMOVED AND RESET	LINEAR FOOT

GENERAL

Work under these items shall conform to the relevant provisions of Sections 500 and 580 of the MassDOT Standard Specifications and the following:

Refer to the following details in Roadway Design Standards:

C.1 Curb - Granite Reset
Item Nos. 504. and 504.1

C.2 Curb - Granite Sloped
Item Nos. 510.11 and 510.12

C.3 Curb - Mountable
Item Nos. 507. and 507.1

C.4 Curb - Granite Curb at Back of Sidewalk
Item Nos. 504.01 and 504.11

D.1 Driveway - Residential
Item No. 516.60

MATERIALS

All curb to be set, reset, or relocated shall be placed on a crushed stone base in accordance with the plans and specifications for Item 156.12, Crushed Stone for Curb Foundation.

All granite curbing shall be in conformance with Subsection M9.04 of the MassDOT Standard Specifications and the details on the contract drawings.

Granite Curb Corner Type VA4, 6 Foot Radius shall be one piece, 6'-3½" in length.

Granite Curb Type VA4 – Sloped shall be used in straight curb applications and curved radii to 11 feet or more.

Granite Curb Type VA4 – Sloped (Radius 10 Feet or Less) shall be placed in 1-foot lengths along the curb alignment.

CONSTRUCTION METHODS

All curb to be set, reset, or relocated shall be placed on a crushed stone base in accordance with the plans and specifications for Item 156.12, Crushed Stone for Curb Foundation.

When setting, resetting, or relocating curb in an area where the existing pavement is to remain or is to be resurfaced, the Contractor shall be required to cut the existing pavement with a mechanical saw or by some other method approved by the Engineer.

The bituminous or cement concrete base shall be cut through by the compressor method. The existing pavement and base shall be cut in a straight line running parallel to and 18 inches from the final location of the curb. The Contractor will set the curb on the crushed stone foundation and backfill the roadway side of the trench with the required amount of gravel and a minimum of 4 inches of cement concrete base up to the bottom of the proposed top course of hot mix asphalt.

Curb shall be cleaned of all debris. Surfaces that are painted or dirty or discolored shall be sand-blasted prior to resetting.

Granite Curb Type VA4, either straight or curved, for low retaining wall shall be installed along the back of the sidewalk as directed by the Engineer. The Engineer may substitute a different material, such as concrete pavers, granite block etc., as required due to existing conditions. The Contractor shall excavate a sufficient area in depth and width in order to install the curb on a crushed stone base in accordance with the plans. The Contractor shall set the curb on the crushed stone foundation prior to the installation of the new sidewalk material. The Contractor shall backfill behind the granite curb to restore disturbed areas to existing conditions.

The granite curbing shall be in installed in conformance with the construction drawings.

METHOD OF MEASUREMENT

The length of curb, sloped curb, and T-100 curb shall be as measured along the front arris of the curb. The measurement will be made along the edging at the lowest exposed level after completion of shoulder or pavement.

Granite Curb Corner Type VA4, 6 Foot Radius will be measured per each installed.
Granite Curb Corner Type A, and Granite Curb Inlet (Curved and Straight) will be measured per each installed.

Curb Removed and Reset will be measured along the arris of the curb that has been actually removed and reset.

BASIS OF PAYMENT

The various types of Granite Curb will be paid for by the contract unit price per linear foot, complete in place which price shall constitute full compensation for grading, furnishing and placing all materials, labor, tools, equipment and incidentals necessary to complete the work.

Existing curb corners and granite curb will be reused when shown on the plans or as directed by the Engineer.

The cost of removing, relocating, and resetting VA4 curb, sloped curb, T-100 curb, curb inlets, and curb corners, including resetting curb corners when widening or narrowing existing driveways, will be paid for under Item 580., Curb Removed and Reset.

Crushed stone will be paid for under Item 156.12, Crushed Stone for Curb Foundation.

Cement concrete base will be paid for under Item 431.1, High Early Strength Cement Concrete Base Course.

Gravel will be paid for under Item 151.02, Gravel.

HMA Surface Course will be paid for under the appropriate HMA Surface/Top Course item included and/or specified in the Contract Documents or as directed by the Engineer.

Any rock removed for purposes of the edgestone trench shall be paid for under Item144., Class B Rock Excavation.

The cost of saw cutting and removing pavement and base shall be included in the prices bid for the respective curb items.

Any work requiring chamfering and/or cutting of curbing shall be incidental to the above items.

ITEM 583.5 GRANITE BLOCK HIP GUTTER RELAID LINEAR FOOT

GENERAL

The work under this item shall consist of removing and relaying of granite block hip gutters in a new concrete base where shown on plans or where required by the Engineer.

MATERIALS

Concrete shall be 4,000 psi, 1 ½ inch, 565 and meet requirements of Division III, Section M4.02 in the MassDOT Standard Specifications.

CONSTRUCTION METHODS

The granite blocks are to be laid in new concrete base. The blocks are to be firmly imbedded in the concrete. All joints shall be broken with a lap of at least 3 inches. The concrete foundation is to be 4 inches wider than the 3 rows of granite block and is to be 4 inches in depth.

After being brought to a uniform surface, the block shall be wet and Portland cement grout shall be spread over the surface with brooms, hoes, squeegees, or other suitable tools, until the joints are entirely filled.

The hip gutters are to be laid to required line and grade.

The granite block hip gutters are to be approximately 12 inches in width and the slope will be determined by the water line.

Refer to the following details in Roadway Design Standards:

C.5 Curb – Granite Block Hip Gutter

METHOD OF MEASUREMENT

Granite Block Hip Gutter Relaid will be measured by the linear foot, complete in place.

BASIS OF PAYMENT

Granite Block Hip Gutter Relaid will be paid for at the contract unit price bid per linear foot which price shall constitute full compensation for concrete base, cement grout jointing, cleaning of existing granite block hip gutters, and furnishing of any granite block needed.

ITEM 584. GRANITE BLOCK HIP GUTTER EXCAVATED FOR SALVAGE LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 120 of the MassDOT Standard Specifications and the following:

The Contractor will furnish vehicles for transportation of excavated granite block hip gutter and will deliver the materials to the location indicated on the plans or as directed by the Engineer. The Contractor shall carefully excavate and load the granite block hip gutter into the above-mentioned vehicles for transportation from site. Reasonable care shall be exercised to render the salvaged material free of foreign materials. The Contractor shall transport salvaged granite blocks from the job site to the location directed by the Engineer. The Contractor will work in close cooperation with the Engineer or his/her representatives to insure proper scheduling for the delivery of salvaged materials.

METHOD OF MEASUREMENT

Granite Block Hip Gutter Excavated for Salvage will be measured by the linear foot prior to excavation.

BASIS OF PAYMENT

Granite Block Hip Gutter Excavated for Salvage will be paid for at the contract unit price per linear foot which price shall constitute full compensation for removing and loading of granite block hip gutter, and for all labor, tools, equipment, materials, and all incidentals necessary to complete the work.

ITEM 590. CURB REMOVED AND STACKED LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 580 of the MassDOT Standard Specifications and the following:

Only curb, curb inlets, and curb corners considered reusable by the Engineer shall be included under this item.

The Contractor will furnish vehicles for transportation of excavated granite block hip gutter and will deliver the materials to the location indicated on the plans or as directed by the Engineer. The Contractor shall carefully excavate and load the granite block hip gutter into the above-mentioned vehicles for transportation from site. Reasonable care shall be exercised to render the salvaged material free of foreign materials. The Contractor shall transport salvaged granite blocks from the job site to the location directed by the Engineer. The Contractor will work in close cooperation with the Engineer or his/her representatives to insure proper scheduling for the delivery of salvaged materials.

METHOD OF MEASUREMENT

Curb Removed and Stacked will be measured by the linear foot of curb length actually delivered to the District Yard.

BASIS OF PAYMENT

Curb Removed and Stacked will be paid for at the contract unit price per linear foot which price shall constitute full compensation for removing, stacking, and transporting curb and for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Any curb considered by the Engineer to be unsuitable for re-use shall be disposed of and paid for under Item 120.1, Unclassified Excavation.

ITEM 620.1 STEEL BEAM HIGHWAY GUARD (SINGLE FACED) LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 601 of the MassDOT Standard Specifications and the following:

Highway guard shall conform to the latest MassDOT Construction Standard Details.

METHOD OF MEASUREMENT

Steel Highway Guard (Single Faced) will be measured by the linear foot along the top of the rail element and end sections from center to center of end posts to which guard rail and terminal sections are attached, along the scale or the top edge of rail elements, complete in place.

BASIS OF PAYMENT

Steel Highway Guard (Single Faced) will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

No separate pay item will be made for terminal sections or buried ends or other associated items to install guard rail as specified on the contract drawings as they shall be considered inclusive to this item.

ITEM 635.1 HIGHWAY GUARD REMOVED AND DISCARDED LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 630 of the MassDOT Standard Specifications and the following:

The Contractor shall remove and dispose of steel beam highway guardrail where shown on the plans or required by the Engineer. The work will include removal of highway guard as well as terminal sections, anchors and buried ends.

METHOD OF MEASUREMENT

Highway Guard Removed and Discarded including steel beam terminal sections and buried ends will be measured per the linear foot in its original position and will be the length actually removed and discarded. Measurement will be from center to center of end posts to which guard rail and terminal sections are attached, along the scale or the top edge of rail elements.

BASIS OF PAYMENT

Highway Guard Removed and Discarded will be paid for at the contract unit price per linear foot which price shall be full compensation for removing, stacking, and transporting and for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Steel beam terminal sections and buried ends removed and discarded will be paid for at the contract unit price under Item 635.1., Highway Guard Removed and Discarded.

ITEM 645.148	48 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	LINEAR FOOT
ITEM 645.160	60 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	LINEAR FOOT
ITEM 645.172	72 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	LINEAR FOOT
ITEM 645.196	96 INCH CHAIN LINK FENCE (PIPE TOP RAIL) TYPE 1	LINEAR FOOT

GENERAL

Work under these items shall conform to relevant provisions of Section 644 of the MassDOT Standard Specifications and the following:

All material used shall be zinc-coated. Line posts shall be 2 ⅜-inch O.D. steel pipe with a weight of 3.65 pounds per linear foot (±5%). End posts shall be 2 ⅞-inch O.D. steel pipe with a weight of 5.79 pounds per linear foot (±5%). Steel top rail shall be 1.66-inch O.D. tubular pipe with a nominal weight of 2.27 pounds per linear foot, in accordance with ASTM A120, Schedule 40.

Work under this item shall include removal and disposal of the existing chain link fence. Work shall also include installing end posts with bracing and cement concrete foundations for end posts and line posts as shown in the construction details.

Chain link fence shall conform to the latest MassDOT Construction Standard Details.

METHOD OF MEASUREMENT

Chain Link Fence (Pipe Top Rail) Type 1 will be measured by the linear foot for the height specified complete in place.

BASIS OF PAYMENT

Chain Link Fence (Pipe Top Rail) Type 1 will be paid for at the contract unit price per linear foot for the height specified which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

The cost of furnishing and installing end posts with bracing and cement concrete foundations shall be included in the unit prices bid under these items.

ITEM 666. CHAIN LINK FENCE REMOVED AND RESET LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 665 of the MassDOT Standard Specifications and the following:

The work shall consist of removal and resetting of existing chain link fence at the back of sidewalk, if necessary, for construction of pedestrian ramps requiring lowering of the back of sidewalk, or at other locations, as directed by the Engineer.

Materials shall be the existing fence fabric and posts, wire fasteners, and other appurtenances. Fence posts shall be set plumb in a minimum of one cubic foot of concrete conforming to M4.02 4,000 psi, 1 ½ inch, 565 Cement Concrete.

METHOD OF MEASUREMENT

Chain Link Fence Removed and Reset will be measured by the linear foot in the final position outside to outside of end posts.

BASIS OF PAYMENT

Chain Link Fence Removed and Reset will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Concrete for post bases and any new posts, rails, hardware or additional wire fasteners ordered by the Engineer, will be considered incidental to the Contract unit price paid for Item 666., Chain Link Fence Removed and Reset, and no separate payment will be allowed therefor. Any fence posts or fabric damaged by the Contractor shall be replaced in kind by the Contractor at his own expense.

ITEM 670.1 IRON FENCE REMOVED AND RESET LINEAR FOOT

GENERAL

Work under this item shall consist of removing, storing and resetting existing iron fences at the back of sidewalk, if necessary, for construction of pedestrian ramps requiring lowering of the back of sidewalk, or at other locations, as directed by the Engineer.

MATERIALS

Fence posts shall be set plumb in a minimum of one cubic foot of concrete conforming to M4.02 4000 psi, 1 ½ inch, 565 Cement Concrete.

CONSTRUCTION METHODS

The existing fence shall be carefully removed, before beginning any other work in the immediate area and stored in a location to be designated by the Engineer. All existing concrete shall be

removed from the bottom of fence posts.

Following completion of sidewalk construction, the fence shall be reset in new cement concrete footings in the same location from which it was removed.

METHOD OF MEASUREMENT

Iron Fence Removed and Reset will be measured by the linear foot in the final position outside to outside of end posts.

BASIS OF PAYMENT

Iron Fence Removed and Reset will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment materials and incidentals necessary to complete the work, including concrete for footings. Any fence posts or sections damaged by the Contractor shall be replaced in kind by the Contractor at his own expense.

ITEM 670.2 WOOD FENCE REMOVED AND RESET LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 665 of the MassDOT Standard Specifications and the following:

The work shall consist of the removal and resetting of portions of existing wood picket fences at the back of sidewalk, if necessary, for construction of pedestrian ramps requiring lowering of the back of sidewalk, or at other locations, as required by the Engineer.

Fence posts shall be set plumb in a minimum of one cubic foot of concrete conforming to M4.02 4000 psi, 1 ½ inch, 565 Cement Concrete.

Any fence posts or sections damaged by the Contractor shall be replaced in kind by the Contractor at his own expense.

METHOD OF MEASUREMENT

Wood Fence Removed and Reset will be measured by the linear foot in the final position outside to outside of end posts.

BASIS OF PAYMENT

Wood Fence Removed and Reset will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work, including concrete for footings. Any fence posts or sections damaged by the Contractor shall be replaced in kind by the Contractor at his own expense.

ITEM 697.1 CATCH BASIN INSERT FOR SEDIMENT CONTROL EACH

GENERAL

The work to be done under this item shall include furnishing, installing, maintenance and removal of sediment collection sacks in retained existing and proposed inlet structures within the limits of work during construction operations for the protection of the environment as specified by the following:

CONSTRUCTION METHODS

The sediment collection insert shall be as manufactured to fit the opening of the drainage structure under regular flow conditions.

Sediment collection inserts shall be a reusable sediment control device utilized during construction that mounts under the grate in catch basins, made of a permeable geotextile fabric that allows water to pass but prevents silts and sediment from entering the drainage system. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure.

The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Sediment collection inserts shall remain in place until the placement of the pavement overlay or top course and the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of sediment collection inserts after each rainstorm and during major rain events. When emptying the insert, the contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractor's expense. The silt and sediment from the insert shall be legally disposed of off-site. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

Sediment collection inserts, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the City.

All curb openings shall be blocked to prevent storm water from bypassing the device.

Refer to construction plan details showing the sediment collection insert device. The Contractor shall be responsible for field measuring all existing and new drainage structures to ensure that the proper size sediment collection insert is provided for each structure.

MATERIALS

The sediment collection insert shall be manufactured from a woven polypropylene fabric with an oil-absorbent pillow insert or made completely from an oil-absorbent fabric with a

woven pillow insert that meets or exceeds the following specifications.

PROPERTIES	TEST METHOD	UNITS
Grab Tensile	Strength ASTM D-4632	265 LBS
Grab Tensile	Elongation ASTM D-4632	20%
Puncture	ASTM D-4833	135 LBS
Mullen Burst	ASTM D-3786	420 PS
Trapezoid Tear	ASTM D-4533	45 LBS
UV Resistance	ASTM D-4355	90% Apparent Opening Size
	ASTM D-4751 20	US SIEVE
Flow Rate	ASTM D-4491	200 GAL/MIN/SQ FT
Permittivity	ASTM D-4491	1.5 SEC-1

METHOD OF MEASUREMENT

Item 697.1 Catch Basin Insert for Sediment Control will be measured by each. Each will be measured as one Catch Basin Inlet Sediment Control, regardless of the number of times that it is reused. Each active work zone is required to have Catch Basin Insert for Sediment Control installed in all downstream catch basins.

BASIS OF PAYMENT

Item 697.1 Catch Basin Insert for Sediment Control will be paid for at the contract unit price per each sediment collection insert installed. The sediment collection inserts shall be inspected on a regular basis and cleaned or replaced as necessary or as directed. Payment shall be made only once for each drainage structure, regardless of how often the sediment collection insert must be cleaned. Legal disposal of accumulated sediment from the insert and replacement (if required) shall be considered incidental to the Contract unit price bid. Used sediment collection inserts, determined to be in suitable condition, may be thoroughly cleaned and reused. At the completion of the project, the Contractor shall remove all sediment collection inserts used on the project.

No separate payment will be made for made for maintenance, cleaning, removal, replacement (if required), and legal disposal of the sediment from the insert, but all costs in connection therewith shall be included in the Contract unit price bid.

ITEM 698.3	NON-WOVEN GEOTEXTILE FABRIC	SQUARE FOOT
ITEM 698.6	IMPERMEABLE LINER	SQUARE FOOT

GENERAL

The work of this Section includes subgrade preparation and installation of a subsurface infiltration bed.

Submittals

Submit a list of materials proposed to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are

to be obtained.

Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified requirements.

Quality Assurance

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.

Codes and Standards - All materials, methods of construction and workmanship shall conform to applicable requirements of the Boston Public Works Department (PWD) Special Provisions, Boston Water and Sewer Commission (BWSC) Standards, MassDOT Standard Specifications, and AASHTO Standards, unless otherwise specified.

MATERIALS

Non-woven geotextile (drainage filter fabric) shall conform to the following:

A. Minimum flow rate of 110 gal/min/sf – ASTM D4491 - 99A
B. Grab tensile strength min 150 lb – ASTM D4632 - 91
C. Mullen Burst strength min 300 psi – ASTM D3786 - 87
D. Puncture strength min 90 lb – ASTM D4833 - 00
E. Apparent opening size 60-70 US Sieve – ASTM D4751 - 99A

Impermeable Liner shall be 30 mil polyethylene liner manufactured by Solmax, Poly-flex, Inc., or approved equal.

CONSTRUCTION METHODS

Installation of Subsurface Stone Stormwater Beds

A. Impermeable liner, non-woven geotextile, and/or sand shall be placed immediately after approval of subgrade preparation. Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked (at least 3 inches) to scarify bottoms of infiltration systems prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to City of Boston.

   1. Observation wells, where applicable, shall be installed as indicated in the Drawings prior to placement of aggregates in the trenches. Care shall be taken to avoid compacting the bottom of the bed during the excavation necessary for observation well installation.
   2. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of 18 inches or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least 4 feet outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.

B. Install coarse aggregate in 8-inch maximum lifts. Lightly compact each layer with equipment, keeping equipment movement on storage bed subgrades to a minimum. Install aggregate to grades indicated on the drawings. Install detectable underground utility warning tape at the perimeter of the subsurface stone storage trench on all sides. Once aggregate is backfilled and compacted to grades indicated on the Drawings, geotextile shall be folded over and overlapped on top of the bed to prevent soil intrusion into the aggregate bed.

   1. Impermeable liner shall be placed in accordance with manufacturer's instructions and as indicated in the Drawings. All seams and openings in the liner shall be sealed according to manufacturer's recommendations and specifications. Adjacent strips of impermeable liner shall overlap a minimum of 18 inches or per manufacturer specifications, whichever is greater.

C. Where an existing utility lateral or branch main intersects the stone stormwater storage system, a pass-through conduit (utility sleeve) shall be constructed to convey the existing utility. City of Boston shall review and approve any pass-through conduits for utility lines not indicated on the Drawings, and any utility laterals that may be reconstructed such that a pass-through conduit is not necessary shall be so reconstructed.

   1. Pass-through conduits shall be constructed of Schedule 40 PVC pipe of adequate diameter to convey the utility lateral within.
   2. Waterstops shall be installed at either end of the pass-through conduit, outside the geotextile wrap of the stone stormwater storage.
   3. The conduit shall be of watertight construction and shall be sealed at either end around the existing pipe with non-shrink grout or sealant.

4. Any pass-through conduits for utilities shall be considered incidental to the work.
5. The Contractor shall coordinate sleeving of all existing and intersecting utility lines with the owners/operators of said utility lines.

METHOD OF MEASUREMENT

Non-woven Geotextile Fabric and Impermeable Liner will be measured by the square foot, in place as determined by the Engineer. Measurements shall be based upon the height, length, and width of the trench. The bed/trench height, length, and width shall not exceed the limits set forth in in the Contract Drawings. All geotextile fabric and impermeable liner materials shall be new. There shall be no additional compensation for any overlap.

BASIS OF PAYMENT

Non-woven Geotextile Fabric and Impermeable Liner will be paid for at the contract unit price per square foot which price shall constitute full compensation for all labor, tools, equipment, materials, and incidentals necessary to complete the work.

No payment will be made for the furnishing of fabrics or liners to line any excavation made for the Contractor's convenience or excavations beyond the limits set forth in the Contract Drawings.

No payment shall be made for the subgrade preparation; however, such work will be considered incidental to the Impermeable Liner item.

ITEM 701.	CEMENT CONCRETE SIDEWALK	SQUARE YARD
ITEM 701.001	CONCRETE WALKING SURFACE (MAINTENANCE)	SQUARE FOOT
ITEM 701.1	CEMENT CONCRETE SIDEWALK AT DRIVEWAYS	SQUARE YARD
ITEM 701.2	CEMENT CONCRETE PEDESTRIAN RAMP	SQUARE YARD

GENERAL

Work under these items shall conform to the relevant provisions of Section 701 of the MassDOT Standard Specifications and the following:

The work includes constructing or reconstructing cement concrete sidewalks, cement concrete sidewalks at driveways, and constructing cement concrete pedestrian ramps with detectable warning panels as detailed on the plans.

The Contractor's attention is directed to the fact that cement concrete sidewalks normally will be 6-inches thick; cement concrete sidewalks at driveways will be 6-inches thick; and cement concrete pedestrian ramp will be 6-inches thick, as shown on plans or where directed.

If subsequent testing on hardened concrete by the City shows that the concrete does not meet the specification requirements, the contractor shall in addition to being responsible to replace any material or workmanship which is rejected, shall also be responsible for the cost of the testing.

Refer to the following driveway details in the Roadway Design Standards:
D.1 Driveway – Residential
D.2 Driveway – Commercial
D.3 Driveway – Sidewalk Widths Less Than 7’

Refer to the following pedestrian ramp details in the Roadway Design Standards:
R.1 Pedestrian Ramp – General Information
R.2 Pedestrian Ramp – Sidewalk Width 6.5’ and Greater
R.3 Pedestrian Ramp – Sidewalk Width Less Than 6.5’
R.4 Pedestrian Ramp – Sidewalk Width Non-Walking Area
R.5 Pedestrian Ramp – Detectable Warning Panel
R.6 Perpendicular Pedestrian Curb Ramp – Dual Uni-Directional with Sidewalk Width of 6.5’ or Greater
R.7 Perpendicular Pedestrian Curb Ramp-Dual Uni-Directional with Sidewalk Width of 6.5' or Greater
R.8 Parallel Pedestrian Curb Ramp-Dual Uni-Directional with Sidewalk Width Less than 6.5'
R.9 Pedestrian Curb Ramp for One Continuous Direction Travel with Sidewalk Width of 6.5' or Greater
R.10 Pedestrian Curb Ramp for One Continuous Direction Travel with Sidewalk Width Less Than 6.5'
R.11 Blended Transition for Two Continuous Direction of Travel with Sidewalk Width of 6.5' or Greater
R.12 Blended Transition for Two Continuous Directions of Travel with Sidewalk Width Less Than 6.5'
R.13 Perpendicular Pedestrian Curb Ramp With Existing Vertical Obstruction for Sidewalk

Width of 6.5' or Greater
R.14 Maximum Pedestrian Curb Ramp Alignment Limits
R.15 Pedestrian Refuge Island
R.16 Raised Crossing Ramp
R.17 Pedestrian Curb Ramp Adjacent to Raised Bike Lane
R.18 Pedestrian Curb Ramp Adjacent to Median Separated Road Level Bike Lane

Refer to the following sidewalk details in the Roadway Design Standards:
S.1 Sidewalk – Concrete

MATERIALS

The Contractor will furnish to the Engineer, for approval, a specific design mix for the combination of materials and sources of supply to be used on each project. The test results from the trial batches will also be submitted. Any time there is a change in the source of material, a new mix design will be submitted.

Concrete shall be 4000 psi, air entrained, ¾ inch maximum size aggregate with 660 lbs. of cement per cubic yard. Entrained air shall be between 5.5% and 7.5% with a slump not exceeding 4 ½ inch. Type II cement conforming to ASTM C150 shall be used.

The use of mineral additives or supplements such as ground granulated Blast Furnace Slag, Fly Ash, Silica Fume or Micro Silica are strictly prohibited.

Fine and coarse aggregates shall comply with the applicable paragraphs contained in the MassDOT Standard Specification for Highways and Bridges, Section M4.

Preformed ⅜-inch expansion joint filler shall conform to the requirements of AASHTO M 33.

Type 2 Liquid Membrane-Forming Compounds for Curing Concrete shall be used in accordance with ASTM C309 - 58 or AASHTO M 140-57 or the latest revisions thereof.

Detectable warning panels shall have dome geometry in accordance with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for Accessible Public Rights-of-Way, Section R305 – Detectable Warning Surfaces. Raised truncated domes shall have a nominal diameter of 0.9-inches, a nominal height of 0.2-inches, and a center-to-center spacing of 1.6 inches to 2.4-inches. Panels shall be 24-inches deep in the direction of travel and the full width of the proposed ramp. The panel shall be cast iron and shall have an integral non-slip texture on and between the truncated dome shapes. The panel is to be colored via powder coat paint. The color of the panel will depend on the project location and is further described in the paragraphs that follow. The panel material shall conform to either Gray Iron ASM A 48 Class 35 B, and/or AASHTO M 105, Class 35B gray iron, and/or ASM A 536 Ductile Iron and/or ASTM A-48, Class 30A minimum. The contractor must provide a shop drawing submittal to the Engineer for review and approval prior to ordering the panels. The panels shall have a slip resistance more than 0.80 wet or dry. Panels shall have an integral iron anchor tab to ensure proper restraint in the concrete slab. Castings shall be of uniform quality, free from sand holes, gas hoes, cracks, shrinkage, and other surface defects. Castings shall be reasonably well cleaned by shot blasting. Runners, risers, fins, and other cast-on pieces shall be removed from the castings and such areas shall be ground smooth. As-cast

dimensions may vary within accepted foundry tolerances as outlined in the Iron Castings Handbook published by the American Foundrymen's Society, Inc. Nominally, casting dimensional tolerances shall be 1/16th-inch per foot. The system of manufacturing quality assurance must conform to the requirements of ISO 9001:2015.

The appearance of the finished ramps will vary on the location of the ramp. Presently there are two designations, those constructed in Boston's Historic Districts and those outside these designated areas.

Non-Historic Districts

A. All standards for clearances and slopes set forth by the Americans with Disability Act (ADA), Public Right-of-Way Accessibility Guidelines (PROWAG), Massachusetts Architectural Access Board (AAB), and the City of Boston Access guidelines will be adhered to.

B. Where the existing sidewalk is brick, the slope, flares, and landing will be constructed of cement concrete.

C. The detectable warning panel shall be federal yellow in color (Federal color # 33538) unless otherwise specified by PWD.

Historic Districts

A. All standards for clearances and slopes set forth by the Americans with Disability Act (ADA), Public Right-of-Way Accessibility Guidelines (PROWAG), Massachusetts Architectural Access Board (AAB), and the City of Boston Access guidelines will be adhered to.

B. Where the existing sidewalk is cement concrete the slope, flares and landing will be constructed of cement concrete.

C. Where the existing sidewalk is constructed of brick, the landing and sidewalk approaches will be constructed of wire cut bricks on a bituminous concrete setting bed and blended into the existing brick sidewalk. The slope and flares will be constructed of cement concrete. At the direction of the Engineer the landing may be constructed with cement concrete.

D. The detectable warning panel in Historic Districts shall be a brick red color and shall conform with RAL 2001, unless otherwise specified by PWD.

Because of the configurations and site challenges in Historic Districts, the Public Works Department will coordinate with the respective Historic Commissions on the location and finish material of these ramps so as not to delay the construction process.

CONSTRUCTION METHODS

The sub-grade for the walk, driveway, or pedestrian ramp shall be shaped to a true surface conforming to the proposed slope of the walk thoroughly rolled at optimum moisture content

and tamped with a power roller weighing not less than 1 ton and not more than 5 tons. All depressions occurring shall be filled with suitable material and again rolled or tamped until the surface is smooth and hard.

Sub-base: After the sub-grade has been prepared as hereinbefore specified, a sub-base of gravel at optimum moisture content shall be placed, thoroughly rolled by a power roller, and tamped.

If during the reconstruction of sidewalks, driveways, or pedestrian ramps, the Engineer determines that some suitable gravel exists, the Contractor shall add additional gravel to obtain the required thickness specified in the drawings.

Forms: The forms for sidewalks shall be smooth, free from warp, of sufficient strength to resist springing out of shape, and of depth to conform to the thickness of the proposed walk. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with the upper edge of the form conforming to the grade of the finished walk. The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum). An unobstructed path of travel with a minimum width of 4 feet shall be maintained past all obstructions (utility poles, signs, trees, signal foundations, along driveway openings, etc.). A minimum 3-foot clearance may be provided only with authorization from the Engineer. For sidewalks and driveways, before the concrete is placed, the sub-base shall be thoroughly dampened so that it is moist throughout but without puddles of water. The concrete shall be placed as near to its final position as practicable with precautions taken not to overwork it while it is still plastic. The concrete shall be thoroughly spaded along the forms or screeds to eliminate voids or honeycombs at the edges. Except as otherwise directed, the concrete sidewalks shall be separated by ⅜-inch preformed expansion joint filler every 30 feet. Preformed expansion joint filler shall be placed adjacent to or around existing structures where directed.

Pedestrian ramp slopes, level landings, and side slopes (transitions) shall conform to the requirements of the Massachusetts Architectural Access Board (AAB) CMR 521, Public Right-of-Way Accessibility Guidelines (PROWAG) and all pedestrian ramps shall have a detectable warning panel (also defined as a detectable warning surface) installed as shown in the details on the construction drawings. The Contractor shall exercise extreme care to construct the ramps as designed, with the proper sidewalk slopes and clearances. If the Contractor is unable to construct the ramps as designed, they shall contact the Engineer immediately for resolution. Any modifications to the proposed ramp designs must be approved by the Boston Public Works Department, Engineering Division, Design Section. The construction of all ramps will require precise grading of sidewalks, edgestone, and pavements. It is the Contractor's responsibility to request all necessary measurements and grades from the Engineer prior to constructing the ramps. All ramps shown on the plans are subject to field revision due to underground obstructions and changes in grades during construction.

Concrete: On the sub-base as specified above, the concrete shall be thoroughly consolidated in place. The concrete for sidewalks, driveways, and pedestrian ramps shall be worked and floated to give a smooth uniform and attractive surface finish. In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost, and the concrete must be so handled that the concrete will be of uniform composition throughout, showing neither excess nor lack of mortar in any one place.

The concrete materials shall be mixed to produce a concrete of such consistency that the water will flush to the surface under heavy tamping.

Contractor shall comply with ACI 304 and 309. The adding of water on-site is prohibited except when all the following are satisfied.

1. The slump is less than 4 ½ inch.
2. The addition of water shall not increase the water cement ratio above the maximum permitted by the specification.
3. The water shall be added to the entire batch, not in the middle or end.
4. Water cannot be added beyond 1.5 hours from time of batching or after 300 revolutions.
5. Water shall be added into the batch at the head section of the drum or by injection into the head and discharge section of the drum.
6. Water added requires an additional 30 revolutions at mixing speed.
7. Batching plant shall document on the driver's delivery ticket any water withheld at the batching plant.

Concrete with a slump exceeding 4 ½ inches, air entrainment outside of the allowable range, a temperature exceeding 90°F is not to be placed. In addition, concrete must be placed within 90 minutes of when it was batched as recorded on the delivery slip. The 90 minutes can be exceeded only if the concrete remains workable, there is no appreciable loss of slump, no water has been added and the temperature does not exceed 90°F.

Re-tempering of the concrete will not be permitted. The application of neat cement to the surface in order to hasten hardening is prohibited.

Concrete Finishing: The finishing of concrete surface shall be done by experienced and competent cement finishers approved by the Engineer. The concrete surface shall be struck off to the required elevation and cross section followed by the roller, leveled with a bull float or screed the minimum necessary to remove irregularities. **No finishing operations shall be performed while free water is present. Finishing operations will be delayed until all bleed water and water sheen has left the surface and the concrete has started to stiffen.**

When installing pedestrian ramps, the concrete shall be placed and finished level, true and smooth to the required dimensions prior to placement of the detectable warning panel (also defined as a detectable warning surface). The detectable warning panel shall be installed in accordance with the manufacturer's procedures. **The location of the detectable warning panel shall comply with PROWAG R305.2.** Where a concrete border is required for proper installation of a detectable warning surface (DWS), a concrete border not exceeding 2 inches shall be permitted on all sides of the detectable warning surface except between the detectable warning surface and the edge of pavement where a setback is already permitted. Where a DWS and utility cover conflict the DWS shall be cut to fit, but a 2" concrete collar surrounding the utility cover may be provided as approved by the Engineer. The total DWS should be maximized in these scenarios. The DWS may also be cut to fit for installations along a curve as required by the ramp or blended transition type. **For new construction, retrofit installations will not be allowed**. The tolerance for elevation differences between the panel and the adjacent surface shall not exceed 1/16-inch.

The pedestrian ramp, including the detectable warning panel, shall be protected from all traffic, vehicular or pedestrian, during the curing process. Prior to completion, clean all debris or concrete off the face of the panel.

Concrete surface shall be uniformly scored into block units or areas not more than 36 square feet as directed to a minimum of ¼ of the total depth of the slab. Round and edge all joints. Concrete will be finished utilizing a steel trowel, all finishing is to be done by hand. After tooling, the surface shall be brushed by drawing a soft-bristled push broom with a long handle over the surface of the concrete to produce a non-slip surface.

The Contractor shall make every effort to protect the newly poured concrete surface against vandalism and marking or defacing, and must stand ready to replace any blocks which, in the opinion of the Engineer, are excessively marked or defaced without any additional compensation. Type 2 pigmented liquid membrane- forming curing compound shall be applied immediately following final finishing before any marked dehydration of the concrete or surface checking occurs. The compound shall be applied in 1 or 2 applications as directed by the Construction Engineer. When the compound is applied in 2 applications, the second shall follow the first within 30 minutes. The compound shall be applied in a continuous film by means of power-operated pressure spraying equipment at a rate not less than 1 gallon per 200 square feet of surface. Sufficient pressure shall be applied to the spray machine to force the compound to leave the nozzle as a fine spray. The material shall adhere to the surface and make a tight bond to the concrete but shall have a fugitive dye. The compound shall form a uniform continuous, coherent film that will not check, crack, or peel and be free from pin holes or other imperfections.

Whenever the atmospheric temperature is 90°F or more, the Construction Engineer shall have the right to require a second application of compound with no additional compensation. Any section damaged by rain or in any other way before the compound has dried to a stable coating shall be re-treated by the Contractor with no additional compensation.

Concrete surface to which compound has been applied shall be protected for a period of at least 3 days. All vehicular and pedestrian traffic is considered injurious to the film of applied compound. Any damage to the film in the 3-day period shall be promptly repaired by application of the compound. Adequate protection shall be provided where temperatures of 40°F or lower occur during placing of concrete and during the early curing period. The minimum temperature of fresh concrete after placing and for the first 3 days shall be maintained above 55°F In addition to the above requirements an additional 3 days of protection from freezing shall be maintained.

Water Boxes and Manhole Frames: Water boxes and manhole frames shall be carefully set to the proposed finished grade.

Prior to pouring the cement concrete, the Contractor shall install a ⅜-inch preformed asphalt expansion joint filler adjacent to or around all existing structures which are either flush with or protruding through the sidewalk area, if such structures are 36 square inches or more in area.

This pre-molded asphalt expansion filler is to be fitted tightly and neatly around each structure. Around lighting and utility poles the Contractor shall install the above-mentioned filler to allow for a break-away section 20 inches by 20 inches around the pole. The back of the edgestone

shall constitute one side of this form whenever feasible.

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.

Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Concrete Walking Surface (Maintenance) will be measured per square foot, complete in place.

Cement Concrete Sidewalk, Cement Concrete Sidewalk at Driveways, and Cement Concrete Pedestrian Ramp will be measured by the square yard, complete in place.

The limits of the area of Cement Concrete Pedestrian Ramp to be measured will be from the top of the slope stones to the back of the level landing.

BASIS OF PAYMENT

Item 701.001

Concrete Walking Surface (Maintenance) will be paid for at the contract unit price per square foot which shall include all proper shaping and compacting of the sub-grade, all forms, labor, material, and equipment. The excavation of the existing sidewalks, driveways, and/or pedestrian ramps will be incidental to Item 701.001.

For pedestrian ramps constructed under Item 701.001 Concrete Walking Surface (Maintenance), detectable warning panels will be paid for under Items 701.993, 701.995, or 701.999 as directed by the engineer.

Sawcutting the front or back of drives to achieve neat lines or meet grades will be considered incidental to Item 701.001.

HMA used to repair the walkways will be paid for under Item 702.1, Hot Mix Asphalt Walk Surface (Maintenance)

HMA used to repair the area behind driveways will be paid for under Item 703.1, Hot Mix Asphalt Driveway (Maintenance).

Items 701., 701.1, and 701.2

Cement Concrete Sidewalk, Cement Concrete Sidewalk at Driveways, and Cement Concrete Pedestrian Ramp will be paid for at the contract unit price per square yard which price shall constitute full compensation for all forms, labor, tools, equipment, material and incidentals necessary to complete the work. Furnishing and installing (including cutting) of the detectable warning panels shall be considered incidental to the price bid for Item 701.2, Cement Concrete Pedestrian Ramp.

In the reconstruction of streets and/or sidewalks being constructed utilizing Items 701. Cement Concrete Sidewalk, 701.1 Cement Concrete Sidewalk at Driveways and 701.2 Cement Concrete Pedestrian Ramp, the excavation of existing walks which are to be replaced will be paid for under Item 120.1, Unclassified Excavation, and the excavation shall be calculated using the following fixed depth:

Any type existing sidewalks (except gravel) - 6 inches
Any type existing driveways (except gravel) - 6 inches
Any type existing ramps (except gravel) - 6 inches
Existing gravel sidewalks - actual depth measured

All Items

The Public Works Department will be available to assist with the layout of difficult pedestrian ramps. The Contractor shall request assistance through the Engineer.

Any unusual additional excavation required on these reconstructed streets, necessary because of poor sub-grade conditions, shall be measured separately and added to total figures on the fixed depth dimensions listed above. Gravel used in sub-base of sidewalks, driveways, and ramps shall be paid for under Item 151.02, Gravel

HMA used to repair the roadway area in front of driveways will be paid for under 455.245 Superpave Surface Course – 9.5(b) (SSC – 9.5(b)mm) or Item 455.235 Superpave Surface Course – 12.5 (SSC -12.5mm), as specified by the Engineer.

Preformed joint filler, pre-molded asphalt expansion filler, and the application of Type 2 Liquid

Membrane-Forming Compound for Curing Concrete and hand tooled score marks are to be considered as incidental work and the cost of such work must be included in the price bid under these items.

Any casting within the sidewalk area that requires one or less courses of brick to adjust to the proper line and grade shall be considered as incidental to and paid for under the sidewalk and driveway items.

Work to be done under this section shall include the satisfactory resetting to the proper line and/or grade, the access tube and frame and cover for curb stops, located in sidewalk, driveway, and ramp areas. This work shall be incidental to these items.

The Contractor shall cut off roots of existing trees only where directed by the City Arborist. and shall be considered incidental to the work in these items.

All work that does not meet the applicable standards shall be replaced by the Contractor with no additional cost to the City of Boston.

ITEM 701.993 CAST-IN-PLACE RESIN DETECTABLE WARNING PANEL (MAINTENANCE) SQUARE FOOT

GENERAL

Work under this item shall consist of furnishing and installing a resin based Detectable Warning Panel (DWP) at Pedestrian Curb Ramps and/or Blended Transitions. The DWP shall be set on properly primed and clean surfaces. The Contractor shall adhere to City of Boston standards, Americans with Disabilities Act (ADA) and Public Right-of-Way Accessibility (PROWAG) Guidelines for sizing and placement of truncated domes on the detectable surface. The DWP includes both the base layer as well as truncated domes.

Refer to the following Pedestrian Ramp Details in the Roadway Design Standards:

R.5 Pedestrian Ramp - Detectable Warning Panel

The use of cast-in-place resin DWP shall be at locations as determined and approved by the Engineer and/or shown on the Plans. The typical use case of this item should be along curved corners where standard tactile panels do not easily fit without significant labor, cutting, or other modifications to the DWP.

MATERIALS

The Resin DWP must have the following material properties:

Viscosity 6000 - 12000 cps, ASTM D2196 - Brookfield #7 spindle @20 rpm, 77 degF
Tracking None after 60 minutes max., ASTM D711, 50mils wet @77 degF
VOC 25 g/l max., ASTM D2205
Hardness Shore Durometer, A-1, 80 minimum after 24 hours
Tensile Strength 125 psi minimum at break, ASTM D638
Percent Elongation 20% minimum, ASTM D638

Water Absorption Maximum 0.5% (ASTM D570)
Chemical Resistance Seven day immersion test:

Motor oil……no effect	*Transmission fluid…no effect*	*Diesel fuel……no effect*
Anti-freeze……no effect	*Gasoline……no effect*	*Road salts……no effect*

Adhesion Portland cement; minimum 200 PSI. Asphalt; dependent on tensile failure of substrate
Skid Resistance Minimum 45 (ASTM E303) in units (British pendulum)
Reflectivity 200 millicandela minimum initial reading
Composition Comprised of resins, reactive monomers, pigments, glass beads, and fillers. Exact composition is at the manufacturer's discretion. The material is resistant to ultra-violet light.
Color Final color of the DWP after curing shall adhere to City of Boston Standards unless otherwise specified by the Public Works Department. If the exact color cannot be matched, the Contractor shall use the nearest possible with approval of the Engineer.

Non-Historic Districts……Federal Yellow #33538	Historic Districts……RAL 2001

The Contractor shall use the following Manufacturer(s) or Approved Equal:

VANGUARD ADA Systems
18122 SR 9 SE, Ste. F
Snohomish, WA 98296
(360) 668-5700

CONSTRUCTION METHODS

The Contractor shall adhere to the manufacturer's requirements for all means of installation of the resin material necessary to install a DWP. Prior to installation of the DWP, the Contractor shall prime the surface of application under the following methods, but all surfaces shall be clean and dry prior to installation.

- **Asphalt:** Truncated dome installation on asphalt utilizes the same technique as concrete installations. The asphalt must be inspected by the installer prior to installation to determine if a mix or additive adjustment is required.
- **Seal Coat:** Products shall not be placed on asphalt or coal tar sealers. If a surface has been sealed, grind the entire area to be installed to remove all sealers.
- **Concrete:** Minimum compressive strength 2500 PSI. Concrete must cure for minimum of 10 days prior to the installation (due to wide swings in climatic environments nationwide). The installer shall retain full discretion to determine whether it may (or should) be installed earlier or later than above defined timelines to ensure proper bonding. All concrete coloring/additives shall be integral, not surface applied. All "surface curing" compounds or sealers shall be removed by method of

grinding on any concrete that is less than 6 months old if deemed necessary by installer before the products are installed. Surface finish should be medium broom finish for maximum adhesion

- **Temperatures:** Surface temperatures of the substrate material should not exceed 88 degree F, or be below 35 degree F. Adjustments should be made in appropriate mixing ratios for extreme temperatures. Some regional adjustments may also be required due to climatological discrepancies.

Upon installation the Contractor shall provide adequate time for the curing of the resin as required by the manufacturer. Only upon completion of the curing time may the pedestrian ramp or blended transition be open to public travel.

Truncated domes must be formed and spaced as required by City of Boston Standards and the ADA. Truncated domes shall be an integral part of the resin DWP and installed as specified by the Manufacturer.

Construction of sidewalk surfaces (Concrete, etc.) at Pedestrian Ramps and Blended Transitions shall adhere to item 701.001 Concrete Walking Surface (Maintenance).

METHOD OF MEASUREMENT

Cast-in-place Resin Detectable Warning Panel (Maintenance) will be measured per square foot complete in place. The measurement area shall be taken for the width of the panel (generally to be two feet wide) along either edge perpendicular to the curb, while the length shall be measured from the mid-point to mid-point of the sides, taken parallel to the curb.

BASIS OF PAYMENT

Cast-in-place Resin Detectable Warning Panel (Maintenance) will be paid at the contract unit price per square foot complete in place, which price shall constitute full compensation for all forms/templates, labor, tools, equipment, material and incidentals necessary to complete the work. Priming and cleaning of the existing surface prior to installation shall be included in the bid unit price.

Work related to the installation of pedestrian curb ramps or blended transitions surface (i.e. the concrete) prior to the placement of the DWP shall be paid under Item 701.001 Concrete Walking Surface (Maintenance).

Temporary traffic control devices as needed for the installation of Item 705.993 Cast-in-Place Resin Detectable Warning Panel (Maintenance) shall be paid under their respective items.

ITEM 701.995 COMPOSITE DETECTABLE WARNING PANEL (MAINTENANCE) SQUARE FOOT

GENERAL

Work under this item shall consist of furnishing and installing setting a Composite Detectable Warning Panel (DWP) at pedestrian curb ramps and/or blended transitions. The DWP shall be set on properly primed and clean surfaces. The Contractor shall adhere to City of Boston standards and Americans with Disabilities Act (ADA) for sizing and placement of truncated

domes on the detectable surface. The DWP includes both the base layer as well as truncated domes.

Refer to the following Pedestrian Ramp Details in the Roadway Design Standards:

R.5 Pedestrian Ramp - Detectable Warning Panel

The use of a composite DWP shall be at locations as determined and approved by the Engineer and/or shown on the Plans.

MATERIALS

Composite detectable warning panels shall have dome geometry in accordance with ADA Regulations for Detectable Warning on Curb Ramps. They shall be raised truncated domes with a nominal diameter of 0.9-inches, a nominal height of 0.2-inches, and a center-to-center spacing of 1.6 inches to 2.4-inches. Panels shall be 24-inches deep in the direction of travel and the full width of the proposed ramp. The panel shall be a homogenous glass and carbon reinforced composite, which is colorfast, and UV stable. The panel is to be colored throughout and not a painted coating. In Non-Historic Districts, the color shall be Federal Yellow, conforming to the requirements of Federal No. 33538, unless otherwise indicated on the plans or directed by the Engineer, In Historic Districts, the color shall be in conformance with RAL 2001. The panels shall have a compressive strength more than 10,000 psi, flexural strength more than 3,000 psi, and a slip resistance more than 0.80 wet or dry.

METHOD OF MEASUREMENT

Composite Detectable Warning Panel (Maintenance) will be measured per square foot complete in place. The measurement area shall be taken for the width of the panel (generally to be two feet wide) along either edge perpendicular to the curb, while the length shall be measured from the mid-point to mid-point of the sides, taken parallel to the curb.

BASIS OF PAYMENT

Composite Detectable Warning Panel (Maintenance) will be paid at the contract unit price per square foot complete in place, which price shall constitute full compensation for all forms/templates, labor, tools, equipment, material and incidentals necessary to complete the work. Cutting of panels due to utility covers, fitting along a curve, or any other modifications as required by the design and or Engineer shall be included in the bid unit price. Priming and cleaning of the existing surface prior to installation shall be included in the bid unit price.

Work related to the installation of pedestrian curb ramps or blended transitions surface (i.e. the concrete) prior to the placement of the DWP shall be paid under Item 701.001 Concrete Walking Surface (Maintenance).

Temporary traffic control devices as needed for the installation of Item 705.995 Composite Detectable Warning Panel (Maintenance) shall be paid under their respective items.

ITEM 701.999	CAST IRON DETECTABLE WARNING PANEL (MAINTENANCE)	SQUARE FOOT

GENERAL

Work under this item shall consist of furnishing and installing setting a Cast Iron Detectable Warning Panel (DWP) at pedestrian curb ramps and/or blended transitions. The DWP shall be set on properly primed and clean surfaces. The Contractor shall adhere to City of Boston standards and Americans with Disabilities Act (ADA) for sizing and placement of truncated domes on the detectable surface. The DWP includes both the base layer as well as truncated domes.

Refer to the following Pedestrian Ramp Details in the Roadway Design Standards:

R.5 Pedestrian Ramp - Detectable Warning Panel

The use of a composite DWP shall be at locations as determined and approved by the Engineer and/or shown on the Plans.

MATERIALS

Materials shall conform the relevant provisions related to cast iron detectable warning panels specified in Item 701.2.

METHOD OF MEASUREMENT

Cast Iron Detectable Warning Panel (Maintenance) will be measured per square foot complete in place. The measurement area shall be taken for the width of the panel (generally to be two feet wide) along either edge perpendicular to the curb, while the length shall be measured from the mid-point to mid-point of the sides, taken parallel to the curb.

BASIS OF PAYMENT

Cast Iron Detectable Warning Panel (Maintenance) will be paid at the contract unit price per square foot complete in place, which price shall constitute full compensation for all forms/templates, labor, tools, equipment, material and incidentals necessary to complete the work. Cutting of panels due to utility covers, fitting along a curve, or any other modifications as required by the design and or Engineer shall be included in the bid unit price. Priming and cleaning of the existing surface prior to installation shall be included in the bid unit price.

Work related to the installation of pedestrian curb ramps or blended transitions surface (i.e. the concrete) prior to the placement of the DWP shall be paid under Item 701.001 Concrete Walking Surface (Maintenance).

Temporary traffic control devices as needed for the installation of Item 705.999 Cast Iron Detectable Warning Panel (Maintenance) shall be paid under their respective items.

ITEM 702.	HOT MIX ASPHALT WALK SURFACE	TON
ITEM 702.1	HOT MIX ASPHALT WALK SURFACE (MAINTENANCE)	SQUARE FOOT
ITEM 703.	HOT MIX ASPHALT DRIVEWAY	TON
ITEM 703.1	HOT MIX ASPHALT DRIVEWAY (MAINTENANCE)	SQUARE FOOT

GENERAL

Work under these items shall conform to the relevant provisions of Section 701 of the MassDOT Standard Specifications and the following:

Refer to the following sidewalk details in the Roadway Design Standards:
S.3 Sidewalk – HMA

MATERIALS

Hot mix asphalt shall meet the relevant requirements of hot mix asphalt Superpave materials in these Special Provisions.

Asphalt top course shall conform to Item 455.245, Superpave Surface Course – 9.5(b) (SSC - 9.5(b)mm).

Asphalt intermediate course shall conform to Item 455.325, Superpave Intermediate Course – 19.0 (SIC – 19.0mm).

CONSTRUCTION METHODS

Hot Mix Asphalt Walk Surface shall include constructing new HMA sidewalks, repairing existing HMA sidewalks, and repairing existing HMA walks at the back of street line. The HMA shall be laid in 2 courses to a depth after rolling of 3 inches. The bottom course shall be 1½ inches thick, and its surface after rolling shall be 1½ inches below and parallel to the proposed grade of the finished surfaces. The top course shall be 1½ inches thick after rolling.

Hot Mix Asphalt Driveway shall include constructing new HMA driveways or repairing existing HMA driveways at the back of street line. The HMA driveway surface shall be laid in 2 courses to a depth, after rolling, of 4 inches. The bottom course shall be 2 inches thick, and its surface, after rolling, shall be 2 inches below and parallel to the proposed grade of the finished surface. The top course shall be 2 inches thick after rolling. A pedestrian path of travel must be maintained across the driveway opening. The dimensions, cross slope, grades and tolerances of the pedestrian path shall be in conformance with the standard construction details.

The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum).

Any casting requiring one (1) course or less of brick to adjust to the proper line and grade shall be considered incidental to these items.

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the

approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.

Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Hot Mix Asphalt Walk Surface and Hot Mix Asphalt Driveway will be measured by the ton, complete in place.

Hot Mix Asphalt Walk Surface (Maintenance) and Hot Mix Asphalt Driveway (Maintenance) will be measured per square foot of HMA furnished to the specified thickness and installed as measured by the Engineer.

BASIS OF PAYMENT

Hot Mix Asphalt Walk Surface and Hot Mix Asphalt Driveway will be paid for at the contract unit price per ton which price shall constitute full compensation for bitumen, and for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work. Any pavement removed at the back of street line shall be paid for under Item 120.1, Unclassified Excavation. Saw cutting will be paid for under Item 482.4, Saw Cut, unless otherwise specified in the Contract Documents.

Hot Mix Asphalt Walk Surface (Maintenance) and Hot Mix Asphalt Driveway (Maintenance) will be paid for at the contract unit price per square foot including the sawcutting, excavation, stripping, and/or removal of the of the existing bituminous material, furnishing, hauling, and placing all materials including forms and equipment, tools and all other incidental work necessary for final completion of the items as specified. All necessary gravel shall also be

considered incidental to Item 702.1 Hot Mix Asphalt Walk Surface (Maintenance) and Item 703.1 Hot Mix Asphalt Driveway (Maintenance).

All work must conform to the applicable ADA, PROWAG, and AAB standards.

It is the responsibility of the Contractor to notify the Resident Engineer of any repair that cannot be constructed to the applicable ADA, PROWAG, and AAB standards.

All work that does not meet the ADA, PROWAG, and AAB standards shall be replaced by the Contractor with no additional cost to the City of Boston.

ITEM 706.05 BRICK WALK – MORTAR JOINTS SQUARE YARD

GENERAL

The work under this item shall consist of furnishing and laying of brick paving bonded with mortar in a full mortar bed 1 inch in thickness including a minimum 3-inch or maximum 5-inch concrete base constructed on a gravel subbase of 6 inches minimum depth to the required lines and grades as shown on the plans and as required by the Engineer.

The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum).

MATERIALS

Brick

The brick shall be for exterior paving, bonded with mortar and shall meet the requirements of ASTM C902 - 79a, Class SX, Abrasion Type I, Application PS with a maximum 8% cold water absorption after a 24-hour submersion test and a 50-cycle freeze thaw test. Laminated brick will not be accepted. Unsanded side of brick beds shall be waxed with minimum 150° wax with not more than ½ of 1% oil content which after laying, shall be cleaned by Steam Jenny with capacity of 150 gallon per hour, 325°F coil temperature, 120 psi. Standard face brick shall not be acceptable. Each brick shall be individually molded in Cherry wood molds by single slugs of clay to eliminate lamination.

All brick shall be batch type burned to provide the various colors by controlled atmosphere and temperature conditions required to obtain the Boston City Hall colors, (85% red and 15% dark to purple) or as noted in the plans. The brick shall be highly resistant to abrasion and shall have an average compressive strength of 8,000 or more psi. The nominal size shall be 7 ¾ inches by 3 ½ inches by 2 ¼ inches.

Bricks shall be delivered to the site on pallets or in packages with wax surfaces protected by paper separators or facing each other.

The brick paving at the Boston City Hall was manufactured by the Stiles and Hart Brick Company of Bridgewater, MA 02324, but brick of other manufacturers conforming to the requirements of these specifications, especially to the matching of City Hall Blend of colors and texture will be accepted.

Sand

Sand shall be a clean, washed uniformly well graded masonry sand conforming to the requirements of ASTM C144 - 70 with the further requirements that the fineness modulus shall be maintained at 2.25 plus/minus 0.10. Sand shall be from a single source meeting these requirements and as approved by the Engineer after laboratory test. Source of supply shall not be changed during the course of job without written consent of the Engineer.

Portland Cement

Portland Cement shall conform to the requirements of AASHTO M 240 mortar.

Water

Water shall be potable and free of injurious contaminants.

Colorant

The colorant shall be of a type and quality which will not adversely affect workability, setting or strength and shall be compatible with the latex bonding agent employed. The color shall be chemically inert, non-fading, alkali fast mineral oxides, finely ground and specially prepared for use in cement mortar. Color of brick mortar shall closely match color of the brick. Colorant additive shall be "Color-Port", C-492 as manufactured by Riverton Corp or an approved equal.

Latex Bonding Agent

The latex bonding agent shall be non re-emulsifiable in the presence of moisture and shall have at least 50% internally plasticized solids. It shall be similar and equal to Laticrete and used in accordance with manufacturer's instructions. Laticrete 3701 is a grout and mortar admixture, manufactured by Laticrete International, Woodbridge, Connecticut.

Preformed Joint Filler

Preformed joint filler shall be non-extruding and resilient non-bituminous and shall conform to AASHTO M 153 65 Type II for Standard Cork Filler.

Joint Sealant

Joint sealer shall be a one part, moisture-cured, non-sag, polyurethane sealant which meets or exceeds Federal Specification TT-S00230c, Type II, Class A. Sealant shall be similar to Sikaflex-la as manufactured by Sika Chemical Corp, Lyndhurst, NJ, or an approved equal.

Compressible Filler

Compressible filler shall be installed along the perimeter of brick paving and at other locations where shown on the contract drawings or where directed by the Engineer.
The filler shall be pre-formed, closed-cell foam polyethylene, sponge rubber, and of proper thickness to be under compression, ⅜-inch thick and shall be kept 1 inch below the top of the

brick paving to allow the caulking with an additional sealant back-up which is compatible with the sealant used prior to the installation sealant itself.

Concrete Base

Concrete for base course shall conform to the requirements of Division III, Section M4.02 of the MassDOT Standard Specifications for Air-Entrained 4000 psi, ¾ inch, 610 Cement Concrete.

Sample Materials and Panels

Prior to ordering materials, the Contractor shall submit to the Engineer for approval, samples of brick and of masonry accessories. Samples of other materials to be used and samples for testing shall be submitted as requested by the Engineer. Bricks shall be submitted in whole straps or panels to show color range and texture. Before construction is begun a sample panel of at least 25 bricks shall be laid as a job site panel to be retained for reference until the project is accepted.

Material Storage

All materials shall be delivered, stored and handled to protect them from wetting, staining, chipping, or other damage. Cement and similar perishable materials shall be stored in watertight sheds with elevated floors. Bricks shall be stored off the ground and under watertight covers. Any material showing evidence of water or other damage will be rejected.

CONSTRUCTION METHODS

Excavation

The paving shall be designed to provide proper drainage at all points, above and below ground and the required excavation shall be made, and the subgrade shall be fine graded ⅛ inch to ¼ inch per foot to provide proper drainage of the ground before placing the gravel subbase.

Concrete Base Slab

The 3 to 5-inch cement concrete base slab, or depth as specified in the Contract Drawings, shall be constructed on the gravel subbase and rough finished true, uniform, parallel with and 3 inches below the surface of the finished brick paved areas. Expansion joints in the slab shall be located as shown on the plans or where directed by the Engineer. These are located not more than 16 feet apart and shall correspond to joints in the overlaying brick paving.

Brick Paving

Mortar for joints between bricks shall be mixed to a reasonably stiff consistency and shall consist of 1 part of Portland cement and 2 ½ parts of dry sand. To this there shall be added the latex bonding agent at the rate of not less than 1 gallon to 1 bag of Portland cement. The use of lime is prohibited. Mortar for exposed joints shall, in addition, contain the colorant herein specified, if colorant is to be used. The colorant shall not be used in excess of 7% by weight of cement.

All masonry shall be laid by skilled workmen under adequate supervision and shall be laid true to lines and levels referred to in previous paragraphs. Masonry work shall not be laid in temperatures below 40°F., unless provisions are made to adequately protect the masonry materials and the finished work from frost by heating materials, enclosing the work, and heating the enclosed spaces and contact surfaces. All masonry materials used in freezing weather shall be at a temperature between 50°F. and 90°F. Protect masonry against freezing for a minimum of 48 hours after being laid. Anti-freezing admixtures will not be allowed in the mortar. Frozen work shall not be built upon. Any completed work found to be affected by the frost shall be taken apart and rebuilt at the Contractor's expense.

The brick paving has been designed to provide adequate drainage at all points. If any condition is encountered between given elevations where drain-off is questionable, the Contractor shall notify the Engineer thereof and not proceed with the work until instructions are given. The finished work shall not deviate from the graded elevations.

After the excavation has been completed, the subgrade fine graded, the gravel subbase placed, fine graded and compacted, the concrete base slabs constructed, and before commencing the work of brick paving, the slabs shall be thoroughly cleaned of all dust, dirt and foreign matter. Coursing shall be laid out so that end conditions of bricks will not have to be cut to a length of less than 1 ½ inches. The bricks shall have a low rate of suction at the time they are laid. The brick shall not gain more than a maximum of 20 grams in weight when placed in ⅛ inch of water for 1 minute. The slab shall be thoroughly saturated with water before laying bricks, and the top surface of the slab shall be dry before starting to lay bricks.

Bricks shall be laid in a full setting bed of mortar at the proper level, with the unsanded waxed side up. Dip, brush or paint the back of each prewetted brick with a mixture of cement and Laticrete 3701 latex (Laticrete shall be mixed with water in a 1:1 ratio) or approved equal and set the brick into the freshly installed mud setting bed, tamping the brick level and true. Leveling of the brick shall be done as the setting operation proceeds so that it is not necessary to disturb the bricks set earlier. Grouting shall not be done until the under bed sets and hardens (Minimum 24 hours). Ungrouted brick areas will be protected from pedestrian traffic.

Joints shall be solidly filled to the full depth with mortar which has the colorant added (if specified). Joints shall be a nominal 5/16 inch to ⅜ inch wide. Care shall be taken not to smear mortar on adjoining brick, cut stone or other surface.

After the initial set of mortar, joints shall be finished by tooling with a 1-inch diameter non-staining jointer (a hard maple jointer is preferred) to produce a very slightly concave polished joint, free from drying cracks. After installation, the joints shall be cured for at least 5 days by covering with curing paper or other approved material. As soon as the joints have been cured, the wax shall be removed with high pressure steam. Care shall be taken not to damage mortar by overheating any area.

The Contractor shall be responsible for closing off traffic to avoid damage to paving until mortar has set.

In case the continuity of the work is suspended, the Contractor shall terminate his paving against temporary wood blocking. The bricks along this blocking shall be set in sand to allow

removal and toothing of the bricks in the work to be later continued. All exposed brick surfaces shall be thoroughly cleaned with a solution of soap and water, using stiff fiber brushes. In extreme cases area shall be wetted with a 5% solution of muriatic (hydrochloric)) acid but this shall be preceded and followed by a copious bath of fresh clean water.

All imperfect or frozen mortar joints shall be raked out to a depth of ⅜ inch and repointed as directed by the Engineer at the Contractor's expense. The entire work shall be left in perfect condition, clean and free from all blemishes.

NOTE: All bricks that are laid in a radial pattern shall be saw cut so they will have a uniform ⅜-inch joint.

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.

Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Brick Walk – Mortar Joints will be measured by the square yard, complete in place.

BASIS OF PAYMENT

Brick Walk – Mortar Joints will be paid for at the contract unit price per square yard which price shall constitute full compensation for furnishing and installing all bricks, concrete base, mortar

joints, compressible filler, sealant, steam cleaning, and all labor, tools, equipment, materials and incidentals necessary to complete the work.

The forming of all tree pits shall be considered as incidental work.

Excavation will be paid for under Item 120.1, Unclassified Excavation.

Gravel will be paid for under Item 151.02, Gravel.

Pedestrian ramps, in accordance with City of Boston Standard Details and special details shown on plans, shall be constructed as directed throughout the project. Shaping of the cement concrete base and brick work adjacent to the pedestrian ramps shall be included for payment under Item 706.05, Brick Walk - Mortar Joints.

ITEM 706.15 BRICK WALK RESET OR REPLACED IN KIND SQUARE YARD
ITEM 706.151 BRICK WALK RESET OR REPLACED IN KIND (MAINTENANCE) SQUARE FOOT

GENERAL

The work under this item shall consist of resetting or replacing brick sidewalks where shown on the plans, or as directed by the Engineer.

The existing brick sidewalks may be constructed in a variety of patterns and on several different bases (cement concrete, hot mix asphalt, or stone dust).

It is the intent of the City under this item to relay or replace existing brick walks and install new brick walks as shown on the plans or as directed by the Engineer. Any bricks considered salvageable by the Engineer shall be carefully removed, cleaned, and reused. New bricks will be required to supplement missing and unsalvageable bricks.

Where the existing brick sidewalk is disturbed, the Engineer shall direct the Contractor to reset or replace the affected areas using the appropriate method. Specifications for brick on cement concrete (Item 706.05, Brick Walk – Mortar Joints), brick on stone dust (Item 706.25, Brick Sidewalk on Stone Dust Setting Bed) and brick on hot mix asphalt (Item 706.26, Brick Sidewalk on Hot Mix Asphalt Setting Bed) are included in these Special Provisions. All brickwork shall conform to one of the above-mentioned specifications; however, all brickwork will be paid for under Item 706.15.

The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum).

CONSTRUCTION METHODS

In the areas to be repaired, the Contractor shall remove, clean, and stockpile all brick designated as reusable by the Engineer.

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.

Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat

moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Brick Walk Reset or Replaced in Kind will be measured by the square yard, complete in place.

Brick Walk Reset or Replaced in Kind (Maintenance) will be measured by the square foot, complete in place.

BASIS OF PAYMENT

Brick Walk Reset or Replaced in Kind will be paid for at the contract unit price per square yard which price shall be full compensation for removing, cleaning, transporting, stockpiling, and installing existing brick designated for reuse, furnishing and installing new brick, and for all labor, tools, equipment, materials and all incidentals necessary to complete the work.

Brick Walk Reset or Replaced in Kind (Maintenance) will be paid for at the contract unit price per square foot which price shall be full compensation for removing, cleaning, transporting, stockpiling, and installing existing brick designated for reuse, furnishing and installing new brick, and for all labor, tools, equipment, materials and all incidentals necessary to complete the work.

For Item 706.15, excavation of existing subbase materials and disposal of unsalvageable bricks will be paid for under Item 120.1, Unclassified Excavation.

For Item 706.151, excavation of existing subbase materials and disposal of unsalvageable bricks shall be considered incidental to the work.

For both Items 706.15 and 706.151, any gravel furnished and placed will be paid for under Item 151.02, Gravel.

No separate payment will be made for removing, cleaning, transporting and stockpiling bricks designated to be reused, furnishing and installing additional new bricks, stone dust for setting bed or joints, cement concrete base, mortar, sand asphalt setting bed, HMA intermediate course and surface course, but all costs in connection therewith shall be included in the contract unit price bid.

ITEM 706.25 BRICK SIDEWALK ON STONE DUST SETTING BED SQUARE YARD

GENERAL

The bricks will be laid on a stone dust setting bed, on a properly leveled and compacted gravel subbase. New and salvaged brick shall be interspersed in so far as is practical.

The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum).

MATERIALS

Brick

A. The bricks shall be for exterior paving and shall meet or exceed the requirements and allowances of ASTM C902, Class SX, Abrasion Type I, and Application PX.

B. The bricks shall be Pine Hall Pavers, wire cut brick pavers as manufactured by Pine Hall Brick, P.O. Box 11044, 2701 Shorefair Dr. (27105), Winston-Salem, NC 27116-1044 and distributed by Spaulding Brick Co., 5 Lopez Road, Wilmington, MA (617) 666-3200, or approved equal.

C. The color shall be Pathway Red, Full Range or an approved equal. Bricks shall be 8 inches by 4 inches by 2 ¼ inches with a wire cut texture.

D. All materials shall be delivered, stored, and handled to protect them from wetting, staining, chipping, or other damage. Perishable materials shall be stored in watertight sheds with elevated floors. Bricks shall be stored off the ground and under watertight covers. Any material showing evidence of water or other damage will be rejected.

Stone Dust

Stone dust shall consist of inert materials that are hard, durable stone, free from surface coatings and deleterious materials. Gradation requirements shall be as follows:

Stone Dust Gradation Requirements

Sieve Size	Minimum Percent Passing by Weight
No. 4	100
No. 8	96
No. 16	68
No. 30	43
No. 50	29
No. 100	17
No. 200	11

CONSTRUCTION METHODS

The gravel subbase shall be prepared and compacted to a grade parallel to and 2 inches (minimum) plus the thickness of a brick below the finished surface. On the properly prepared subbase, a layer of stone dust shall be spread. Special care shall be taken to make the surface of the stone dust parallel to the finished grade of the sidewalk. The stone dust shall be rolled, tamped, and sprinkled to form a compacted layer of sufficient thickness (2-inch minimum) to bring the bricks to the proper grade and slope when rammed firm.

The bricks shall be laid to match the brick pattern noted in the plans, with hand tight butt joints. A plank covering several courses shall be placed upon the bricks and carefully rammed with a heavy rammer until the bricks reach a firm, unyielding bed and present a surface of the proper grade and slope. Any divergence from line and grade is to be corrected by taking up and relaying the bricks.

After bricks are rammed, sweep in stone dust until joints are completely filled. Fog lightly with water, repeating the process a minimum of three times or until joints are compacted and full. All surplus stone dust remaining on the sidewalk after the joints have been properly filled shall be removed carefully by sweeping. Care shall be taken to avoid raking out the joints during the removal of the stone dust.

All fitted pieces of brick shall be saw cut and shall be no smaller than 2 inches wide by 3 inches long.

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.

Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Brick Walk on Stone Dust Setting Bed will be measured by the square yard, complete in place.

BASIS OF PAYMENT

Brick Walk on Stone Dust Setting Bed will be paid for at the contract unit price per square yard which price shall constitute full compensation for furnishing and installing new brick, stone dust for setting bed and joints, and for all labor, tools, equipment, materials and all incidentals necessary to complete the work.

Excavation of existing subbase materials will be paid for under Item 120.1, Unclassified Excavation.

Any gravel furnished and placed will be paid for under Item 151.02, Gravel.

ITEM 706.26	BRICK SIDEWALK ON HOT MIX ASPHALT SETTING BED	SQUARE YARD
ITEM 706.261	BRICK SIDEWALK ON HOT MIX ASPHALT SETTING BED (MAINTENANCE)	SQUARE FOOT

GENERAL

The work under this item shall consist of furnishing and laying of brick paving with hand-tight butt joints swept with a polymeric sand on mastic adhesive on a sand asphalt setting bed on a hot mix asphalt top course (dense mix) on a hot mix asphalt dense binder course on a gravel base course to the required lines and grades as shown on the Drawings. The cross slope of the finished sidewalk shall not exceed 1.5% (2% maximum).

Refer to the following sidewalk details in the Roadway Design Standards:
S.2 Sidewalk – Brick

MATERIALS

Before proceeding with the work, the Contractor will be required to submit brick samples to the Engineer/Landscape Architect for approval. Samples of brick shall be submitted in whole straps or panels to show the color range and texture. Before construction is begun a sample panel of at least 25 bricks shall be laid as a job site panel to be retained for reference until the project is accepted.

Brick

A. The bricks shall be for exterior paving and shall meet or exceed the requirements and allowances of ASTM C902, Class SX, Abrasion Type I, and Application PX.

B. The bricks shall be Pine Hall Pavers, wire cut brick pavers as manufactured by Pine Hall Brick, P.O. Box 11044, 2701 Shorefair Dr. (27105), Winston-Salem, NC 27116-1044 and distributed by Spaulding Brick Co., 5 Lopez Road, Wilmington, MA (617) 666-3200, or approved equal.

C. The color shall be Pathway Red, Full Range or an approved equal. Bricks shall be 8 inches by 4 inches by 2 ¼ inches with a wire cut texture.

D. All materials shall be delivered, stored, and handled to protect them from wetting, staining, chipping, or other damage. Perishable materials shall be stored in watertight sheds with elevated floors. Bricks shall be stored off the ground and under watertight covers. Any material showing evidence of water or other damage will be rejected.

Mastic Adhesive - Adhesive shall consist of 2% neoprene (Grade WM1) oxidized asphalt with 155°F softening point (80 penetration).

Sand Asphalt Setting Bed - Asphalt cement shall conform to ASTM D946, penetration grade 85-100. Sand shall be clean, hard sand with durable particles uniformly graded from coarse to fine and all passing the No. 4 sieve and conforming to ASTM C144. The asphalt cement and sand shall be mixed at an asphalt plant in the proportion of 7% asphalt cement and 93% sand.

The mix shall be heated to 300°F.

Hot Mix Asphalt Surface Course – Asphalt surface course shall conform to Item 455.245, Hot Mix Asphalt Surface Course – 9.5(b) (SSC – 9.5(b)mm).

Hot Mix Asphalt Intermediate Course – Asphalt intermediate course shall conform to Item 455.325, Hot Mix Asphalt Intermediate Course – 19.0 (SIC – 19.0mm).

CONSTRUCTION METHODS

Excavation - Excavation shall conform to the requirements of Item 120.1, Unclassified Excavation.

Hot Mix Asphalt Surface Course and Hot Mix Asphalt Intermediate Course - Top and dense binder courses shall be placed in accordance with the relevant provisions of Section 701 to the depths after rolling as shown on the Drawings. The finished surface of the top course shall be 3 inches below and parallel to the proposed finished sidewalk grade.

Sand Asphalt Setting Bed - Sweep the hot mix asphalt top course clean. Set ¾-inch depth bars; adjust with shims where necessary to bring the bars to proper grade. Spread sand asphalt mixture and pull with striking board over the control bars several times. After each pass, shower fresh mix over low spots until a smooth, firm and even setting bed is achieved. Carefully fill depressions remaining after depth control bars and shims are removed. Roll while hot with a light steel roller to a final surface depth.

Brick Laying

A. All brick shall be laid by skilled workmen under adequate supervision, true to lines and levels and patterns as shown on the Drawings or as directed by the Engineer. Contractor will take care to select bricks which will allow accurate patterns and uniform joint alignment, especially for corner conditions around tree grate bands.

B. Cut bricks to provide butt joints with parallel brick edges. Use no brick smaller than one-half size in any dimension for any cut pieces.

C. All brick cutting shall be accomplished with a water-cooled masonry saw only.

D. The brick paving has been designed to provide adequate drainage at all points. If any condition is encountered between given elevations where drain-off is questionable, the Contractor shall notify the Engineer and not proceed with the work until instructions are given. The finished work shall not deviate from the graded elevations.

E. Apply asphalt mastic adhesive to the sand asphalt setting bed using a trowel having 1/16-inch serrations.

F. Set brick with hand-tight joints in the various patterns shown on the drawings. Saw cut brick to fit as required by job conditions. Use machine saw cuts only.
G. Protect newly installed units with plywood panels against uneven settlement and misalignment and correct any deficiencies. Continually check the surface for finished

line and grade with a straight edge. If any settlement occurs that produces a mismatch of more than 1/16-inch at the interface between brick pavements and other pavements prior to final acceptance, relay the bricks near the interface for a sufficient distance to provide a smooth transition of the brick surfaces and to provide a satisfactory match between brick and adjacent surfaces.

H. Fill joints between bricks with an interlocking sand meeting the gradation requirements of ASTM C144 swept into joints until completely filled. Fog surface with water to compact mix into the joints. Repeat the process until joints are compacted and filled. Sand shall either be pre-treated with a polymeric joint stabilizer or a liquid polymeric joint stabilizer shall be applied. The Contractor shall strictly adhere to the manufacturer's instructions for application. The joint stabilizer shall not discolor the brick surface. Stabilizers shall be water-based so as to not damage the asphalt setting bed. **Sand cement mixes shall not be used**. All sand joint stabilizing products shall be approved by the Engineer prior to use. Should staining occur, stains shall be cleaned immediately by Steam Jenny with capacity of 150 gallons per hour, 325°F coil temperature, 120 psi.

ASTM C144

	Percent Passing by Weight	
Sieve Size	**Natural Sand**	**Manufactured Sand**
No. 4	100	100
No. 8	95-100	95-100
No. 16	70-100	70-100
No. 30	40-75	40-75
No. 50	10-35	20-40
No. 100	2-15	10-25
No. 200	0-5	0-10

Working Adjacent to Trees

No tree shall be removed by the Contractor in conjunction with highway work without the approval of the City of Boston Parks and Recreation Department.

During the performance of highway work, the Contractor shall exercise special care to minimize damage to trees. Excavation where tree roots are present shall be done entirely by hand.

When major roots are in the way, pipes or conduits shall be placed under or between roots, if possible, to avoid cutting them.
Roots over 2 inches in diameter which are severed shall be trimmed and shall be painted with a tree-healing paint (not creosote).

In order to prevent fungus infection, no torn or damaged ends shall be left.

The cut ends shall be painted with a mixture of ⅓ loam, ⅓ sand, and ⅓ leaf mulch (or peat moss, commercial baled variety corrected to a pH of 6 to 7.

Exposed roots shall not be left to dry in heat or sun or to freeze in cold but shall be covered

promptly. In no case shall more than ⅓ of the total root structure be disturbed or cut.

When working near trees, the Contractor shall avoid injuring the bark. If damage to bark occurs, the bark shall be cut back to a clean edge and the wound shall be covered with a tree-healing paint.

Where directed by the Construction Engineer, the Contractor shall cut off roots of existing trees and the related work shall be considered as incidental.

METHOD OF MEASUREMENT

Brick Sidewalk on Hot Mix Asphalt Setting Bed will be measured by the square yard, complete in place.

Brick Sidewalk on Hot Mix Asphalt Setting Bed (Maintenance) and Brick Sidewalk on Edge on Hot Mix Asphalt Setting Bed (Maintenance) will be measured by the square foot, complete in place.

BASIS OF PAYMENT

Brick Sidewalk on Hot Mix Asphalt Setting Bed will be paid for at the contract unit price per square yard which price shall constitute full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work.

Brick Sidewalk on Hot Mix Asphalt Setting Bed (Maintenance) will be paid for at the contract unit price per square foot which price shall constitute full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work.

For Item 706.26, excavation of existing subbase materials and disposal of unsalvageable bricks will be paid for under Item 120.1, Unclassified Excavation.

For Item 706.261, excavation of existing subbase materials and disposal of unsalvageable bricks shall be considered incidental to the work.

For both Items 706.26 and 706.261, any gravel furnished and placed will be paid for under Item 151.02, Gravel.

No separate payment will be made for hot mix asphalt setting bed (sand asphalt setting bed, HMA Superpave surface course, HMA Superpave intermediate course, bricks, or adhesive, but all costs in connection therewith shall be included in the contract unit price bid.

Any gravel furnished and placed will be paid for under Item 151.02, Gravel.

ITEM 706.35 MISCELLANEOUS PAVEMENTS EXCAVATED FOR SALVAGE SQUARE YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 120 of the MassDOT Standard Specifications and the following:

It is the intent under this item to recover all existing pavement materials that are in good condition and of a historic nature at all locations within the limits of this contract for reuse by the City of Boston. Examples of such pavements are: granite cobbles, granite slabs, original bricks (yellow and red), slate slabs, granite bollards, etc.

The Contractor shall transport salvaged material from the job site to the location directed by the Engineer. The Contractor shall carefully excavate and load the materials into vehicles for transportation from site. Reasonable care shall be exercised to render the salvaged material free of roots, trees, asphalt, cement or any other foreign materials. The Contractor will work in close cooperation with the Superintendent of Highway Maintenance or his/her representatives to insure proper scheduling for the delivery of salvaged materials.

METHOD OF MEASUREMENT

Miscellaneous Pavements Excavated for Salvage will be measured by the square yard prior to excavation.

BASIS OF PAYMENT

Miscellaneous Pavements Excavated for Salvage will be paid for at the contract unit price per square yard which price shall constitute full compensation for removing and loading, transportation of materials, for all labor, tools equipment, materials and all incidentals necessary to complete the work.

Any excavation required below or adjacent to the salvaged pavements, or pavements and materials not deemed salvageable, will be paid for under Item 120.1, Unclassified Excavation.

No payment will be made under this item for any materials removed and reset or relaid on the same street in this contract.

ITEM 706.4 BLACK STEEL BOLLARD 4-INCH DIAMETER EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 701 of the MassDOT Standard Specifications and the following:

The work shall consist of furnishing and installing galvanized and powder coated steel pipe bollards filled with cement concrete and set in a cement concrete base as shown on the plans, in accordance with these special provisions, and/or as required by the Engineer.

MATERIALS

Bollards: Pipe used for bollards shall be 6-foot lengths of 4-inch outside diameter steel pipe

Coatings: Provide manufacturer's best-quality powder coating materials that are factory formulated and recommended by manufacturer for application indicated.

Reflective Tape: A 3-inch wide yellow reflector tape shall be securely attached horizontally around the bollard 8 inches from the top and after coating has cured. Tape shall meet requirements of ASTM D4956.

CONSTRUCTION METHODS

Surface preparation:

Clean ungalvanized surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.

Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

Galvanizing:

Hot-dip zinc coat pipe according to ASTM F1083 - 93 or approved equal.

Powder Coating:

Coat bollard with shop-applied three-coat urethane or fluoropolymer powder coating system. Coatings shall be as follows or an approved equal:

Urethane System: (Surface Preparation: SSPC-SP6)

One Coat:
1. Tnemec 90-1K97 at 3 mils DFT;
2. PPG PMC 68 at 3 mils DFT;
3. Dupont Urethane Ganicin Zinc Rich Primer 80% zinc load at 3.0 mils DFT
4. International Interzinc 315 at 2.0 to 3.0 mils DFT
5. Sherwin-Williams Corothane Galvapac 1K at 2.0 to 4.0 mils DFT

And One Coat
1. Tnemec N69 Hi-Build Epoxoline II at 3.0 mils DFT
2. PPG PMC Amerlock 400 Hi-Build Epoxy at 3.0 to 5.0 mils DFT.
3. Dupont 25P High Solids Epoxy at 4.0 to 6.0 mils DFT
4. International Intergard 475 HS at 4.0 to 8.0 mils DFT
5. Sherwin-Williams Macropoxy 646 at 5.0 to 10.0 mils DFT

And One Coat
1. Tnemec 1075 Endura-Shield at 3.0 mils DFT
2. PPG PMC Amerlock 450H Polyurethane Topcoat at 3.0 mils DFT
3. Dupont High Solids Imron Urethane at 4.0 mils DFT
4. International Interthane 990 HS at 2.0 to 3.0 mils DFT
5. Sherwin-Williams Acrolon 218 HS at 3.0 to 6.0 mils DFT

Fluoropolymer System:
(Surface Preparation: SSPC-SP6)

One Coat
1. Tnemec 90-1K97 at 3.0 mils DFT; use for touch-up
2. Dupont Ganicin Urethane Zinc Rich at 3.0 mils DFT
3. PPG Coraflon ADS570 Zinc Rich Epoxy Primer at 3.0 mils DFT
4. Sherwin-Williams Corothane Galvapac 1K at 2.0 to 4.0 mils DFT

And One Coat
1. Tnemec V73 Endura-Shield at 3.0 mils DFT
2. Dupont Imron HS at 3.0 mils DFT
3. PPG Pitthane HB Urethane 95-8800 at 3.0 mils DFT
4. Sherwin-Williams Acrolon 218 HS at 3.0 to 6.0 mils DFT

And One Coat
1. Tnemec 1070 Fluoronar at 2.0 mils DFT with 1072 semi-gloss finish
2. Dupont Fluoropolymer at 3.0 mils DFT
3. PPG Coraflon ADS Fluoropolymer at 1.5-2.0 mils DFT
4. Sherwin-Williams Fluoro Kem at 2.5 to 3.0 mils DFT

Installation:

Install bollards as shown on the plans. Bollards shall be set plumb and project 4 feet above the finished surface. Fill pipe with 4,000 psi, ⅜ inch, 660 concrete mounded at the top to shed water.

METHOD OF MEASUREMENT

Black Steel Bollard 4-Inch Diameter will be measured by the each, complete in place.

BASIS OF PAYMENT

Black Steel Bollard 4-Inch Diameter will be paid per at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

No separate payment will be made for galvanized and powder coated pipe, cement, excavation, backfill and formwork for foundations, but all costs in connection therewith shall be included in the Contract unit price bid.

ITEM 706.5 BOLLARD RESET EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 701 of the MassDOT Standard Specifications and the following:

The work shall consist of removing, storing, and resetting existing bollards of various types and sizes as shown on the plans, in accordance with these special provisions, and as/or required by the Engineer.

CONSTRUCTION METHODS

The pipe shall be set plumb above the finished surface. The bollard shall be set in cement concrete base as shown in the detail.

Unit Installation

Refer to the specific site elements and the Drawings for horizontal and vertical alignment.

Bollard shall be securely installed to a ¼-inch tolerance overall and shall be installed plumb and level, unless otherwise shown in the Drawings. Items that fall outside of this tolerance shall be required to be reset to meet tolerance, as a condition of acceptance.

Protection

Protect all stored and installed units from damage, use, theft, or vandalism until acceptance. Contractor shall adjust, repair, or replace damaged, missing, or unacceptable items at their own expense. Site items shall be clean, and finishes shall be as specified as condition of acceptance. Contractor to clean with non-abrasive means, careful not to damage finishes.

METHOD OF MEASUREMENT

Bollard Reset will be measured per the each, complete in place.

BASIS OF PAYMENT

Bollard Reset will be paid for at the contract unit price per each which price shall constitute full compensation for resetting existing bollards, including cleaning and all labor, tools, equipment, materials, and incidentals necessary to complete the work.

ITEM 706.7 PERMEABLE PAVERS SQUARE YARD

GENERAL

The work consists of providing and installing permeable pavers and stone base courses for stormwater treatment and infiltration as shown on the Contract Drawings and as listed below.

Submittals

Permeable Pavers

A. Samples for verification: Three representative full-size samples of each paver type, thickness, color and finish that indicate the range of color variation and texture expected upon project completion.

B. Accepted samples become the standard of acceptance for the product produced.

C. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C936.

D. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

Permeable Joint Opening and Setting Bed Aggregate

A. Provide three representative one-pound samples in containers of aggregate materials that indicate the range of color variation and texture expected upon project completion.

B. Accepted samples become the standard of acceptance for the product produced.

C. Test results from an independent testing laboratory for compliance with ASTM No. 8.
D. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C136.

E. Test results for void space percentage per ASTM C29.

Permeable Base and Aggregate

A. Test results from an independent testing laboratory for compliance with ASTM No. 57.

B. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C136.

C. Test results for void space percentage per ASTM C29.

Paving Installation Contractor

A. Job references from a minimum of three projects similar in size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

Quality Assurance

Utilize a Manufacturer having at least 10 years of experience manufacturing interlocking concrete pavers on projects of similar nature or project size.

Source Limitations

A. Obtain Permeable Pavers from one source location with the resources to provide products of consistent quality in appearance and physical properties.

B. Obtain Permeable Joint Opening Aggregate from one source with the resources to provide materials and products of consistent quality in appearance and physical properties.

Paving Contractor Qualifications

A. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.

B. Utilize a Contractor conforming to all local, state licensing and bonding requirements.

Mockups

A. Install a 1.5 ft x 7 ft paver area.

B. Use this area to determine surcharge of the bedding aggregate layer, joint sizes, lines, laying pattern(s), color selection, and levelness.

C. This area will be used as the standard by which the work will be judged.

D. Subject to acceptance by the City, mock-up may be retained as part of finished work.

E. If mock-up is not retained, remove, and properly dispose.

Delivery, Storage & Handling

Manufacturer required to complete production of materials within 30 days after order has been placed to avoid construction delays.

Deliver Permeable Pavers in manufacturer's original, unopened and undamaged container packaging with identification labels intact.

A. Coordinate delivery and paving schedule to minimize interference with normal use of streets and sidewalks adjacent to paver installation.

B. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.

C. Unload pavers at job site in such a manner that no damage occurs to the product or adjacent surfaces.

Store and protect materials such that they are kept free from mud, dirt, and other foreign materials.

Project/Site Conditions

Environmental Requirements

A. Do not install permeable pavers on bedding sand.

B. Do not install pavers on frozen permeable setting bed aggregate materials.

C. Do not install pavers over frozen permeable base or subbase aggregates.

D. Do not install permeable base or subbase aggregates over frozen subgrade.

Maintenance

Provide a minimum of 5% additional material for overage to be used during construction.

Contractor to provide 100 square feet of each product and size used to City for maintenance and repair. Furnish Pavers from the same production run as installed materials.

Manufacturer to supply maintenance and reinstatement manuals for Permeable Pavers.

MATERIALS

Permeable Paver

A. Pavers shall be Hanover Permeable Pavers as manufactured by Hanover Architectural Products, 5000 Hanover Road, Hanover, PA (www.hanoverpavers.com) or approved equal.

B. Concrete Permeable Unit shall be 4” x 8” sized at 3 7/8” x 7 7/8” x 3”. Finish: Natural.

C. Pavers shall have a minimum compressive strength of 8,000 pounds per square inch at 28 days, a maximum absorption rate 5% or less at 50 cycles of freeze thaw testing per ASTM C67, and a density of 155.0 pounds per cubic foot.

D. Pavers are made from Portland cement, fine and coarse aggregates. The aggregate used should have a PA S.R.L. Test of H and a Specific Gravity of 2.78 and Absorption of 2.60. The aggregates should be washed with no deleterious substances, with no thin or elongated pieces. The aggregates should have a L.A. Abrasion Test of 21 and L.A. Rattles Loss Test of 21.8% (at 500 revolutions). Most specifically, the aggregates should have a Wash Test of less than 1%. This includes materials lost by washing the aggregate-even those finer than 200 mesh. Mix should be prepared in a stationary mixer to a five-inch slump, mixed a maximum time of two minutes and placed in the mold in a homogeneous state. The whole of the paver is to be the same design and a single mix system. Hydraulic pressure to be employed should be a minimum of 800,000 pounds without the use of any vibration.

E. Concrete pavers are to be integrally colored with custom blended shades. Final color approval shall be made by City or authorized representative after viewing mock up.

   Product color: Red/Charcoal Blend

   Product Joints: Manufacturer’s hidden spacers shall be built in to the paver.

F. Pavers shall meet the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units.

   1. Average compressive strength 8,000 psi with no individual unit under 7,200 psi.

   2. Average absorption of 5% with no unit greater than 7% when tested according to ASTM C 140.

   3. Resistance to 50 freeze-thaw cycles, when tested according to ASTM C 67, with no breakage greater than 1.0% loss in dry weight of any individual unit. This test method shall be conducted not more than 12 months prior to delivery of units.

G. Accept only pigments in concrete pavers conforming to ASTM C979. ACI Report No. 212.3R provides guidance on the use of pigments.

Note: Efflorescence is a whitish powder-like deposit that sometimes appears on concrete products. Calcium hydroxide and other water-soluble materials form or are present during the hydration of Portland cement. Pore water becomes saturated with these materials and diffuses to the surface of the concrete. When this water evaporates, the soluble materials remain as a whitish deposit on the concrete surface. The calcium hydroxide is converted to calcium carbonate during a reaction with carbon dioxide from the atmosphere. The calcium carbonate is difficult to remove with water. However, the efflorescence will wear off with time, and it is advisable to wait a few months before attempting to remove any efflorescence. Commercially available cleaners can be used, provided directions are carefully followed.

Some cleaners contain acids that may alter the color of the pavers.

Maximum allowable breakage of product is 5%.

Permeable Joint Opening and Setting Bed Aggregate

Provide Permeable Joint Opening and Setting Bed Aggregate materials conforming to ASTM C33 and gradation requirements of ASTM D448 No. 8 as presented in Table 1. All aggregate shall be clean and double-washed.

Table 1. Permeable Setting Bed Aggregate Gradation Requirements

ASTM No. 8	
Sieve Size	**Percent Passing**
½ inch	100
⅜ inch	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

Permeable Base Aggregate

Provide Permeable Base Aggregate materials conforming to ASTM C33 and gradation requirements of ASTM D448 No. 57 as presented in Table 2. All aggregate shall be clean and double-washed.

Table 2. Base Aggregate Gradation Requirements

ASTM No. 57	
Sieve Size	**Percent Passing**
1 ½ inch	100
1 inch	95 - 100
½ inch	25 - 60
No. 4	0 - 10
No. 8	0 - 5

Permeable Sub-Base Aggregate

Provide Permeable Base Aggregate materials conforming to ASTM C33 and gradation requirements of ASTM D448 No. 2 as presented in Table 3. All aggregate shall be clean and double-washed.

Table 3. Sub-Base Aggregate Gradation Requirements

ASTM No. 2	
Sieve Size	**Percent Passing**
3 inch	100
2 ½ inch	90 - 100
2 inch	35 - 70
1 ½ inch	0 - 15
¾ inch	0 - 5

Note: Provide washed, clean, zero plasticity, free from deleterious or foreign matter, crushed, angular rock and contain no No. 200 sieve size aggregate materials used in the construction of permeable pavement. Aggregate materials serve as the structural load bearing platform of the pavement as well as a temporary receptor for the infiltrated water that is collected through the openings in the pavement's surface.

CONSTRUCTION METHODS

Examination

Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance before placing the Permeable Concrete Pavers.

A. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.

B. Verify that Geotextiles, if applicable, have been placed according to drawings and specifications.

C. Verify that Permeable Base Aggregate materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.

D. Provide written density test results for soil subgrade and Permeable Base Aggregate materials to the City, General Contractor and paver installation subcontractor.

E. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

Proceed with installation only after unsatisfactory conditions have been corrected.

Preparation

A. Verify that the soil subgrade is free from standing water.

B. Stockpile Permeable Setting Bed, Joint, and Base Aggregate materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

C. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the Permeable Base Aggregate materials.

D. Keep area where pavement is to be constructed free from sediment during entire job. Remove and replace all Permeable Joint, Setting Bed, and Base Aggregate materials contaminated with sediment with clean materials.

E. Complete all subdrainage of underground services within the pavement area in conjunction with subgrade preparation and before the commencement of Permeable Base Aggregate construction.

F. Do not damage underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.

G. Compact soil subgrade uniformly to at least 90% of Standard Proctor Density per ASTM D698 for pedestrian areas. Compact soil subgrade uniformly to at least 95% Modified Proctor per ASTM D1557 for vehicular areas.

H. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof-rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground. Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the driveway, street, or parking area. The truck shall traverse the length of the street or parking area once for each 12 feet of width at speeds less than 5 mph. Additional passes along the traverse shall be completed as directed by the DFD Project Representative to further define unsatisfactory subgrade.

I. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with compacted backfill or fill as directed.

Note: Compaction of the soil subgrade shall be based on the recommendations of the Designing Engineer. The Engineer shall inspect subgrade preparations, elevations and conduct density tests for conformance to specifications.

Note: Mechanical tampers (jumping jacks) are recommended for compaction of soil subgrade and aggregate base around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions. Areas not accessible to roller compaction equipment shall be compacted to the specified density with mechanical tampers.

CAUTION - Care shall be taken around the perimeters of excavations, buildings, curbs, etc. These areas are especially prone to consolidation and settlement. Wedges of backfill shall not be placed in these areas. If possible, backfilling and compacting in these areas particularly shall proceed in shallow lifts, parallel to the finished surface.

Installation

Edge Restraints

A. Steel edging shall be installed where pavers where specified on the plans or as directed by the Engineer.

Permeable Sub-Base Aggregate (No. 2 Stone)

A. Provide the Permeable Sub-Base Aggregate in uniform lifts not exceeding 6 inches, loose thickness and compact to at least 95% as per ASTM D4254 to depths as indicated.
B. Compact the aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10-ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
C. Tolerance: Do not exceed the specified surface grade of the compacted aggregate material more than ± ¾ inches over a 10-foot long straightedge laid in any direction.
D. Grade and compact the upper surface of the aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

Note: In-place density of the aggregate materials may be checked per ASTM D4254. Compacted density shall be 95% of the laboratory index density established for the subbase and base stone.

Permeable Base Aggregate (No. 57 Stone)

A. Provide the Permeable Base Aggregate in uniform lifts not exceeding 6 inches, loose thickness and compact to at least 95% as per ASTM D4254 to depths as indicated.
B. Compact the aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10-ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
C. Tolerance: Do not exceed the specified surface grade of the compacted aggregate material more than ±¾ inches over a 10-foot long straightedge laid in any direction.
D. Grade and compact the upper surface of the aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

Note: In-place density of the aggregate materials may be checked per ASTM D4254. Compacted density shall be 95% of the laboratory index density established for the subbase and base stone.

Permeable Setting Bed Aggregate (No. 8 Stone)

A. Provide and spread aggregate evenly over the base course and screed to a nominal thickness of 1 ½ inches.
   1. Do not disturb screeded aggregate.
   2. Do not substantially exceed screed area which cannot be covered by pavers in one day.
   3. Do not use aggregate material to fill depressions in the base surface.
B. Keep moisture content constant and density loose and constant until pavers are set and compacted.
C. Inspect the aggregate course prior to commencing the placement of the permeable concrete pavers.

Permeable Pavers

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.

D. Provide Permeable Pavers using joint pattern as indicated. Adjust joint pattern at pavement edges such that cutting of edge pavers is minimized. Cut all pavers exposed to vehicular tires no smaller than one-third of a whole paver.

E. Place units hand tight against spacer bars. Adjust horizontal placement of laid pavers to align straight. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

F. Provide space between paver units of 1/32 inches wide to achieve straight bond lines.

G. Do not exceed joint (bond) lines more than ±½ inches over 50 feet from string lines.

H. Fill gaps between units or at edges of the paved area that exceed ⅜ inch with pieces cut to fit from full-size unit pavers.

I. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

J. Where full units are not possible and cutting is required, place cut pavers on the side of the paver strip furthest from the flow of pedestrian traffic.

K. Do not allow traffic on installed pavers until Permeable Joint Aggregate has been vibrated into joints. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and Permeable Joint Aggregate material.

L. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 5000-lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
2. Compact installed concrete pavers to within 6 feet of the lying face before ending each day's work. Cover pavers that have not been compacted and leveling course on which pavers have not been placed, with non-staining plastic sheets to prevent Permeable Setting Bed Aggregate from becoming disturbed.

M. Remove any cracked or damaged pavers and replace with new units prior to installing Permeable Joint Opening Aggregate material.

N. Provide, spread, and sweep Permeable Joint Opening Aggregate into joints immediately after vibrating pavers into Permeable Setting Bed course until full. Vibrate pavers and add Permeable Joint Aggregate material until joints are completely filled, then remove excess material. This will require at least 4 passes with a plate compactor.

O. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage). Do not exceed ⅛ inch in 10 feet from level, or indicated slope, for finished surface of paving.

P. Remove excess Permeable Joint Aggregate broom clean from surface when installation is complete.

Field Quality Control

Verify final elevations for conformance to the drawings after sweeping the surface clean. Do not deviate final surface tolerance from grade elevations more than ±⅜ in. under a 10 ft straightedge or indicated slope, for finished surface of paving.

Set surface elevation of pavers ⅛ in. above adjacent drainage inlets, concrete collars or channels.

Lippage: There shall be no greater than ⅛ in. difference in height between Permeable Interlocking Concrete Pavers and adjacent paved surfaces.

Repairing, Cleaning and Sealing

Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

Cleaning – Remove excess dirt, debris, stains, grit, etc. from exposed paver surfaces; wash and scrub clean. Clean Permeable Pavers in accordance with the manufacturer's written recommendations.

Apply Sealer for Permeable Pavers in accordance with the manufacturer's written recommendations.

Protection

Protect completed work from damage due to subsequent construction activity on the site.

Vacuum Sweeping

The Contractor shall perform one cleaning of the permeable pavers with vacuum sweeper after 120 days and before 150 days after date of Substantial Completion/Provisional Acceptance.

Permeable Joint Aggregate Material Refilling

Following vacuum sweeping, provide additional Permeable Joint Aggregate material to replenish removed Joint Aggregate to the lip of the paver.

METHOD OF MEASUREMENT

Permeable Pavers for the type specified in the contract drawings will be measured by the square yard, complete in place.

BASIS OF PAYMENT

Permeable Pavers will be paid for at the contract unit price per square yard which price shall constitute full compensation for installing permeable pavers, permeable sub-base (No. 2 Stone), permeable base (No. 57 Stone), setting bed (No. 8 Stone), and joint aggregate; vacuum sweeping installed pavers, replenishing joint aggregate, and for all other labor, tools, equipment, materials and incidentals necessary to complete the work.

The forming of all tree pits shall be considered as incidental work.

Excavation will be paid for under Item 120.1, Unclassified Excavation.

Payment for steel edging shall be made under Item 707.4, Steel Edge.

ITEM 707.4 STEEL EDGE LINEAR FOOT

GENERAL

The work shall consist of providing and installing metal edging and stakes where specified on the plans.

Submittals

Samples for verification: Steel Edging and Steel Stake

MATERIALS

Steel edging shall be manufactured by Border Concepts, Inc., Charlotte, NC 28217, Phone # 704-541-5509, www.borderconcepts.com, or approved equal.

Metal Edge

Commercial steel edging ¼-inch thick x 5-inch deep and as shown on construction drawings. Edging fabricated in 10'-0" or 16'-0" sections with anchor stake loops stamped in face of section 12 inches on center.

Corners are bent to fit tightly against pavers.

Steel Stake

Use 15 inch tapered steel anchoring stakes (3/16 inches thick) provided by manufacturer.

Paint

Edging and stakes to be finished with Wrought Iron Black enamel paint, or similar.

METHOD OF MEASUREMENT

Steel Edge will be measured by the linear foot, complete in place.

BASIS OF PAYMENT

Steel Edge will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 710.41	BOUND – PLAIN GRANITE (MUNICIPAL STANDARD)	EACH
ITEM 711.	BOUND REMOVED AND RESET	EACH

GENERAL

Work under these items shall conform to the relevant provisions of Section 710 of the MassDOT Standard Specifications and the following:

Bounds will be 6-inch square by 4 feet in length. The top will be smooth and free of any drill holes or marks.

The top of the bound shall be set flush with the finished surface of the work. Gravel (if required) will be paid for under Item 151.02, Gravel.

METHOD OF MEASUREMENT

Bound – Plain Granite (Municipal Standard) and Bound Removed and Reset will be measured by the each, complete in place.

BASIS OF PAYMENT

Bound – Plain Granite (Municipal Standard) and Bound Removed and Reset will be paid for at the respective contract unit prices per each which price shall be full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 720. CITY COVERS ADJUSTED EACH

GENERAL

The work under this item shall consist of adjusting to proper line and grade all castings under the jurisdiction of the City for which provisions are not made under other items. Also included is adjusting existing coal holes that are to remain and closing those that are no longer in service.

Any casting within the sidewalk area requiring one or less courses of brick to adjust to the proper line and grade shall be considered as incidental to and paid for under the sidewalk and driveway items.

All construction methods shall conform to the Boston Water and Sewer Specifications for Item C9-1A, Adjust Water Casting to Grade and Item D3-1A, Adjust Sewer or Drain Casting to Grade.

METHOD OF MEASUREMENT

City Covers Adjusted will be measured by the each, complete in place.

BASIS OF PAYMENT

City Covers Adjusted will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 751.5 LOAM AND SEEDING CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Sections 751 and 765 of the MassDOT Standard Specifications and the following:

MATERIALS

Loam Borrow shall meet the requirements specified in Subsection M1.05.0 of Division III, Materials.

Grass Seed shall meet the requirements specified in Subsection M6.01.0 of Division III, Materials.

CONSTRUCTION METHODS

Acceptability

A satisfactory stand of grass, as determined by the Engineer, shall be required. To be acceptable, a stand of grass shall consist of at least 60% established permanent grass species, with a uniform count of at least 100 plants per square foot.

METHOD OF MEASUREMENT

Loam and Seeding will be measured by the cubic yard, complete in place and accepted, based on tickets delivered with each load or by such other acceptable method as the Engineer may direct. Tickets shall be signed by an Inspector.

BASIS OF PAYMENT

Loam and Seeding will be paid for at the contract unit price per cubic yard which price shall constitute full compensation for grading of areas where stockpiles of topsoil are removed, furnishing, and placing all materials, including loam, limestone, fertilizer, seeding, mowing, and all labor, tools, equipment, materials and incidentals necessary to complete the work.

No payment shall be made for Loam and Seeding until a satisfactory stand of grass has been established and accepted.

ITEM 767.6 AGED PINE BARK MULCH CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 767 of the MassDOT Standard Specifications and the following:

Mulch shall be shredded softwood pine bark processed to yield fibrous, pliable slices not exceeding ½ inch in width and/or 3 inches in length. It shall be 98% bark containing less than 2% wood with a pH range of 3.5 to 4.5. Moisture content of packaged material is not to exceed 35%. Mulch shall be placed at a depth of 3 inches or as directed by the Engineer.

METHOD OF MEASUREMENT

Aged Pine Bark Mulch will be measured by the cubic yard, complete in place, and based on tickets delivered with each load or by such other acceptable method as the Engineer may direct. Tickets shall be signed by an Inspector.

BASIS OF PAYMENT

Aged Pine Bark Mulch will be paid for at the contract unit price per cubic yard which price shall constitute full compensation for grading, furnishing and placing mulch, including all labor, tools, equipment materials and incidentals necessary to complete the work.

ITEM 811.999 PULLBOX COVER REPLACED (STREET LIGHTING OR TRAFFIC) EACH

GENERAL

Work under this item shall include the removal and replacement of existing street lighting or traffic pull box/hand hole frame(s) and covers(s), cleaning of pull box of all debris, proper grounding of the frame and all associated work as directed by the Engineer. The work under this item shall conform to the relevant portions of Subsection 801 of the MassDOT Standard Specifications, to the requirements of the PWD Street Lighting Division, BTD, and the following:

MATERIALS

Frames and covers installed in the sidewalk shall be composite concrete. Frames and covers installed in the roadway shall be cast iron.

Sidewalk frames and covers shall be constructed of composite concrete/polymer material as required and shall be non-conductive. Frames and covers can be purchased in the standard City of Boston Grey for concrete sidewalk applications and Boston City Hall Brick Red for brick sidewalk applications. Street lighting covers should be consistent with PWD Street Lighting Standards. BTD covers should be consistent with BTD Standard Detail A8.2.

Roadway frames and covers shall be constructed of cast iron. Street lighting covers should be consistent PWD Street Lighting Standards. BTD covers should be consistent with BTD

Standard Detail A8.1.

CONSTRUCTION METHODS

The existing frame(s) and cover(s) shall be removed and disposed of by the Contractor. The Contractor shall provide new frame(s) and covers(s) of the specified material (composite or cast iron) and transport them to the job site. Frame(s) and cover(s) shall be approved by the Engineer prior to any installation. The Contractor shall remove all debris, trash, etc. from the pullboxes. If there are any electrical deficiencies noted the Contractor should immediately contact either the PWD Street Lighting Division or BTD for their respective pull boxes. The Contractor shall allow the City to make any electrical repairs necessary prior to the installation of the new frame(s) and cover(s). The frame(s) and covers(s) shall be properly secured to the existing pullbox using ¾" (three quarter inch) threaded rod and securing nuts or bolts, or as directed. The new frame(s) and covers(s) shall be set to the appropriate level so that the top of the frame will be at grade with the sidewalk when complete.

Cast iron pullbox frames and covers shall be grounded in accordance with PWD Street Lighting and BTD standards.

For street lighting pull boxes, as required or as directed by the Engineer, the Contractor shall proceed to install the street lighting non-conducting insulating sleeve after the pullbox frame and cover has been installed.

METHOD OF MEASUREMENT

Pullbox Cover Replaced (Street Lighting or Traffic) will be measured for payment by each unit installed, complete in place.

BASIS OF PAYMENT

Pullbox Cover Replaced (Street Lighting or Traffic) will be paid for at the contract unit price for each unit, which price shall include all labor, tools, materials, equipment and incidental costs required to replace the existing pullbox cover(s) as directed by the Engineer.

ITEM 826.53	FIRE ALARM BASE AND MIDDLE SECTION ADJUSTED	EACH
ITEM 826.54	FIRE ALARM BASE AND MIDDLE SECTION REMOVED AND STACKED	EACH
ITEM 826.55	FIRE ALARM BASE AND MIDDLE SECTION	EACH
ITEM 826.56	FIRE ALARM SERVICE CONNECTION	LUMP SUM

GENERAL

Work under these items shall conform to the relevant provisions of Section 800 of the MassDOT Standard Specifications and the following:

General

Item 826.53: This work shall consist of vertically adjusting existing fire alarm bases and middle sections to grade at locations indicated on the plans or as directed by the Engineer.

Item 826.54: This work shall consist of removing for salvage existing fire alarm bases and middle sections at locations indicated on the plans or as directed by the Engineer.

Item 826.55: This work shall consist of furnishing and installing fire alarm bases and middle sections at locations indicated on the plans or as directed by the Engineer.
Item 826.56: This work shall consist of the coordination of providing a new service connection to a fire alarm where shown on the plans or as directed by the Engineer.

The Contractor shall notify the General Foreman of Fire Alarm Construction (Tel # 617-343-2897) of the Boston Fire Department, Fire Alarm Division at least 72 hours prior to starting the work.

Refer to the following utility details in the Roadway Design Standards:
U.3 Utility – Fire Alarm Base

MATERIALS

New fire alarm bases and middle sections will be furnished by the Contractor and shall conform to the specifications of the Boston Fire Department.

Conduit shall conform to Section M5.03.7. of Division III, Materials of the MassDOT Standard Specifications.

Cement concrete for foundation mat, if required, shall be 3,000 psi, 1 ½ inch, 470 and conform to Section M4.02.00. of Division III, Materials of the MassDOT Standard Specifications.

Sand shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coating, and deleterious materials. Sand shall conform to the following grading limitations, as determined by AASHTO T 11 and T 27:

Sieve Size	Percent Passing by Weight
½ inch	100
⅜ inch	85 - 100
No. 4	60 - 100
No. 16	35 - 80
No. 50	10 - 55
No. 100	2 - 10

Gravel shall conform to Section M1.03.0. of Division III, Materials of the MassDOT Standard Specifications.

CONSTRUCTION METHODS

When adjusting existing fire alarm base and middle section, the breakaway flange shall be flush with the finished surface. The Contractor shall accomplish this using any method that is acceptable to the Boston Fire Department. The Fire Alarm Division will provide personnel to manipulate the existing cables, so the fire alarm base and middle section can be adjusted without disassembly.

Fire alarm bases and middle sections will be removed and stacked when directed by the Boston Fire Department. No base and middle section will be removed until the Fire Alarm Division has installed a new fire alarm box at the new location and removed existing cables servicing the location to be abandoned. The existing base and middle section shall be removed and delivered to the Fire Alarm Division at 115 Southampton Street, Roxbury.

New fire alarm bases and middle sections shall be installed at locations shown on the plans and in accordance with the Standard Details. Base and middle section shall be set plumb on a sub base of compacted gravel with its opening facing the curb. In order to prevent settling of the fire alarm base, a concrete mat may be required. The dimensions of such a mat and its necessity shall be determined by the Engineer.

A 4-inch PVC conduit complete with a ⅜-inch polypropylene pull rope will be installed between the base and the nearest Boston Fire Department or telephone manhole and a 2-inch PVC conduit with pull rope will be installed between the base and the nearest street lighting pull box or Eversource manhole.

Conduit Installation

The PVC Conduit shall be enveloped in sand as called for in the Contract Drawings.

Plastic conduits entering concrete pull boxes shall be terminated 1 ½ inches inside the wall of the pull box and shall have attached a Duct Bell End of the required size, using the solvent cement as called for in the specifications.

For fire alarms that require a gas line connection, the Contractor shall coordinate with the gas company for a new service connection to the fire alarm.

METHOD OF MEASUREMENT

Fire Alarm Base and Middle Section shall be considered as a single unit.

Fire Alarm Base and Middle Section, Fire Alarm Base and Middle Section Removed and Stacked, and Fire Alarm Base and Middle Section Adjusted will be measured per each, complete in place.

Fire Alarm Service Connection will not be measured; however, will be paid for per lump sum.

BASIS OF PAYMENT

Fire Alarm Base and Middle Section Adjusted will be paid for at the contract unit price per each which price shall constitute full compensation for adjusting the base and middle section, excavation, backfill and for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Fire Alarm Base and Middle Section Removed and Stacked will be paid for at the contract unit price per each which price shall constitute full compensation for removing, stacking, and transporting the existing base and middle section, excavation, backfill and for all labor, tools, equipment, materials and incidentals necessary to complete the work.
Fire Alarm Base and Middle Section will be paid for at the contract unit price per each which price shall constitute full compensation for furnishing and installing the base and middle section, excavation, backfill and for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Fire Alarm Service Connection will be paid for at the contract unit price per lump sum which price shall constitute all necessary fire alarm connections associated with the project. The lump sum price shall include:

- Payment for all cable as required for connecting the new fire alarm.
- Payment for Verizon service connection.
- Payment for National Grid gas service connection (where applicable).
- Payment for Eversource gas service connection (where applicable).
- Payment for all labor provided by Boston Fire Department staff to make necessary connections.

The lump sum price shall be considered an allowance of funds available to compensate for the work necessary for connecting service to a new fire alarm. Payment under this item shall be made for the actual amount invoiced by the Boston Fire Department, Verizon, Eversource, and/or National Grid for this work. The allowance price set as a lump sum is merely an estimate of the total cost for this work. The actual final payment amount on this item may be less than or greater than this price depending on the total value invoiced. Original invoices from the Boston Fire Department, Verizon, Eversource, and/or National Grid and proof of payment shall be provided to the Engineer to receive payment under this item. No payment shall be made prior to submittal of these invoices and proof of payment.

Rock excavation will be paid for under Item 144., Class B Rock Excavation.

Gravel will be paid for under Item 151.02, Gravel.

Sand will be paid for under Item 154.01, Sand for Conduit Trench.

Cement concrete for a concrete mat will be paid for under Item 431., High Early Strength Cement Concrete Base Course.

2-inch and 4-inch conduit will be paid for under their respective items, Item 804.22, 2" Electrical Conduit Type NM Plastic (UL) (Municipal Standard) and Item 804.44, 4" Electrical Conduit Type NM Plastic (UL) (Municipal Standard).

ITEM 832.1 WARNING – REGULATORY AND ROUTE MARKER – ALUMINUM PANEL (TYPE A) SQUARE FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 828 of the MassDOT Standard Specifications and the following:

All signs in this category shall be fabricated with high intensity encapsulated lens reflective sheeting. Transparent red and blue and/or black opaque paint (ink) may be used over high intensity encapsulated lens reflective sheeting in accordance with the provisions of Section M9.30.2 "D.2 Surface" of the MassDOT Standard Specifications, where these colors are specified.

METHOD OF MEASUREMENT

Warning – Regulatory and Route Marker – Aluminum Panel (Type A) will be measured by the square foot, complete in place.

BASIS OF PAYMENT

Warning – Regulatory and Route Marker – Aluminum Panel (Type A) will be paid for at the contract unit price per square foot which price shall constitute full compensation for fabricating, furnishing, erecting and attaching the completed sign panel, preparing all reflectorized materials, backgrounds, legends, borders, arrows, shields, paints, hardware and all other labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 832.2 REGULATORY SIGN – TYPE A - ALUMINUM (MAINTENANCE) EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications for Highways and Bridges and the following:

The work to be done under this item shall include the fabrication and installation of signs for the closure of sidewalks.

All sign panels shall be aluminum –Type A.

All signs shall be “Sidewalk Closed – Use Other Side” Signs including arrow conforming to MUTCD sign R9-10.

The sign shall be forty eight (48) inches by twenty-four (24) inches.

CONSTRUCTION METHODS

The Contractor shall be required to provide safe and convenient access to all residences, stores, and businesses during construction operations. Access shall be in accordance to all relevant ADA, PROWAG, and AAB regulations.

The Contractor must maintain a four (4) foot clear sidewalk at all times. When closure is unavoidable the sidewalk may be closed upon approval of the Resident Engineer. Two (2) “Sidewalk Closed – Use Other Side” must be posted on either side of the site at the nearest intersecting street corners.

Failure to provide the required access or signage may result in violations, fines and project termination.

METHOD OF MEASUREMENT

Regulatory Sign – Type A - Aluminum (Maintenance) will be measured per each sign as counted by the Engineer. This shall be full compensation for fabricating, furnishing, erecting, attaching, all hardware and any other item incidental to providing the required sign.

BASIS OF PAYMENT

Regulatory Sign – Type A – Aluminum (Maintenance) will be paid at the contract unit price per each, which price shall include full compensation for fabricating, furnishing, erecting, attaching, all hardware and any other item incidental to providing the required sign.

ITEM 834.19 FLEX POST REMOVAL (MAINTENANCE) EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 828 of the MassDOT Standard Specifications and the following:

CONSTRUCTION METHODS

The Contractor shall be required to carefully remove all bolts, quick curb, and any other mounting hardware or components, where applicable. All materials are to be disposed of by the Contractor.

METHOD OF MEASUREMENT

Flex Post Removal will be measured per each post removed as counted by the Engineer.

BASIS OF PAYMENT

Flex Post Removal will be paid at the contract unit price per each, which price shall include full compensation for all labor, tools, and disposal of removed materials.

ITEM 852. SAFETY SIGNING FOR TRAFFIC MANAGEMENT SQUARE FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

Safety signing shall be installed according to the approved Traffic Management Plan or as directed by the Engineer

METHOD OF MEASUREMENT

Safety Signing for Traffic Operations will be measured by the square foot, and the quantity shall be only that which is actually used on the project. Regardless of the number of times that a sign may be reused on the project, it will not be measured for payment more than once.

BASIS OF PAYMENT

Safety Signing for Traffic Operations will be paid for at the contract unit price per square foot which price shall constitute full compensation for furnishing, maintaining, positioning, repositioning, and removing the signs and all other labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 852.12 TOW ZONE NO PARKING SIGNS ALUMINUM PANEL (TYPE A) EACH

GENERAL

The work to be done under this item shall consist of furnishing and erecting temporary Tow Zone - No Parking Signs at locations as directed by the Engineer. The work shall also include the moving and relocating of the signs as directed and as stage construction progresses within the contract. At the completion of the project the signs shall remain the property of the Contractor.

Materials for this item shall conform to the relevant provisions of Section 828 of the MassDOT Standard Specifications.

All Tow Zone signs shall be as Per Boston Transportation Department legends – C1 thru C6 as shown below.

TEMPORARY SIGNS
All C Signs

C-1	**C-2**	**C-3**
Tow Zone	Tow Zone	Tow Zone
NO	NO	NO
Standing	Standing	Standing
Anytime	7am-5pm	7pm-am
Permitted	Permitted	Permitted
Construction	Construction	Construction
Vehicles Only	Vehicles Only	Vehicles Only

C-4	**C-5**	**C-6**
Tow Zone	Tow Zone	Tow Zone
NO	NO	NO
Standing	Standing	Standing
Anytime	7am-5pm	7pm-am
Permitted	Permitted	Permitted
Construction	Construction	Construction
Vehicles Only	Vehicles Only	Vehicles Only
Effective:	Effective:	Effective:
Expires:	Expires:	Expires:

The Contractor shall comply with Boston Transportation Department Requirements for Temporary Signs.

Where "Tow Zone" signs are necessary the Contractor shall meet the following requirements:

1. **Not later than 72 hours prior to the installation of any regulatory signs, the Contractor shall notify in writing the Commissioner of the Boston Transportation Department of such request with the following information:**

    a. The street, side and limits where construction will occur.
    b. Anticipated date of start and completion of construction.

2. **In residential and/or mixed residential/commercial areas the Contractor shall leaflet all vehicles and mailboxes once each day for the 2 days prior to the start of construction informing those persons living in the affected area of the following:**

    a. The regulation and effective hours of the regulation that will be posted.
    b. The start date and the approximate completion date of the construction
    c. The agency and/or the company that has contracted the work to be done
    d. The name and telephone number of the Contractor doing the work.

    A copy of said leaflet must be submitted before dissemination for approval and must include any translations appropriate to the location. A sample of an approved leaflet is available at the Boston Transportation Department, Construction and Event Management Office, Room 721, Boston City Hall.

3. **Installation of signs shall be done in the following manner:**

    a. All signs shall conform to B.T.D. specifications.
    The exact legend shall be determined by the Construction and Event Management Office (CEMO).
    b. All signs shall indicate the effective date and estimated completion date of the construction project and shall be installed at a frequency (distance between signs) determined by the CEMO.
    c. All signs shall indicate the effective hours of the regulations.
    d. The Contractor shall be responsible for the actual installation of signs a minimum of 24 hours prior to the effective date and the maintenance and immediate replacement of all signs so installed.
    e. The Contractor shall cover all existing signs in conflict with the construction signs in the following manner:

* Use of a cover approved by the CEMO which shall be securely fastened to the existing and shall completely cover the legend.

* The cover shall remain in place as an effective cover until the construction is complete at which time the cover shall be immediately removed by the Contractor

    f. The Contractor shall remove all construction related signs immediately upon the completion of the project.

4. Interruption of Work

a. Should the Contractor interrupt or stop work at a particular location, street or point thereof, for a period exceeding four working days, Monday through Friday, the Contractor shall be required to re-leaflet and re-sign in accordance with the above procedure. No work is to resume prior to the aforementioned notification schedule.

5. Detour and Warning Signs

The Contractor shall be responsible for the installation of all detour signs in the following manner:

a. The legend for all detour signs shall be determined by the CEMO and shall conform to the Manual on Uniform Traffic Control Devices (MUTCD).
b. Locations for detour signs shall be determined by the CEMO and shall be installed, maintained, and removed by the Contractor.
c. Detours, when approved by the CEMO shall be continuous and shall direct the motorist along the most practical route around the actual construction site to a location along the street where the detour originated.

6. Leaflets or Signs

No leaflets or signs shall be installed that have not been approved as to location and form without the advance approval of the Boston Transportation Department.

METHOD OF MEASUREMENT

Tow Zone No Parking Signs Aluminum Panel (Type A) will be measured per each, complete in place.

BASIS OF PAYMENT

Tow Zone No Parking Signs Aluminum Panel (Type A) will be paid for at the contract unit price per each which price shall constitute full compensation for fabricating, furnishing, erecting and attaching the completed sign panel, preparing all reflectorized materials, backgrounds, legends, borders, arrows, shields, paints, hardware and all other labor, tools, equipment, materials and incidentals necessary for the completion of the signs as specified.

ITEM 853.11 TEMPORARY PRE-CAST CONCRETE MEDIAN BARRIER LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

The work to be done under this item consists of furnishing, installing, maintaining and removing temporary pre-cast barriers when positive barriers are needed for traffic control in construction zones.

The Temporary Pre-cast Concrete Median Barrier shall be constructed in accordance with Massachusetts Department of Transportation Construction Standard 403.1.0, 403.2.0, and 403.3.0, and installed as directed and in accordance with these specifications. All units either new or used shall be approved by the Engineer before being used on the project.

Upon satisfactorily completing the work, as determined by the Engineer, the Temporary Pre-Cast Median Barriers shall be removed from the site by the Contractor.. Payment for this work will be included under this item.

METHOD OF MEASUREMENT

Temporary Pre-Cast Concrete Median Barrier will be measured by the linear foot, complete in place.

BASIS OF PAYMENT

Temporary Pre-Cast Concrete Median Barrier will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

No separate payment will be made for furnishing, installing, delineating, aligning, maintaining, removing and resetting barrier as part of contractor daily operations, removal from site at completion of construction and transportation to the nearest City of Boston maintenance yard, but all costs in connection therewith shall be included in the Contract unit price bid.

ITEM 853.3 PORTABLE BREAKAWAY BARRICADE TYPE III EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

The work shall consist of furnishing, installing, moving, removing and maintaining Portable Breakaway Barricades Type III where indicated on the plans or as directed by the Engineer.

MATERIALS

Pipe shall be polyvinyl chloride (PVC) pressure rated SDR 26 ASTM D2241. Fittings may be PVC-ASTM D2665 or Acrylontrile Butadiene (ABS) ASTM D2551 (Drainage Waste and Vent).

All other materials used for Portable Breakaway Barricades Type III shall conform to the requirements of the latest version of the Manual on Uniform Traffic Control Devices with MassDOT amendments.

CONSTRUCTION METHODS

The Contractor shall furnish, set up and remove Portable Breakaway Barricades Type III as required or directed by the Engineer. A 4-foot unit of portable barricade fence shall be constructed. The alternating 6-inch wide diagonal stripes shall be orange and white and shall slope downward at 45° toward the end by which traffic is to pass.

Portable Breakaway Barricades Type III shall be maintained in good and serviceable condition throughout the project and shall be moved from place to place as required during construction and as directed by the Engineer.

METHOD OF MEASUREMENT

Portable Breakaway Barricade Type III will be measured per each. Each 4-foot section of Portable Breakaway Barricade Type III shall be considered as one unit.

BASIS OF PAYMENT

Portable Breakaway Barricade Type III will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to furnish, install, move, remove and maintain the devices.

ITEM 854.014 TEMPORARY PAVEMENT MARKINGS – 4-INCH (PAINTED) LINEAR FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

Temporary pavement markings shall be installed where directed by the Engineer to ensure safety on the public way during construction.

Standard white or yellow color shall conform to current MUTCD standards.

METHOD OF MEASUREMENT

Temporary Pavement Markings – 4-Inch (Painted) will be measured by the linear foot, complete in place.

BASIS OF PAYMENT

Temporary Pavement Markings – 4-Inch (Painted) will be paid for at the contract unit price per linear foot which price shall constitute full compensation for furnishing, installing, maintaining, and removing the markings and all other labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 854.2 PAVEMENT MARKING REMOVAL SQUARE FOOT

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

Pavement markings shall be removed to the fullest extent possible where indicated on the plans or as directed by the Engineer.

METHOD OF MEASUREMENT

Pavement Marking Removal will be measured by the square foot of pavement marking removed.

BASIS OF PAYMENT

Pavement Marking Removal will be paid for at the contract unit price per square foot which price shall constitute full compensation for removing existing markings, repair to the roadway surface and all other labor, tools and equipment necessary to complete the work.

ITEM 856.12 PORTABLE CHANGEABLE MESSAGE SIGN UNIT DAY

GENERAL

The work under this Item shall consist of the furnishing and installing of Portable Changeable Message Signs as shown on the Plans, as directed by the Engineer, and the following:

The work to be performed under this Item shall conform to the relevant provisions of the MassDOT Standard Specifications Section 850.

Seven days prior to the commencement of the roadway resurfacing phase of this project, the Contractor shall place two (2) Portable Changeable Message Signs, one at each end of the project limits, to inform the travelling motorists of possible interruptions in the traffic conditions.

METHOD OF MEASUREMENT

Portable Changeable Message Sign will be measured per unit day in accordance with MassDOT Standard Specifications Section 850.80 and 850.81

BASIS OF PAYMENT

Portable Changeable Message Sign will be paid for at the contract unit price per unit day and shall include all labor, equipment, supplies, tools, and incidentals necessary to complete the work.

No payment will be made for unit days when the sign is not functioning.

ITEM 859.	REFLECTORIZED DRUM	DRUM DAY
ITEM 859.1	REFLECTORIZED DRUM WITH FLASHER (TYPE A)	DRUM DAY

GENERAL

Work under this item shall conform to the relevant provisions of Section 850 of the MassDOT Standard Specifications and the following:

Reflectorized drums shall be placed according to the approved Traffic Management Plan or as directed by the Engineer.

METHOD OF MEASUREMENT

Reflectorized Drum will be measured per each drum per day (drum day). Each period of up to 24 hours during which a reflectorized drum is in use will be measured as one drum day regardless of the number of times that the drum is positioned, repositioned, removed or returned to service.

Reflectorized Drum with Flasher (Type A) will be measured per each drum per day (drum day). Each period of up to 24 hours during which a reflectorized drum is in use will be measured as one drum day regardless of the number of times that the drum is positioned, repositioned, removed or returned to service.

BASIS OF PAYMENT

Reflectorized Drum will be paid for at the contract unit price per drum day which price shall constitute full compensation for all labor, tools and equipment necessary to complete the work.

Reflectorized Drum with Flasher (Type A) will be paid for at the contract unit price per drum day which price shall constitute full compensation for furnishing, positioning, repositioning, and removing drums and all other labor, tools, equipment materials and incidentals necessary to complete the work.

ITEM 864.04	PAVEMENT ARROWS AND LEGENDS REFLECTORIZED WHITE (THERMOPLASTIC)	SQUARE FOOT
ITEM 864.05	PAVEMENT BIKE SYMBOLS REFLECTORIZED WHITE (THERMOPLASTIC)	SQUARE FOOT
ITEM 864.11	PREFORMED SHARROW FOR BIKE LANE REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	EACH
ITEM 864.12	PREFORMED BIKE LANE RIDER REFLECTORIZED WHITE - THERMOPLASTIC (MAINTENANCE)	EACH
ITEM 864.13	PREFORMED 6’ BIKE LANE ARROW REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	EACH
ITEM 864.14	PREFORMED ENGLISH BIKE SYMBOL REFLECTORIZED WHITE – THERMOPLASTIC (MAINTENANCE)	EACH
ITEM 865.1	CROSSWALKS AND STOP LINES REFLECTORIZED WHITE (THERMOPLASTIC)	SQUARE FOOT
ITEM 866.104	4 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 866.108	8 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 866.112	12 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 867.104	4 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 867.108	8 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	LINEAR FOOT
ITEM 867.112	12 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	LINEAR FOOT

GENERAL

Work under these items shall conform to the relevant provisions of Section 860 of the MassDOT Standard Specifications, material Subsection M7.01.20 and the following:

Pavement arrows and the legend "ONLY" shall be reflectorized white thermoplastic and in compliance with the Standard Alphabets for Highway Signs and Pavement Markings. The height of the letters shall be 8 feet, and the height of the left or right arrows shall be 8 feet.

Quality Control

The Contractor shall be responsible for the thermoplastic material furnished and installed against failure due to poor adhesion resulting from defective material or methods of application.

The Contractor shall guarantee to replace without cost to the City that part of the pavement markings which, in the judgement of the Engineer, have not remained to perform useful service as follows:

90% of a unit for 1 year
80% of a unit for 2 years
60% of a unit for 3 years

Where a unit is defined as any 2,000 linear feet of applied material.
The replacement material installed under the guarantee shall be guaranteed the same as the original material, from the date of the original installation.

To assure execution of the guarantee, the Contractor will be required to post a maintenance surety bond in the amount of $1,000.00.

CONSTRUCTION METHODS

Crosswalks shall be installed as per BTD Standard Detail **A308, Special Emphasis Crosswalk,** or **A309, Standard Crosswalk**.

Lane lines shall be installed as per BTD Standard Detail **A311, Typical Installation for Lane Line Pavement Markings**.

Gore lines can be 8 to 24 inches in width and shall be applied in accordance with the design and widths shown on the plans.

METHOD OF MEASUREMENT

Pavement Arrows and Legends shall be measured by square foot. The square foot areas to be paid for under this item are as follows:

Arrow, Straight	11.8 Square Feet
Arrow, Left or Right	15.8 Square Feet
Arrow, Combination (Straight with Left or Right)	28.1 Square Feet
"ONLY" Legend	22.5 Square Feet
Yield Lines (Shark Teeth)	3 Square Feet each

Any project-unique pavement arrows and legend not listed above will be measured by the actual square footage installed and accepted.

Pavement Bike Symbols shall be measured by square foot. The square foot areas to be paid for under this item are as follows:

Bike Lane Symbol & Arrow	14 Square Feet
Shared Lane Bike Symbol & Sharrows	11 Square Feet

Any project-unique bike symbols not listed above will be measured by the actual square footage installed and accepted.

Preformed Sharrow for Bike Lane Reflectorized White – Thermoplastic (Maintenance), Preformed Bike Lane Rider Reflectorized White – Thermoplastic (Maintenance), Preformed 6’ Bike Lane Arrow Reflectorized White – Thermoplastic (Maintenance), and Preformed

English Bike Symbol Reflectorized White – Thermoplastic (Maintenance) will be measured per each installed in place, as directed.

Crosswalks and Stop Lines Reflectorized White (Thermoplastic) will be measured by the square foot based on measurements of actual area of lines as determined by the Engineer.

Reflectorized, thermoplastic white and yellow lines for the width specified will be measured by the linear foot, complete in place.

BASIS OF PAYMENT

Pavement Arrows and Legends and Pavement Bike Symbols Reflectorized White will be paid for at the contract unit price per square foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Preformed Sharrow for Bike Lane Reflectorized White – Thermoplastic (Maintenance), Preformed Bike Lane Rider Reflectorized White – Thermoplastic (Maintenance), Preformed 6' Bike Lane Arrow Reflectorized White – Thermoplastic (Maintenance), and Preformed English Bike Symbol Reflectorized White – Thermoplastic (Maintenance) will be paid for at the contract unit price per square each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Crosswalks and Stop Lines Reflectorized White (Thermoplastic) will be paid for at the contract unit price per square foot which price shall constitute full compensation for all labor, tools, equipment, materials, and incidentals necessary to complete the work.

Reflectorized, thermoplastic white and yellow lines for the width specified will be paid for at the contract unit price per linear foot which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 864.15 COLORED HIGH FRICTION SURFACE TREATMENT FOR PAVEMENTS (HFST) SQUARE FOOT

GENERAL

This work shall consist of furnishing and placing a green-colored High Friction Surface Treatment (HFST) on asphalt or concrete pavement. The HFST shall be comprised of surface preparation and a minimum of a single layer using a Binder Resin System which holds a surface applied aggregate firmly in place. The Binder Resin System shall include Polymeric or Methyl Methacrylate (MMA) Resins.

QUALIFICATIONS OF INSTALLER

The installer shall submit a minimum of three projects with the owner's contact information on which a cumulative minimum of 5,000 square yards of HFST has been placed within the past three years. An installer who does not meet this minimum shall be allowed if they are certified by the manufacturer to install and a manufacturer's representative is onsite during installations. The Quality Control (QC) Plan shall be project-specific detailing installer's key personnel, equipment, materials, proposed methods of installation, materials blending procedures,

monitoring of ambient temperature, proposed methods of curing and corrective action plan. The QC plan shall also specify that either mark-up panels with approved colors and/or shop drawings showing the same shall be submitted to the Engineer for approval prior to installation of the HFST. The Contractor shall submit a QC plan to the Engineer for approval at least 30 days prior to placement. Any deviation from the approved QC plan shall be cause for immediate suspension of operations.

MATERIALS

Resin Binder Systems shall be recommended by the manufacturer as suitable for use on the intended pavement surface and for the potential range of atmospheric exposure.

The Contractor shall furnish and install a Resin Binder System that meets the criteria in Table 1:

Table 1 - Resin Binder System

Property	Test Method	Requirements	
		Polymeric Resin	MMA
Ultimate Tensile Strength	AASHTO M-235	2000-5000 psi	1500-5000 psi
Elongation at break point	AASHTO M-235	30-70%	30-70%
Compressive Strength	ASTM C-579	1600 psi min.	1600 psi min.
Compressive Strength	AASHTO M-235	1000 psi min. at 3 hours 5000 psi min. at 7 days	1000 psi min. at 3 hours 2000 psi min. at 7 days
Water Absorption	AASHTO M-235	1% max.	1% max.
Durometer Hardness (Shore D)	ASTM D-2240	60-80	40-75
Viscosity	ASTM D-2556	Class C: 7-30 poises	Class C: 12-20 poises
Gel Time	AASHTO M-235	Class C: 10 minutes min.	Class C: 10 minutes, min.
Cure Rate (Dry through time)	ASTM D-1640	3 hrs. max.	3 hrs. max.
Adhesive Strength at 24 hours	ASTM D-4541	250 psi min. or 100% substrate failure	250 psi min. or 100% substrate failure

Independent laboratory reports per formulation shall be provided, documenting that the resin binder meets the requirements of this specification. A sample of the resin binder or components lot/batch shall be provided a minimum of 14 days prior to the commencement of work.

At the request of the Engineer, the manufacturer of the Resin Binder System shall certify that the Resin Binder System meets the requirements of this specification. Such certification shall consist of either a copy of the manufacturer's test report or a statement by the manufacturer, accompanied by a copy of the current test results, that the Resin Binder System has been sampled and tested. Such certification shall indicate the date of testing and shall be signed by the manufacturer.

The Contractor shall furnish and install a high friction aggregate that is clean, dry and free from deleterious material. The high friction aggregate shall be Calcined Bauxite.

The calcined bauxite aggregate shall meet the properties shown in Table 2:

Table 2 - Calcined Bauxite Aggregate		
Property	**Test Method**	**Requirement**
Polish Stone Value	AASHTO T-279	65 min.
Resistance to Degradation	AASTHO T-96	20% max.
Aggregate Grading	AASHTO T-27	No. 4 Percent Passing 100% min. No. 6 Percent Passing 95% min. No. 16 Percent Passing 5% max.
Moisture Content	AASHTO T-255	0.2% max.
Aluminum Oxide	ASTM C-25	87% min.

All aggregates shall be furnished in appropriate packaging that is clearly labeled and protects the aggregate from any contaminates on the jobsite and from exposure to rain or other moisture.

Unless the HFST is on the MassDOT Qualified Products List, the manufacturer shall provide a 50 lb. bag of aggregate accompanied to the DOT for approval a minimum of 14 days prior to the commencement of work. On all projects and regardless of the HFST status on the MassDOT Qualified Products List, the manufacturer of the aggregate shall certify that the aggregate meets the requirements of this specification. Such certification shall consist of either a copy of the manufacturer's report or a statement by the manufacturer, accompanied by a copy of the current test results, that the aggregate has been sampled and tested. Such certification shall indicate the date of testing and shall be signed by the manufacturer.

The color of the HFST material shall be green, as specified in the Federal Highway Administration (FHWA) Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14), dated April 15, 2011. Green pigment used for this purpose can be applied to the Resin Binder System and/or the aggregate. The Contractor shall certify that any Resin Binder System and/or aggregate treated with green pigment shall conform to the above material requirements of this specification.

CONSTRUCTION METHODS

A manufacturer's representative of the Resin Binder System shall be present at the jobsite during all construction operations relating to the preparation and placement of the HFST. All construction operations relating to the HFST shall meet the recommendations of the manufacturer's representative. Final approval of all HFST placement operations will be given by the engineer.

Resin Binder system shall not be placed on any wet surface or when the ambient temperature or the temperature of the pavement is below the manufacturer's recommendations or when the anticipated weather conditions would prevent the proper application of the surface treatment
as directed by the manufacturer's representative.

The surface shall be thoroughly cleaned immediately prior to installation of the HFST. The surface shall be clean, dry and free of all dust, oil, debris and any other material that might interfere with the bond between the resin binder material and the existing surface as recommended by the manufacturer's representative. HFST may not be placed on any new HMA pavement that has been placed in the previous 30 days with motor vehicle traffic or 60 days without motor vehicle traffic.

The Contractor shall pre-treat joints and crack greater than ¼ inch in width and depth with the mixed Resin Binder System. Once the resin binder in the pre-treated areas has gelled, the installation of the HFST may proceed.

Surface preparation work, surface temperature and placement of the HFST shall be in conformance with the binder supplier's specifications and as approved by the manufacturer's representative.

All existing edge line pavement markings that are adjacent to the HFST location shall be covered and protected as approved by the engineer prior to performing surface preparation. HFST shall not be placed over existing pavement markings or rumble strips. Lane line pavement markings that conflict with the HFST installation shall be removed by methods approved by the manufacturer's representative. Any existing edge line pavement markings that are damaged during the HFST application process shall be replaced at the Contractor's expense per direction of the Engineer.

HFST shall be allowed to cure for the minimum duration as recommended by the binder component supplier's specifications and during that time the application area shall be closed to all vehicles and Contractor's equipment traffic. After placement and cure of the HFST, the Contractor shall test the finished surface in accordance with ASTM D7234 to detect un-bonded areas.

Excess and loose aggregate shall be removed from the traveled way and shoulders in such a way that the HFST is not damaged or disturbed. Excess aggregate that can be reused shall be reclaimed by a Vacuum sweeper. The recovered aggregate shall be clean, uncontaminated and dry, if it is to be re-used in the HFST application.

Utilities, drainage structures, curbs and any other structures within or adjacent to the treatment location shall be protected against the application of the HFST materials.

HFST shall not be applied to newly placed asphalt pavement surfaces that are less than 30 days old, unless the surface is sandblasted as approved by the manufacturer's representative, prior to application.

The surface friction of the completed HFST shall meet a minimum requirement of 65 FN40R from the ASTM E274 test. BTD and/or Boston PWD will perform this test within 7 calendar days after completion of the HFST.

Any surface that fails to conform to the above friction requirement must be removed and replaced at the Contractor's expense within 24 hours after being notified by the Engineer. HFST shall be applied in accordance with the manufacturer's recommendations. The HFST

can be applied by either mechanical or manual techniques as follows: mechanical application shall be required for all travel lanes and shoulders, mechanical or manual application is required for smaller surface areas requiring hand work such as small areas of HFST application, crosswalks, narrow median or smaller areas of special delineation and as approved by the Engineer.

The Resin Binder System shall be blended and mixed in the ratio per the manufacturer's specification (+/- 2% by volume) and shall be continuously applied once blended. The Resin Binder System shall be applied at a uniform thickness of 50-65 mils (25-32 square feet per gallon). Coverage rate is based upon expected variances in the surface profile of the pavement.

The operation shall proceed in such a manner that will not allow the mixed material to separate, cure, dry, be exposed or otherwise harden in such a way as to impair retention and bonding of the high friction aggregate.

The high friction aggregate shall be immediately applied at a rate of 12-15 pounds per square yard (achieving saturation) in such a manner that there is no disruption to the leveled binder. It is the responsibility of the contractor to ensure full embedment of the high friction aggregate. Wet spots shall be covered with the high friction aggregate prior to the gelling of the Resin Binder System.

Walking, standing on, or any form of contact or contamination with the wet uncured Resin Binder System, prior to application of the aggregate, will result in that section of Resin Binder System being removed and replaced at the Contractor's expense.

METHOD OF MEASUREMENT

Colored High Friction Surface Treatment for Pavements (HFST) will be measured for payment by the total square foot area of HFST material and shall be the actual number of square feet applied as directed and approved by the Engineer.

BASIS OF PAYMENT

Colored High Friction Surface Treatment for Pavements (HFST) will be paid for at the contract unit price per square foot of HFST material applied under this item in the Contract, which shall be full compensation for all labor, materials, tools, equipment, testing and incidental items necessary to complete the described work to the satisfaction of the Engineer.

ITEM 874.09	STREET NAME SIGN (BOSTON) 9-INCH STREET NAME BLANK	EACH

GENERAL

Street name signs shall meet minimum retroreflectivity requirements specified in the Manual on Uniform Traffic Control Devices.

MATERIALS

Street Name Blanks

BTD standard sign blanks shall be 9 inches high and variable in width based on standard sign lettering requirements.

Sign blanks shall be fabricated from Aluminum Alloy 5052 with a thickness of 0.080 inches and free of burr, corrosion, white rust and dirt.

All sign blanks shall have the street name on both sides. The sign sheeting and lettering shall conform to the specifications below:

Sheeting

Green EC film over white reflective “High Intensity Prismatic” grade sheeting.

Lettering

The letter size shall be 6”, series C upper case for the street name and 3”, series C upper case for the “ST”, “AVE”, “PL”, etc.

The colors shall be white lettering on green background with ½-inch border.

Brackets

The brackets shall be in accordance with the latest BTD specifications. (#800 Metro Wing Bracket (or equal) and 2-inch or 2 ½-inch square cap when applicable).

Finish

All aluminum parts shall have an Alodine 1200 (or equivalent) finish.

All steel parts shall have a yellow zinc dichromate finish.

See BTD Standard Plan A51.

For more information or assistance, contact the BTD Operations Division – Sign Shop at 617-635-2145.

CONSTRUCTION METHODS

Street name signs shall be mounted on existing or proposed utility poles (i.e., traffic signal pole or street light pole) where possible. If a new street name sign pole has been approved by BTD, it shall be installed according to BTD Standard Plans A201, A203 and A205.

Existing or Proposed Utility Pole

1. All street name sign installations shall be mounted 14 feet above the surface of the sidewalk to the bottom of the lowest sign using #800 Metro Wing Bracket (or equal).

2. When two street name signs are mounted on the same pole there shall be a 2-inch space between the bottom of the top sign and the top of the bottom sign.

3. When two street name signs are mounted on the same pole, the "main street" street name sign shall be mounted on top.

4. Street name signs shall be mounted with their faces parallel to the streets they name, pointing towards the property line.

2 ½-Inch Street Name Sign Pole

1. When one street name sign is mounted on a 2 ½-inch pole, it shall be center mounted using a 2 ½-inch square cap on top of the sign pole.

2. When two street name signs are mounted on a 2 ½-inch pole, the top sign shall be center mounted using a 2 ½-inch square cap on top of the sign pole and the bottom sign shall be cantilevered to the sign pole using a #800 Metro Wing Bracket (or equal).

3. When two street name signs are mounted on the same pole, the “main street" street name sign shall be mounted on top.

4. Street name signs shall be mounted with their faces parallel to the streets they name, pointing towards the property line. The minimum mounting height shall be 7 feet per MUTCD standards.

2-Inch Sign Pole

1. When one street name sign is mounted on a 2-inch pole, it shall be center mounted using a 2-inch square cap on top of the sign pole.

2. When two street name signs are mounted on a 2-inch pole, the top sign shall be center mounted using a 2-inch square cap on top of the sign pole and the bottom sign shall be cantilevered to the sign pole using a #800 Metro Wing Bracket (or equal).

3. When two street name signs are mounted on the same pole, the “main street" street name sign shall be mounted on top.

4. Street name signs shall be mounted with their faces parallel to the streets they name, pointing towards the property line. The minimum mounting height shall be 7 feet per MUTCD standards.

Notes:

1. A sample of the street name sign may be observed at the BTD Sign Shop.

2. Proposed equals shall be submitted to the BTD Director of Operations for approval prior to the fabrication and/or installation of any street name sign.

METHOD OF MEASUREMENT

Street Name Sign (Boston) 9-Inch Street Name Blank will be measured by the each, complete in place.

BASIS OF PAYMENT

Street Name Sign (Boston) 9-Inch Street Name Blank will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 874.018 STREET NAME SIGN (BOSTON) 18-INCH ON MAST ARM EACH

GENERAL

Street name signs shall meet minimum retroreflectivity requirements specified in the Manual on Uniform Traffic Control Devices.

MATERIALS

Street Name Blanks

See BTD Standard Plan A50.

BTD standard sign blanks shall be 18 inches high and variable in width based on standard sign lettering requirements.

Sign blanks shall be fabricated from Aluminum Alloy 6061-T6 with a minimum thickness of 0.080 inches and free of burr, corrosion, white rust and dirt.

All sign blanks shall have the street name on both sides. The sign sheeting and lettering shall conform to the specifications below:

Sheeting

Green EC film over white reflective “High Intensity Prismatic” grade sheeting.

Lettering

The letter size shall be 8 inch, series D upper case for the street name and 5-inch, series D upper case for the “ST”, “AVE”, “PL”, etc.

The colors shall be white lettering on green background with ¾ inch border.

Brackets

The Contractor shall submit a cut sheet for the proposed brackets for BTD approval.

Safety Chain

A safety chain sized to support the sign if the bracket were to fail shall secure the sign to the mast arm.

Finish

All aluminum parts shall have an Alodine 1200 (or equivalent) finish.

All steel parts shall have a yellow zinc dichromate finish.
For more information or assistance, contact the BTD Operations Division – Sign Shop at 617-635-2145.

METHOD OF MEASUREMENT

Street Name Sign (Boston) 18-Inch Street Name Blank will be measured by the each, complete in place.

BASIS OF PAYMENT

Street Name Sign (Boston) 18-Inch Street Name Blank will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 874.2 TRAFFIC SIGN REMOVED AND RESET EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 840 of the MassDOT Standard Specifications and the following:

Any sign scheduled to be removed and reset, regardless of type or size, will be included in this item, unless specifically designated for inclusion under another item. Any additional hardware (bolts, nuts, washers, brackets, etc.) necessary to install the specified signs at the designated locations on new or existing posts will be supplied under this item. This includes the removal and disposal of the existing sign support foundations and the backfilling of resulting holes with necessary material as approved by the Engineer.

CONSTRUCTION METHODS

The signs and supports shall be carefully dismantled and stacked on boards at a location designated by the Engineer. The holes caused by the removal of the supports and foundations shall be backfilled with suitable material and thoroughly compacted. The existing signs shall not be removed until the new signs and structures replacing them are ready for traffic or until the Engineer shall permit. This may require removing and resetting the existing signs, in temporary locations, prior to stacking.

METHOD OF MEASUREMENT

Traffic Sign Removed and Reset will be measured by the each, complete in place.

BASIS OF PAYMENT

Traffic Sign Removed and Reset will be paid for at the contract unit price per each which price shall constitute full compensation for any additional mounting hardware, transportation, stacking, removal and disposal of existing sign support foundations and all other labor, tools, equipment, materials, and incidentals necessary to complete the work.

Where new posts are required, payment will be made under Item 877.3 Sign Post 2-inch Steel or Item 877.4 Sign Post 2 ½-inch Steel, unless otherwise specified.

ITEM 874.3	TRAFFIC SIGNS REMOVED AND STACKED	EACH
ITEM 877.2	SIGN POST REMOVED AND STACKED	EACH

GENERAL

Work under these items shall include the dismantling, removal, transporting and stacking of the existing roadside traffic signs and/or posts as indicated on plans or as directed by the Engineer including the removal and disposal of the sign supports and their foundations.

The work shall include removing the supports, excavating the existing foundation, the disposal of the concrete and supports, the backfilling with compacted gravel of the holes resulting from the excavation and the removal of the supports and the replacement, in kind, of any surface material disturbed outside of areas to be reconstructed under this project. If in the opinion of the Engineer, the existing foundation will not interfere with new construction, it may be removed to a depth of 6 inches below the existing ground, backfilled with compacted gravel and the existing surfaces restored or replaced in kind.

The signs and posts removed shall be delivered to the Boston Transportation Department, Operations Division - Sign Shop, 12 Channel Street, Suite 105, Boston, MA in the EDIC Industrial Park.

The existing signs shall not be removed until the new signs and structures replacing them are ready for traffic or until the Engineer shall permit.

METHOD OF MEASUREMENT

Traffic Signs Removed and Stacked will be measured by the each.

Sign Post Removed and Stacked will be measured by the each.

BASIS OF PAYMENT

Traffic Signs Removed and Stacked will be paid for at the contract unit price per each which price shall constitute full compensation for dismantling, loading, transporting, and stacking of the signs as designated above. The excavating and disposal of the existing foundation of the

same and the supplying and placing of compacted gravel backfill where foundations and posts are removed, restoration of surface, and all other labor, tools, equipment, materials and incidentals necessary to complete the work.

Sign Post Removed and Stacked will be paid for at the contract unit price per each, which price shall constitute full compensation for dismantling, loading, transporting, and stacking of the signs posts as designated above. The excavating and disposal of the existing foundation of the same and the supplying and placing of compacted gravel backfill where foundations and posts are removed, restoration of surface, and all other labor, tools, equipment, materials and incidentals necessary to complete the work.

Signs and posts to be removed and discarded shall be incidental to Item 120.1 Unclassified Excavation.

ITEM 875.11	PARKING METER POST REMOVE AND REPLACE	EACH
ITEM 875.12	PARKING METER POST AND BASE	EACH

GENERAL

This work shall consist of either removing and replacing existing parking meter posts or installing new parking meter posts as indicated on the Contract drawings or as directed by the Engineer.

MATERIALS

Parking meter posts shall be set plumb in concrete conforming to Division III, Materials M4.02.00 of the MassDOT Standard Specifications for 4,000 psi, 1 ½ inch, 565 Cement Concrete.

CONSTRUCTION METHODS

Before any meter posts are removed from their existing locations, the Contractor shall obtain a permit from the BTD Engineering Division - Permits Section at least 5 days before post removal is scheduled. The Contractor shall provide each parking meter's alpha numeric number located in the bubble of the meter head, so the permit agent can create a work order for the BTD Operations Division – Meter Shop to schedule the removal of the meter heads. **No parking meter posts are to be removed until BTD Operations Division has removed the meter heads.**

The Contractor shall dispose of the old meter post and replace with new meter post. The old posts shall NOT be used. Installation shall conform to BTD Standard Plans A100, A101, A102, A104, A105 and A107. A lateral offset of at least 18 inches shall be used. Care shall be taken to ensure the post is not damaged or deformed in any way during installation.

The Contractor shall layout new meter post locations and notify BTD Engineering Division – Permits Section at least 5 business days before the new posts are scheduled to be installed to have a BTD Engineer approve the layout.

The Contractor shall notify the BTD Operations Division – Meter Shop no more than 48 hours after the new meter posts have been installed so BTD can reinstall the meter post sleeves and meter heads.

Contact Information
BTD Operations Division – Meter Shop: 617-635-3123 or 617-635-3127
BTD Engineering Division – Permits Section: 617-635-4675

METHOD OF MEASUREMENT

Parking Meter Posts Removed and Replaced will be measured by the number of posts replaced, complete in place. Posts removed but not replaced will be included in item 120.1, Unclassified Excavation.

Parking Meter Posts and Base will be measured by the number of posts placed, complete in place.

BASIS OF PAYMENT

Parking Meter Post Remove and Replace will be paid for at the contract unit price per each which price shall constitute full compensation for keying pins, anchor bolts and all other labor, tools, equipment, materials and incidentals necessary to complete the work. Cost of cement concrete for post foundations will be included in this item.

Parking Meter Post and Base will be paid for at the contract unit price per each which price shall constitute full compensation for furnishing and installing new parking meter posts, keying pins, anchor bolts all other labor, tools, equipment, materials and incidentals necessary to complete the work. Cost of cement concrete for post foundations will be included in this item.

ITEM 875.13 MULTI-SPACE PARKING METER REMOVE AND RESET EACH

GENERAL

This work shall consist of removing and resetting existing multi-space parking meter kiosks including base system as indicated on the Contract drawings or as directed by the Engineer. **Removal of existing multi-space parking meter kiosks will be done by the BTD Operations Division – Meter Shop.** It is the Contractor's responsibility to contact the BTD Operations Division – Meter Shop at least 5 business days in advance to coordinate the removal of existing multi-space parking meter kiosks. The resetting of multi-space base systems shall be done by the Contractor. A lateral offset of at least 18 inches shall be used.

CONSTRUCTION METHODS

The multi-space parking meter kiosk must be firmly secured to the sidewalk in accordance with manufacturer's recommendations using a base installation system including all anchors, bolts, plates, foundation (if necessary), etc. approved by BTD Operations Division – Meter Shop. It is the Contractor's responsibility to coordinate this in advance of laying out the multi-space parking meter locations.

The Contractor shall layout new multi-space base system locations and notify BTD Engineering Division – Permits Section at least 5 business days before the new base system is scheduled to be installed to have a BTD Engineer approve the layout.

The Contractor shall notify the BTD Operations Division – Meter Shop no more than 48 hours after the new base installation system has been installed so BTD can reinstall the multi-space parking meter kiosk units.

Contact Information
BTD Operations Division – Meter Shop: 617-635-3123 or 617-635-3127
BTD Engineering Division – Permits Section: 617-635-4675

METHOD OF MEASUREMENT

Multi-Space Meter Remove and Reset will be measured by the number of meters replaced, complete in place including base system. Base systems removed but not replaced will be included in item 120.1, Unclassified Excavation.

BASIS OF PAYMENT

Multi-Space Meter Remove and Reset will be paid for at the contract unit price per each which price shall be full compensation for labor, tools, equipment, mounting materials, and all incidental expenses necessary to complete this item to the satisfaction of the Engineer.

ITEM 877. SIGN POST REMOVED AND RESET EACH

GENERAL

Work under this item shall conform to the relevant provisions of the Section 840 of the MassDOT Standard Specifications and the following:

Sign posts are to be removed and reset where indicated on the plans, unless specifically designated for removal under another item.

Installation of 2-inch steel sign posts shall conform to BTD Standard Plans A201, A203 and A205.

Installation of 2 ½-inch steel sign posts shall conform to BTD Standard Plan A201.

The Contractor shall unbolt the sign from the post, excavate the post and foundation and remove the concrete foundation from the post. The Contractor shall reattach the sign to the post after the post has been reset. A lateral offset of at least 18 inches shall be used.
Restoration to match adjacent surface will be included in this item when no additional work is proposed in the area of post removal.

In the event that the post is not salvageable as deemed by the Engineer, then the Contractor shall furnish a new post, for which payment for the new material will be made under Item 877.3

or 877.4. Posts made non-salvageable by the Contractor's careless operations will be replaced by him at no additional cost to the City.

METHOD OF MEASUREMENT

Sign Post Removed and Reset will be measured per each, complete in place.

BASIS OF PAYMENT

Sign Post Removed and Reset will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools equipment, materials (except new materials required to replace non-salvageable items shall be paid for under other items) and incidentals necessary to complete the work.

ITEM 877.3	SIGN POST 2-INCH STEEL	EACH
ITEM 877.4	SIGN POST 2 1/2-INCH STEEL	EACH

GENERAL

Work under this item shall conform to the relevant provisions of Section 840 of the MassDOT Standard Specifications and the following:

New 2-inch steel sign posts to be installed shall conform to BTD Standard Plans A201, A203 and A205.

New 2 ½-inch steel sign posts to be installed shall conform to BTD Standard Plan A201.

A lateral offset of at least 18 inches shall be used.

METHOD OF MEASUREMENT

Sign Post 2-Inch Steel will be measured per each, complete in place.

Sign Post 2 ½-Inch Steel will be measured per each, complete in place.

BASIS OF PAYMENT

Sign Post 2-Inch Steel will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

Sign Post 2 ½-Inch Steel will be paid for at the contract unit price per each which price shall constitute full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.

ITEM 879.3 SPECIAL DUTY POLICE (STATE TROOPER) HOUR

GENERAL

At locations where City of Boston streets intersect with roadways or other locations under the jurisdiction of the Commonwealth of Massachusetts, it may be necessary to employ the use of a police officer to direct traffic and ensure public safety.

The contractor shall provide such uniformed police officers (outside their regular tour of duty) as the Commander of the appropriate District State Police Barracks shall deem necessary, to avoid so far as reasonably possible, danger to the safety of persons and substantial interference with the free flow of traffic.

When a detail is needed, the Contractor shall contact the Detail Clerk at the appropriate barracks to arrange for the detail.

Revere Barracks	(781) 284-0038	East Boston
Old Colony Barracks	(617) 727-6780	Boston Proper, Dorchester, Roxbury, South Boston
Lower Basin Barracks	(617) 727-6780	Boston Proper, Roxbury, West Roxbury
Upper Basin Barracks	(617) 727-4812	Brighton, West Roxbury
Blue Hill Barracks	(617) 698-5840	Hyde Park, Dorchester, Roxbury, West Roxbury

Refer to the Special Notice to Bidders for proper location in this contract.

METHOD OF MEASUREMENT

Special Duty Police (State Trooper) will be measured per the hour.

BASIS OF PAYMENT

Special Duty Police (State Trooper) will be paid at the contract unit price per hour. The contractor shall pay the amount due to the State Police Department.

The Contractor shall submit to the City a monthly payroll of the police troopers used and signed by the barracks Detail Clerk and will be reimbursed by the City.

All details will be for a minimum of 4 hours per day.

ITEM 902.41 CONCRETE WALL FOR BACKING UP SIDEWALK CUBIC YARD

GENERAL

Work under this item shall conform to the relevant provisions of Section 900 of the MassDOT Standard Specifications and the following:

Concrete for backing up sidewalks shall have a compressive strength of 3,000 psi at 28 days and be used in a wall 10 inches wide and up to 5-feet high overall, where directed. The wall shall be not more than 32 inches below ground on the exposed side. Forms shall be used on both sides from bottom of wall to 4-inches below finished grade for concrete sidewalks, and for all other sidewalks, forms shall be used on both sides from bottom of wall to the finished grade of the back of the sidewalk. Forms shall be made of planed lumber or plywood on the exposed side of the wall. All forms shall be thoroughly braced to prevent warping and insure a true line. Expansion joints shall be provided at least every 50 feet and shall consist of ¾-inch pre-molded asphalt filler for the full depth of the wall.

METHOD OF MEASUREMENT

Concrete Wall for Backing Up Sidewalk will be measured by the cubic yard, complete in place.

BASIS OF PAYMENT

Concrete Wall for Backing Up Sidewalk will be paid for at the contract unit price per cubic yard which price shall constitute full compensation for excavation and backfill, construction and removal of forms, expansion joints and joint filler, surface finish, and all other labor, tools, equipment, materials, incidentals necessary complete the work.

ITEM 904.72 MISCELLANEOUS CLASS D CEMENT CONCRETE MASONRY CUBIC YARD

GENERAL

This work shall consist of furnishing, placing, finishing and curing of cement concrete masonry, inclusive of all necessary form work and stripping of forms where required for repair and/or reconstruction of concrete steps, thumb walls and elsewhere as specified and as directed by the Engineer, in conjunction with sidewalk reconstruction under other items of this Contract.

This item shall only be used for work not specifically provided for or incidental to some other item or items of work.

MATERIALS

Concrete shall meet requirements of Division III Section M4.02 of the MassDOT Standard Specifications. Concrete shall have 28-day compressive strength of 4000 psi. Minimum cement content shall be 565 pounds per cubic yard. Aggregate size shall be 1 ½ inches.

CONSTRUCTION METHODS

Placement, curing, testing, protection, and form work shall conform to the applicable requirements of Section 901 of the MassDOT Standard Specifications.

METHOD OF MEASUREMENT

Miscellaneous Class D Cement Concrete Masonry required in the work, for which payment is not specifically provided in or incidental to some other item or items of work, will be measured by the cubic yard complete in place.

BASIS OF PAYMENT

Miscellaneous Class D Cement Concrete Masonry will be paid for at the contract unit price per cubic yard which price shall constitute full compensation for furnishing and removing all forms; for furnishing, placing, finishing, curing and protecting all concrete; and for all other labor, tools, equipment, materials and incidentals necessary complete the work.

ITEM 908.11 PARGING OR REPOINTING OF WALLS AND FOUNDATIONS SQUARE FOOT

GENERAL

Work under this item shall conform to the relevant provisions of the MassDOT Specifications Section 900 and the following:

In order to construct ADA complaint cross pitches of sidewalks and pedestrian ramps, it is often necessary to lower the backline grade. This work results in exposing existing wall and building foundations. This work shall consist of furnishing, placing, finishing, cement mortar to parge or repoint these exposed areas of walls and foundations where directed by the Engineer.

METHOD OF MEASUREMENT

Parging or Repointing of Walls and Foundations will be measured for the actual number of square feet installed as measured by the Engineer.

BASIS OF PAYMENT

Parging or Repointing of Walls and Foundations will be paid at the contract unit per square foot installed and shall include full compensation for all labor, tools, equipment, excavation, material and all other incidental expenses necessary to complete the work and be accepted by the Engineer.